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PROCEEDINGS

OF THE

COTTESWOLD NATURALISTS' CLUB.

VOLUME II.



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*An Address to the Cotteswold Club, delivered on January the
31st, 1854,*

By T. BARWICK LLOYD BAKER, Esq., President.

Eight Summers, my friends, I think I may say of enjoyment, and we will hope of improvement, to all of us, have now passed over our Cotteswold Club, and again at our Winter Meeting it is my task to lay before you a slight reminiscence of what we, as a club, have seen and done in the last two years.

Such a retrospect is usually made annually; but a circumstance occurred last year which, alas, threw us out of our usual course. I need not call on those comparatively few who stood, in July, 1846, on Birdlip hill, around Sir Thomas Tancred, who had called us together, and at his suggestion formed the plan of those pleasant rambles which, under his guidance, have given us for now nearly eight years some of the most satisfactory and enjoyable days we have spent—I need not, I say, call on those few, but I appeal to all who have since joined our gatherings, and have seen how his love of science and his constant good nature and attention to all have, up to last year held our club together—to say whether the loss of such a man was not sufficient to throw us out of our usual course, and excuse any breach of our regular routine.

True, he did not leave us without finding a successor. True, that that successor has supplied the place right well—and truly grateful are we to him for the zeal and kindness and attention he has shewn to us, yet I think that even Professor Buckman will be one of the first to join us in regretting the absence of Sir Thomas Tancred.

But let us lose no time in vain regrets, as we have much to do. On February the 10th it had been arranged that the Club should meet at Bristol. Many of us came down on the previous evening, and greatly enjoyed some hours spent at the house of Mr. King, the celebrated optician, in seeing a most interesting collection of Diatomaceæ and Desmidiæ, prepared by Thwaites, and beautifully shewn by one of the finest and most complete microscopes ever made for the reception of Ross's object glasses. The interest of these, and of many other curious instruments—among them the then new stereoscope—was much heightened by the kindness and the happy explanations of Mr. King himself, and it was late ere we returned to our inn.

The next day, after breakfast, we proceeded, under Mr. King's guidance, to a most curious old house, now a bookseller's, but formerly the residence of that princely merchant of Bristol, Canynge, the re-founder of that architectural gem of the old city, the church of St. Mary de Redeliffe, where we afterwards saw his tomb. The back part of the present shop was formerly a Chapel, or Oratory, and remains if unimproved, at least unspoiled; the floor, and a gallery half way up the walls appear untouched since

Canyng's day, as does the very small room behind it, which was probably the ordinary abode of the great merchant.

Thence we went to the Cathédral with its fine Norman Chapter room, the Mayor's Chapel with its encaustic tiles and gorgeous blazonries, and the newly decorated Merchants' Hall, and then spent an enjoyable hour or two—all too short, in the Park Street Institution.

Being here joined by several other Members of the Club, amongst whom, one of the principal was, alas, our deeply lamented friend Strickland, who brought with him his friend Mr. W. Saunders, a geologist of repute, and well acquainted with the country, we agreed, though our winter meetings are usually confined to the house—yet, as the day was fine, that we would explore the Gorge of the Avon, through whose magnificent cliffs of mountain limestone the river has apparently forced its way, presenting a series of geological phenomena, scarcely equalled for interest and grandeur. The varied arrangement of geological beds in this immediate vicinity, independently of the physical changes and contortions to which they have been subjected, renders the examination of the geology of the district highly instructive. Here we see the Mountain Limestone and Millstone Grit, at high angles of inclination, bringing up the Coal Measures, which are succeeded by the New Red Sandstone series and the Lias; and, at a distance of three or four miles, Dundry Hill presents its out-lying mass of inferior oolite. The latter indeed we did not reach, but returned from a longer ramble than our winter meeting usually permits, well satisfied though we made no greater discoveries to science than a *Conularia* in situ at the base of one of the cliffs quarried for road stone, which, so far as any then present knew, had never before been observed in that formation. If, however, we had done nothing to instruct or enlighten the learned of the land, it was something not to be despised, if we had in any degree enlightened ourselves by leading our own minds to thoughts connected with the great truths of nature. At least so thought simplehearted naturalists like—Strickland.

After dinner Mr. Jones produced his drawings of the hieroglyphics on the mummy presented by E. Hopkinson, Esq. to the Literary and Scientific Society at Gloucester. But Mr. Jones found that he had it not all to himself, for Mr. D. W. Nash, an active member of the Syro-Egyptian Society, having come to dine with us, a discussion on the interpretation of the hieroglyphs ensued; which had the effect of shewing to those ignorant of the matter, like myself, how very nearly two men who have separately studied even so abstruse a science as that of Egyptian hieroglyphs, may bring their interpretations to the same point.

On Tuesday, May 4, 1852, the Club met at Cheltenham, and, after breakfasting at the Lamb, proceeded, under the excellent guidance of Dr. Wright, for Southam, whence, ascending the hill to the Rising Sun, we turned to the right over the down of Cleeve

Cloud, stopping a few minutes to look at one of the finest views in the upper part of the vale of Gloucester—wanting, indeed, the variety afforded by the broad estuary of the Severn, as seen from the hills nearer Bristol; but shewing most grandly the beauties of the upper part of the vale, with the Malvern and Abberley hills on the one side and Bredon on the other.

After a walk over the down, we reached the quarries above Postlip, but I fear that our Geologists found but little encouragement from a most unfossiliferous bed of freestone; while at Postlip itself we should have much more enjoyed the sight of a fine old mansion, (though now somewhat dilapidated and used as a farm house,) had we not been previously somewhat saddened by the sight of a once beautiful though small chapel, converted into a cow-shed. All the information we could get, was that “It hadn’t been used as a chapel for twenty years, and, for aught they could tell, not for fifty.” Thrice the latter period would probably have been nearer the mark.

Here we called a council of war, and agreed to form sections. The one party continuing their geological examination of Cleeve Hill, on the summit of which they lighted on a somewhat peculiar bed of sand, while others walked on to Sudeley Castle, where, though from the absence of the kind and hospitable owner we were prevented from seeing the interior of the house, the exterior well repaid our walk.

After dinner was read,—alas, in Mr. Buckman’s absence,—his interesting notice of a new sepistarium, obtained from the Lias Clays, at Cheltenham, remarkable as being so nearly allied to the true sepias of our present seas: thus differing widely from the Belemnno-sepias, or Belemnites, which are so abundant in the Lias. The present individual possessed a very perfect ink bag, which, with its tube, measuring about four inches, was full of the fossilized pigment, mineral sepia, from which drawings, illustrative of the specimen, had been made by Professor Buckman.

On the 22nd of June, we met at Fairford, in a great measure for the purpose of examining that most interesting collection of the corals found in that neighbourhood, by Miss Slatter, whose researches may yet throw a new light on the stratigraphical distribution of the rocks around Fairford. But the subject of corals is one which is wont to give rise to such long though highly interesting discussions, that, as we have plenty of work for this evening, the corals shall be left to their rest.

We next went to the church, whose magnificent windows of painted glass were most ably illustrated and explained by Mr. J. D. Thomas Niblet, whose long study of the subject makes us wish much that we had a more fully published account of the church from his pen and pencil. So thoroughly, indeed, is he “at home” here, that at one period the only direction by which a letter could find him was—J. D. Thos. Niblet, Esq., West Window, Fairford Church.

The site of the Fairford Saxon graves, situated about one mile

from the town, was our next point; but, as the investigations under Mr. Wylie have long been discontinued, there was but little visible evidence of those resting places of about one hundred bodies of our Saxon forefathers, whose remains, corporeal and ornamental, furnished Mr. Wylie with such curious evidence of the manners and customs, arts and manufactures, of the ancient Saxon race, as he has given us in his interesting volume, entitled *Saxon Graves*. A few beads, from a cottager, furnished us with a souvenir of the Saxon; some of pottery inlaid with strips of glass or enamel, others of amber. We know not whether this gum was supposed to possess any extraordinary charm, but it appears to have been much cherished by the Saxons, and the number of beads of this description found at Fairford would fill two or three pint measures.

On August 3rd we met in Gloucester and took the rail to Chepstow; a more scientific party may have occasionally met together, but not often a party more thoroughly disposed to enjoy an exquisite day amongst exquisite scenery. We started from Chepstow on a coach under the guidance of my excellent trooper, Jem Dobbs, of the White Hart, who drove us to within a short distance of the summit of the Windcliffe, whence we saw at our feet such meanderings of the Wye, that a cannon-ball would cross the river four times in its course to Chepstow Castle; while, if we raised the eye above the rock and wood of the opposite bank, it met the full range of the Cotteswold hills in the distance. Descending to the Moss Cottage, where we again found our vehicle, which descent was performed by some via the path with steps leading from the right of the summit, (where by the way we found the *Asplenium trichomanes*, growing in unusual luxuriance and beauty), and by others, more adventurous, who determined to find or make a way to the left, (by that extraordinary providence which the Musselman believes to attach to certain classes none were killed: Jem Dobbs still points out the scar of rock which one came down)—by right or left all finally arrived at the bottom and proceeded to Tintern.

I will not attempt to give any ideas of my own of this exquisite Abbey, but, as I in right of my office as President, claim the right of plagiarizing to any extent from the ideas of any of our members, a privilege of which I avail myself largely, often without acknowledging it, I will read Professor Buckman's ideas of it as slightly better than any I could give of my own.

An examination of its details must leave the following impressions upon a thoughtful mind:—

1st, The great economy of materials, every part being nicely adjusted to the work it had to do.

2nd, The complete absence of constructive ornament, its carvings are merely for the *ornamentation of some useful and necessary part of the structure*, and in no instance is anything unnecessarily obtruded so as to display ornament. -

3rd, The ornamentation has been so nicely balanced, that the

whole structure strikes one as perfection ; presenting an unity of purpose which precludes the idea of what the Artist calls *spottiness*.

4th, The work has been executed with such exactitude and freedom of hand as seen in the capitals and bases of columns, in the window mullions, and the bosses of the groined roof, as at once must give us a lofty idea of the mechanical skill and the deep heartfelt emotions with which the artificer, no less than the designer of a sacred pile, were both actuated in past times.

The neighbourhood of Tintern is exceedingly rich in native plants ; amongst which the *Campanula latifolia*, *Hypericum androsæmum*, *H. montanum*, and *Euphorbia platyphylla* are remarkable. The geology of the Wye is of great interest, in the masses of old red sandstone conglomerate, standing out boldly on the banks of the stream, supporting the superincumbent mountain limestone.

Returning to Chepstow Castle, we spent an hour among its picturesque ruins, (observing, amongst other plants, that death-like parasite the *Orobanche hederæ*, or Ivy broomrape, growing from the roots of the Ivy,) and then returned to the White Hart, after examining and admiring the beautiful mechanical construction, though in no degree whatever admiring the picturesque beauty of that singularly hideous contrivance, the new railroad tubular bridge.

On the 14th of September we met at Gloucester, and proceeded in my break, which has gradually become dignified by the name of the Club Omnibus, to Huntley. Here we divided, and while some ascended May Hill, and enjoyed the glorious view we had before seen and attempted to describe, others strolled through the Silurian quarries of Longhope.

But, alas, there was a cloud on this meeting, which not the view from May Hill, nor the interest of the Longhope quarries could brighten. We were here to take leave of him who had first called us together, who first suggested the idea of the Club, and by his constant attention had hitherto held us together, and endeared himself personally to every member.

We will say no more than to be thankful for two things. First, that we have had several letters from him, speaking with delight of his new home, where we will sincerely wish him every happiness ; and secondly, for ourselves, that his place is filled by a successor in every way so desirable as Professor Buckman.

Our Winter Meeting took place on January 31st, just twelve months ago, at the house of your unworthy President, and glad indeed would the said President be to think that the day at Hardwicke afforded nearly as much pleasure to the members as their visit gave him.

We took a short walk, spite of wet and dirt, to the Reformatory School, which has since then obtained an amount of public notoriety little anticipated ; in which, by the way, I have managed somehow, unintentionally, to obtain for my own name the credit

due to that of Mr. Bengough, as effectually as I am in the habit of stating Mr. Jones's or Mr. Buckman's ideas in an address, and passing them off as my own.

As I am, by the way, addressing a Club composed principally of Gloucestershire men, I may perhaps be pardoned if I indulge in a little quiet county boasting; as it is not, I think, foreign to the purpose of our Club to notice the deeds of good men of our county. Hence we find that fifty years ago the gaols throughout the world were in a state that nowadays we cannot read of without much pain. I do not speak of the temperature being three degrees too hot or too cold, or the gruel too thick or too thin, but I speak of the days when sprigs of rue were laid round the prisoner in the dock; a custom still continued in many places for custom's sake, but then used in the hope of preventing those in court from catching the *gaol fever*, which arose from the filth, starvation, and misery, to which the prisoners were exposed, nay, on one occasion, chronicled as the Black Assizes, at Oxford, in 1577: *Baker's Chronicle*, informs us that "all who were present died within forty hours: the Lord Chief Baron, the Sheriff, and about three hundred more."

Howard, to whose name be all honour, drew public attention to the dreadful state of the matter, but it was reserved for a Gloucestershire Magistrate, Sir G. O. Paul, to invent a system which should remedy the evil. This system was first carried out in Gloucester gaol; thence it was taken to America, and, they said, greatly improved upon. It was tried in all parts of the world and improved upon everywhere, till at last, after fifty years consideration of the subject by all the world, after it had been improved upon till it was greatly altered from the original plan, the last great crowning improvement has been, to bring it back to nearly what Sir G. Paul first made it.

This, Gentlemen, I hold to be a triumph gained for Gloucestershire, by our excellent old Chairman, worthy of the notice of a Club who take an interest in all matters connected with the county. And perhaps it may be not without interest to remark that we do not appear to be retrograding, but that, as by Sir G. Paul's labours, who followed out the triumphs of Howard, Gloucestershire was the first county that possessed a good gaol, so by the energy of Mr. Bengough, who has followed out the system of poor Captain Brenton, Gloucestershire is the first county that has made adequate provision for the cure of its juvenile offenders.

Forgive me, Gentlemen, if I have said too much on this point, but the kindness with which you have frequently allowed me to digress has perhaps spoiled me.

From the School we walked over Acklow (or rather, I suspect, Oakleigh,) hill, to the lias quarry of Elmore, where the insect limestone was said to be opened to large extent; but, if I remember right it was in the south western pit where Mr. Brodie found the true bed.

Our dinner was marked by two circumstances—First, the

alarming announcement that, instead of our usual subscription of from one shilling to three and sixpence a year, a call was now to be made, amounting to fifteen shillings. When, however, it was remembered that we had paid no subscription the previous winter, we were somewhat pacified. When we thought of Dr. Wright's most valuable papers, which he had read, and the exquisite specimens he had produced to us of the *Pteroceras Wrightii*, and the Echinoderms, of which copies were promised us, we were reconciled; but it was not till the work was actually produced, on May 3rd, and we were able to estimate the credit accruing to our Club from the production of a work so valuable in its letter-press, and so beautifully illustrated, as Dr. Wright's care has rendered it, that we were quite happy.

The second, and more important, as well as more agreeable feature of the day was, that amongst our visitors was the Rev F. Symonds, of Pendock, a member of the Woolhope Naturalists' Club, and President of that newly established at Malvern; both clubs, we believe we may venture to say, formed on our model. If nothing had been seen or done on this day further than to make arrangements for the meeting of our Club, which took place on the 7th of June, and which laid the foundation, we trust, for many future annual meetings—that alone would have been sufficient to mark the day in the annals of our Club.

On May the 2nd, the Club commenced its summer rambles for 1853, at Gloucester, whence we proceeded by steamer down the canal to Sharpness. The weather certainly did not favour us, but it gave us a proof that the interest in the study of nature is not so dependent upon mere weather as many might suppose. It poured the whole day! We went in the cabin of the steamer all the way to Sharpness—we sat in the kitchen of the cottage nearly all the time we were there—and we returned in the cabin of the steamer. Yet interesting discussions filled up the greater part of the time; and particularly Mr. Buckman having crept out into the garden for a few minutes, under an umbrella, had collected a number of varieties of the common Primrose, which afforded us, from simple elements, and in simple language, a lecture such as Professor Buckman can give, revealing in a simple form some of the great truths of the physiology of the vegetable kingdom.

On the 7th of June was our great field day, on which we were to appear, I may say, in the very respectable position of fathers and grandfathers to the Clubs of Woolhope and Malvern. And well did the day turn out, to realize our best hopes, though, alas, a sad shadow is now thrown on our remembrance of it.

We of the Cotswold Club met at Gloucester, and, after breakfast, proceeded in the Club Omnibus to near Eastnor, where alighting and walking to the Valley of the White-leaved Oak,—(alas, the name is merely traditionary, no white-leaved oak now existing)—we met Mr. Symonds and many members of the Malvern Club, and Mr. Lewis, the President, with a considerable

number of the Woolhope Club. Proceeding along the ridge of of that most interesting line, known as the Malvern Range, for some distance under the guidance of our lamented friend Strickland, it will long live in the recollection of those who enjoyed it, that he proposed a half hour's halt on one of the peaks, and, while we lay on the greensward around him, gave us such a brief but comprehensive lecture as few save Strickland could give, on the vast and extraordinary disruptions which, as far as human proof could shew, had caused the features of the exquisite landscape now spread at our feet: shewing how and at what period that wondrous cliff on which we stood was reared, which though now, from the washing away of its apex, stands but a few hundred feet in height, must at one time, in all probability have towered two miles in height above the Worcestershire vale, now stretched at our feet; while the latter, probably in those days and long after, was a broad arm of the sea, separating England from Wales.

Deeply as we lament our loss of such a man, endeared to most of us as a friend, as much as admired by all as one of the most eminent naturalists of the day, I cannot but for my own part rejoice that the last recollection we have of him was one so truly characteristic.

Proceeding through Lord Somers's Park, where we examined some of the Silurian beds, to the inn at Eastnor, (not having time, alas, to make a digression even to see the mistletoe in the oak, a short distance from the end of the ridgeway drive), we reached the inn, and dined, to the number of sixty members of the three Clubs; the principal feature of the evening being, I think, the appointment of a committee who undertook to draw up for us a Flora of Worcestershire, Gloucestershire, and Herefordshire. We trust that this may not be lost sight of. A most interesting paper on fishes of his county, was read by Mr. Whateley, and one by Mr. Lees, on the Malvern flora, and one by Mr. Davies, of Tewkesbury, on the natural history of the swallow.

On July 16, we again attempted the visit to Sharpness, the pleasure of which, if not altogether lost, had been sadly diminished by the rain; and this time we were more successful. After breakfasting at the Spread Eagle, at Gloucester, we embarked in the Wave steamer, which took us down the canal to Frampton bridge; from whence we walked across to Fretherne Cliff, and returning to the canal proceeded by steamer again to near Purton Cliff, where the Lias and Silurian Strata appear in close proximity. From hence we walked by the grand works of the Basin at the mouth of the Gloucester and Berkeley Canal to Sharpness Point, a small pleasure ground of Lord Fitzhardinge's, which juts out boldly into the Severn, affording an exquisite view of the lower part of the estuary down to Bristol and Chepstow.

On August 16, we made a new experiment in our Club, and, emboldened by our previous success, we ventured to invite a large party of Ladies to our meeting at Cirencester. Alas! the weather was less propitious than our fair guests. The latter came in con-

siderable numbers, but the rain poured down without ceasing. Delightful walks through the Park had been proposed, but were clearly out of the question. Never mind. If people are blessed with good humour, and a determination to make the best of circumstances, they are not easily defeated. We went to the Church, where the kind Rector, Mr. Powell, occupied us well and profitably in shewing and explaining to us the highly interesting features of the building, which he has partially restored with excellent taste.

We then put ourselves under the guidance of Professor Buckman, to see the pavements discovered in the town, which he has so ably illustrated in his "*Corinium*," and which we trust will ere long be placed in a building now in actual course of erection, under the care of Lord Bathurst, (who, I am sure, will forgive the impatience with which the work is looked upon,) which will add a feature of so great interest to the town.

After seeing these, however, a couple of hours still remained to dinner, and the rain continued. We went to the Museum. Perhaps we may be forgiven if we say that the room had not the appearance of light and gaiety most captivating to Ladies. Nevertheless, Dr. Wright, who understands his subject so truly as to be never at a loss, taking his subject from a small collection of echinoderms, but branching from thence into the general principles of fossil zoology, gave us an off-hand but most interesting lecture, which, with a reply by Mr. Buckman, allowed us scant time to return to prepare for dinner.

After dinner the time was spent very agreeably, by examining a large variety of drawings and specimens, and listening to a very interesting discussion on the habits of the Hedge-hog.

On Sept. 20, the Club met to breakfast at Painswick House, by the invitation of our hospitable member, Wm. Henry Hyett, Esq. Mr. Gyde exhibited after breakfast a most perfect camera, for taking photographs, I think in less than five seconds. We then walked through the gardens to a beautiful collection of Ferns, which were flourishing as they are rarely seen to do in a newly planted collection, and returning to the house examined the stained woods for the successful preparation of which Mr. Hyett has long been celebrated, together with some trunks of trees, now in the progress of absorption. The process is interesting, independently of the staining of the wood, as presenting several new and curious features in vegetable physiology.

One party then went to examine the Quarries near the Horse-pools, while the remainder walked over Painswick Beacon, passing the spot on which it is recorded that the unhappy Charles stood with his sons, watching his army retiring from Gloucester, till the eldest being tired, begged him to go home, and the monarch made the sad but memorable reply, "My Sons, we have no home to go to!"

Leaving the grand encampment which crowns the summit, we proceeded to Pinknash Park, the seat of James Ackers, Esq.,

where, in seeing his very curious and beautiful mansion, eating his excellent luncheon, and seeing his magnificent Hereford cattle, scarce time or appetite were left for the dinner at Painswick.

Forgive me, Gentlemen, that I have detained you so long, but as you have, alas, been shewn in the pecuniary affairs of the Club, when we miss the payment of one year the next is likely to fall heavy, so not having bored you with an address this day twelvemonth, you must now grumble as little as you can at a heavier infliction this year. If, however, I have not spared you, I think you will forgive a record of Meetings which, I may venture to say, have occasioned so much enjoyment as those of the Cotteswold Club.

On Hand-bricks, from the Island of Herm,
By W. V. GUISE, Esq., F.G.S.

In the course of a ramble amongst the Channel Islands, last summer, my attention was attracted by the unusual abundance of those "cairns" of stones, known by the name of "*Cromlechs*," which, in the little Islet of Herm, in particular, meet the eye everywhere, in the vallies as well as upon the eminences, and which, to the least poetical observer, lead the mind back to periods of dim and remote antiquity, when it might well seem that the vast Cyclopean masses around were

"Rear'd by the hands of giants,
In god-like days of old."

The exploring pick of the patient antiquary, however, speedily dispels these imaginings, and dreams of white-robed priests, and altars streaming with the blood of human victims, vanish before the cold realities of Truth, and the supposed temple, or altar, turns out, in every case which has been satisfactorily investigated, to be a place of burial, a vault or catacomb, which has, in most instances, been not merely the sepulchral chamber of an individual, but has been evidently used for the purpose of interment of many successive generations.

A vast proportion of those now visible (for many have been destroyed and all vestiges of them removed during the last century) have been explored by that able and indefatigable antiquary, Mr. C. F. Lukis, of Guernsey, whose papers, scattered through the earlier volumes of the *Archæological Journal*, have thrown so much light upon this obscure subject. In his Museum I first observed the baked clay clumps, or "Hand-bricks," as he calls them, which I have the pleasure of laying upon the table this evening; and during a short visit afterwards to the Islands of Herm I had an opportunity of investigating an almost inexhaustible hoard of the same singular objects, stored up in a manner and to an extent which would appear to defy the ingenuity of the most speculative mind to account for.

The site of this deposit in the Islands of Herm, is a sea-cliff of sand, about 40 feet in height, resting upon solid rock, the spurs of which projecting below, prevent the encroachments of the sea. The sole outward indication of the buried hoard is to be found in the appearance upon the surface of the cliff of extraordinary quantities of limpet shells, scattered in profusion over the sand, and which, taking their presence as a standard of measurement, would seem to manifest an extension of the deposit to the distance of nearly a quarter of a mile. It was the presence of these shells in such unusual abundance which first drew the attention to the spot of an intelligent fisherman, who had been employed by Mr. Lukis, in assisting him in his researches, who, connecting these shells with those found in such remarkable profusion in the

cromlechs which he had seen opened, was led to make excavations which resulted in the discovery of the vast storehouse of curious objects similar to those now before us.

The soft and yielding nature of the sandy cliff offers but little resistance to the pick and spade, and at the distance of little more than three feet from the surface, are found the baked clay clumps, to which have been given the name of "Hand-bricks," because, as will at once be observable upon inspection, they have been formed by simply moulding in the grasp a handful of kneaded clay, and then stamping the ends upon flat boards or stones, in which state they have been fired; and their surface still bears the imprint of the cuticle and fingers which were employed in their manufacture. They are found, not lying indiscriminately, but packed together with evident order, care, and arrangement, lying transversely over and across one another, and, at intervals, as if to support the weight and pressure, are placed a sort of rude flat bricks, shaped as if formed without a regular mould, but merely pressed together with boards; the length I was not able to ascertain, having failed in procuring a perfect example, but probably 14 or 16 inches. Associated with these is a great abundance of broken pottery, both baked and unbaked, mostly coarse and of the rudest manufacture, but here and there portions occur which bear marks of the wheel, and of more careful elaboration. I have unfortunately lost the only specimen illustrative of this fact which I possessed, but it was apparently sun-dried, and of finer clay than any of the examples now before us. Limpet shells innumerable are profusely distributed throughout the deposit, which, from age, have parted with their animal matter, and adhere more or less to the tongue. The accompanying stone* was disinterred at the same time; to which I draw attention, as it will be seen, upon examination, that it is not in its normal condition, but bears marks, in its bevelled edge and smooth surface, of having been subjected to friction, and made use of probably as a muller, in the manufacture of the clay for the accompanying pottery.

The old fisherman who was my guide attributed the fabrication of the "Hand-bricks" to the Druids, who, like other representatives of unknown powers, are occasionally made responsible for facts which cannot be referred to any known origin. Amongst ourselves, Julius Cæsar and "Old Scratch" divide the honour of similar ascriptions. Mr. Lukis, however, informs me that the period to which they may most probably be referred is the Romano-British or Gaulish, but that this point is doubtful and requires further elucidation.

It seems possible, indeed, looking to the isolated situation of these islands, that their inhabitants may have remained in a rude and barbarous condition, and have retained their primitive habits, uses, and customs, for a considerable period after the tribes in-

* The Stone here referred to, together with specimens of the Hand-bricks and Pottery, were laid upon the table at the time this paper was read, and are now deposited in the Museum of the Royal Agricultural College, at Cirencester.

habiting the neighbouring continent may have been converted to a more civilized mode of life. Thus it may not be impossible that the ancient processes of manufacture, together with religious rites and modes of interment, may have come down to a much later date than even the Roman occupation of the adjoining continent. We see instances in point now, amongst the barbarous tribes of the Polynesian Islands, who, in spite of steam navigation, and continual intercourse with more civilized nations, still cling to their axes of jade and arrows tipped with bone; and I have read, that, within the last century, Pagan rites were celebrated upon the Isle de Batz, and other islands upon the northern coast of Brittany.

The purpose served by these "Hand-bricks" would seem to be explained in some measure by their association with the broken pottery, which goes to substantiate the supposition that they were in some way used in the process of its manufacture, possibly as a sort of rude furnace, which would have afforded a means of economising wood, which is, and always must have been, scarce upon those rocky islets.

Mr. Lukis informs me that similar substances, that is "Hand-bricks" and "Pottery," have been found associated in Lincolnshire and in Romney Marsh—in the former place, it is said in company with Roman fictile vessels. In Herm, he states, that one fragment of true Samian ware was discovered in 1841. All this would seem to point to the Romano-British period, were it not that these same "Hand-bricks" have been found within more than one cromlech, associated only with stone implements of the rudest description. One such is mentioned by Mr. Lukis in his second paper on the Primæval Antiquities of the Channel Islands, in the 1st vol. of the *Archæological Journal*. The cromlech referred to was opened by him on the plain of L'Anresse, in the northern part of Guernsey, in which he states, "He found many pieces of clay, of a peculiar form, from three to six inches in length, made by rolling a piece of clay in the hand, and striking each end against a board, and still bearing the mark of the inside of the fingers and impression of the skin of the maker." "With these," he adds, "were found no vestiges of any metal," "and the many rude stone implements found with them made it evident there were none then in use."

Hence arise doubts which can only be solved by further investigation; and when last I heard from Mr. Lukis, he informed me that he was about shortly to undertake the exploration of a hitherto undisturbed cromlech, in the hopes of finding further evidences to elucidate this intricate subject.

In conclusion, I have only to state that I am mainly indebted to Mr. Lukis, and to his published Papers, for any information I may have been able to lay before you this evening, which, under ordinary circumstances, I should hardly have ventured to attempt; but, as we number amongst us many who are interested in Archæological pursuits, I trust that the novel and peculiar nature

of the substances which form the subject of my communication this evening, may be held in some measure to justify me in bringing under your notice a matter, which, though not included within the range of Natural History, yet possesses in itself claims upon the attention and sympathy of the enquiring mind, which can hardly fail to meet with due appreciation amongst the Members of the Cotteswold Club.

W. V. G.

Notes on British Ferns.

By JAMES BUCKMAN, F.G.S., F.L.S., Professor of Geology
and Botany, in the Royal Agricultural College.

A slight acquaintance with plants will shew us that while there are very many that ornament the earth with those showy or curious parts which we term flowers, there are others which do not flower, or at least in the same way, and the differences of these two groups may be summed up in the following manner :

1st, *Flowering Plants*. Bearing leaves whose modifications form other leaves which are called "floral envelopes" (Calyx and Corolla); further change makes (Stamens and Pistils) the latter of which contains the germ and produces seed by its maturation.

2nd, *Non-Flowering Plants*, in which is no Calyx or Corolla, and whose sexual organs, if they possess them, are concealed.

In the first or higher class of plants detached cells are produced by the Stamen, and known as *Pollen*; the contents of the Pollen cell are received into a reservoir of the germ, now full of a saccharine formative fluid, upon which they live and propagate new cells, which become united into different shapes, and covered with varied envelopes, and so compounded they separate from the parent plant, and in this state are called seeds, the plumule of which consists of young leaves. Seeds, therefore, may be viewed as separable buds, protected in various ways, and wrapped up in the most convenient form.

In the Non-flowering plants there are also separable cells developed, but here they are not sown in a sugary pabulum like pollen, but, when separated from the plant, they appear to have the power of reproducing other cells, each of which, in the lower tribes, becomes an independent plant, whilst in the higher the cells do not separate, but make up organs by aggregation, until a distinct organ is set apart for the production of the separable cell, which,

in these, is the seed. Hence the reproduction, as shewn in the two great divisions of plants, may be thus summed up :

In Flowering Plants.

A separable cell is formed. "Pollen," which is sown in the Pistil, and produces the embryo of a plant, "Seed," corresponding with the higher orders of animal life, in which the egg is hatched in the parent.

In Non-Flowering Plants.

A separable cell becomes the future Plant, without mediate gestation—warmth, moisture, and surrounding media—thus analogous to the production of animals from eggs.

Now it is to the non-flowering plants that the Ferns belong, and inasmuch as they have leafy appendages, whilst the Fungi have not; we hence form two groups of non-flowering plants, or,

ACOTYLEDONS.

a. Plants without leaves, sometimes forming a kind of crust or Thallus (*Thallogens*)—Fungi, Lichens, &c.

b. Plants with leaves, whose parts modify to produce *spores*, seed, (*Acrogens*)—Mosses and Ferns.

Native Ferns present the following parts :—

A *root*, more or less fibrous, sometimes springing from an underground stem, *Rhizome*; this is the true stem of the plant, the which, growing upright, constitutes the tree fern of the tropics.

Leaves (*Fronds* of the Botanist), consisting of a leaf-stem (*Stipes*), which sending out fibres right and left, covered by expansions of the bark, constitutes the green leaf-matter. The frond may be entire as in the *Hartstongue*, simply winged as in the common *Polypody* and *Hard Fern*, or doubly winged as in the *Lady Fern*; the first divisions being termed *pinnæ*, the smaller ones *pinnulæ*.

Fronds of Ferns are distinguished from the leaves of flowering plants, 1st, by an involute method of growth, the young leaf being rolled over like a shepherd's crook or pastoral staff.

In the compound fronds æstivation proceeds as follows :—The frond gradually unfolds lengthwise. Then the *pinnæ* unroll. The *pinnulæ* follow, and the more or less divided leaf is exposed to view.

2nd, The ramifications of its woody fibre, forming "*leaf veins*," are always in a *bifurcate* or fork-veined form.

Seeds are the result of the gradual separation of a cell destined for reproduction, and which are thus produced :—1st, The Capsule, which, in some examples, as the *Shield Fern*, consists of a membranous case having a row of cells involuted around it, forming a spring to liberate the *sporules*. Or the *pinnulæ* are metamorphosed into seed cases, as in the *Royal Fern*. Bunches of the former are called *Sori*—the cases of the latter *Theca*.

The number of seeds produced on a single Fern may be estimated by the following calculation, arrived at from an examination of the *Aspidium Filix Mas*, Male or Shield Fern.

A capsule contains 20 cells, sporules. A sori consists of 40 capsules. Each pinnulæ has 6 sori. There are 22 pinnulæ to each pinnæ. There are 40 pinnæ to each frond. There are 8 fronds to each root.

Hence $20 \times 40 \times 6 \times 22 \times 40 \times 8 = 33,792,000$.

The necessity for the production of so many seeds is explained when we consider that ferns cannot grow everywhere; hence the casualties to which they are liable are amply provided for.

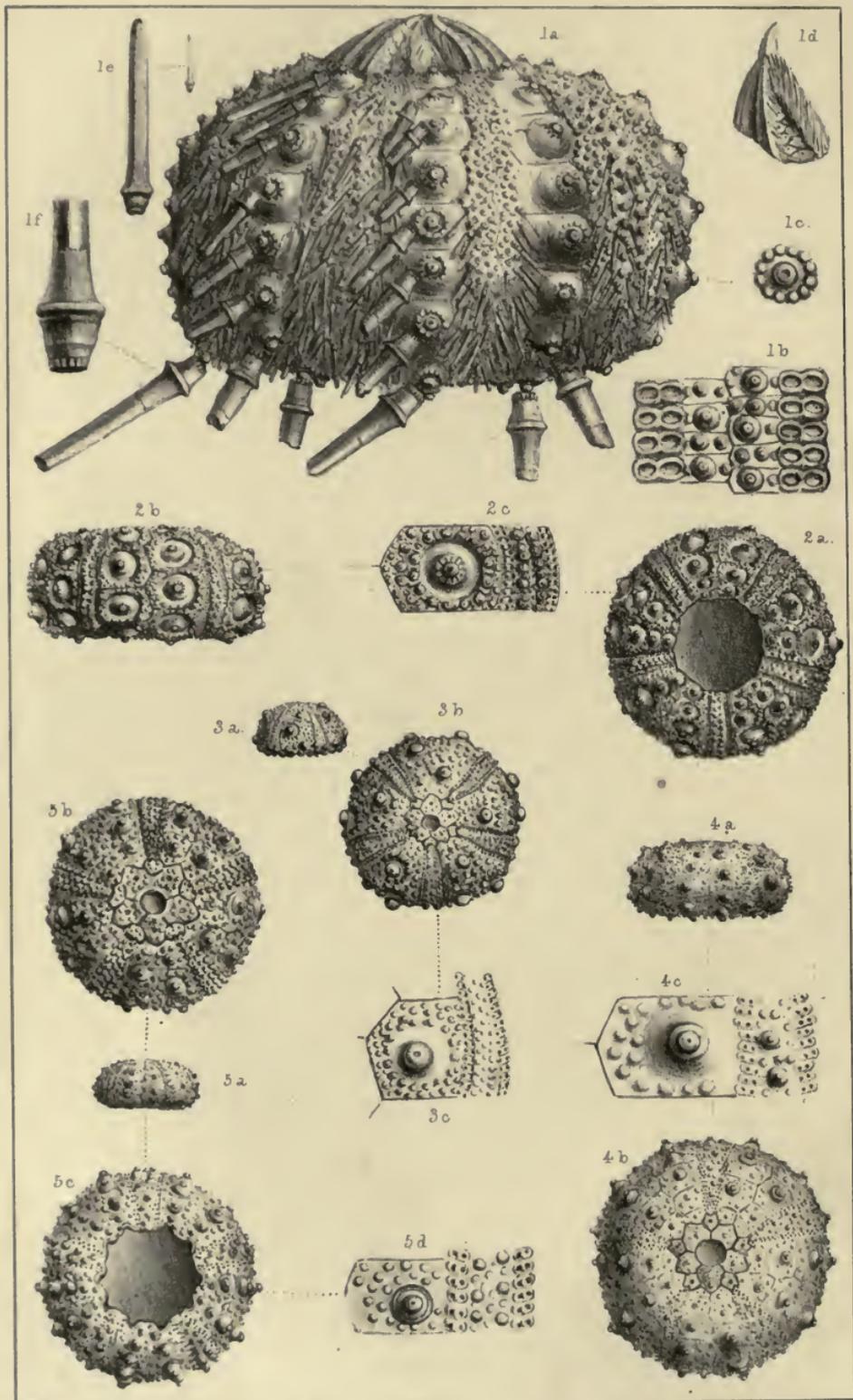
The clusters of capsules, in most instances, begin forming beneath the epidermis, and attach to the nervures on the under side of the frond, the epidermis remaining as a protective covering until the seeds are ripe, when it dries up. The form and disposition of this membrane, which is analogous to the Calyx, differs in different genera and species; it is called an Involucre or *Indusium*.

In as far as British Ferns are concerned, we may divide them into genera, depending upon the *presence* or *absence*, the *disposition*, and form of the parts heretofore described. The species being dependent, for the most part, upon the form of the divisions of the frond.

The following is a List of the Genera of the British Ferns.

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|--|---|----------------------------|
| 1. Sori nude. That is, not covered by an Indusium. | { | 1. <i>Ceterach</i> . |
| | | 2. <i>Polypodium</i> . |
| | | 3. <i>Woodsia</i> . |
| 2. Sori, covered by an Indusium. | { | 4. <i>Aspidium</i> . |
| | | 5. <i>Cystopteris</i> . |
| | | 6. <i>Asplenium</i> . |
| | | 7. <i>Scolopendrium</i> . |
| | | 8. <i>Pteris</i> . |
| | | 9. <i>Cryptogramma</i> . |
| | | 10. <i>Blechnum</i> . |
| | | 11. <i>Adiantum</i> . |
| 3. Thecæ (Seed vessels) Open cases at the edges of the leaves. | { | 12. <i>Trichomenes</i> . |
| | | 13. <i>Hymenophyllum</i> . |
| Thecæ, closed capsules, splitting by a pore. | { | 14. <i>Botrychium</i> . |
| | | 15. <i>Osmunda</i> . |
| | | 16. <i>Ophioglossum</i> . |





W.H. Bailey

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|--------|---------------------------|---------|
| 1 a-f. | <i>Cidaris Edwardsoni</i> | Wright |
| 2 a-c. | <i>Bouchardu</i> | |
| 3 a-c. | <i>Hemicidaris minor</i> | Agassiz |
| 4 a-c. | <i>Pedina Bakeri</i> | Wright |
| 5 a-c. | <i>Etheridgei</i> | |

Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites. By THOMAS WRIGHT, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School.

READ 4TH MAY 1852.

Cidaris Edwardsii, Wright. Pl. I. fig. 1, a-f.

Test crushed, the form therefore unknown. Ambulacral areas narrow, with two rows of small perforated tubercles, and smaller perforated ones interspersed amongst them; interambulacral areas about four times the width of the ambulacral, having two rows of large tubercles with confluent areolas; the primary spines long, with a compound structure; the secondary spines short with blunt apices, the surfaces of both sculptured with delicate longitudinal lines; mouth armed with powerful jaws, each with three prominent triacinated ridges. Upper part of the test and ovarial disc unknown.

Description.—It is much to be regretted that no other specimen of this noble Urechin but the one before us has been obtained from the Lias of Gloucestershire, and as the specimen exhibits only the lower half of the test, many points of its anatomy remain unknown; enough of its structure, however, is shown to enable us to point out some important affinities and differences in this rare species.

The narrow ambulacral areas are provided with two rows of small perforated tubercles, amongst which smaller tubercles are irregularly scattered; these tubercles all support short stout spines with a minutely sculptured surface, and which are abundantly preserved *in situ* on the specimen. The wide poriferous avenues are occupied with large oblong pedal pores with very thin partition-walls between them, a circumstance which forms a good diagnostic character between *C. Edwardsii* and *C. Fowleri*, which it very much resembles in many points of structure, the pores in *C. Fowleri* being small and separated by thick partition-walls. The interambulacral areas are four times the width of the ambulacral, and are occupied by two rows of large tubercles set closely together in a vertical direction, so that the areolas above and below are quite confluent throughout.

The imperfect condition of the shell prevents us from ascertaining the precise number of these tubercles there were in each row, but judging from the number (eight) contained in an imperfect column, we suppose there could not have been less than from twelve to fourteen; they increase gradually in size from the mouth upwards, and are of a moderate magnitude when compared with the shell they adorn. The areolas are small and not prominent, and the tubercles are deeply perforated. The space between the two rows of tubercles is wide and filled with close-set miliary tubercles, most of which are raised on elevations, and have their summits perforated; these all support small spines, which are well preserved *in situ* in our specimen.

The spines are of two kinds—those articulated with the large tubercles (the primaries), and those articulated with the small tubercles (the secondaries). The primary spines exhibit a peculiar structure: the head is large, increasing gradually in diameter from the articulating cavity to the circular band; the rim of the acetabulum is coarsely and deeply crenulated, and the raised band is prominent, narrow, and finely milled; the neck tapers gradually from the band to the point where it joins the stem, which has the same structure as the head, and its surface is delicately sculptured with fine longitudinal lines; the stem is united to the neck by an oblique harmonia suture. The structure of this part of the spine differs from that of the head and neck; in the spines denuded of their external layer, it has a horny semi-transparent appearance; in those in which this layer is present the surface is sculptured with longitudinal lines of microscopic delicacy, and there are numerous small processes, having their points directed forwards, arranged with some regularity in rows. The stem is circular or slightly compressed; but as none of the spines are complete, a part having been broken off, we are unable to ascertain their length. The secondary spines are very uniform in size and structure, and are abundantly preserved *in situ*; they measure from $\frac{6}{20}$ ths to $\frac{7}{20}$ ths of an inch in length and are round, and have their surface ornamented with fine longitudinal lines. The mouth is armed with a powerful dental apparatus: three of the jaws are very prominent; the external surface of each is strengthened by three prominent ridges; the teeth are large, but are fractured. As the under surface of the test only is shown, we are unable to describe the ovarial disc and the dorsal surface thereof.

Affinities and differences.—This Urchin belongs to the same group as *C. Fowleri* and *C. maxima*, Goldf. It resembles the former in the form and structure of both areas, and in the gradual development of the primary tubercles from the mouth upwards. It is distinguished from that species, however, by the

greater size and uniform perforation of the miliary tubercles, but above all by the form and structure of the primary spines. Having ascertained that our conjecture* relative to the spines of *C. Fowleri* is correct, from having seen a specimen recently found with some spines attached to it, we can speak positively upon this point.

Locality and stratigraphical range.—Found by Mr. G. E. Gavey, C.E., in the upper shale beds of the Lower Lias at Mickleton Tunnel near Chipping Campden. It was associated with *Pentacrinus Goldfussii*, Wright, *Ophioderma Gaveyi*, Wright, *Uraster Gaveyi*, Forbes, and *Ammonites planicosta*, Sow.

History.—Isolated plates of this species have been found in beds of the same geological horizon in other localities of the county of Gloucester, but the specimen before us is the only one from which the anatomy of the Urchin could be made out. We dedicate this species to Prof. Milne-Edwards, of the Museum of Natural History at the Jardin des Plantes, Paris, as a tribute of gratitude for the pleasure and profit derived from the study of his admirable monograph on British Fossil Corals.

Cidaris Bouchardii, Wright. Pl. I. fig. 2, a-c.

Test circular, depressed; ambulacral areas narrow and flexuous; interambulacral areas with two rows of primary tubercles, 5-6 in each row; the areolas of the small mammillary eminences deeply excavated, and surrounded by an elevated ridge, on which a distinct circle of granules for each areolar space is disposed.

Dimensions of the largest specimen. Height $\frac{1}{2}\frac{3}{8}$ ths of an inch, transverse diameter 1 inch and $\frac{7}{10}$ ths.

Dimensions of a moderate-sized specimen. Height $\frac{1}{2}\frac{1}{8}$ ths of an inch, transverse diameter 1 inch and $\frac{2}{10}$ ths.

Description.—It was for some time doubted whether the young forms of this Urchin were not the *C. elegans*, Goldf., but a comparison of several individuals of our fossil with a typical specimen of Goldfuss's species, kindly sent us by our friend Dr. Roemer of Bonn, which he had identified with the original *C. elegans* in the Bonn Museum now under his care, has convinced us of their distinctness. The test of our Urchin is circular and much depressed from the great flattening of both poles; the ambulacral areas are narrow and slightly flexuous, and have two rows of small marginal granules set nearly opposite to each other throughout the areas. The poriferous avenues are much depressed, and the pairs of pedal pores are

* Annals of Nat. Hist. Oct. 1851.

disposed in a single file. The interambulacral areas are about five times the width of the ambulacral, and have two rows of primary tubercles of moderate size, with from five to six in each row. The mammillary eminences on which the tubercles are supported are surrounded by areolas deeply excavated out of the substance of the test plates; the margin bounding the areolas is raised into a ridge on which a distinct row of close-set granules is disposed, so that each tubercle is thereby separated from its fellow; the elevation of the marginal ridges produces a zigzag depression down the centre of the areas, which is covered with a small close-set granulation. The mouth-opening is small and circular, and lies in a slight depression; the apical disc is absent in all the specimens that have yet been found. The crenulations on the mammæ are small, but distinct, and the tubercles are of moderate size and not deeply perforated.

Affinities and differences.—This Urchin has many affinities with *C. coronata*, Goldf., and *C. propinqua*, Münt., and has been catalogued as the former by some authors; it is therefore important that we should point out the diagnostic characters by which it is distinguished from them. In both these corallian forms the ambulacral areas have four rows of granules, whilst in *C. Bouchardii* there are only two rows. From *C. propinqua* and *C. coronata* it is further distinguished by having more rows of primary tubercles in the interambulacral areas, in having the areolas smaller and more deeply sunk, the tubercles proportionately smaller, and the marginal circle of granules smaller and set closer together. With *C. marginata*, Goldf., it has some affinity in the excavated style of its areolar spaces, but it is distinguished from this beautiful form in having the tubercles smaller and more numerous. In *C. marginata* the ambulacral areas moreover are broader and more prominent, and they support four rows of small granules, whilst in *C. Bouchardii* there are only two. With *C. elegans*, Goldf., it has no resemblance whatever; it belongs therefore to a different group of Cidarites than these foreign corallian forms. From *C. Fowleri*, nobis, it is distinguished by having narrower and more deeply concealed poriferous avenues, fewer primary tubercles in the interambulacral areas, and deeper excavated areolar spaces with a more elevated marginal rim around them: these characters serve to distinguish *C. Fowleri* from *C. Bouchardii* at a glance, and the same diagnostic traits separate it from *C. Edwardsii*, nobis.

Locality and stratigraphical range.—We have found this species in the Pea-grit of the Inferior Oolite of Crickley, Leekhampton, and Birdlip Hills, Gloucestershire, but have never met with any traces of it in the Upper Ragstone beds so rich in Urchin forms. Some separate plates collected from the Bradford

clay near the Tetbury Road Station, Great Western Railway, closely resemble this form; but as no entire specimen, that we are aware of, has been found, it is impossible to state whether it has a wider range in the higher beds of the lower division of the Oolites or not.

We dedicate this species to our friend M. Bouchard Chantreaux of Boulogne, to whom we are indebted for some beautiful and rare specimens of Echinoderms and other fossils from the rocks of the Boulonnais, most kindly contributed by him to aid us in the composition of these memoirs.

Hemicidaris minor, Agassiz. Pl. I. fig. 3, a-c.

SYN. *Hemicidaris minor*, Agassiz, Catalogus Systematicus, p. 9; Agassiz and Desor's Catalogue raisonné des Echinides, Annales des Sci. Nat. tom. vi. p. 339.

Acrosalenia rarispina, M'Coy, Ann. of Nat. Hist. 2nd Series, vol. ii. p. 411.

Test hemispherical above, flat at the base; ambulacral areas slightly flexuous, not prominent, with six large tubercles at their base, and four rows of small unequal-sized granules in the middle, diminishing to two rows in the upper part of the areas; interambulacral areas three times the width of the ambulacral, with three primary tubercles on the upper surface and three smaller ones at the base; the wide intertubercular spaces are covered with small distinct nearly equal-sized granules, which form complete circles around the margins of the areolas of the primary tubercles; the apical disc is of moderate size, and its ovarial plates are covered with a delicate granulation; base flat, mouth-opening large and decagonal; pores arranged in the avenues in a single file throughout.

Height $\frac{6}{20}$ ths of an inch, transverse diameter $\frac{9}{20}$ ths of an inch.

Description.—This beautiful little Urchin was first discovered in the étage Bathonien of Langrune, Calvados, the true equivalent of the Great Oolite of English geologists; it was entered in M. Agassiz's 'Catalogus Systematicus*' as *Hemicidaris minor*, from specimens sent to him by M. Michelin; it afterwards found a place in the 'Catalogue raisonné des Echinides' of Agassiz and Desor, accompanied with this remark: "Se distingue entre tous les *Hemicidaris* par les tubercules très espacés, dont il n'y a que deux ou trois dans une rangée.—Terrain Jurassique de France.—Michelin." Professor M'Coy, in his paper "On some new Mesozoic Radiata†," afterwards described this Urchin under the

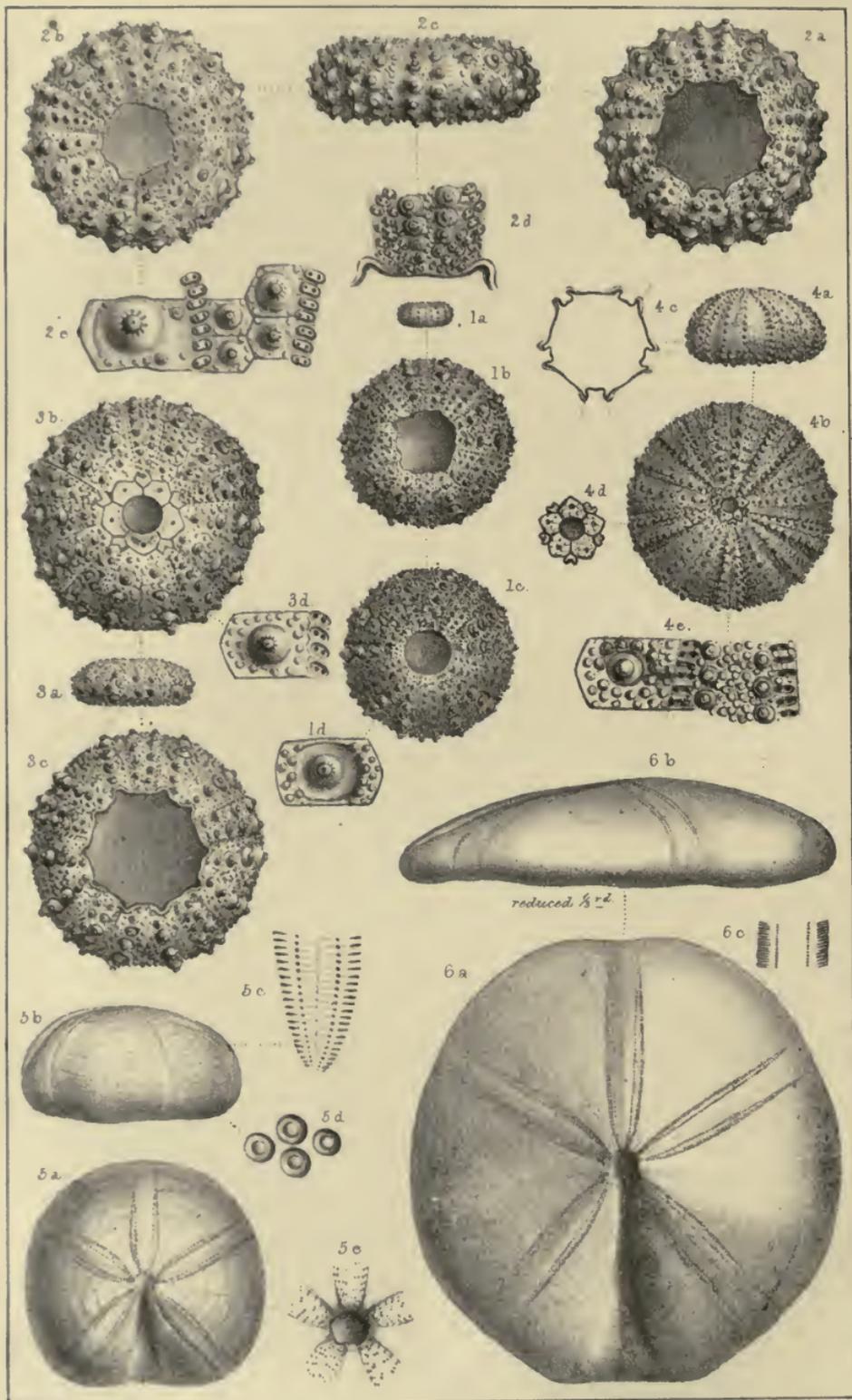
* Catalogus Systematicus Ectyporum Echinoderm. Foss. Mus. Neocomensis, 1840.

† Annals of Natural History, 2nd Series, vol. ii. p. 411.

name *Acrosalenia rarispina*, giving the Great Oolite of Minchinhampton for its locality. As that gentleman has kindly favoured us with pen-and-ink sketches of the species described as new in that paper, we have no difficulty in deciding on the identity of his specimen. Moreover we have ascertained the collection from whence it originally came. The error committed by this learned author in the genus must have arisen from the disc in his specimen having been covered with "adhering siliceous matrix," and from his having overlooked the very remarkable character pointed out by Agassiz, "les tubercules très espacés." We have been fortunate to receive a typical specimen of the original species from the Great Oolite of Langrune, through the kindness of our friend Professor Deslongchamps; we have compared the French Urchin with specimens obtained from the same locality as that from whence Prof. McCoy's was collected, and there is not a shadow of a doubt about their perfect identity. We have figured in detail this beautiful and singular form, to prevent the possibility of mistakes occurring about it in future.

This pretty little *Hemicidaris* is very distinct from all others of the group to which it belongs: the test is nearly hemispherical, and the few primary tubercles stand prominently at great distances apart from the surface of the test. The narrow ambulacral areas are slightly flexuous above, and have from four to six large perforated tubercles at their base only, the sides and upper part of the areas having first four, and then two rows of small imperforate granules upon their surface about equal in size to the granulation which covers other parts of the test. The poriferous avenues are depressed, and the pedal pores are disposed in pairs throughout. The interambulacral areas depart considerably from the typical structure of this portion of the test in other Echinidæ; they are three times the width of the ambulacra, and have at their base three large primary tubercles, two on one side and one on the other, with a smaller tubercle above the single large one; on the sides and upper part of the areas there are only three primary tubercles, two on one side and one on the other, making only three pairs of primary tubercles in the interambulacral areas, those of the base being closely set together, and those on the sides at great distances apart; the tubercles are large and hemispherical and only slightly perforated; the mammillary eminences which support them are small and ring-like with faintly marked crenulations, and the areolas are rather wide and only slightly grooved, so that the tubercles project prominently and abruptly from the surface of the test. The margin of the areolas is encircled by a row of granules rather larger than those which cover the rest of the intertubercular surface of the plates; here the granules are close-set and disposed without much regularity.





W.H. Baily

Printed by Hullmandel & Walton.

- | | | |
|--------|-----------------------------------|--------|
| 1 a.d. | <i>Acrosalenia crumifera</i> | Wright |
| 2 a.e. | <i>Diadema Davidsoni</i> | " |
| 3 a.d. | <i>Moorei</i> | " |
| 4 a.e. | <i>Polycyphus Deslongchampsii</i> | " |
| 5 a.e. | <i>Nucleolites Woodwardii</i> | " |
| 6 a.c. | <i>Michelini</i> | " |

The apical disc is of moderate size and slightly prominent; the five ovarial plates are large and of a heptagonal form, the ocular plates are small and heart-shaped, and the surface of both is covered with a close-set delicate granulation; the anal opening is nearly central and circular; the base is flat; the mouth-opening is large and widely decagonal from the great span of the ambulacral arches, and the comparative smallness of those of the interambulacra. The spines are as yet unknown.

Affinities and differences.—This remarkable little Urchin is so entirely different from its congeners, that it is impossible to mistake it for any other of the group to which it belongs. The presence of tubercles at the base of the ambulacral areas only, and of granules on the sides of these spaces, associate it with *H. diademata*, but the small number of the primary tubercles on the interambulacra, added to the great distance at which they are placed apart, serve to distinguish it from the young of that species; in fact, these characters alone are perfectly diagnostic of *H. minor* among all other forms of *Hemicidaris*.

Locality and stratigraphical range.—It was first found in the "Grand Oolite" of Langrune, Calvados, from whence the beautiful specimen before us was obtained, and kindly sent by Professor Deslongchamps of Caen. We take the present opportunity of recording our grateful acknowledgements to that eminent naturalist for his kindness and courtesy, not only in contributing specimens to our cabinet for comparison and reference, but likewise for communicating many rare species of oolitic Echinidæ which served as the types of several of M. Agassiz's species, and which specimens have been of much service in clearing up doubts as to the identity of some other English forms. *H. minor* was collected in this country by W. Walton, Esq., from the Great Oolite of Hampton near Bath.

History.—First named by M. Agassiz from specimens in M. Michelin's cabinet; afterwards described as *Acrosalenia rarispinia* by Prof. M'Coy from specimens in the Cambridge Museum, which came from Mr. Walton's series collected near Bath; it has never yet been found either by Mr. Lycett or ourselves in the Great Oolite of Minchinhampton.

Acrosalenia crinifera, Wright. Pl. II. fig. 1, a-d.

SYN. *Echinus minutus*, Buckman, Geology of Cheltenham, 2nd ed. p. 95.

Cidarites criniferus, Quenstedt, Handbuch der Petrefactenkunde, tab. 49. fig. 32. p. 574.

Test circular, depressed; ambulacral areas narrow, with two rows of microscopic tubercles placed at some distance apart on each

side of the areas, those of the right side alternating with those of the left ; interambulacral areas with two rows of primary tubercles, 9–10 in each row, so disposed that the test appears to possess only ten rows of primary tubercles nearly equidistant from each other ; spines long, numerous and hair-like.

Height $\frac{5}{20}$ ths of an inch, transverse diameter $\frac{6}{20}$ ths of an inch.

Description.—This singular little Urchin has been long known to collectors, and has been often a puzzle to them, for although a few specimens have been collected in a tolerable state of preservation, still for the most part the test is much injured by pyrites ; under the most favourable circumstances, it requires a good lens and much patient study to make out the details of its structure. It was first found in the black shales of the lower Lias near this town, and recently, with its hair-like spines attached to the test, from the same bed near Gloucester, when excavating the new docks of that city ; it was there associated with *Ammonites oxynotus*, Quenst. It is difficult to say whether this tiny Urchin is a *Hemicidaris* or an *Acrosalenia*, and the absence of the apical disc leaves the question unsolved ; we incline to the opinion that it is an *Acrosalenia* from the structure of the ambulacral areas, the shape, length and development of the spines when compared with the diameter of the test, the spines being more than four times the diameter of the latter ; be this however as it may, it is neither an *Echinus* nor a *Cidaris*, as previous authors have supposed. The ambulacral areas are narrow, with two rows of small marginal tubercles not much larger than the common granulation of the test ; these tubercles are placed in each row at some distance apart, and the tubercles of the one side alternate with those of the opposite side ; between these rows of tubercles the surface of the plates is adorned with a delicate granulation, which is arranged into a zigzag line ; the tubercles are very uniform in size and distribution throughout the areas, and do not increase at the base thereof, as is the case in the genus *Hemicidaris*. The interambulacral areas are wide, and have two rows of primary tubercles, from 9–10 in each row ; their mammillary eminences have well-defined areolas, the summits of the mammæ are deeply crenulated, and the tubercles are small and widely perforated ; the areolas are confluent above and below ; between the two rows of tubercles an elevated band extends from the mouth to the apical disc, composed of from 4–6 rows of unequal-sized granules. When viewed at the equator with the naked eye, this Urchin appears to possess only ten rows of tubercles placed nearly equidistant from each other ; but when examined with an inch object-glass under the microscope its true structure is disclosed,—the narrowness of the ambulacral

areas, the closeness and smallness of their rows of tubercles, the granular band down the centre of the interambulacra, and the unequal size of its component tubercles, alike contribute to make the deception almost complete.

The most remarkable parts of the structure of this tiny fossil are the spines, which in some crushed specimens are preserved *in situ*; they are long, delicate and hair-like, and have large articular heads; these spines look like so many bristles laid down in all directions upon some slabs of the Lias shales; in a crushed test of four-tenths of an inch in diameter the spines measured an inch and a half in length.

Affinities and differences.—The only *Cidarites* for which *A. crinifera* is likely to be mistaken are *Diadema Moorei* and *Pedina Etheridgii*; from the former it is easily distinguished by the narrowness of the ambulacral areas and the smallness of the tubercles thereof; from the latter it differs in the comparative smallness of its ambulacral areas, and above all in having the mammillary eminences of its tubercles deeply crenulated, a character which is absent in all the *Pedinas* we know; at present we know of no other Urchin in the Lias for which it can be mistaken.

Locality and stratigraphical range.—*A. crinifera* has been found only in the lower shales of the lower Lias near Lansdowne, Cheltenham, and in the same stratum near Gloucester; it is associated with *Turrilites Valdani*, D'Orbig., and *Ammonites oxynotus*, Quenstedt. It has been collected by Prof. Quenstedt in the lowest schist of the "Posidonienschiefer von Pliensbach bei Boll" in Würtemberg. We have before us now two slabs of this curious bed; one surface of the slab is covered over with the long hair-like spines strewed about in all directions, with here and there the crushed test of one of these Urchins with its spines attached and *in situ*.

History.—Described by Mr. Buckman under the name *Echinus minutus*, but previously noticed by M. Quenstedt in his work on the Flötzgebirge of Würtemberg; it has been recently figured by him in his 'Handbuch der Petrefactenkunde,' under the name *Cidarites criniferus*.

Diadema Davidsoni, Wright. Pl. II. fig. 2, a-e.

Test depressed, circular; tubercles elevated upon prominent mammillary eminences; pores in a single file throughout; a few small secondary tubercles in the interambulacra; the primary ambulacral tubercles nearly as large as those of the interambulacra.

Height $\frac{9}{20}$ ths of an inch, transverse diameter 1 inch and $\frac{6}{20}$ ths.

Description.—This beautiful Urchin has a regular circular

test, not at all inclined to the pentagonal form of many of its oolitic congeners. The ambulacral areas are three-fourths the width of the interambulacral areas, and are nearly of a uniform width throughout, tapering slightly and gracefully inwards towards their superior third; the contraction assumes the form of a gentle curve slightly inclined towards the centre. The double row of tubercles gradually increases in size from the mouth to the equator, where three pairs are about the same size; from this point upwards they gradually decrease, and terminate in two pairs of minute rudimentary tubercles at the disc. A single row of granules, arranged in a zigzag form, separates the primary tubercles from each other, a larger granule marking each of the angles. There is no granulation or other sculpture between the mammillary eminences of the tubercles and the poriferous avenues. There are from twelve to thirteen pairs of tubercles in each area. The interambulacral areas are nearly $\frac{4}{10}$ ths of an inch in width, and $\frac{1}{4}$ th wider than the ambulacral areas; they retain their width uniformly throughout, and are occupied by two rows of primary tubercles, nine to ten in a row, the mammillary eminences of which are large and prominent, and separated from each other by two rows of small granules which extend only a short distance beyond the equator; the remaining space between their termination and the disc being destitute of sculpture, where likewise the areas are slightly depressed; and a single row of granules rises on the external side of the tubercles, with here and there a secondary tubercle towards the basal portion of the test.

The poriferous avenues are very narrow: the pedal pores are arranged in a single file, only three or four additional pairs being introduced in the increased spaces around the circumference of the mouth. The tubercles of both areas are of moderate size, but exceedingly prominent, in consequence of being elevated upon large mammillary eminences, the apices of which are deeply crenulated. The tubercles of the ambulacral areas at the equator are not much less than those of the interambulacral areas, but upon the upper surface of the test they become much smaller and more numerous.

The mouth is decagonal and of moderate size: the arches over the bases of the ambulacral areas are about one-third greater in span than those across the interambulacra. The disc is absent in all the specimens, four in number, that we have seen.

Affinities and differences.—This species resembles *Cidarites* (*Diadema*) *mamillanus*, Roemer, in the prominence of the tubercles and depression of the test; but Roemer's figure* is so indi-

* Die Versteinerungen des Norddeutschen Oolithen Gebirges, pl. 2. fig. 1.

stinct and devoid of details, that it is impossible to institute a strict comparison between our Urchin and the one figured by him. The difference between *D. Davidsoni* and *D. subangulare* is so marked that it is impossible to mistake them—the pentagonal outline, large tubercles, wide granulated space between the primary tubercles of both areas, with the pores arranged in double files on the upper surface of the test, form a group of characters which distinguish *D. subangulare* from our Urchin. From *D. pseudodiadema* it is distinguished by the tubercles in *D. Davidsoni* of the ambulacral equalling in size those of the interambulacral areas, whilst in that species they are unequal. The rudimentary condition of the secondary tubercles in our species forms a striking contrast to the size they attain in *D. pseudodiadema*. The naked condition of the central parts of the interambulacral areas connects it with *D. subnudum*, Ag., of the Chalk, and the neatness of its outline allies it with other cretaceous forms.

Locality and stratigraphical range.—We have collected this species in the clays of the Coral rag near Calne, Wilts; it is a very rare Urchin, as we only know four specimens of it.

We dedicate this species to our friend Thomas Davidson, Esq., whose learned monographs on the Brachiopoda have earned him the gratitude of all palæontologists. We take this opportunity likewise of recording our deep obligations to Mr. Davidson for many friendly acts of assistance given during the preparation of these memoirs, by which we have been enabled to compare a considerable number of foreign Echinidæ with those of our own island, and thereby have been enabled to obtain a better knowledge of the affinities existing among the Echinoderms of the European Oolitic fauna.

Diadema Moorei, Wright. Pl. II. fig. 3, a-d.

Test circular, depressed; ambulacral tubercles smaller than those of the interambulacral areas; plates of the test covered with a small wide-set prominent granulation; mouth large and decagonal; anal opening large; apical disc of moderate size.

Height $\frac{5}{20}$ ths of an inch, transverse diameter $\frac{1}{2}$ $\frac{2}{0}$ ths of an inch.

Description.—There is much difficulty in distinguishing some of the smaller Diademas from each other, inasmuch as the young condition of many of the larger species so closely resembles the adult state of others, that it is only after one obtains a number of individuals of different species in their various phases of growth, that the naturalist feels himself upon sure ground when he endeavours to distinguish the affinities and differences that exist among them.

After a diligent search for Urchins in the Lias of Gloucestershire, we have succeeded in collecting only a very few examples of this group from these rocks. In addition to those found here, our friend Mr. Moore of Ilminster kindly presented us with a few specimens which he collected from the Upper Lias near Ilminster, and from these collective materials the species under consideration was discovered. *Diadema Moorei* has a circular outline slightly inclining to a pentagonal contour; it is much depressed at the upper surface and is flattened at the base. The ambulacral areas are very narrow, being less than one-third the width of the interambulacral; their margins are occupied by two rows of tubercles about eight in each row, which, at the base and up to the equator, are nearly as large as those of the interambulacra; but from that region to the apex of the area they rapidly diminish in size, and are here very disproportionate in magnitude to them; a zigzag line of single granulation separates the two rows of tubercles from each other. The interambulacral areas are wide and well developed, and have two rows of tubercles, from 8-9 in each row, which occupy the centre of the plates; the areolas of the tubercles on the upper surface are surrounded with a circle of granules which separates them from each other, but those of the base are confluent above and below. The intertubercular surface at the base of the test has a number of granules scattered over it, whilst on the upper surface, the plates are destitute of any other ornament beyond the faint circles that surround the tubercles. The pedal pores are arranged in pairs in a single file; the avenues are, however, rather flexuous below; the basal tubercles of both areas are nearly alike in size, but on the dorsal surface those of the ambulacra dwindle into large granules, whilst those of the interambulacra maintain their size up to the last pair, which are small near the margin of the disc. The mouth-opening is large, and its margin is divided into ten nearly equal-sized lobes. The apical disc is partly preserved in the specimen here figured; it consists of five large ovarian plates of a heptagonal form; two of the sides unite with the interambulacral plates, two with the ocular, two with the adjoining ovarials, and the single surface contributes to form the boundary of the anal opening, which is of moderate size; the five ocular plates are small and heart-shaped, their apex is directed towards the anal opening, and their base to the area; the madreporiform tubercle is slightly elevated on the single ovarian plate, and the surface of the discal plates is almost destitute of sculpture or granulation.

Affinities and differences.—*D. Moorei* resembles *D. depressum*, Ag., in the depression of its upper surface and the flatness of its base, likewise in having the tubercles of both areas of nearly a

uniform size around the base; but it is readily distinguished from *D. depressum* by the number and greater development of the tubercles of the ambulacra, which maintain their size throughout; whilst in *D. Moorei* the ambulacral tubercles are fewer in number and rudimentary in size in all the upper part of the areas. The contour of the test moreover does not assume the pentagonal outline of *D. depressum*, nor has the upper surface of the interambulacral areas the median depression seen on the test of the latter. The mouth-opening is larger, and the decagonal lobes are more equal in size in *D. Moorei* than in *D. depressum*.

Locality and stratigraphical range.—We have collected *D. Moorei* in the Upper Lias of Gloucestershire. Mr. Moore found it in the same stratum near Ilminster with *Ammonites communis* and *A. serpentinus*. Professor Deslongchamps has communicated a specimen of this Urchin which he found in the Lias supérieure of May, Calvados, associated with *Leptaena Davidsoni* and *Thecidea Bouchardii* and several other species.

We dedicate this species to Mr. Moore, of Ilminster, whose assiduous researches have brought to light so many interesting forms from the Upper Liassic beds of Somersetshire.

Genus PEDINA, Agassiz.

As this genus was incorrectly defined in our memoir on the Cidaridæ, it having been there stated that the mammillary eminences were “crenulated like those of *Diadema*,” we take this opportunity of correcting the error, and giving a definition more in accordance with our present knowledge.

Test thin, circular, more or less depressed; primary tubercles small and perforated; mammillary eminences with smooth ring-like summits without crenulations; pores in general disposed in triple oblique pairs; mouth small and slightly decagonal, margin not much notched; ovarial disc small and not prominent; ambulacral areas with one, two, or more rows of small tubercles; interambulacral areas sometimes with two rows only, sometimes with two rows and additional secondary rows of tubercles more or less complete.

This genus is extinct, and is found in the oolitic cretaceous rocks.

Pedina Bakeri, Wright. Pl. I. fig. 4, a-c.

Test circular, depressed; ambulacral areas narrow, with one row of small tubercles disposed in a slightly zigzag line down the centre of the areas; interambulacral areas broad, with two rows of primary tubercles raised on prominent mammillary emi-

nences in the centre of the plates; the margins of the areolas surrounded with circles of small granules; no secondary tubercles.

Height $\frac{7}{10}$ ths of an inch, transverse diameter $\frac{1}{2}\frac{5}{10}$ ths of an inch.

Description.—This *Pedina* presents a different form from its other congeners: the test is circular and depressed; the ambulacral areas are narrow, about one-third the width of the interambulacra; the usual double row of tubercles in this region is reduced to one row, the tubercles of which are disposed alternately on the right and left sides of the areas, thereby forming a single zigzag line down the centre thereof; the tubercles at the equator and on the upper surface are small, but there are two or three of a larger size at the base of the areas; a few granules form imperfect crescents round their narrow areolas. The interambulacral areas are nearly three times the width of the ambulacra; they are adorned with five pairs of primary tubercles of nearly a uniform size throughout, which are raised on prominent mammillary eminences, the summits of which are smooth, ring-like and without crenulations; circles of small granules bound the areolar spaces; there are no secondary tubercles, nor any sculpture upon the intertubercular surface of the plates, so that down the centre of the areas there is a smooth valley between the primary tubercles. The apical disc is well preserved in our specimen; the ovarial plates are of an irregular octagonal form and of moderate size, they are covered with a few granules scattered irregularly over their surface; the ocular plates are of a rhomboidal form and have large eye-holes. The base of the specimen is covered up with hard rock, so that it is impossible to expose the mouth-opening without endangering the specimen.

Affinities and differences.—The *Pedinæ* have been so imperfectly described by M. Agassiz in his ‘Descriptions des Echinodermes fossiles de la Suisse,’ that there is much difficulty in making out the species figured and described in that monograph. When it is recollected how limited were the materials at Agassiz’s command when he published that valuable contribution to Palæontology, and how delicate the test of this genus is, we can readily understand how so many different forms of the same *Urechin* came to be described and named as distinct species. After a careful examination of many specimens, we confess that *Pedina aspera*, *rotata*, *ornata* and *sublævis*, Agass., appear to us to be so many different forms of one and the same species. We have before us likewise the original type specimen of *P. granulosa*, Ag., which has been kindly communicated by Professor Deslongchamps. An examination of that Urchin has convinced us

that it is only a larger individual of *P. aspera*, as we find it in the Inferior Oolite, and is identical with the fossil which we have described as *P. rotata*. On a further examination of this specimen, M. Agassiz, it would appear, had arrived at a similar conclusion, for on the ticket which accompanies it is the following remark in his handwriting:—" *Pedina granulosa*, Ag. C'est sous ce nom que cette espèce est citée dans mon catalogue; cependant il se pourrait qu'elle ne fut qu'une variété un peu enflée de mon *P. aspera*." This species was collected by Prof. Deslongchamps from the Great Oolite of Ranville. We have likewise before us a portion of *Pedina* collected from the Oxford clay of the Boulonnais by M. Bouchard-Chantereaux, and marked by that eminent palæontologist, who kindly sent us the specimen, "très rare. J'en ai encore trouvé que trois morceaux de cette espèce." It so nearly resembles the Ranville Urchin that we have no doubt of their identity. By the extreme kindness of M. Michelin and M. de Lorière, we have before us specimens of *P. Gervillii*, Ag., from the Kellovien étage of Chauffour, department of the Sarthe, which are identical with *Pedina aspera* or *rotata*, collected by us from the upper beds of the Inferior Oolite of Gloucestershire. In fact the French and English specimens are so entirely alike, that we should mistake the one for the other had we not previously marked them. It would appear from these remarks, that whether we retain the specific name *rotata* or *aspera* for this widely distributed Urchin, we must at least cancel the other names which have been given to various forms of the same, as we have now before us well-preserved specimens from the Inferior Oolite, Gloucestershire, the Great Oolite, Ranville, Calvados, the Oxford clay near Boulogne, Pas de Calais, the Kellovien of Chauffour, Sarthe.

[Since these sheets were sent to press, the Rev. A. W. Griesbach has communicated a *Pedina*, collected by him in the Cornbrash at Rushden, Northamptonshire; as this fossil is in a good state of preservation, we have been able to make a careful comparison of it with a fine *P. aspera* now before us, and there can be no doubt of their identity. The discovery of this Urchin in the Cornbrash is another link in the chain of evidence showing the wide stratigraphical range of this form in the Oolitic seas.]

P. Bakeri differs so entirely from the forms named in the preceding remarks, that it is impossible to mistake it for either of them; its diagnostic characters consist of the size and small number of the primary tubercles, the absence of secondary tubercles, the scanty granulation on the interambulacral areas, the narrowness of the ambulacra, and the single row of tubercles thereon. We have only met with the small but tolerably perfect specimen of this species figured (Pl. I. fig. 4, a-c).

Locality and stratigraphical range.—We collected this rare form of *Pedina* from the Pea-grit of Crickley Hill, and have seen fragments of its test in the same bed at Leckhampton, but never in any other locality.

We dedicate this species to our friend T. Barwick L. Baker, Esq., of Hardwicke Court, the President of the Cotteswold Naturalists' Club, for the warm interest he takes in the progress of the Palæontology of Gloucestershire.

Pedina Etheridgii, Wright. Pl. I. fig. 5, a-d.

Test circular, depressed; ambulacral areas with from six to eight small perforate tubercles at their base, and a double row of small granules on their upper surface; the interambulacral areas with primary tubercles only, the areolas of which are surrounded with regular circles of granules; pedal pores not numerous, arranged in nearly a single file with a slight elevation between the two pores of each pair; apical disc large; ovarian plates leaf-like; mouth-opening small.

Height $\frac{5}{20}$ ths of an inch, transverse diameter $\frac{1}{20}$ ths of an inch.

Description.—This pretty little Urchin has a circular outline in the young state, which in larger specimens inclines towards a pentagonal form; the base is flattened, and the upper surface of the test is much depressed. The ambulacral areas are narrow, and have from six to eight small perforated tubercles at their base, and a double row of from twelve to fourteen minute imperforate granules in each row on their upper surface, which in figure and size resemble those covering the other parts of the test; between the pedal pores of each pair is a small elevation; these collectively form a prominent moniliform line which extends from the margin of the disc to the mouth-opening; the pores are disposed in nearly a single file, and do not form the triple oblique pairs which we observe in the larger *Pedinae*. The interambulacral areas are about twice the width of the ambulacra; the rows of primary tubercles occupying the centre of the plates have seven tubercles in each row, they are small in size and are rendered prominent from being raised upon uncrenulated mammillary eminences, the bases of which are sharply defined and surrounded by complete circles of moderately sized and regularly arranged granules; the regular disposition of these granulations gives an air of decoration to this little species not observed among other congeneric forms; the entire absence of secondary tubercles from the areas renders the decoration more complete. The apical disc is large; the ovarian plates are widely rhomboidal, the oculars are small and heart-shaped, and the sur-

face of both is covered with minute granules nearly as large as those which adorn the other parts of the test. The madreporiform tubercle makes a distinct elevation on the surface of the single plate, and the anal aperture is transversely oblong; the base is flat, the mouth-opening is small, and its margin is divided into ten nearly equal-sized lobes; the spines are unknown.

Affinities and differences.—In its general outline and depressed upper surface, with the pedal pores in nearly a single file, this little Urchin resembles a *Diadema*; from that group however it is distinguished by the rudimentary condition of the ambulacral tubercles, and the absence of crenulations from the summits of the mammillary eminences. It is distinguished from *P. Bakeri* by having small primary tubercles set more closely together, and in having a greater number in each row. From *P. aspera* it is known by having the upper surface more depressed, the pedal pores separated by a moniliform line of granules, and in the absence of secondary tubercles. It has a strong resemblance at a first glance to *Diadema Moorei*, but an examination with the lens at once discloses the points of difference, which are these:—the ambulacral areas in *Pedina Etheridgii* have imperforate granules on their upper parts, whilst in *Diadema Moorei* there are perforated tubercles; the moniliform line between the pedal pores in *P. Etheridgii* is absent in *D. Moorei*; the mouth-opening is likewise much smaller in *P. Etheridgii* than it is in *D. Moorei*.

Locality and stratigraphical range.—*P. Etheridgii* has been collected from the marlstone of Bredon Hill, Gloucestershire. Mr. Moore found it in the Upper Lias of Ilminster, and we have collected several specimens from the Pea-grit (Inferior Oolite) of Crickley and Leckhampton Hills, but have never seen a trace of this species in any of the upper beds; it seems therefore to have a limited vertical range between the marlstone and the basement-beds of the Inferior Oolite, and is one of the few species which lived in the Liassic and Oolitic seas.

We dedicate this species to our friend Mr. Etheridge, of the Bristol Museum, who has kindly assisted us in comparing our specimens with the fine series of Echinoderms under his care, and has likewise otherwise aided us in the most friendly manner in working out the subjects of these memoirs.

Genus POLYCYPHUS, Agassiz.

Small Urchins having a subglobular form; the upper surface of the test is covered with numerous small imperforate tubercles of a very uniform size; the base and basal angle are furnished with several tubercles of a size disproportionately large when compared with those of the upper surface; the pedal pores are dis-

posed in a triple oblique series of pairs; the mouth is large and pentagonal; the anal plates form a narrow prominent ring at the vertex, and the interambulacral areas are in general divided by a median depression.

Polycyphus nodulosus, Münster.

- SYN. *Echinus nodulosus*, Goldfuss, Petrefact. Ger. tab. 40. fig. 16;
 Agassiz, Cat. Syst. p. 12.
Arbacia nodulosa, Agass. Prodróm.
Polycyphus nodulosus, Agass. & Desor's Cat. raisonné, Ann. Scien.
 Nat. tome vi. p. 361.

Test hemispherical; ambulacral areas a little more prominent than the interambulacral areas; ambulacra with from four to five rows, and interambulacra with from twelve to fourteen rows of small tubercles disposed in nearly parallel lines; bases of the ambulacra with twelve, those of the interambulacra with sixteen larger tubercles.

Height $\frac{7}{20}$ ths of an inch, diameter $\frac{11}{20}$ ths of an inch.

This pretty little Urchin was first described by Prof. Goldfuss from specimens named by Count Münster from the Oolites of Baireuth; the hemispherical test exhibits a disposition to assume a subpentagonal circumference from the greater prominence of the ambulacral areas; the surface of the test is divided into fifteen nearly equal lobes by the ten poriferous avenues, and the five depressions which divide the interambulacra down their mesial lines; these lobular divisions are more defined in young and small specimens than in large and old ones; the ambulacral areas are one half the width of the interambulacral, and have nine large tubercles at their base, and four or five rows of small tubercles at their widest part, which gradually diminish to three, two and one as we approach the apex of the area; the interambulacral areas are twice the width of the ambulacral, they have about twenty-four large tubercles at their base, and about twelve rows of small tubercles at their widest part, which gradually diminish by the disappearance of the external rows to ten, eight, six, four and two, as we trace the rows from the equator to the apex of the areas; the tubercles on the sides and upper surface of the test are nearly of a uniform size, they are arranged in rows, the tubercles are opposite each other and do not alternate as in some other genera. The interambulacral areas are each divided by a slightly depressed line into two lobes; these are separated from the ambulacral areas by straight narrow poriferous avenues, so that the test of this beautiful Urchin appears to consist of fifteen nearly equal lobes, those of the ambulacra being the most prominent and best defined, in consequence of the

depth of the poriferous avenues being greater than the sulcus which divides the interambulacra.

The mouth is large and decagonal, and lies in a concave depression in the base, surrounded by the larger tubercles which occupy this region of the test. The ovarian plates are small, and form a rather prominent ring around the anal opening; the eye-plates are small, but in some of the foreign individuals now before me the eye-holes are very distinct.

Affinities and differences.—This Urchin resembles *Arbacia Forbesii*, but may be distinguished from that species by having the ambulacral areas proportionately wider, the tubercles larger and opposite to each other, and the poriferous avenues having the pedal holes in triple oblique pairs; it belongs moreover to a newer rock of the Oolitic series.

Locality and stratigraphical range.—We know only one English specimen of this species, which was found in the Cornbrash by Mr. Buy near Sutton Benger, Wilts; on the continent it occurs in the Baireuthian Jurakalke, where it was found by Count Münster. It has been collected from the Great Oolite of Langrune by Prof. Deslongchamps and M. Tesson, and from the Calcaire à polypiers at Ranville by M. Michelin. We beg to record to each of these gentlemen our best thanks for the beautiful series of type specimens of this Urchin with which they have so liberally supplied us.

History.—Figured and described for the first time by Goldfuss. We are not aware that any detailed description of the species has been given before, with the exception of the very brief one contained in the 'Petrefacta Germaniæ.'

Polycyphus Deslongchampsii, Wright. Pl. II. fig. 4, a-c.

Test hemispherical, circumference circular; ambulacral areas with two rows of larger and two rows of smaller tubercles; interambulacral areas with two rows of larger and several rows of smaller tubercles; the small tubercles in both areas often degenerating into mere granulations; basal tubercles large and prominent.

Height $\frac{7}{20}$ ths of an inch, transverse diameter $\frac{1}{2}\frac{5}{6}$ ths of an inch.

Description.—Amongst the many beautiful forms of Urchin structure, this pretty little species will bear comparison for neatness and symmetry with any of the family to which it belongs. We found the first specimen about eighteen months ago, and since then have added an interesting series to our collection. It must be a rare form, as only two or three specimens have been obtained besides those collected by ourselves. The ambulacral areas are one half the width of the interambulacral, and have one row of

tubercles on each side of the margins of the area, between these are several rows of small granulations arranged without much order; at the base of the area ten larger tubercles are disposed in pairs, the tubercles on the right side alternating with those on the left; the interambulacral areas are about twice the width of the ambulacral; a single row of tubercles occupies the centre of each of the two columns of plates, and numerous smaller tubercles degenerating into mere granules cluster around the base of the large tubercles; a second row of tubercles extends upwards from the basal angle towards the equator, where it terminates; the basal tubercles consisting of about six pair occupy all the base of the area—they are about the same size as those of the ambulacra, but are arranged somewhat less regularly. The median depression in the centre of the interambulacra is very well marked in this species, so that the test has the appearance of being divided into fifteen lobes. The anal plates form a prominent narrow ring around the oblong anal opening, and the eye-plates are closely soldered to them; the eye-holes are very distinct in most of our specimens. The mouth-opening is of moderate size, and is slightly decagonal; the poriferous avenues lie in considerable depressions of the test, which throws the ambulacral areas into prominent relief from the interambulacra.

Affinities and differences.—The marginal rows of tubercles on the ambulacra, and the central rows of tubercles on the plate columns of the interambulacral areas serve to distinguish this species from *P. nodulosus*. It has a considerable resemblance to the young forms of *Echinus germinans*, but the regularity of the rows of tubercles on the sides and upper surface of the test, and the size and arrangement of those at the base afford good diagnostic characters by which it may be easily distinguished from that common form; the same group of characters serves to distinguish it from *Arbacia Forbesii*.

Locality and stratigraphical range.—We have only found this species in the Pea-grit of Crickley Hill; all the other specimens that were collected by Mr. Gibbs of the Geological Survey, were found in the same bed of this locality.

We dedicate this fossil to Professor Deslongchamps of Caen, to whom palæontology is indebted for many important contributions to the Oolitic fauna published in the 'Mémoires de la Société Linnéenne de Normandie.'

Nucleolites Woodwardii, Wright, 1852. Pl. II. fig. 5, a-e.

Test subquadrate, sides tumid, dorsal surface flatly convex, anal valley deep, narrow and spear-shaped, extending from the apical disc to the posterior border; ambulacral areas narrowly

lanceolate; posterior lobes short and truncated; base flat; antero-interambulacra and postero-interambulacra slightly swollen at their base; the single ambulacrum scarcely produced; mouth-opening pentagonal, situated anteriorly; apical disc small and nearly central.

Height $\frac{6}{10}$ ths of an inch, antero-posterior diameter 1 inch and $\frac{1}{10}$ th, transverse diameter 1 inch and $\frac{2}{10}$ ths; the larger specimens are so much deformed by pressure that their proportional dimensions cannot be accurately given.

Description.—Some individuals of this species were formerly considered by us to be only varieties of *Nucleolites orbicularis*, Phil., but a better knowledge of the structure of this Urechin, derived from the study of a series which we collected last summer and have carefully compared with good typical examples of *N. orbicularis*, leaves no doubt about the distinctness of *N. Woodwardii* from that Cornbrash form. The test is thin and not often sufficiently well preserved for determining the species; the one which we have figured is a small but a very perfect specimen, it has a subquadrate outline and is $\frac{1}{10}$ th of an inch broader than it is in the antero-posterior diameter; it is slightly narrower anteriorly than posteriorly, and (which is more apparent when it rests upon its dorsal surface) the posterior margin is seen to be broadly truncated; the sides are tumid, sometimes irregularly so, and the test is higher across the apices of the postero-lateral ambulacra than at any other point; the tumidity of the sides produces a greater flatness of the dorsal surface than we observe in any other of the small Nucleolites of the Oolitic rocks; the ambulacral areas are nearly all of the same width, they have a narrow graceful lanceolate form, from the mouth to about midway between the margin and the apical disc, they are nearly of equal width; at this point the pores gradually change their form, and are slightly separated apart for a short distance, and begin again to converge as they approach the disc; the internal row are circular, the external in the form of oblique slits, the widest part of which is outwards, the circles are formed by notches in the upper and under sides of the small ambulacral plates, and the oblique slits by uncalcified portions of the margins of the same plates; from the termination of the petaloid portion of the ambulacral areas to the mouth, the pores are small and set wider apart, whilst the diameter of the areas remains about the same; near the mouth-opening they are again more closely crowded together, and terminate in arches the convexity of which look towards that aperture; the interambulacral areas are of unequal width; the anterior pair are the narrowest, the posterior pair are wider than the anterior, and the single interambulacrum is the widest;

the anal valley is a long narrow depression extending from the apical disc to the margin, it has perpendicular sides and a small anal opening, the base is flat and only slightly depressed at the mouth; the anterior and posterior pairs of interambulacra are moderately convex in this region, and the basal portion of the single interambulacrum is very slightly produced; the mouth-opening is excentral, nearer the anterior margin, it has a pentagonal form with five rudimentary lobes. The surface of the test is covered with microscopic tubercles requiring a good lens to distinguish them; these bodies are only a little larger at the base of the test; the apical disc is small and nearly central, its elements are so closely soldered together that its general form can alone be distinguished; the eyeholes are situated at the apices of the ambulacra, and the ovarial holes further outwards and between them, whilst the madreporiform tubercle occupies the centre of the disc; the test is very thin and often deformed, its upper surface having sometimes an irregular appearance. The beauty and regularity of the specimen figured forms an exception to all the others we possess of this species.

Affinities and differences.—*Nucleolites Woodwardii* most nearly resembles *N. orbicularis*, and is the only one among its Oolitic congeners for which it could be mistaken. The following characters are diagnostic of *N. Woodwardii*. The tumidity of the sides and flatness of the dorsal surface, both of which are absent in *N. orbicularis*. In our species the base is flat and the interambulacra are slightly produced, whilst in *N. orbicularis* the base is concave and the interambulacra are convex and prominent. In *N. Woodwardii* the anal valley is narrow, whilst in *N. orbicularis* it is wide; the general outline of our species is subquadrate, that of the *N. orbicularis* is circular; the petaloid arrangement of the ambulacral areas extends downwards nearer to the margin in *N. orbicularis* than in *N. Woodwardii*; the narrowness of the anal valley in our species establishes an affinity between it and *Clypeus altus*, M'Coy; but the flatness of the base and the depression of the dorsal surface in *N. Woodwardii*, make a wide distinction between it and that species, which has a high convex dorsal surface and extremely prominent basal interambulacra, with a greatly produced interambulacrum; it differs from *N. Hugii* in having the anal valley extended from the disc to the posterior margin, whilst in that species a portion of the test intervenes between the disc and the valley; the difference between *N. Woodwardii* and *N. scutatus* and *N. clunicularis* is so great, that it is scarcely possible that *N. Woodwardii* can be mistaken for either of these forms.

Locality and stratigraphical range.—We have collected this Urchin from the Great Oolite near Cirencester and at Salperton Tunnel, Great Western Railway, and from beds of the same age

near Pewtdown, Gloucestershire, and near Burford, Oxon; it has likewise been found near Minchinhampton: as far as we know, it appears to be a Great Oolite species.

We dedicate this species to our friend Mr. S. P. Woodward, of the British Museum, to whose kindness we are much indebted for the privilege of comparing our specimens with the magnificent series of Echinodermata under his care, and which he has rendered so valuable for reference by a systematic classification and a correct nomenclature.

Nucleolites Michelini, Wright. Pl. II. fig. 6, a-c.

Test circular or oblong, discoidal and much depressed, posterior border produced, truncated and slightly deflected in old individuals; ambulacral areas narrowly lanceolate; pedal pores closely set together, vertex and apical disc nearly central; anterior half of the dorsal surface convex, posterior half much declined from the vertex to the posterior border; anal valley narrow above, diverging below, extending from the apical disc to the border; base flat, slightly concave; mouth excentral, margin with five small lobes; postero-lateral interambulacral areas slightly tumid at the base.

Height $\frac{9}{10}$ ths of an inch, antero-posterior diameter 3 inches and $\frac{5}{20}$ ths, transverse diameter 2 inches and $\frac{2}{10}$ ths of an inch.

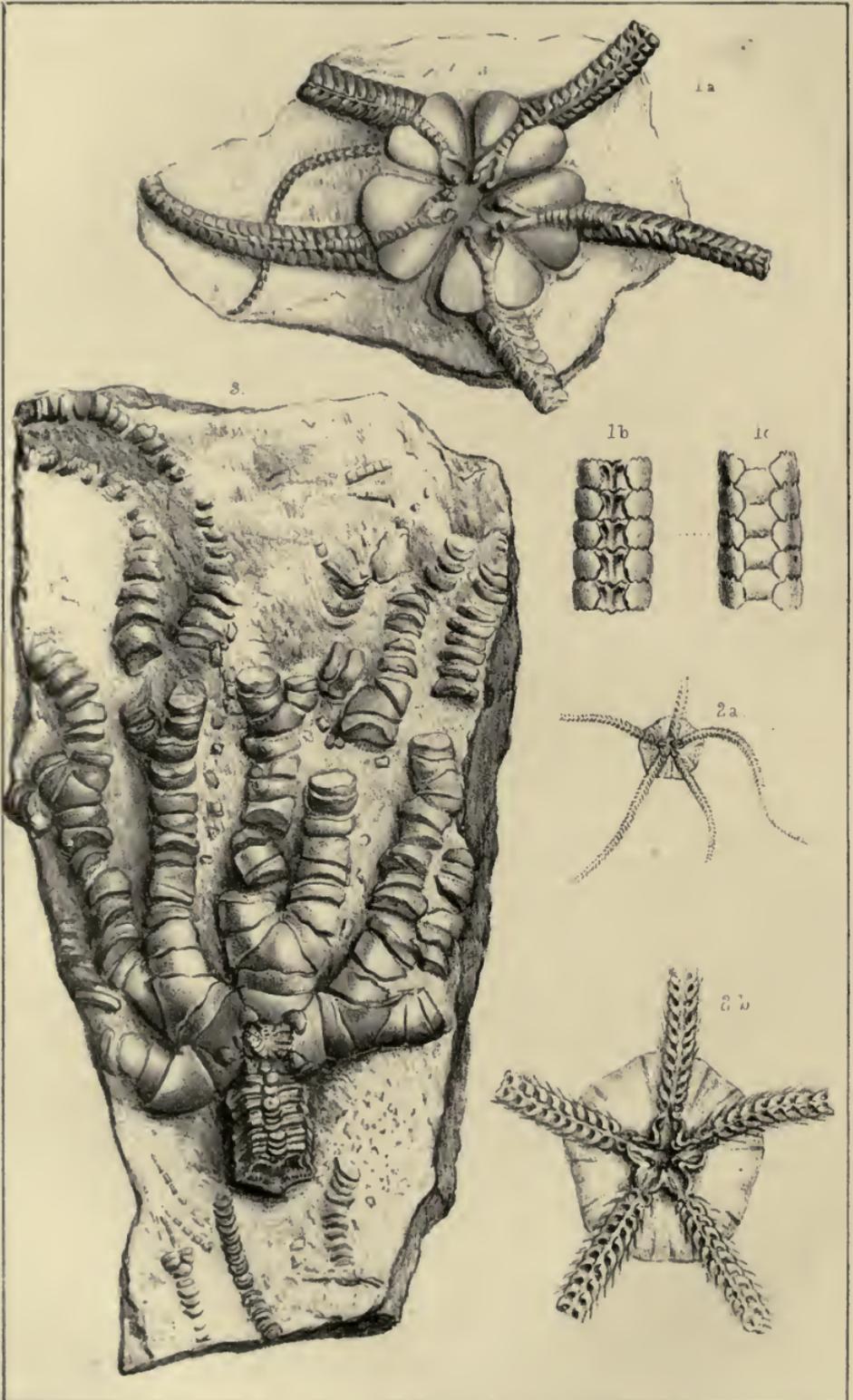
Description.—The outline of this Urchin varies in different individuals, and it likewise varied at different periods of life in the same individual; its most typical form is oblong, convex anteriorly, produced and truncated posteriorly, and swollen out in the region of the postero-lateral interambulacra; in others the circumference is nearly circular, and in some it is transversely oval; the first form is we think characteristic of adult life, as the production and truncation of the single interambulacrum were markedly shown in the only two large specimens of this rare species which we have seen; in all the test is very flat, the anterior half is gently and nearly equally convex, the posterior half is sloping and much declined in the direction of the posterior border. The ambulacral areas are narrow, the anterior one most so; the antero-lateral and postero-laterals are about the same width, they have a lanceolate form, and are composed of very narrow plates; about $\frac{3}{10}$ ths of an inch above the margin, the pores slightly diverge from each other, and continue apart until they approach the apical disc; the distance between the rows of pores in this species is less than in any other Nucleolite of the same size we know, and forms one of the characters by which it is distinguished from its congeners; the ambulacral areas are likewise slightly elevated above the general surface of the test in

all the specimens we have examined; the interambulacral areas are of unequal width, the antero-lateral pair are the narrowest, they are however about nine times the width of the anterior single ambulacral area; the postero-lateral pair are $\frac{5}{10}$ ths of an inch wider than the antero-laterals, and the single interambulacrum is about the same width as the latter. The anal valley extends from the apical disc to the posterior border; it is very narrow, with deep perpendicular sides above, which become shallow and expanded below; the postero-lateral interambulacra are swollen out at the margin; the single interambulacrum is considerably produced, and its posterior border is broadly truncated and slightly deflected, within which the expanded sides of the anal valley are excavated. The base is nearly flat, the elevations are due to the prominence of the postero-lateral interambulacra, and to the deflection of the single interambulacrum. The mouth is excentral, nearer the anterior margin, and the oral lobes are small; the apical disc was of moderate size, judging from the space it occupied, but it is absent in all our specimens; the surface of the test was covered with very minute tubercles, which in the examples before us are nearly all effaced.

Affinities and differences.—*N. Michelini* in its oblong form, truncated posterior margin, and narrow anal valley resembles *N. Solodurinus*, but it is readily distinguished from it by the form, narrowness, and structure of the ambulacral areas; in *N. Solodurinus* they are expanded and petaloid, and in *N. Michelini* they are narrow and lanceolate; the pores at no point are at any great distance apart; the anal valley in both species extends from the apical disc to the margin, but it is more expanded below and deeper above in *N. Michelini* than in *N. Solodurinus*. We have before us *Clypeus angustiporus*, Agass., from a coarse Oolitic rock (Bradfordien?) near Metz, collected by M. Terquem, and kindly sent us by M. de Lorière; from this species *N. Michelini* differs in many particulars; in the French Urchin the apical disc is excentral, the anal valley is wide above and not much expanded below, the ambulacral areas are narrow, and the test gradually declines from the vertex to the anterior border, which forms a rather acute angle; the base is undulated, and the mouth-opening is nearly central; these characters clearly distinguish our Urchin from it. *N. Michelini* differs so widely from all the various varieties of *N. sinuatus* with which we are acquainted, that it cannot possibly be mistaken for either of them, if any care be taken when a comparison is made between them.

Locality and stratigraphical range.—We have collected this species only from the Freestone beds of the Inferior Oolite of Wallsquarry and Nailsworth; the specimen figured was cut out of the centre of a block of building stone; the oolitic grains are





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1 a. c. *Ophoderma Gaveyi*
 2 a. b. " *Griesbachii*
 3. *Pentacrinus Goldfusii*

Wright

imbedded in the plates of the test, and have in some measure injured the surface.

We dedicate this species to M. Michelin of Paris, the distinguished author of the 'Iconographie Zoophytologique,' as a tribute of gratitude for the valuable collection of Echinoderms he liberally and generously sent us from his unrivalled cabinet, to facilitate our studies of these beautiful forms of ancient life.

Nucleolites scutatus, Lamarck.

Since the publication of our memoir on the CASSIDULIDÆ of the Oolites*, we have received from Professor Deslongchamps and M. Tesson a series of type specimens of *Nucleolites scutatus* from the Coral Rag of Trouville, Calvados, which we have compared with *Nucleolites dimidiatus*, Phillips, described in that memoir; from this comparison it is certain, that our Wiltshire and the Yorkshire Nucleolite, figured by Professor Phillips as *N. dimidiatus*, is the true *N. scutatus* of Lamarck. This circumstance affords another example of the great importance of comparing all our British Oolitic fossils with those collected from the Jurassic strata of the continent of Europe, before assigning them a position in our catalogues of species.

Ophioderma Gaveyi, Wright, 1852. Pl. III. fig. 1 a-c.

Diagnosis.—Disc large, upper surface not exposed, under surface with five pairs of heartshaped plates, above which the five rays pass; the median scutal plates of the rays form a ridge in the centre of each pair of plates; the mouth-opening is surrounded with five pairs of very prominent toothlike processes; the rays are slender and gently tapering; the central scutal plates on the dorsal and ventral surfaces of the rays are narrow, those on the ventral surface resemble the bodies of small vertebræ deprived of their neural elements.

Transverse diameter of the body-disc 1 inch and $\frac{2}{10}$ ths, transverse diameter of the rays at their junction with the disc nearly $\frac{3}{10}$ ths of an inch.

Description.—This Sea-star must have been rather abundant in the Liasic sea; we have seen many fine specimens of it, and numerous fragments of others in the locality where it was collected. The body-disc is large and pentagonal, it is composed underneath of ten thin, delicate triangular plates arranged in pairs, each pair forming a heartshaped shield, having an elevated rugose carina down its centre, formed by the median element of the ventral scutal plates which protrudes between each of the two plates forming a pair; the five shields are otherwise smooth

* Annals of Natural History, vol. ix.

on their under surface, and were united together in the living state by a membrane, but in the specimen before us they are quite separate from each other; at the apex of each of the ten triangular plates a sharp toothlike process projects downwards, which together form an imposing dental circle around the mouth-opening. The rays are long, slender, and gently tapering; we have not been able to measure the absolute length of one, as those which we have met with were always fractured; the dorsal median pieces of the rays are hexagonal and elongated transversely, the ventral median pieces are elongated in the direction of the length of the ray, and resemble the bodies of small vertebræ which had been deprived of their neural arches; the marginal plates are rounded and finely imbricated, their outward free border is toothed with five or six pectinated processes, which in the living state supported as many spines; the remains of these are sometimes seen attached to their supports; the lateral scutal plates clasp the rays firmly and securely, and overlap the median pieces both above and below.

Affinities and differences.—This elegant Sea-star somewhat resembles in its general contour *Ophioderma Milleri*, but it is distinguished from that marlstone species by having a proportionately larger body-disc, with more slender and more tapering rays: in the form and structure of the scutal elements of the rays themselves there is likewise a difference, those in *O. Milleri* are of a more elongated and regular form, whilst in *O. Gaveyi* they are shorter, more ridgy and vertebrate-like; the ten triangular ventral discal plates are smaller in *O. Milleri* than in *O. Gaveyi*; they want likewise, in the figures given by Mr. Charlesworth in the London Geological Journal, the toothlike spines at their apices which are so characteristic of our *Ophiura*.

Locality and stratigraphical range.—This Sea-star was collected by Mr. Gavey from the upper shales of the Lower Lias at Mickleton Tunnel near Chipping Campden, Gloucestershire, whilst making the Oxford, Worcester and Wolverhampton Railway; and we have found some fragments of a Sea-star much resembling in structure this species in a Liasic bed of the same horizon at Hewlitt's Hill near Cheltenham, during the excavation of the new reservoir of the Water Works Company of that town.

We dedicate this species to our friend Mr. G. E. Gavey, whose careful and minute investigation of the beds exposed in the section which he has so well described*, added to the discovery of new forms of Radiata and Mollusca in the same, has enriched our knowledge of the Liasic fauna of Gloucestershire.

* Railway Cuttings at Mickleton Tunnel and Aston Magna, by G. E. Gavey, Quart. Journ. Geol. Soc. February 7, 1853.

Ophioderma Griesbachii, Wright. Pl. III. fig. 2 a, b.

Diagnosis.—Body-disc small, upper surface not exposed, under surface irregularly subpentagonal, formed of five pairs of heart-shaped plates; rays long, slender, and awl-shaped, prolonged beneath into the centre of the body-disc; inferior surface with median vertebrate-like elements, and lateral scutal plates in the form of oblique pyramidal pieces, which clasp the sides of the rays in an imbricated manner, and support at their terminal points short stout spines; mouth subpentagonal, surrounded by ten blunt spinous processes, formed by the development of the first lateral scutal plates of the rays, where they join each other around the mouth.

Diameter of the body-disc $\frac{7}{20}$ ths of an inch, length of the rays from the mouth-margin to their apex $\frac{1}{2}\frac{5}{6}$ ths of an inch.

Description.—This beautiful Brittle-star of the Oolitic sea was discovered by our friend the Rev. A. W. Griesbach, of Wollaston, and we owe to his kindness and liberality the series of exquisite specimens before us, by which we have been enabled to complete the description of this new fossil. The body-disc is small, consisting of five pairs of heart-shaped plates; the union between the separate elements of the disc was very intimate, as it is only at one or two points that a suture is exhibited; so close is the union, that in other specimens the body-disc seems to be formed of a single circular element; each pair of plates has a heart-shaped form, and the ray corresponding thereto stands out in bold relief from the under surface of the disc. In none of the specimens found is the upper surface of the disc exposed, and we know not with certainty what kind of ornamentation adorned its dorsal surface; at one part, however, where a portion of one of the plates is weathered, we think we detected with our inch object-glass under the microscope, a series of small imbricated scales resting on the rock surface; the rays are long, slender, and gently tapering; their under surface, the only one exposed, exhibits, 1st, a central element having an elongated form, which resembles the body of a fish's vertebræ in miniature; 2nd, lateral elements more largely developed, consisting of triangular plates of a pyramidal form slightly twisted round, by which arrangement the apices of the pyramids are made to clasp each other, and thereby produce a regular imbricated structure; the points of the lateral plates support small, short, stout spines, which are only seen in one of the rays of the three specimens before us. Where the base of the ray crosses the under surface of the body-disc it is firmly attached thereto, and as they approach the centre, each of the lateral plates of the rays becomes greatly developed, and form by their union five channels, which

extend into the mouth ; this opening is in the centre of the disc, and has a subpentagonal form ; it is of a moderate size, and is surrounded by ten stout spines formed by the development of the first lateral plates, which are much expanded and terminate at the oral border in short stout spinous processes ; the lateral plates from the adjoining rays are here united together, so that two spines from the lateral plates of different rays are closely approximated, and the five rays are thereby united together round the mouth-opening like five Gothic arches, so that the mouth with its channels, formed by these arches, resembles a miniature starfish in the centre of the disc ; the five pairs of spines may have served as jaws.

Affinities and differences.—Our knowledge of fossil *Ophiurida* is unfortunately so limited, and the details of those forms known are so meagre, that there is much difficulty in making a comparison between the extinct genera of this family. In our description of *Ophioderma Gaveyi* a diagnosis has been attempted between it and *O. Milleri*, Phil., both of these being Liassic species. The other forms hitherto published are those figured by Goldfuss, namely the *Ophiura prisca*, Münster, from the Muschelkalk of Baireuth ; the *Ophiura loricata*, Goldf., from the Muschelkalk of Württemberg ; the *Ophiura speciosa* and *O. carinata*, Münster, from the Lithographic slates of Solenhofen ; of these Goldfuss's figures are excellent, and leave nothing to be desired, as that able natural-history artist Herr Hohe, whose crayon has added such lasting value to the 'Petrefacta Germaniæ,' has given accurate details of structure which prevent the possibility of confusion regarding the identification of the species drawn by him.

The *Ophiura Egertoni*, Brod.*, found in nodules of micaceous sandstone at the base of the Inferior Oolite near Charmouth, is so entirely distinct from our fossil, that to mistake them is impossible ; between *O. Griesbachii* and *O. speciosa* and *O. carinata*, the difference is likewise very great ; *O. loricata* comes nearer to our Brittle-star than either of the others, but the great development of the lateral plates of the rays, and the clasping and imbricated character of the same in *O. Griesbachii*, forms a structural character which separates it widely from Goldfuss's species. If we seek further for resemblances to our Brittle-star, we must look for them more amongst the beautiful *Ophiocomæ* of our seas than among any forms we are acquainted with in the fossil state, but even between it and them the differences are many and distinct.

Locality and stratigraphical range.—This beautiful fossil was collected by the Rev. A. W. Griesbach from the Forest marble of

* Geol. Trans. 2nd series, vol. v. pl. 12.

Oundle, Northamptonshire, where it is rare. We have dedicated this species to that gentleman, to whom we are indebted for much valuable information relative to the stratigraphical distribution of Echinoderms in his county, and likewise for a liberal contribution of materials to aid us in the completion of these memoirs.

Pentacrinus Goldfussii, Wright. Pl. III. fig. 3.

Diagnosis.—Calyx composed of a central pentagonal plate, five small heart-shaped pieces, and five large triangular basal elements; rays thick, strong and bifurcated; total number of their subdivisions unknown; the five primary rays consist of two pieces, the basal piece is flat, and has a slightly elevated portion about the centre of the upper surface, the brachial piece is strong and triangular, its base resting firmly on the former; the sides of the triangle support two arms; the ten secondary rays consist of from ten to eleven circular pieces with smooth unequal undulated surfaces, whereby their thickness is rendered very unequal; the secondary rays support twenty tertiary rays, which have the same general character as the secondary rays; the number of pieces entering into the composition of each is unknown; from the fragmentary state of this part of the specimen the number may be estimated at from fifteen to twenty pieces. The column near the calyx is composed of thin, deeply divided five-rayed plates, with well-marked transverse articular impressions on their surfaces; every fourth plate is thicker, broader, and more prominent than the one above it or below it; the side arms are numerous, and composed of thin circular plates: the lower part of the column is unknown.

Description.—This beautiful Sea Lily is remarkable among its Liasic congeners for the comparative strength and thickness of its rays; the centrum of the calyx is simply a thickened and enlarged columnar joint to which the upper part of the column is articulated; around the apices of the rays of this centrum five small heart-shaped basal pieces are inserted, the points of which are directed outwards; they are very convex externally, projecting from the surface of the calyx, and have the appearance of five mammillary eminences disposed around the union of the column with the calyx.

The rays are short and robust; the primary portion consists of two pieces, a flat basal plate and a triangular brachial plate; the basal plate has a slight elevation on its outer and upper articular surface; the brachial plate has the form of an equilateral triangle, it is very convex externally, and has its base firmly

planted on the flat basal plate, and its sides support the secondary rays; these are ten in number, and consist of from ten to eleven circular plates, each differing in form and thickness from the other, their articular surfaces being smooth and undulated in different directions, the elevations of the one plate always corresponding to the depressions of the other with which it is articulated; these inequalities are well seen in the specimen before us; from the various angles at which these plates lie in relation to each other, the ultimate brachial piece of each of the secondary rays has a triangular form externally, the sides of which support the tertiary rays; these, like the secondary rays, consist of unequal-sized plates with undulated articular surfaces, which are marked with fine lines that radiate from the centre to the circumference; the number of the elements in these tertiary rays cannot be accurately made out in consequence of the imperfection of this part of the skeleton; judging however from the remains of the plates in a part of the slab once occupied by a tertiary ray, we estimate their number to have been from fifteen to twenty. The inferior surface of the centre of the calyx exhibits a depression produced by the convexity of the brachial elements and the prominence of the heart-shaped basal pieces; into this depression the summit of the column closely fits. It is unfortunate that so small a portion of the column of this Crinoid is preserved, as it is possible that the lower part of the stem was different from that which is preserved; the upper part of the column before us consists of thin star-shaped plates, the rays of which are deeply divided, and their surfaces are sculptured with well-marked transverse articular processes; between every third plate a thicker and broader plate is introduced; the side-arms appear to have been numerous about the upper part of the column; they were composed of thin circular plates having undulated surfaces similar to those observed on the secondary and tertiary rays.

Affinities and differences.—*Pentacrinus Goldfussii* resembles in some points *P. tuberculatus*, Mill.: through the kindness of Major Austin and Mr. Etheridge we had the privilege of comparing our fossil with Miller's type specimen in the Bristol Museum, but the imperfection of that Crinoid makes a rigorous comparison impossible; one point of difference which Miller thought specific of *P. tuberculatus* he thus describes: "The column differs in its joints, being thinner, and their having been covered all over with a more conspicuous muscular coat, which shows itself in numerous minute tubercles the result of its contraction*:" this character is certainly absent in our fossil. It is distinguished from

* Miller's Crinoidea, p. 65.

P. briareus, Mill., *P. subangularis*, Mill., and *P. scalaris*, Goldf., by the absence of lateral branches from the rays, and from all others of its Liasic congeners with which we are acquainted in the strength and thickness of the rays themselves.

Locality and stratigraphical range.—This remarkable Sea Lily was discovered by Mr. R. E. Gavey, C.E., in the Lower Lias of Mickleton Tunnel near Chipping Campden, Gloucestershire; it is imbedded in shale resting on a hard slab of limestone, and was associated with the remains of other Radiata.

We dedicate this fine Liasic Crinoid to the memory of the late Prof. Goldfuss, whose great work, 'Petrefacta Germaniæ,' has so much increased our knowledge of the Liasic and Oolitic fauna.

A Tabular View of the Stratigraphical Distribution of the New Species described in this Memoir.

Genera and Species.	Authority.	Lower Lias.	Marlstone.	Upper Lias.	Inferior Oolite.	Great Oolite.	Combrash.	Forest Marble.	Coralline Oolite.
<i>Cidaris Edwardsii</i>	Wright ...	*							
— <i>Bouchardii</i>	Wright ...	...	...	...	*	
<i>Hemieidaris minor</i>	Agassiz ...	...	...	...	...	*
<i>Acrosalenia erinifera</i>	Quenstedt	*							
<i>Diadema Davidsoni</i>	Wright ...	...	...	...	...	...	...	...	*
— <i>Moorei</i>	Wright ...	...	...	*			
<i>Pedina Bakeri</i>	Wright ...	...	...	...	*	
— <i>Etheridgii</i>	Wright ...	...	...	*	*		
<i>Polyeyphus nodulosus</i> ...	Münster ...	...	...	...	...	*	*
— <i>Deslongchampsii</i> ...	Wright ...	...	...	...	*	
<i>Nueleolites Woodwardii</i> ...	Wright ...	...	...	...	...	*
— <i>Michelini</i>	Wright ...	...	...	...	*	
— <i>scutatus</i>	Lamarek...	...	...	...	...	...	...	...	*
<i>Ophioderma Gaveyi</i>	Wright ...	*							
— <i>Griesbachii</i>	Wright ...	...	...	...	...	...	...	*
<i>Pentacrinus Goldfussii</i> ...	Wright ...	*							

EXPLANATION OF PLATES I. II. AND III.

PLATE I.

- Fig. 1. *Cidaris Edwardsii*: *a*, natural size, and restored to its globular form; *b*, portion of an ambulacral area magnified, showing the pedal pores and tubercles; *c*, primary tubercle, with its circle of areal granules, magnified; *d*, one of the jaws and its tooth, of the natural size; *e*, secondary spine, natural size and magnified; *f*, primary spines, natural size and magnified.
- Fig. 2. *Cidaris Bouchardii*: *a*, *b*, natural size; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 3. *Hemicidaris minor*: *a*, natural size; *b*, magnified two diameters; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 4. *Pedina Bakeri*: *a*, natural size; *b*, magnified one and a half diameter; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 5. *Pedina Etheridgii*: *a*, natural size; *b*, upper surface and ovarian plates, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle and ambulacral area, magnified.

PLATE II.

- Fig. 1. *Acrosalenia crinifera*: *a*, natural size; *b*, upper surface, magnified three diameters; *c*, under surface, magnified three diameters; *d*, primary tubercle and lateral granules, magnified.
- Fig. 2. *Diadema Davidsoni*: *a*, under surface and mouth-opening, natural size; *b*, upper surface and anal opening, natural size; *c*, side view, showing the tubercles of both areas; *d*, base of one of the ambulacral areas, showing the clustering together of the pedal pores in this region; *e*, primary tubercle, ambulacral area, and pedal pores, magnified.
- Fig. 3. *Diadema Moorei*: *a*, natural size; *b*, upper surface and ovarian disc, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle, circle of granules, and pedal pores, magnified.
- Fig. 4. *Polycyphus Deslongchampsii*: *a*, natural size; *b*, upper surface and ovarian disc, magnified one and a half diameter; *c*, outline of the mouth-opening; *d*, genital and ocular plates of the ovarian disc, magnified; *e*, primary tubercle, areal granules, pedal pores, and ambulacral area enlarged.
- Fig. 5. *Nucleolites Woodwardii*: *a*, upper surface, of the natural size; *b*, side view, of the natural size; *c*, ambulacral area and pedal pores, magnified two and a half diameters; *d*, tubercles and areas, magnified; *e*, mouth-opening and ambulacral area, magnified one and a half diameter.
- Fig. 6. *Nucleolites Michelini*: *a*, upper surface, reduced one-third in size; *b*, lateral view, reduced one-third in size; *c*, a portion of the ambulacral area and pedal pores, natural size.

PLATE III.

- Fig. 1. *Ophioderma Gaveyi*: *a*, disk, with portion of the rays, natural size; *b*, part of the upper side of a ray, enlarged three diameters; *c*, under side, enlarged three diameters.
- Fig. 2. *Ophioderma Griesbachii*: *a*, natural size; *b*, disk and a part of the rays, enlarged three diameters.
- Fig. 3. *Pentacrinus Goldfussii*: natural size.

Upon a new species of "*Alpheus*" discovered upon the coast of
 "Herm" (Channel Islands). By W. V. GUISE, Esq., F.G.S.

READ 9TH MAY 1854.

IN the course of an excursion to the Channel Islands, undertaken last summer with a view to natural-history pursuits, I spent three days in the little islet of Herm, which, though a mere rock, scarcely three miles in circumference, is equalled by few spots of similar extent within the area of the British seas, in respect of the rich field it offers for the researches of the marine naturalist.

The Channel Islands, though an appanage of the crown of Great Britain, are, geographically speaking, rather a part of France than of England; and this situation, in a sort of debatable ground, may perhaps in some degree account for the fact of their natural history having been to a certain extent overlooked by the naturalists of both countries; though few districts can be expected to yield a richer harvest to the scientific investigator, constituting as they do the northern limit to many Mediterranean forms, which, here found flourishing in full vigour, and showing no signs of decrepitude, dwarfishness or decay, suddenly disappear, and find no footing upon our side of the Channel. This is well known to be the case amongst the testaceous Mollusca; and there is little reason to doubt, that researches prosecuted amongst the other kingdoms of nature would be rewarded by the discovery of many novel and important facts.

Amongst the Crustacea, to which I propose especially to direct your attention, it is only necessary to refer to the discovery of the singular and beautiful "*Phyllosoma sarniense*," figured and described by Mr. C. F. Lukis in the 8th volume of 'Loudon's Magazine of Natural History,' which example, still I believe unique, has its only analogues in one Mediterranean species, and in a few others confined to tropical areas.

I propose now to lay before you another Crustacean, which it has been my good fortune to obtain in a tide-pool at low water on the islet of Herm, and which, from its immediate recognition as the "red shrimp" by the fisherman who accompanied me, I have reason to believe is not of unfrequent occurrence. My first idea was, that I had obtained "*Alpheus ruber*," itself a great

prize, being a Mediterranean species of the greatest rarity in our seas; but upon comparing it carefully with the descriptions of Milne-Edwards in his 'Histoire Naturelle des Crustacés,' I became convinced that I had had the good fortune to obtain an entirely new species of *Alpheus*; and further investigations have only tended to confirm me in that opinion.

The genus "*Alpheus*" is thus characterized by Milne-Edwards:—

Carapace prolonged in form of a hood or vault over the eyes.

Rostrum small, and sometimes wanting.

Superior antennæ small; first articulation short, and armed without with a plate, generally spiniform; two following joints cylindrical, having two terminal threads, of which the superior is thicker and shorter than the inferior, and presenting traces of a division into two filaments towards the end.

Inferior antennæ inserted without and below the preceding.

Lamellar palp of moderate size, sometimes small and pointed.

Mandibles provided with a short, broad, palpiform appendage.

External pedipalps more or less slender and elongated, termination broad and somewhat foliaceous.

Two first pairs of legs didactyle, the first pair strong; the one much larger and more robust than the other.

Second pair weak and filiform, having the wrist multi-articulate.

Three last pairs of legs monodactyle and of moderate length.

This genus, says M. Edwards, appears to belong properly to the seas of warm climates. Some species are found in the Mediterranean; but the greater part come from the seas of the Antilles or from the Indian Ocean.

The genus is *divided* into those which *have*, and those which *have not*, a *spiniform rostrum*. It is further *subdivided* into those having a spine attached externally to the basal joint of the *external antennæ*, and those *not* so furnished.

The example now before us will be found to belong to the second subdivision of the first division, *i. e.* to those provided with a pointed beak, and not having an external spine at the base of the *external antennæ*.

Under this head three species are described by M. Edwards as inhabiting the European seas, *viz.*—

Alpheus ruber, *Alpheus Edwardsii*, and *Alpheus dentipes*, which are characterized as follows:—

Alpheus ruber. "Body very slender; larger hand provided with four longitudinal carinæ, two on the upper edge, two on the

external face; lower margin obtuse; moveable finger *much shorter* than the immoveable one. A spine upon the upper margin of both arms at some distance from the termination."

It will be remarked that nothing is here said concerning the character of the anterior portion of the carapace; but as this species is said to be "très voisine de la précédente" ("*Alpheus brevisrostris*," a new Holland species), which is characterized as having the border of the supra-orbital hood rounded and *without spines*, it is to be inferred that the like character also applies to *A. ruber*.

Alpheus Edwardsii. "Very closely allied to the preceding. *Anterior* borders of *supra-orbital vaults* armed with a *spine*, so that the front presents three nearly equal teeth. The second joint of the superior antennæ about half as long again as the first. Lamellar appendage of the external antennæ dilated a little within towards the end, and not passing the footstalk of the superior antennæ. Pedipalps very narrow towards the end, and extending beyond the footstalk of the superior antennæ. Anterior legs nearly of the same form as in the preceding species, but more enlarged, and having the pincers more irregular; those on one side slender and lengthened."

Alpheus dentipes. "Closely allied to the preceding: having likewise the supra-orbital vaults prolonged into points, but having the two anterior legs nearly of the same size; the pincers of the smaller large at the base, but becoming extremely narrow towards the end; having the third articulation of the second, third and fourth pairs of legs armed with a pointed tooth externally, at one-third the length of each."

Upon comparison of my Channel Island individual with the three species described above, I find the following points of agreement and difference between them.

It *assimilates* with *A. ruber* in having the larger hand furnished with longitudinal carinæ on the upper and the outer surface;

Differs, in *not* having the moveable finger shorter than the immoveable one; and *essentially* in the spinous armature to the supra-orbital hoods.

It *assimilates* with *A. Edwardsii* in having the anterior edge of the supra-orbital hoods armed with short spines; and in having the second joint of the superior antennæ half as long again as the first;

Differs, inasmuch as the lamellar appendage is *not* dilated towards the end; in the longitudinal carinæ upon the upper and outer surface of the larger pincers; in the proportions and form of the anterior feet, and in other minor particulars.

Assimilates with *A. dentipes*, as with *Edwardsii*, in the spinous terminations to the supra-orbital hoods;

Differs, with respect to the comparative proportion between the two anterior pairs of legs; and inasmuch as the three hinder pairs of legs are not armed externally with a pointed tooth.

Having thus shown in what respects the *Alpheus* from Herm assimilates with, and differs from, the three species above referred to, it remains to describe its own particular characteristics, which are as follows:—

The medial line of the carapace prolonged anteriorly into a short beak: *supra-orbital vaults*, each furnished at the extremity with a minute spine: *anterior legs unequal*; the *larger hand* having upon the upper edge two carinæ, one behind the other, each terminating anteriorly in a small tooth projecting forwards; two carinæ upon the outer surface of the claw, the lower one having a short tooth: the *moveable finger not* shorter than the immoveable one, flattened laterally, and broad at the point: the *immoveable finger* triangular, strong, and forming a kind of socket into which the opposing finger fits by a tubercle at its extremity: *lesser pincer* having a toothed keel upon its upper edge, equal in length to the others, but thinner, narrower, and much less robust: second pair of legs didactyle, slender, and having the wrist many-jointed.

Length 15 lines.

Colour deep scarlet, except the chelæ, which are mottled with yellow.

From the want of other works of reference, besides those of M. Edwards and of Professor Bell, I have it not in my power to ascertain whether the species now under notice has been distinguished by later careinologists; but I have endeavoured, I think satisfactorily, to show that it cannot be identified with either of the European species of *Alpheus* described by the former distinguished naturalist. As regards both the figure and description of *Alpheus ruber* in Bell's 'British Crustacea,' they having been confessedly taken from an *imperfect* individual, found in the stomach of a Cod-fish, have so little in common with my Channel Island example, that, if identical with it, it must be presumed that all the more marked points of agreement between them had been digested away in the interior of the fish.

In the 8th volume of 'Loudon's Magazine of Natural History,' page 272, is however a notice of a Crustacean by the late Mr.

Hailstone, which certainly agrees far more nearly with my example than do either of those to which I have already referred; so nearly indeed, that but little doubt remains upon my mind of its being identically the same. This species, which Mr. Hailstone calls "*Hippolyte rubra*," and of which a figure is annexed, is thus described:—

"Superior antennæ with two setæ, the upper ones fringed with hair and excavated below. Inferior antennæ nearly the length of the body. Pedipalps with three exerted joints, the last bluntly pointed, and twice the length of the preceding one, with two rows of fasciculi of hairs. First pair of legs didactyle, very large, with the hands much compressed, unequal, the right being the larger, bristly; the thigh excavated beneath, and its inner margin spinulose; second pair didactyle, very long, slender; wrists many-jointed; other legs terminated by a single claw and spinulose within; the last pair the most slender. Thorax with three short spines anteriorly. Tail with five plates, the middle one blunt at its apex, with four spines arranged in two lines. Colour deep scarlet, except above the eyes, *which are concealed under the shell*, and above them it is transparent and colourless. The tail is fringed with white hairs, and the legs are mottled with yellow."

Upon this, at page 274 (same volume), is a note by Mr. Westwood, in which, with much skill and critical acumen, he traces Mr. Hailstone's individual to the group of *Alphedæ*, and refers it to *Cryptophtalmus ruber* of Rafinesque, which M. Edwards identifies with his "*Alpheus ruber*." Mr. Westwood afterwards, at page 552, proposed to elevate it into the type of a new genus by the name of '*Dienecia*.'

Mr. Hailstone's description, as quoted above, might almost stand word for word as applicable to my example, with which it seems to tally in all important particulars, excepting as regards size, which, in the case of Mr. Hailstone's Crustacean, is barely two-thirds that of mine. The figures too attached to Mr. Hailstone's notice would serve equally well to illustrate mine, with the exception of the hairy fringe attached to the setaceous extremities of the superior antennæ.

If I am right in my supposition of the identity of my Channel Island Crustacean with the three individuals described by Mr. Hailstone as brought up by the trawl-net off Hastings in 1835, it is evident that the half-digested relics procured by Mr. Cocks at Falmouth are not the first examples of an *Alpheus* having been recorded as an inhabitant of the British seas. Indeed it is impossible to read Mr. Hailstone's careful and minute description without feeling convinced that a true *Alphean* was before him when he made his drawing and description; and I may be par-

done for expressing my surprise, which I do with great deference to the high attainments of Professor Bell, that that distinguished naturalist, in adopting the "*Crangon bispinosus*" and "*trispinosus*" of Mr. Hailstone, should have omitted all reference to a form so very remarkable and so carefully detailed as Mr. Hailstone's "*Hippolyte rubra*."

In the belief that my Channel Island Crustacean is a new and undescribed species, I propose to bestow upon it the name of *Alpheus affinis*; thereby indicating the close relationship which it bears to the three other European species already referred to.

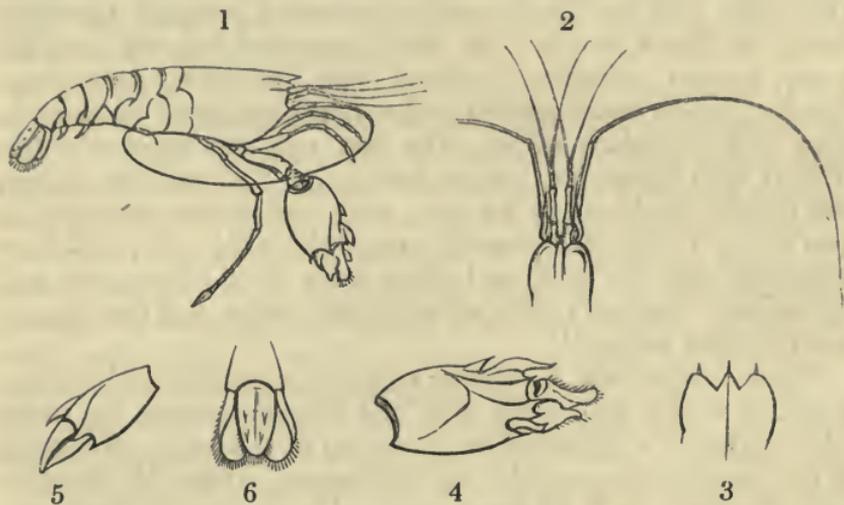


Fig. 1. *Alpheus affinis*, natural size.
 2. Enlarged view of front of carapace, showing supra-orbital vaults, insertion of antennæ, &c.
 3. Front of carapace still further enlarged, showing beaked rostrum and spinous armature of supra-orbital vaults.
 4. Enlarged view of larger pincer.
 5. Enlarged view of lesser pincer.
 6. Tail.

Address read to the Cotswold Naturalists' Club, at their Winter Meeting, held at the Royal Agricultural College, February, 1855.

By T. BARWICK LLOYD BAKER, Esq. of Hardwicke Court,
President.

THE close of another year, my friends, calls upon me, as your unworthy President, to resign into your hands an office which your kindness, and not my fitness, has continued me in for many years, and which I have hitherto accepted because I did not see clearly how to find a substitute with equal leisure and zeal in the cause. Now the case is altered, and I would seriously ask you to look through your list of members, and see if you cannot find one who, with more youth, activity, and leisure, and with talents really fitting him to preside over your discussions, has, if we may trust to appearances, not less—though certainly not more—good will to the cause than myself. If you can find such a one—and I think it cannot be difficult to do so—and can prevail upon him to accept it—I would most gladly give into his hands one half of my office, namely, that portion of it which appertains to the Presidency—and retain for myself the other portion, which is better suited to my talents, namely, that of helping to find conveyances, endeavouring to find the way in our rambles, reminding the members—most unpleasantly—of the flight of time, and—less unpleasantly—of the approach of the dinner hour.

But, before I resign my office, I must recall to your recollection the sayings and doings, and, I trust, the enjoyings of the past year.

In the first place I must congratulate the Club on the accession of some new names, which—though we are anxious to confine our numbers within certain limits—we cannot but rejoice to see on our list, namely, Dr. Voelcker and Mr. A. Williams, the Chemical and Natural Philosophy Professors of the Royal Agricultural College; The Rev. S. Lysons, a name so well known to the Antiquarians of England, and particularly of this county; The Rev. H. W. Bellairs, the Inspector of Schools for this and several other counties; and J. H. Elwes, Esq., our worthy High Sheriff.

Secondly, I must congratulate you, Gentlemen, on the series of papers which this year have been read at our meetings.

1st, On some Rolled Bricks, from the Channel Islands, by Mr. Guise.

2nd, On the remains of an Ancient Cross, at Ampney Crucis, by Mr. C. Pooley.

3rd, On a New Crustacean, from the Channel Islands, by Mr. Guise.

4th, On the superstitious reverence shewn to Parsley, Elder, and other plants. By Mr. Jones.

5th, On Mammalian Remains, from the gravel, at Stroud, by Professor Buckman.

6th, On some Maltese Echinoderms, by Dr. Wright.

These papers, Gentlemen, are a most valuable addition to our Club. The credit which accrues from them to our Society is a point that I most highly value. Yet still we must remember that

as it introduces a new feature, and in some degree carries the Club from its original unpretending and economical character, it is only right and fair that the point should be fully considered and made the subject of a special vote from the Club, to which I purpose, if you will permit me, to call your attention later in the evening.

To proceed, then, to recall to your recollection the days we have enjoyed as Club meetings this year.

On Tuesday, Jan. 31, the Club met, as now, within the hospitable halls of the Royal Agricultural College, at Cirencester, which, not content with being the most valued seat of science during term time, does not disdain, in the vacation, to give their assistance to the humbler efforts of less regular votaries. After the election of the officers, some valuable papers were read by Mr. Guise and Mr. Pooley; and Mr. Stronge shewed us a curious growth of a root whose spongy texture had entirely choked a drain at, I think, a depth of four feet; the natural history of which was ably commented upon by Mr. Buckman.

An examination of the College Museum occupied the time till dinner, after which we had a long discussion on the memorial Window proposed to be erected to our valued and lamented member, Hugh E. Strickland; and the Revs. H. R. Barker, W. Symonds, and F. Bayley, and Mr. Jones and Mr. Buckman were appointed as a committee to select a design.

On Tuesday, May 9, I was prevented by yeomanry duties from attending; but I am informed that the Club met at Gloucester, and after breakfasting at the Spread Eagle, proceeded in a barge to the Upper Lode, stopping to examine Wainlode Cliff, below which, the Severn being low, the dredgers succeeded in finding the following fresh-water shells:—

Ancylus fluviatilis.

Paludina vivipara.

Nerita fluviatilis.

Pisidium amnicum, of an extraordinary large size, and

Lymnæus stagnalis.

Unio tumidus.

„ *auricularius.*

At Deerhurst Church the capabilities of the window destined to receive the glass memorial to our lamented associate, Hugh E. Strickland, was inspected, and the proposed design exhibited; and the members present came to an unanimous decision that the early Saxon remains of this most interesting church—probably the oldest of the county—should be faithfully copied and embodied in the records of our Club, while they remain in their present intact and complete state of preservation.

This decision of the Club appears valuable, and well worthy to be carried out. I know not whether any steps have been yet taken in it, but if not, I would propose that some of our members—shall I suggest Mr. Jones and Mr. Buckman should be requested—if they will kindly undertake it—to make a report to the Club at a future meeting.

In the course of the day Mr. Buckman pointed out the low range of hills receding from the west side of the river, and remarked

that they are capped with sand and shingle, curiously marking the boundary of the estuarine period of the broader river. The present stream was observed to have made its way through alluvial beds, which, at the place of embarkation, are sufficiently tenacious for the making of bricks, for which purpose it is largely employed. The men at the pits said that they frequently met with the bones of large animals, perhaps Elephant, Hippopotamus, Rhinoceros, and Deer, which were the inhabitants of these isles long ere Brutus, grandson of Æneas—as the unquestionable authority of Geoffry of Monmouth informs us—landed on them and gave them the name of British.

Mr. Guise's and Mr. Jones' papers finished the proceedings of a good day and a large meeting: many members of the Malvern Club having joined the party.

Tuesday, June 14, had been fixed for a gathering of the four Clubs of this part of England, at the Speech-House, in the Forest of Dean. We breakfasted at Newnham, where we found awaiting us a specimen of that peculiarly hideous fish the *Lophius piscatorius* (Wide-gab fishing frog, or Sea devil), caught in the river a few days before. We then walked over the Bailey, and followed the line of the Railway to Cinderford, through most interesting sections of the Old Red Sandstone, Mountain Limestone, Millstone Grit, and Coal, all lifted up at high angles of inclination, sometimes as much as 61 degrees.

Hence to Lightmoor Colliery, where, in addition to a noble steam engine, we were shewn a most ingenious and valuable contrivance to obviate the effect of the occasional negligence of the engineer, by which the truck of minerals just raised from the mine is occasionally drawn over the pulley, to the great danger both of machinery and human life. In this machine, when the truck approached too near the pulley it was caught and remained suspended, while the rope, detached from it at the same moment, might be carried harmlessly round and round the barrel.

A peculiar blight upon the Forest Oaks, at a distance, was so observable as to give them quite an October aspect, but we did not approach sufficiently near to examine them minutely. Mr. Buckman is disposed to think that it was not a blight, but arose from the circumstance that the first leaves of the oak buds came out early, and soon changed to a dark hue, and then to the autumnal tint. The buds then, in the middle of summer, took a fresh growth, and you had the varied tints arising from prematurely old leaves with an unusually new state of young leaves. This was very general last summer throughout England. However this may be, Sir James Campbell, the Ranger of the Forest, has since told me that he has often seen the same in former years, both in this and other forests, and the effect on many trees which he has annually measured, has been that, in the years when thus affected, they have not grown in size at all.

At the Speech-House, about seventy persons sat down to dinner—half being members of the Cotteswold Club and friends—

the remainder being members of the Worcester, Woolhope, and Malvern Clubs. Mr Jones exhibited a beautiful series of *Rhynchonella subdecorata*, from the inferior oolite, a species erected by Mr. Davidson, from the examples now shewn; and the *Arbacia Forbesii*, a rare Echinoderm, from the Gryphite grit.

Mr. Atkinson, Deputy Gaveler of the Forest, exhibited some curious plans of the coal and iron mines of the district; and Mr. Herbert Mackworth gave us much interesting information on the fire-damp, and exhibited a variety of apparatus for testing its presence, observing particularly on the almost necessity which exists for a higher state of education and intelligence in those workmen who have the charge and care of mines.

A member of the Worcestershire Naturalists' Club announced the interesting discovery in his county, during the past year, of *Carex montana* and *Potamogeton flabellatus*.

On Tuesday, July 11, the Club met at breakfast at Minety Station, and then broke into two sections—the one to examine the Railway cuttings, of which the President and Secretary formed part, and there turning off to Braydon Pond, about a mile from which, close to the high road, was a curious specimen of one of the ancient elms of Lydiard Forest. The trunk, about 25 feet in circumference at six feet from the ground, rose from a tangled and almost solid mass of roots, which, as near as I could measure it, was 21 feet long by 15 feet across.

What was seen by the other section, who, under the guidance of Mr. Bowly and Mr. Taylor, went on an antiquarian expedition to the Market-place and Abbey of Malmesbury, we know not, as no report was given us.

I would venture to suggest, as a rule of the Club for the future, that whenever the Club breaks into sections, some one be appointed as Secretary for the day with each section, who shall be requested to draw up a short report of what has been seen for the next meeting.

On Tuesday, August 8th, we again essayed, in spite of our failure of weather on the former occasion, to persuade Ladies to honour us with their company at Cirencester. This time the weather was most fortunate, and the day was thoroughly enjoyable and enjoyed. After breakfast we proceeded in flies and other vehicles through the Park, stopping to look at the noble Cathedral Firs, and then driving on to the Edgeworth Valley, we rambled and scrambled through it; finding, amongst others the following interesting plants:

Asperula cynanchica.

Dipsacus pilosus.

Vicia sylvatica.

Orchis ustulata.

Hippocrepis camosa.

On a rocky side of the valley, facing the south-west, was found a pretty natural collection of ferns, consisting of

Polypodium calcareum.

Aspidium filix mas.

„ *vulgare*

Cyrtia fragilis.

*Asplenium trichomanes.**Scolopendrium vulgare.*" *adiantum nigrum.*

Returning by the old house of Pimbury Park, with its fine terrace of yew trees, we dined, to the number of 70 in the Woodhouse. Papers—none were forthcoming; but the toast to the health of the strangers, was responded to by the Hon. General Watson Webb, now of New York, but whose ancestors were of our own county; and Mr. Buckman gave us some most interesting and amusing details of his recent American tour.

On September 12th, the Club, contrary to all but irrevocable decree, accepted the invitation of the Earl Ducie to breakfast and dine at his hospitable mansion at Tortworth. The day was most auspicious, and while Lord Ducie most ably acted as Geological pioneer, led one section through a fine geological country embracing the trap rocks, Silurian, old red sandstone, and mountain limestone of the neighbourhood, a second section roamed through the Park, along the walks, round the lake—now being opened out and restored to order—by the entrenchment, which still bears the ominous name of Bloody Acre; by the site of the Vineyard, which flourished at no distant period (though of the flavour of its wine we have no accurate record); by the Lover's Leap, the pens of Circassian Deer (*Cervus Wallichii*); the kitchen gardens, close to which is a remarkably fine *Auracaria*; and then, crossing the road, to the Court, where the Chestnut, described as "The Old Chestnut," in the days of king John, still grows broad and green, a noble specimen of antiquity; while near at hand a considerable variety of Pines, amongst them a remarkably fine *Insignis* and *Sabineana* attest the improvements which latter years have made in giving variety in colour and form to the landscape.

After dinner, several papers were read, particularly one by Dr. Wright, on a number of Echinoderms, collected in Malta by our noble host, and which forms a prominent feature in our forthcoming number.

And now, Gentlemen, before I release you, I must touch upon a few other matters relative to the year which has passed since our last winter meeting.

I cannot but allude to the loss which the cause of science has sustained in the death of Professor Edward Forbes, of whom it has justly been said, by Professor Buckman, He will long be remembered as a *genius*; as a naturalist, who, while he could well trace distinctive characters, was not a mere species maker: this his thorough acquaintance with morphological views, and the great physiological facts connected with both plants and animals, kept him above and beyond. His mind was that of the great but not fanciful generaliser. In Natural History, indeed, he was a *Philosopher*, not a mere collector.

Another point you must allow me to mention, is that of the new number added, or being added, to our transactions. It is one of which we may justly be proud, but I must also remind you

that it is one which entails upon us a considerable expense, and although I for one should be glad to see the expense still farther increased by an increase of such papers—still, as it was not contemplated in the original formation of our Club, I think it right to bring the matter fairly before your consideration.

It appears to me that three courses lie before us. First—to print *all* such papers as may be read, even at an additional increase of expense, yet still amounting to but a small sum per annum if regularly collected. Secondly—to limit ourselves, as was originally intended, to matters connected with the Natural History of the County. And, Thirdly, to make an arrangement by which any members might subscribe for any number of copies they might wish for, and so divide the cost according to the number of copies ordered. This matter, Gentlemen, I beg to leave in your hands—reminding you, however, that the unprecedented call of one pound each is made this year—it is in fact for the transactions of this year and last, as nothing was collected last year.

Though I, however, should be sorry to limit our papers strictly to county matters, yet I confess I should be glad to see these more closely followed up. We have as yet no list of Fossils, Plants, Shells, or Insects, any of which would form a most desirable and appropriate feature in the works of our Club; while of our numerous and interesting antiquities, with the exception of Mr. Pooley's paper of this year, not a word has been said save the simple record that the Club has visited them, as given in the address of your most unscientific President. Forgive, Gentlemen, my calling your attention to this subject. I am, as you all know, a man of few ideas beyond my county, and though I should be sorry to see the transactions of the Club strictly limited to the field of our rambles, yet I cannot but think that we should more especially fulfill our mission, as a County Club, by devoting more attention to the Natural History and Antiquities of our own district.

Notes on the Natural History of the County of Gloucester.

By Professor J. BUCKMAN, F.G.S., F.L.S., &c.

ON THE ORCHIDACEÆ.

The Orchids present such a large assemblage of highly curious plants, that it seems astonishing so little should be popularly known about our native examples. It is true that a few species of exotic Orchids may be met with in the hot houses of the more wealthy, and these are esteemed on account of the strange forms which their flowers frequently assume, and the exquisite perfume some of them exhale. But though it is quite true that these have had their share of attention, yet who in a country walk at home ever plucks an Orchis, much less examines its structure, and yet they abound everywhere, and offer a showiness of flower, a variety of colour and structure with, in some species, an odour which

should make them general favourites. The Primrose, the Cowslip, the Hyacinth, and other of our wild flowers, find their way into the cottage garden, but we never yet saw an Orchis in a cottage garden or taking part in a rustic nosegay; however, great heaps of the commoner ones may occasionally be noticed laying prostrate by a stile or scattered about the country childrens' play-ground, having been gathered by the little unsophisticated creatures who have always a deep love for "pretty flowers," which, in as far as the Orchis is concerned, is early destined to be clouded by a prejudice which, in after life, is so strong as not merely to lead to indifference, but to a positive superstitious dread of these beautiful and harmless creations.

This feeling would appear to have been derived from the name, which country people apply to some of the commoner species, namely, that of "Bloody Man's Fingers;" no doubt applied on account of the digitate roots which are white and fleshy, and bear no distant resemblance to bloodless fingers; and yet, curiously enough, this form of root is not common to the commoner species as the two everywhere met with, the *Orchis morio* and *O. mascula*, have two rounded tuberous appendages below the surface of the soil, which contain so much starch as to make the plant by some be considered as worthy of cultivation.

Little however as these plants have been attended to as objects of floral culture yet they will be found well worthy of notice in this respect, to which end field specimens should be marked when in flower for removal in the autumn, a remark necessary inasmuch as the usual plan of taking up flowering roots when first observed, usually results in disappointment in these, as it would be the case with most plants when in full flower. Of course observation of the locality, soil, and habit of growth, would conduce greatly to success.

The following is a list of all the species which I have met with in our County. These are 18 belonging to 8 genera, being somewhat more than half the genera belonging to the British Flora, as described by Hooker and Arnott, and nearly half the species, the numbers being of total British species 38 appertaining to 14 genera.

List of the Orchidaceæ of Gloucestershire.

1. *Epipactis latifolia*, Broad-leaved Heleborine.—In the woods in Oakley Park, Cirencester, Birdlip, and most of the Cotteswold woods and thickets.
2. „ *grandiflora*, large white H.—Plentiful in Oakley Park, and in the north Cotteswold woods, but no where in the Vale.
3. „ *ensifolia*, narrow-leaved white H.—A few years since I met with two specimens of this plant beneath the Rookery trees of Oakley Park, and not deeming but there would be others, I at once appropriated these examples of an exceedingly rare plant to my Herbarium, but alas, the most diligent search for years has not again given me sight of a living specimen. It may

well serve as a curious subject of enquiry as to how it came there, and may illustrate how easily a plant may become extinct in any given locality.

4. *Listera ovata*, Twayblade.—Common in our woods.
5. „ *nidus-avis*, Bird's-nest Orchis.—Common under the beeches in Oakley and other woods. Having taken up specimens of this plant, with their curious bunches of nest-like roots, I cannot at all agree that it is parasitic, as is usually supposed.
6. *Neottia spiralis*, Ladies' Traces.—The only locality in which I have met with this plant, in Gloucestershire, is in a grass field on the south slope of Marl Hill, near Cheltenham. This field, from its regular ridges, had evidently once been in tillage, and yet it seems an isolated example of a pasture with us containing this plant, which, at the time of my visit, some 15 years since, was very abundant in this habitat.
7. *Orchis Morio*, Green-winged Meadow Orchis.—Too common in pastures, in which its great abundance may betoken poverty of soil, as it is usual in “cold hungry clays.”
8. „ *mascula*, Early purple Orchis.—Common to rough meadows and low thickets.
9. *Orchis ustulata*, Dwarf dark-winged O.—I have met with occasional examples on Sevenhampton Common, near Cheltenham; at Eyford, near Stow-on-the-Wold; and on the slope which descends from Dunsburn into Edgeworth valley.
10. „ *latifolia*, Marsh O.—In damp marshy meadows, frequent.
11. „ *maculata*. Spotted O.—Common to woods and thickets.
12. „ *pyramidalis*, Pyramidal O.—In Oakley and other Cotteswold woods and thickets.
13. *Gymnadenia conopsea*, Fragrant *Gymnadenia*.—Occasionally met with in Oakley, Uley, and other woods and thickets of the county, well distinguished by its lilac coloured flowers and fragrant scent.
14. *Habenaria bifolia*, Butterfly Orchis.—Common in the Cotteswold woods. This is also a highly fragrant species.
15. „ *viridis*, Green H.—At Charlton, near Cheltenham, and Furzen Leaze, near Cirencester.
16. *Herminium Monorchis*, Green Musk Orchis.—This I have only met with in one locality, namely, on the slope of Ravensgate Hill, below Linover wood, where it forms a rounded bay, looking down upon the village of Charlton.
17. *Ophrys apifera*, Bee Orchis.—This beautiful specimen has been met with, more or less sparingly, in several habitats. I have gathered it on Painswick Hill, on Leckhampton Hill, and very fine examples in Oakley Park. The most curious locality in which I have met with it is on a spoil heap thrown out in making the Thames and Severn Canal, by the Engine-house near Tetbury road Station.
18. *Ophrys muscifera*, Fly O.—In Lineover Wood, Charlton Kings, and in the woods bounding the north side of Sapperton Valley, but only sparingly.

On Fossil Echinoderms from the Island of Malta; with Notes on the stratigraphical distribution of the Fossil Organisms in the Maltese beds. By THOMAS WRIGHT, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School.

READ 14TH SEPTEMBER 1854.

A. *Notes on the Maltese beds, with the species they contain.*

THE Island of Malta is entirely composed of tertiary rocks of Miocene age, which have been described by Capt. Spratt, R.N.*, and surveyed and mapped by the Earl Ducie†. Through his lordship's kindness, we have been enabled to study a complete suite of Maltese rock specimens, together with an extensive collection of the fossils obtained from them, whilst resident in the island; and it is but just that we should state, at the outset of these remarks, that whatever is valuable in this memoir relating to the stratigraphical distribution of the Urchins and other fossils in these beds, is entirely due to the Earl Ducie, who has most liberally given us all the information he noted on the spot, relative to the range and distribution of the species. It is to be distinctly understood, however, that neither the measurement of the beds, nor the limitation of the range of the fossils in them, are given as absolute truths, but rather as the nearest approximation thereto which the present state of our knowledge permits.

The Maltese islands comprise Malta, Gozo, and Cumino. Malta is seventeen miles in length by seven in breadth; Gozo is nine in length by five in breadth; and Cumino about two in length by one in breadth. The direction of their long axis is S.E. and N.W., which, with the channels, is about twenty-nine miles in length. All the rocks are sedimentary and marine, having a slight inclination from N.E. to E.N.E.; their direction corresponds with that of the Apennines, and with the intermediate

* "On the Geology of the Maltese Islands," with Notes on the Fossils by Prof. E. Forbes. Proceed. of the Geol. Soc. London, vol. iv. p. 225.

† The Earl Ducie kindly presented a copy of this map to Mr. Goodenough, book- and map-seller, Strado Reale, Malta, by whom it is now being published.

line observed in Sicily from the Val di Noto to Polizzi. Numerous faults traverse the N.W. half of Malta and the S.E. of Gozo, which have much disturbed the beds, caused the depressions now forming the north and south channels between Cumino and Malta and Cumino and Gozo, and left the islet of Cumino an isolated fragment of the uppermost beds, which attests the former continuity of the land, before these islands were fractured by subterranean and denuded by aqueous agency. "The mineral deposits," says Capt. Spratt, "composing this group, have a thickness of 800 feet visible above the sea; they lie nearly horizontal, and are conformable, although there is a great diversity of mineral character and condition in the series. None of the deposits are wholly destitute of organic remains; but, on the contrary, they generally contain them in tolerable abundance, and in a good state of preservation." The strata may be divided into five groups, each of which contains fossils that are special to it, very few of the species being common to the whole series. These, in a descending order, are, 1st, *the coralline limestone*; 2nd, *the yellow sand*; 3rd, *the clay*; 4th, *the calcareous sandstone*; 5th, *the hard cherty limestone*.

No. 1. *The coralline limestone*, consists of a reddish-white calcareous rock, mostly hard and compact, and sometimes changed into an indurated calcareous sandstone. It attains a thickness of 100 feet, but has been much denuded in several localities. Some isolated portions of this bed, from being slightly variegated in colour, were formerly used for certain durable work, under the name of Gozo marble.

Fossils of No. 1.

MOLLUSCA.

Voluta, cast of a large species.
Haliotis, ditto of a n. sp.
Trochus, ditto.
Spondylus quinquecostatus, *Desh.*
Ostrea Boblayei, *Desh.*
Ostrea Virleti, *Desh.*
Pecten Pandora, *Desh.*
 — *squamulosus*, *Desh.*
 — *Burdigalensis*, *Desh.*
Arca, casts of.
Cytherea, ditto.

BRYOZOA.

Eschara monilifera.
Escharina, n. sp.

CRUSTACEA.

Carapaces and chelæ of several species.

ECHINODERMATA.

Cidaris Miletensis, *Forbes.*
Echinus Duciei, *Wright.*
Echinolampas Deshayesii, *Desor.*
Clypeaster crassicostratus, var. of *C. altus.*
Brissus latus, *Wright.*
 — *imbricatus*, *Wright.*
 — *oblongus*, *Forbes, MSS.*
Brissopsis Duciei, *Wright.*
Schizaster eurynotus, *Agassiz.*
Pericosmus excentricus, *Wright.*

CORALLIA.

Stylostræa.

No. 2. *The yellow sand*, is sometimes slightly indurated, and has an abundance of greenish-black grains intermixed with it. In some places it abounds with Foraminifera. Enormous numbers of *Lenticulites complanatus*, Defr., the flat side of the shell corresponding with the bedding of the rock, occur in some localities, as in the cliffs of Ramala Bay, Gozo, and in many places in Malta. Intercalated with these Nummulites are banks of oysters, the teeth and vertebræ of fishes, especially those of the great shark, *Carcharodon megalodon*, with the bones of Cetacea. The greatest number of Echinoderms are likewise found in this bed. It varies in thickness from 10 to 40 feet.

Fossils of No. 2.

- | | |
|--|---|
| MAMMALIA, determined by
Prof. Owen (Forbes). | <i>Ostrea navicularis</i> , Desh. |
| Delphinus, more than one species. | <i>Pecten cristatus</i> , Bronn. |
| Manatus? bones apparently of this
genus. | — <i>squamulosus</i> , Desh. |
| FISHES, determined by Sir Philip
G. Egerton (Forbes). | — <i>Burdigalensis</i> and 3 other sp.
Arca, Isocardia, Venus, and Tellina,
in the form of casts. |
| <i>Cerax aduncus</i> , Agass., teeth of. | <i>Terebratula ampulla</i> , Brocchi. |
| <i>Carcharodon megalodon</i> , Agass., do. | — <i>bipartita</i> . |
| <i>Carcharias productus</i> , Agass., do. | BRYOZOA. |
| <i>Oxyrhina xiphodon</i> , Agass., do. | <i>Cellepora mammillata</i> . |
| — <i>hastilis</i> ? Agass., do. | <i>Retepora</i> . |
| — <i>Mantelli</i> ? Agass., do. | ECHINODERMATA. |
| <i>Hemipristis serra</i> , Agass., do. | <i>Clypeaster altus</i> et var. <i>C. turritus</i> ,
<i>Leske</i> . |
| — <i>paucidens</i> , Agass. | — <i>marginatus</i> , Lamk. |
| With other undetermined Squalidæ. | — <i>folium</i> , Agass. |
| MOLLUSCA. | <i>Echinolampas Richardi</i> , Desmoul. |
| <i>Nautilus</i> , 2 sp., undescribed. | — <i>Kleinii</i> , Goldf. |
| <i>Scalaria retusa</i> , Brocchi. | <i>Conoclypus plagiosomus</i> , Agass. |
| <i>Voluta</i> , <i>Mitra</i> , <i>Cypræa</i> , <i>Conus</i> , 2 sp.,
<i>Columbella</i> , <i>Oliva</i> , <i>Natica</i> , <i>Turri-</i>
<i>tella</i> , <i>Turbo</i> , <i>Pleurotoma</i> , <i>Pyrula</i> ,
<i>Phorus</i> , <i>Trochus</i> ;—casts only of
these genera. | <i>Brissus oblongus</i> , Forbes. |
| <i>Ostrea Virleti</i> , Desh. | FORAMINIFERA. |
| | <i>Lenticulites complanatus</i> , DeFrance. |
| | CORALLIA. |
| | <i>Caryophyllia</i> . <i>Fungia</i> . |

No. 3. *The clay bed*, has a dark blue, drab, or a light gray colour, and is much charged with iron. In it are found crystals of gypsum, and occasionally nodules of sulphur. It varies in thickness from 30 to 60 feet. It is the retentive water-bearing stratum of the islands, and all the water falling upon the upper beds percolates through them, and bursts out in springs along their line of junction with the clay. Casts of shells and fragments of bones are very abundant in it; but Echinoderms are comparatively rare.

Fossils of No. 3.

FISHES.

Teeth of *Myliobatis*, *Lamna*, *Carcharias*, and *Euphyllia*, are abundant.

ECHINODERMATA.

Spatangus Desmarestii, *Goldf.*
Pericosmus latus, *Agass.*

MOLLUSCA.

Megasiphonia zic-zac? (allied to the London-clay species).
Scalaria, *Pleurotoma*, *Mitra*, *Cassis*,
Rostellaria, *Conus*, 3 or 4 sp.,
Pecten, *Ostrea*, *Cardita*, *Lucina*.

CORALLIA.

Fungia?

No. 4. *The calcareous sandstone.*—"This bed covers the greater part of the island of Malta. From it nearly all the building stone is procured, and it is likewise the rock from which the Maltese vases are cut. The lower beds abound in Echinoderms. *Scutella* and *Schizaster* are not unfrequent; but *Hemiaster Scilla* is the most abundant species. These Urchins are often seen standing out in relief on the beach, the sea having worn away the surrounding rock. They are very serviceable in affording a foot-hold on the rocks, which otherwise would be dangerous to land upon." (*Lord Ducie.*) This bed is subdivided by Capt. Spratt into five strata, which he thus describes:—

"D. is a white calcareous sandstone, lying subjacent to the marl, into which it quickly passes, and is from 20 to 30 feet in thickness.

"E. is a bed of fine-grained sandstone, 15 to 20 feet thick, of a reddish-white, and sometimes gray colour. These contain several species of Foraminifera.

"F. a pale yellow calcareous sandstone, often containing flinty nodules, from 30 to 50 feet thick. In some parts it is thinly stratified, and separable into brittle plates of sandstone; but more generally it assumes a closely bound and unstratified character, when it is used for building; but it is very liable to exfoliate on exposure to the weather.

"G. Chocolate-coloured nodules, irregular in figure and size, in calcareous sandstone, with which are mixed casts of shells, *Caryophyllia*, and other organisms; also fishes' teeth, vertebræ, and coprolites are very abundant. All the nodules are of organic origin; it is, in fact, a bone-bed of considerable extent, for it preserves a very uniform character throughout the islands; but in Gozo it is more developed, and contains more remains; especially in a flat ledge just above the sea-level, under the cliffs of Fort Chambray, and at Marsa il Forno, on the north-east coast, where its durability has checked the encroachment of the sea. Its thickness is estimated at from 2 to 8 feet.

"H. A close-grained, pale yellow sandstone, incapable of being

split along the line of bedding. It is extensively quarried for building and other purposes, being easily cut with the knife or saw. Large blocks of it are turned into pillars, vases, balustrades, and other architectural ornaments. This stone is extensively used for building in the islands; and, for the same use, is largely exported to many parts along the shores of the Mediterranean. It attains a thickness of from 40 to 50 feet.

“The stone from which the finely-carved vases are cut, comes from the lower part of this bed, and is obtained near Naxiar. The rock in this locality dries whiter, is finer grained, and more compact than in general.”—*Spratt*.

“It is impossible to distinguish between the beds D, E, F, in the above grouping, except in cliff-sections.”—*Earl Ducie*.

Fossils of No. 4.

REPTILIA.

Chelonia, sp.

FISHES.

Pycnodus, numerous teeth of this genus, with vertebræ and other bones of this class.

MOLLUSCA.

Nautilus, sp. undescribed.
 Scalaria *Duciei*.
 Conus, *Cypræa*, *Solarium*, *Natica*,
 Phorus, casts only.
 Pecten *laticosta*.
 — *Burdigalensis*.
 Lucina. *Tellina*.

CIRRHIPODA.

Balanus *stellaris*.
 Lepas, sp.

CRUSTACEA.

Numerous remains of this class.

ECHINODERMATA.

Schizaster *Parkinsonii*, *Defrance*.
 — *Desori*, *Wright*.
 Spatangus *Hoffmanni*, *Goldf*.
 Scutella *subrotunda*, *Leske*.
 — *striatula*, *Marcel de Serres*.
 Brissopsis *creescenticus*, *Wright*.
 Hemiaster *Grateloupi*, *Desor*.
 — *Scillæ*, *Wright*.
 — *Cotteaui*, *Wright*.

No. 5. *The hard cherty limestone*, “is a yellowish-white cream-coloured limestone, having sometimes semi-crystalline strata alternating with an oolitic grit or sandstone, apparently composed of minute fragments of shells and corals. It attains a considerable thickness, since nearly 400 feet of it in perpendicular depth is visible on the north-west coast of Gozo.” (*Spratt*.) “This bed forms a high and rocky coast-line on the south end of Malta, and dipping to the north appears about the water-line in the neighbourhood of Valetta and Sliema, forming a barrier to the sea. Probably the softer superincumbent beds have in course of time been worn away, till the appearance of this rock arrested any further encroachment. A *Scutella* invariably marks the junction of this bed with No. 4.” (*Earl Ducie*.) The New Dock is built of this rock, and it is quarried in several places for building purposes, and it is likewise burned for lime.

Fossils of No. 5.

The fossils of this bed are imperfectly known, from being obtained with much difficulty. Of Mollusca, casts of *Solarium*, *Conus*, *Phorus*, *Natica*, *Cypræa*, *Pecten*, *Lucina*, and of the Cirrhipoda, *Balanus*, have been recognized in it. Of the Echinodermata, "*Scutella subrotunda*, *Clypeaster*, sp., *Brissus*, sp., identical with that of No. 2. Such is also the case with the *Pectens*." (*Forbes*.)

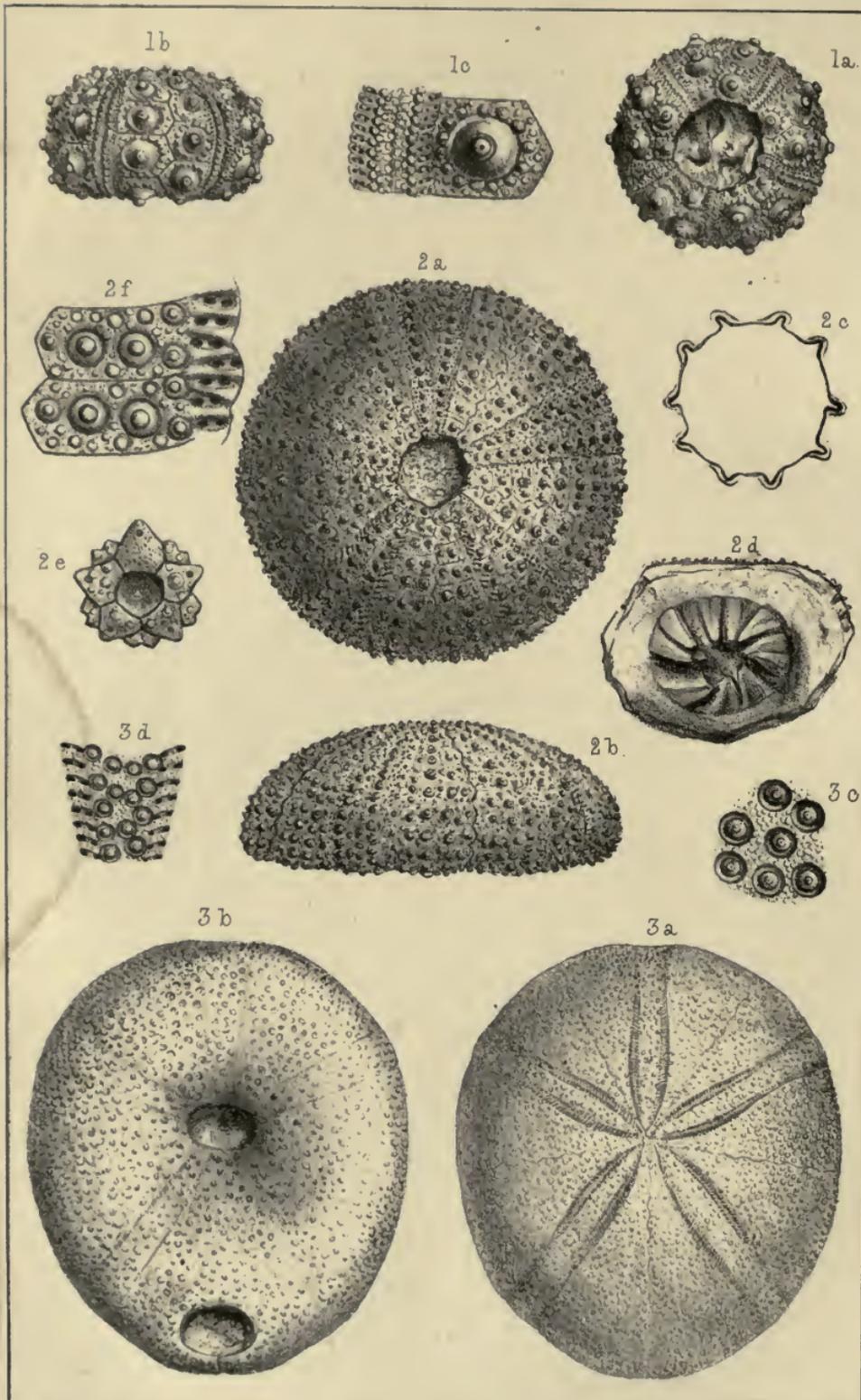
We cannot conclude our brief notice of these Maltese deposits without alluding to a similar Urchin bed of the same age in the island of Corsica. Through the kindness of our friend M. Michelin, the eminent zoophytologist of Paris, we received some time since a number of *Echinidæ* from this Corsican deposit, which we have carefully compared with the fine suite of Maltese Echinoderms now before us. Many of the species from Corsica and Malta are identical, although some from both islands are special to each region. From these data we conclude, that the deposits containing the Echinoderms described in the sequel of this memoir are of the Miocene period, and of the same age as the tertiaries of the south of France, the north of Italy, and of Doberg bei Bünde in Westphalia. M. Collomb, an eminent French geologist, lately visited the Urchin bed near Bonifacio in Corsica, and has given an account thereof in a letter addressed to Prof. Constant Prévost; the following abstract relating thereto will be read with interest:—

"We shall quit now," says M. Collomb, "the eruptive rocks, and transport ourselves to the south, at Bonifacio, where we have remained some days, to go and see the bed of fossil Urchins. They are found in a fragment of limestone completely enclosed in the granite. Bonifacio is built upon a high escarpment of this limestone, formed of horizontal beds having a coarse structure, full of the fragments of shells, the species of which were indeterminable. This escarpment is incessantly beaten and demolished by the action of the wind and the sea. Upon all this coast the beds overhang, and are worn into caverns by the inroads of the sea.

"The bed of Urchins is situated at some leagues to the north-east of Bonifacio, towards the roadstead of Santa-Manza, at the limit of the granite. The escarpment itself is here granitic, and the Urchin limestone caps the granite. The bed which contains the most beautiful specimens is only accessible by means of a ladder, and their extraction is difficult."

The Calcaire à Oursins is only found in three localities in Corsica, at Bonifacio, at Aleria, and at Saint-Florent, and





W. H. Baily, del et hth.

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- 1 a-c. *Cidaris Miletensis*, Forbes
 2 a-f. *Echinus Duciei*, Wright
 3 a-d. *Echinolampas Deshayesi*, Desor.

always in small detached beds of inconsiderable extent, which do not extend into the interior of the island. The deposits of Bonifacio and Saint-Florent were the only ones visited by M. Collomb*. The rock is a light-coloured limestone, sometimes white and soft, or hard and cherty, and contains an abundance of small quartz pebbles derived from the decomposed granite.

B. Description of the Fossil Maltese Echinoderms.

Cidaris Miletensis, Forbes MSS., n. sp. Pl. IV. fig. 1 a-c.

Test oblatly spheroidal, much depressed at both poles; ambulacral areas undulated, depressed in the centre, with an elevated marginal row of close-set tubercles on each side of the areas; poriferous avenues of the same width as the areas; interambulacral areas rather prominent, with two rows of primary tubercles, about six in each row; mammillary eminences large, each with a circle of boundary granules; spines nearly the diameter of the test in length, tapering from the base to the apex; mouth-opening very large.

Dimensions.—Height $\frac{8}{10}$ ths of an inch; transverse diameter $1\frac{5}{10}$ inch.

Description.—This is a very rare Urchin in the Maltese beds. It has an oblatly spheroidal figure, and is much depressed at both poles; the ambulacral areas, with the poriferous zones, are gently undulated; they measure together $\frac{5}{20}$ ths of an inch in width; the areal band is depressed in the middle, and its elevated margins are covered with two rows of large equal-sized close-set granules; internal to these are two rows of much smaller granules, and down the centre is a depressed furrow: the poriferous avenues lie likewise in depressions, bounded internally by the marginal granules of the ambulacral areas, and externally by the encircling granules of the primary tubercles: the interambulacral areas are $3\frac{1}{2}$ times the width of the ambulacral; they form rather prominent convex portions of the test, with from five to six rows of primary tubercles in each of the two rows of these areas: the areolas are large and prominent, the summits are smooth and without crenulations, and the tubercles, which are proportionately large, and with a very small perforation in their summit, stand well out from the body: a circle of larger granules surrounds the base of the mammillary eminences; these circlets are each complete in the two superior tubercles, but one series is common to two tubercles in those near the mouth; the boundary in all, however, is defined, as none of the

* Bull. de la Soc. Géol. de France, tom. xi. p. 67 et seq., 2 série.

areolar spaces are confluent: in the centre of the interambulacral areas is a depressed space, which is filled with small close-set granules: the mouth-opening is very large, and that for the apical disc is so likewise: the spines taper gently from the shoulder to their apex; they are round, and sculptured with longitudinal lines; their absolute length is not determinable, as neither of those before us are perfect; they may have attained the length of the diameter of the test.

Affinities and differences.—We know so few true *Cidarites* from the tertiary rocks, that materials for comparison fail us. The only species we possess is the *C. Alabamensis*, Morton, from the tertiaries of the U. States, which has nearly straight ambulacra, ten tubercles in each row in the interambulacra, with wide intertubercular spaces between each pair of rows. The Maltese Urchin differs essentially from this species, and may be easily distinguished from it by the concave ambulacral areas, and the marginal rows of tubercles that define these portions of the test. It is somewhat remarkable that we should have discovered so few *Cidarites* in all the Urchin beds that have been so diligently explored in the tertiary beds of Europe.

Locality and stratigraphical range.—This species has been found only in bed No. 1, the Gozo marble, where it is rare.

Echinus Duciei, Wright. Pl. IV. fig. 2 a-f.

Test circular, much depressed: ambulacral areas more than half the width of the interambulacral, with two rows of marginal, nearly equal-sized tubercles throughout, and two other rows within these, extending from the border to the mouth; one of these inner rows ascends a short way above the border: interambulacral areas with eight rows of tubercles at the border, diminishing to two rows above the others, disappearing or becoming of secondary size; from the border to the mouth, the eight rows continue of uniform size: the pores are in triple oblique pairs; between each pair there is a slight ridge of the test, which gives a singular zigzag figure to the poriferous avenues: mouth large and decagonal, base flat: apical disc of moderate size, but not preserved.

Dimensions.—Height $\frac{1}{2}\frac{5}{0}$ ths of an inch; transverse diameter $1\frac{1}{2}\frac{7}{0}$ inch.

Description.—This beautiful Urchin has been thought to be identical with the *E. Scillæ*, Desmoul., and the one figured by Scilla in pl. 13. fig. 1, pl. 25. fig. 1, and pl. 26. fig. A, B, of his work*; but the number of tubercles on each of the plates

* De Corporibus Marinis Lapidescensibus.

in our specimen differs from the *Echinus* è *Messana* of that author, who has figured only one large tubercle on each plate of that form. From *E. Scillæ* it is certainly distinct, as we know of no Urechin that is common to the cretaceous and tertiary rocks. The test is circular, much depressed on the upper surface and flat below; the ambulacral areas are almost $\frac{4}{10}$ ths of an inch in width at the border, where we count four rows of tubereles; the marginal rows are very uniform in size and arrangement from the mouth to the disc; the two internal rows are smaller, and continue from the border to the mouth; one of these extends a short distance on the sides, but on the upper half of the areas there are only the two marginal rows: the interambulacral areas are $\frac{7}{10}$ ths of an inch in width at the border; there are eight rows of tubercles at this point and onwards towards the base, they are nearly of the same size; but, from the border to the apical disc, the second row, from the ambulacral areas, alone possesses the size the tubercles have at the border; the tubereles in the others diminish in size, and disappear as the areas become narrower; above, we find only two marginal tubereles of the primary size, and internal to these, a few of secondary magnitude irregularly set: all the tubereles are raised on mammillary eminences, with areolas around their bases, and numerous large granules fill up all the intervening spaces, so that the surface of this *Echinus* has a very tubereulated appearance. The poriferous avenues are on a level with the test; the pores are arranged in triple oblique pairs; between each pair there is a slight elevated ridge; every two ridges of each triple oblique pair of holes is connected by another ridge, which runs at an angle of 45° to them; by this arrangement the poriferous avenues exhibit a curious zigzag character through these little elevations of the test in the line of the pedal pores. The base is flattened, the mouth-opening is large and decagonal, and the jaws and teeth are narrow and much curved inwards; the apical disc is absent in all the specimens we have examined; the space for the same is, however, of moderate size.

Affinities and differences.—This species may be distinguished from *Echinus Serresii*, Desmoul., from the Molasse de Provence, in having larger tubereles, with less granulation at their base, and the absence of the zigzag ridges between the pairs of pores: from *Echinus dubius*, Agass., another tertiary species from the Molasse of Villeneuve in Provence, it is distinguished by the more uniform size of its tubercles, the depression of the upper surface, and the zigzag ridges of the poriferous zones.

Locality and stratigraphical range.—It was collected from bed No. 1, the Gozo marble, Malta, where it is not uncommon. We

have dedicated this species to the Earl Ducic, who collected the beautiful specimens we have figured.

Family CLYPEASTRIDÆ.

This natural family includes all the Urchins which have a circular, elliptical, or pentagonal form, with a thick test, the surface of which is closely covered with small, nearly equal-sized tubercles sunken in the plates, and surrounded by ring-like areolas; these all carry short hair-like spines. The mouth is large, central and pentagonal, and is armed with five strong jaws which carry the same number of teeth: the anus is posterior, and marginal or inframarginal: the interior of the test is sometimes divided by pillar-like processes of the inner layer of the plates. The dorsal portions of the ambulacral areas have a petaloid form, circumscribed by large poriferous zones; the basal portions are narrow, rectilineal, or branched. The five genital plates form a circle around the madreporiform body, and between these are wedged the five ocular plates. This family includes the genera *Clypeaster*, Lamk., *Laganum*, Klein, *Echinarachnius*, Van Phels., *Arachnoides*, Klein, *Scutella*, Lamk., *Dendraster*, Agass., *Lobophora*, Agass., *Encope*, Agass., *Rotula*, Klein, *Mellita*, Klein, *Runa*, Agass., *Moulinsia*, Agass., *Scutellina*, Agass., *Echinocyamus*, Van Phels., *Fibularia*, Lamk., *Lenita*, Desor.

Genus CLYPEASTER (Lamarck, 1816).

Form oval, inclining to pentagonal, rostrated before, truncated behind; upper surface more or less inflated, sometimes campanulate, conical or subconical; inferior surface flat, always concave around the mouth, with five straight simple ambulacral furrows proceeding from the angles of the mouth to the border; the dorsal portion of the ambulacral largely petaloid, greatly exceeding the interambulacra in size, and forming elegant leaf-like expansions, in general convex, arched, and prominent; bounded on each side by large poriferous zones, the pores of which are wide apart and united by transverse sulci; the apical disc formed of five genital plates at the summits of the interambulacra, with five ocular plates alternating with them; in the centre of this circle is the spongy madreporiform body, of a pentagonal figure: tubercles uniform in size and very numerous, equally distributed over the test; summits perforated, and surrounded by very deep areolas; mouth symmetrical, central, pentagonal, lodged in a concave depression in the middle of the base; auricles composed of ten distinct auricular processes set in pairs: the jaws form a pentagonal pyramid, composed of ten separate pieces, truncated at the summit, which is bordered by a subcircular band;

teeth five, large, and bent; anus small, round, and inframarginal: interior of the test with a number of pillar-like processes towards the border. All the species of this genus live in the seas of warm latitudes, or are found fossil in the tertiary rocks only. We have six living and twelve fossil species.

Clypeaster altus, Leske, sp.

SYN. *Echinus* à *Melita*, Scilla, Corp. Mar. pl. 9. figs. 1, 2.

Echinanthus altus, Leske, Klein, Echinoderm. apud Leske, No. 48. p. 189. pl. 53. fig. 4.

Echinus altus, Gmelin, Linné by Turton, vol. iv. p. 149.

Clypeaster altus, Lamarck, Hist. Nat. des Animaux sans Vertèbres, 2nd ed. tom. iii. p. 290; Deslongchamps, Encycl. t. ii. p. 199; Defrance, Dict. Sc. Nat. t. ix. p. 449; Blainville, Man. d'Actin. p. 216; Desmoulins, Echinides, no. 7. p. 216; Agassiz and Desor, Cat. rais., Ann. Sc. Nat. tom. vii. p. 130; Sismonda, Ech. Foss. Nizza, p. 46; Ech. Foss. Piem. p. 40; Grateloup, Mem. Foss. Oursins de Dax, p. 41.

Test oblong; anterior border convex; lateral borders undulated; posterior border squarely truncated; marginal fold more or less thickened; dorsal surface elevated into a dome shape; vertex nearly central; ambulacral areas largely petaloid, their base extending nearly to the margin: base flat; mouth large and pentagonal, with a deep sulcus extending from the angles to the border, and corresponding to the middle suture of the ambulacral areas: anus small, round, and submarginal: granulations larger and more prominent at the base than on the dorsal surface.

Description.—This beautiful *Clypeaster* has been so long known, that it seems unnecessary to give any lengthy details of its structure; although it may be remarked, however, that we are not aware that a detailed description of the species exists. It was first introduced to notice through the figure of Scilla, and the specimens before us belong to the same type as that given in his work. Many of the Maltese varieties of this species, however, are remarkable for their deviation from this typical form; the dorsal surface in them rises into a campanulate shape, and the circumference becomes almost round. These varieties constitute the *Clypeaster turritus*, Agass., from the Miocene of Dax, and the *Clypeaster Agassizii*, Sismonda, from beds of the same age near Nice. We have before us a similar conical variety from Malta, belonging to the Museum of the Bristol Institution; and others, collected by the Marchioness of Hastings, are in the Jermyn Street Museum.

All the specimens in Earl Ducie's cabinet, with one exception,

belong to what we regard as the typical form. This remarkable exceptional specimen agrees with the brief notice of *C. Tauricus**, Desor:—"Très grande espèce, allongée, pentagonale, à bord fortement renflé. Zones porifères très large à leur extrémité. Tert. du Taurus, île de Crète." If we are correct in referring all these varieties to *C. altus*, it follows that this species has a wide range of deviation from what we take to be its typical form; but these limits of variation are probably not greater in this than in some other species of Urchins. The following table shows the relative dimensions of three forms,—the typical, the conical, and the flattened and tumid varieties:—

Forms.	Length.	Breadth.	Height.
Type specimen	5 inches.	$4\frac{1}{2}$ inches.	$2\frac{1}{2}$ inches.
Conical, var. <i>a.</i>	$5\frac{8}{10}$ "	$5\frac{3}{10}$ "	$4\frac{1}{10}$ "
Tumid, var. <i>b.</i>	$6\frac{6}{10}$ "	$5\frac{6}{10}$ "	$2\frac{4}{10}$ "

The ambulacral areas are largely petaloid, nearly equal in length and width; they are rounded, widely open below, and extend over four-fifths of the dorsal surface in the type form, over nearly three-fourths in the conical form, and over almost four-fifths in the tumid varieties; in all, the areas form prominent convex elevations of the test, which are bounded by wide poriferous avenues, composed of two series of simple pores united by oblique grooves; the internal series of pores are round, the external series are elongated transversely in the direction of the grooves; the pores at the end of the avenues are much more so than those of the summit; the apical disc is small, and occupies the centre of the dorsal surface, lying in a slight depression formed by the bending-in of the summits of the areas; those of the single area, and the antero-lateral and postero-lateral areas of the left side, being rather more prominent than those of the right side of the test. The madreporiform body occupies the whole surface of the disc, the ocular and genital plates being quite indistinguishable from the general structure of the test; the five genital pores pass obliquely into the interior, at a short distance from the disc.

The base is flat, and the mouth lies in a very deep depression in the centre of the under surface; the opening is pentagonal, its wide walls being formed by the incurving of the basal portions of the areas; from each of the angles of the pentagonal opening, a deep furrow passes outwards towards the margin of the test, and becomes continuous with the median suture of the

* Cat. raisonné des Echinides, Ann. Sc. Nat. tom. vii. p. 131.

ambulacral areas. The jaws are absent in all the specimens we have examined. The anus is a small round aperture, situated near the posterior margin of the base of the test; in some specimens it is elongated in the transverse diameter, and measures about $\frac{6}{20}$ ths of an inch across. The tubercles are nearly of the same size on the upper surface, and their summits are level with the test, so that the areolas which surround them are excavated out of the superficial layer of the calcareous plates. The intertubercular surface is ornamented with a microscopic granulation, disposed in circles around the areolas of the tubercles, and filling up all the intervening spaces. The tubercles at the base are larger and more closely set together than those on the dorsal surface; a row of five or six tubercles is seen on each of the interfissural bands of the poriferous avenues.

Affinities and differences.—*C. altus* has many traits in common with *C. rosaceus*. In the general outline, in the size, form and extent of the ambulacral areas, there is much resemblance; but the campanulate form of the dorsal surface, the smallness of the apical disc, and the truncature of the posterior border constitute differences which may be traced through all the varieties *C. altus* assumes. The thickness of the marginal fold, and the great development of the ambulacral flower, when compared with the thinness of the border and the limited extent of the ambulacra, distinguish at a glance *C. altus* from *C. Tarbellianus*, *C. marginatus*, and *C. scutellatus*. The dome-shaped upper surface of *C. umbrella*, with its flattened ambulacral areas and convex prominent interambulacral spaces, its star-like apical disc and small mouth-opening, widely distinguish this species from *C. altus*. The affinity, however, is very near between *C. altus* and *C. crassicosatus*, the principal difference consisting in the more prominent rib-like prominence of the ambulacral areas.

Stratigraphical position.—This is the most abundant of all the Maltese Urchins. It is collected from bed No. 2, the yellow sand, associated with *C. Tarbellianus*, *Echinolampas Richardi*, and the other Echinoderms enumerated in the palæontological *résumé* given in the introduction to this memoir. The test is very well preserved in most specimens. Those from the sand with black particles are in the finest preservation. In this stratum the Urchins are accompanied with *Terebratula ampulla*, *Pecten squamulosus*, *P. Burdigalensis*, *Ostrea Virleti*, *O. navicularis*, and masses of *Lenticulites complanatus*, with *Cellepora mammillata*, *Escharina monilifera*, and other Bryozoa.

It has been collected from the Miocene beds of Port-de-Boue, Saint-Miniato, Tuscany; Nice, Turin, Ile de Crète, Ile de Caprée; Bonifacio, Corsica; Oran. The Maltese specimens are

contained in the British Museum, Geological Museum, Jernyn Street, and Bristol Museum; that from the Ile de Caprée is in our cabinet.

History.—First figured by Scilla, in 1670. The list of synonyms prefixed to this article exhibits the various epochs in its history. In none of the works we have consulted is any detailed description of the species given.

Clypeaster marginatus, Lam.

SYN. Scilla, Corp. Mar. tab. 11. fig. inferior.

Clypeaster marginatus, Lam. An. sans Vert. tom. iii. p. 290, 2nd ed.; Deslongchamps, Encycl. Méthod. t. ii. p. 200; Defrance, Dict. Sc. Nat. t. ix. p. 450; Blainville, Man. Act. p. 216; Grateloup, Foss. Ours. p. 40; Agassiz and Desor, Cat. raisonné, t. vii. p. 131; Desmoulin, Etudes des Echinides, no. 12. p. 218.

Test large, depressed, subpentagonal; margin thin, broad, and expanded; outline of the border undulated; ambulacral areas short, oval, and convex, rising abruptly from the thin border, and forming a dome-shaped elevation in the centre of the dorsal surface; base flat; mouth-opening small and pentagonal, with five simple sulci extending from the angles thereof to the margin; anus small, round, and submarginal.

Dimensions.—Antero-posterior diameter $6\frac{7}{10}$ inches, breadth $6\frac{4}{10}$ inches, height at the centre $1\frac{8}{10}$ inch, thickness of the margin about $\frac{1}{8}$ th of an inch.

Description.—This magnificent Urchin was figured by Scilla. The specimens before us agree very well with his drawing, although the foreshortening of the dorsal surface does not give a sufficient elevation to the ambulacral dome. The expansion of the margin, and thinness thereof, make a marked distinction between this and other cognate forms. The figures given by Grateloup of his *C. Tarbellianus* so exactly resemble the large specimen before us, belonging to the Bristol Museum, that we no longer doubt that species being a variety of *C. marginatus*. This species, like *C. altus*, exhibits much deviation from what may be considered to be its type form. A long and attentive study of the *Echinida* has shown us, that such difference of outline is the rule, and not the exception, in the group; and that specific characters must be drawn from organic structure, and not merely from outline, if we wish our species to have a permanent place in the register of Nature's forms. The ambulacral areas are gracefully petaloid, rounded at the base and tapering towards the apex; they are convex and prominent, and extend about half-way between the vertex and the border, the test rising into a dome-shaped elevation in the region of the am-

bulaeral areas. From the base of the areas to the circumference the margin is thin and expanded, and in this respect resembles a *Scutella* much more than a *Clypeaster*. The interambulacra between the poriferous avenues form convex elevations, which give a stellate character to the central dome, all the more conspicuous as it rises abruptly from the thin expanded margin, which is almost destitute of any elevation. The tubercles are larger on the basal than on the dorsal surface. In only one of the specimens before us is the inferior surface exposed. The base is flat. The pentagonal mouth is much smaller than in *C. altus*. In a specimen before us, measuring $4\frac{7}{10}$ inches in length, the mouth-opening is $\frac{7}{20}$ ths of an inch in diameter; the oral lobes curve inwards and form the interspaces thereof. Acute narrow ambulacral grooves pass outwards to the circumference.

Affinities and differences.—The thin and broadly expanded border of *C. marginatus*, with its short ambulacra, and central dome rising suddenly from the middle of the test, form a group of characters which enable us readily to distinguish this species from its congeners, with one exception, *C. Tarbellianus*. The excellent figures of this Urchin, given by Grateloup in his able Memoir*, we have compared with two forms of *C. marginatus* from Malta, and we confess our inability to distinguish the differences between them and the author's type-figure. Agassiz and Desor consider them to be the same, and we agree with their conclusion.

Grateloup observes, in describing *C. marginatus*, "We ought not to confound this species with that which I have described (*C. Tarbellianus*), with which it has great affinities of form, figure, and size. Its test has also a summit *très-renflé*, convex, and more elevated than in *C. Tarbellianus*; but its border is a little less *évasé*, and much less *tranchant*. The ambulacras are equally shorter, more *redressés*, and of a more oval and acute form." We have only to observe, that the characters here cited vary in different individuals, and at most amount to that limit of variation which we have already observed is seen in all species of Urchins, where a number of individuals of the same form are assembled for comparison.

Stratigraphical range.—This species is found in bed No. 2, the yellow sand, associated with *C. altus* and the other forms enumerated from that stratum; it has been found likewise in the Miocene beds of Touraine, Landes, Naros, Bonifacio, Santa Manza, Corsica; and Dax.

History.—First figured by Scilla, and afterwards by Leske. Fine specimens are contained in the Mus. Jermyn Street,

* Mém. sur les Ours. Foss. de Dax, p. 40. pl. 1. fig. 5-6.

British Museum, Bristol Museum, and the Collection of the Earl Ducie. The specimen in our cabinet is from Santa Manza, and was sent us by M. Michelin.

Clypeaster folium, Agassiz.

SYN. *Clypeaster folium*, Agassiz and Desor's Cat. rais., Ann. Sc. Nat. tom. vii. p. 131.

Test subheptagonal, much depressed; borders thin and sharp like *Scutella*; the petaloid ambulacra short, open, and expanded below; acutely lanceolate at the apex; ambulacral rosette small, and rising gently from the middle of the dorsum; poriferous zones lie in angular depressions; apical disc small, with a central prominent madreporiform tubercle.

Dimensions.—Antero-posterior diameter $1\frac{17}{20}$ inch, transverse diameter $1\frac{5}{20}$ inch, height $\frac{5}{10}$ ths of an inch.

Description.—The general outline of this little Urchin, with the structure of its ambulacral rosette, clearly prove it to be a *Clypeaster*, whilst its depressed dorsal surface and thin border show it to have affinities with *Scutella*. Its outline is subheptagonal, with the anterior border slightly produced; the petaloid ambulacral areas are short and widely expanded below, tapering and acutely lanceolate above; their apices closely approach at the vertex, and meet at the circumference of the madreporiform tubercle; the poriferous zones lie in angular depressions of the test, which, added to the convexity of the ambulacra, give a much greater relief to the petaloidal star than in other congeneric forms; the rosette formed by the petaloid portions of the ambulacra is small, being only a little more than one-half the diameter of the antero-posterior axis. The two rows of pores in the poriferous zones diverge gently from each other from the apex to the base, and there are from thirty to thirty-six pairs of holes in each zone. At the junction of the test-plates there are slight depressions on the surface, corresponding to the sutures between the same; the tubercles are small and set rather closely together, and the intervening granulation is quite microscopic; the border is exceedingly thin and entire; the base is concealed by firmly adherent matrix, which cannot be removed without fracturing the test.

Affinities and differences.—*C. folium* is allied to the young condition of *C. marginatus*, but the general flatness of the dorsal surface, and the absence of the campanulate elevation of the ambulacra in that species, added to the greater wideness of the basal opening of the petaloid ambulacral areas, and the more angular depression in the poriferous zones, afford points of comparison whereby these two species may be distinguished

from each other: the thinness of the border and flatness of the dorsal surface are diagnostic characters by which it may be known from its congeners.

Locality and stratigraphical position.—The only specimen we know from Malta is that contained in Earl Ducie's collection; it was obtained from bed No. 2. We have another specimen before us, kindly sent by M. Michelin from the Miocene terrain of Balistro, in the Gulf of Santa Manza, Corsica. Agassiz and Desor, on the authority of M. Deluc, give the tertiary of Palermo as the locality of their specimen.

History.—This species is enumerated in the 'Cat. rais.' of Agassiz and Desor, and stated to be "espèce très plate, à bords tranchant." A detailed description of this interesting form is now given for the first time.

. Genus SCUTELLA (Lamarck, 1816).

Form in general suborbicular, extremely depressed, almost always discoidal, more or less enlarged behind; border often trenchant, disc entire, margin lobed; posterior border truncated; upper surface slightly convex; ambulacral flower small, with elegant, flat, blunt leaves; poriferous zones forming nearly a closed arch around them at their base; genital pores four, set around the spongy madreporiform body; base flat; mouth small, central, and pentagonal, with five ramose ambulacral furrows, sometimes branched, passing from the mouth to the border: tubercles microscopically small and very numerous; test thick, interior divided by pillar-like processes: auricles five; jaws forming a more or less elevated star composed of five distinct pieces, each formed by the organic union of two elements; teeth five, linear, and horizontal. This genus, as now limited, contains only fossil species, one of which is from the chalk of Georgia, United States; all the others are from the tertiary rocks.

Scutella subrotunda, Leske.

SYN. *Echinus Melitensis*, Scilla, De Corp. Marin. tab. 8. figs. 1–3.
Echinodiscus subrotundus, Leske apud Klein, tab. 47. fig. 7. p. 206.
Echinus subrotundus, Gmelin, Linné by Turton, vol. iv. p. 152.
Scutella subrotunda, Lamarck, Animaux sans Vert. 2nd ed. tom. iii. p. 284; DeFrance, Dict. Sc. Nat. tom. xlviii. p. 230; Desmoulins, Etudes des Echinides, no. 24. p. 232; Grateloup, Ours. Foss. pl. 1. fig. 1. p. 36; Agassiz and Desor's Cat. rais., Ann. Sc. Nat. tom. vii. p. 132.

Test very flat, suborbicular; dorsal surface slightly convex; ambulacral areas exceeding in length the semi-diameter of the

disc; base slightly concave; mouth central; anus marginal; ambulacral sulci bifid and branched.

Dimensions.—Antero-posterior diameter $2\frac{8}{10}$ inches, transverse diameter $3\frac{2}{10}$ inches, height $\frac{7}{20}$ ths of an inch.

Description.—The test of this delicate Urchin is extremely flat; it has an irregular suborbicular discoidal form, with a thin sinuous margin; the dorsal surface is regularly and gently convex. The ambulacral areas are more than half the length of the diameter of the test; they are of an oblong form, lanceolate above, and more obtuse below. The pores in the avenues are widely apart; those in the inner series are round, whilst those in the external series terminate in slits that extend about half way across the interporiferous spaces. The apical disc is large, and the elements thereof are intimately soldered together. The madreporiform tubercle occupies the centre, and the four genital pores are pierced at unequal distances around it; the anterior pair are smaller and closer together than the posterior pair; the five ocular pores are very small. The margin of the disc is very thin, and has a sinuous outline; five of the curves thereof correspond to the ambulacral areas, and those appertaining to the postero-lateral areas are the deepest and best defined; a small notch indicates the site of the anal opening. The ventral surface is slightly concave. The mouth, about two lines in diameter, is central and subpentagonal; from the angles thereof, five ambulacral sulci radiate outwards, which soon become bifid, each trunk becoming dichotomously branched in old individuals. The anal opening is round, about half the diameter of the mouth, and is situate near the posterior border. The tubercles are small, and closely placed together; they are nearly of a uniform size on the dorsal surface.

Affinities and differences.—*S. subrotunda* so closely resembles *S. striatula*, *S. Faujasii*, and *S. producta*, that it requires an attentive study to discover the differences between them. As we possess single specimens only of these forms, determined and presented to us by M. Michelin of Paris, we are certain of their identity with the types they represent. The test is narrower before, and the ambulacral areas are much smaller in *S. striatula* than in *S. subrotunda*; the ambulacral areas are wider, their bases and apices are more obtuse, their sides flatter, and their terminations are more truncated, and the anus further from the border in *S. producta* than in *S. subrotunda*; the test is more convex on the dorsal surface, the apical disc is wider, the margin is thicker, the base flatter, and the anal aperture much further from the border in *S. Faujasii* than in *S. subrotunda*; the test is more produced posteriorly, the margin is more sinuous, the ambulacral

areas are more equally lanceolate at the base and apex, the inner row of pores of the same curve more gracefully outwards, and the anus is further from the border in *S. Brongniartii* than in *S. subrotunda*. The size and pyriform shape of the ambulacral areas, the absence of sinuosities in the margin, and the greater convexity of the dorsal surface, distinguish *S. Paulensis* from *S. subrotunda*.

Stratigraphical range and distribution.—This species is not uncommon in the calcareous sandstone bed No. 4, and in the junction beds of No. 5, the hard cherty limestone, at Malta. It is found likewise “in the marine calcaire grossier in the environs of Bordeaux; at Bazas, Léognan, Gradignan, Douai, in Dauphiné; in Tourraine; in Anjou; at Montpellier.” (*Grateloup*.)

History.—The table of synonyms shows the phasis of the history of this species, although other forms have been mistaken for it: in fact, the species of *Scutella* approach each other so closely, that, without an authentic series of specimens for comparison, similar mistakes may be made. This Urchin is found in all the public collections. The specimens before us are from Malta and Léognan.

Scutella striatula, Marcel de Serres.

SYN. *Scutella striatula*, Marcel de Serres, Géognosie des Terrains Tertiaires, p. 156; Desmoulin, Etudes des Echinides, no. 25. p. 234; Agassiz, Monogr. des Scutelles, tab. 18. fig. 1-5. p. 81; Agassiz and Desor's Cat. raison., Ann. Sc. Nat. tom. vii. p. 134. *Scutella subrotunda*, Grateloup, Mém. Ours. Foss. tab. 1. fig. 1. p. 36.

Test very flat, suborbicular; dorsal surface very slightly convex; ambulacral areas small, short and narrow, less than the semi-diameter of the disc; base nearly flat; mouth central; anus marginal; ambulacral sulci bifid.

Dimensions.—Antero-posterior diameter $2\frac{7}{10}$ inches, transverse diameter $2\frac{9}{10}$ inches, height $\frac{7}{20}$ ths of an inch.

Description.—This Urchin so nearly resembles *S. subrotunda*, that it may be doubted whether it is entitled to rank as a distinct species, or ought rather to be considered as a variety of that form. The two specimens before us are from localities widely apart from each other. One is from the Miocene terrains of Terré-Nègre, near Bordeaux, the other from the calcareous sandstone of Malta. Still the similarity exhibited by these specimens, and the persistence of those characters which have been considered as specific, incline us to think that *S. striatula* may be distinct from *S. subrotunda*. The ambulacral rosette is small; the areas are short, narrow and lanceolate, and are less than the semi-diameter of the test; the apical disc is small; the madreporiform

tubercle is prominent and central; the granulations are almost microscopic; the base is flat; the mouth is small and central, and the anus marginal; the ambulacral sulci are bifid; the margin of the test is thin, and the sinuosities well marked. Let the student compare these characters with the detailed description of *S. subrotunda* given in the preceding article.

Locality and stratigraphical range.—It was collected from bed No. 4, the calcareous sandstone at Malta, where it is not common. Our French specimen is from the middle tertiaries of Terre-Nègre.

Genus ECHINOLAMPAS (Gray, 1835).

Test of an elongated or subdiscoidal form; petaloid portion of the ambulacral areas large, generally elevated into convex leaves, contracted towards the base, where they cease to rise above the level of the test; inferior surface concave towards the mouth, which is median, symmetrical, pentagonal, and surrounded by five lobes; basal portions of the ambulacra with five short poriferous zones around the mouth; anus transversely oblong and inframarginal; apical disc small and excentral, five genital and five ocular plates placed around the madreporiform body; tubercles small, uniform and numerous, sunk in the test, and surrounded by ring-like areolas. Three species are living in the seas of warm latitudes; the others are fossil, mostly in the tertiary rocks. A few are found in the upper stages of the cretaceous series.

Echinolampas Kleinii, Goldf.

SYN. *Clypeaster Kleinii*, Goldfuss, Petrefact. Germaniæ, tab. 42. fig. 5. p. 133.

Echinolampas Kleinii, Desmoulins, Etudes des Echinides, p. 346. no. 14; Agassiz and Desor, Cat. raisonné, Ann. Sc. Nat. tom. vii. p. 166.

Test ovato-orbicular in the outline, with the posterior border slightly produced; dorsal surface convex, posterior half more elevated than the anterior; ambulacral areas unequal, usually on a level with the general surface, but sometimes more convex and prominent than the rest of the test; apical disc excentral and anterior; base concave; mouth excentral and anterior; anus inframarginal; both mouth and anus transversely oblong.

Dimensions.—Antero-posterior diameter $2\frac{9}{20}$ inches, transverse diameter $2\frac{1}{2}\frac{5}{10}$ inches, height $1\frac{9}{20}$ inch.

Description.—This Urchin has been well figured by Goldfuss, and is a very characteristic fossil of the Miocene tertiary beds

of Westphalia, where it appears to be common. The specimen before us is the only one we know from Malta. The circumference is nearly ovato-orbicular, slightly inclining to an obsolete pentagon, with the posterior border most produced. The dorsal surface is highly convex, the posterior half being much more so than the anterior. The ambulacral areas are unequal, as regards length, width and development; the single anterior area is the shortest and narrowest, the antero-laterals are next in size, and the postero-laterals are the most fully developed; they have all a lanceolate form, with blunt apices. The surface of the areas is on a level with that of the interambulacra, in the specimen before us; but in some of the Westphalian Urchins the ambulacral areas form convex projections on the surface of the test. The poriferous avenues, extending down more than two-thirds of the dorsal surface, are well marked in our specimen, and lie in depressions of the test; they consist of two series of pores; the internal holes are round, the external run into oblique slits that have a direction upwards and inwards; the pores on the right and left sides of the areas do not always correspond in length; thus, the anterior pores in the antero-lateral areas are often only half as long as those on the posterior side of the same areas, and we see a similar inequality, although not to the same extent, in those of the single ambulacrum. The anterior and posterior pair of the interambulacral areas are much alike in form and development; but the single interambulacrum is different, it forms a more convex eminence than the others above, and is produced into a slight caudal appendage behind. The apical disc is small and excentral, situated nearer the anterior border. The madreporiform body occupies the centre, around which the four genital holes are pierced. The base is concave; the mouth is nearer the anterior border, is transversely oblong, and surrounded by five lobes, formed by the termination of the interambulacra; the posterior single lobe is the largest; the anterior pair are next it in size, and the lobes of the postero-lateral areas are the smallest and most contracted. Between the five oral lobes, the poriferous terminations of the ambulacral areas form petaloidal depressions, which are perforated with numerous holes; these run out and form lines which indicate the basal boundaries of the areas. The anus is transversely oval, $\frac{4}{10}$ ths of an inch in its long diameter, is more convex on its anterior than its posterior border, and is situated close to the margin; it is rather larger than the mouth-opening. The tubercles are small, uniform in size, and closely set together on the dorsal surface, and longer and more widely apart on the base.

Affinities and differences.—The great convexity of the dorsal

surface, the greater elevation of the posterior than the anterior half thereof, the inflated ridge-like eminence formed by the single interambulacrum, and the well-defined character of the poriferous avenues, form a group of characters by which *E. Kleinii* is distinguished from its congeners. It has many points of resemblance in common with *E. ovalis*; but the greater length of the ambulacral areas in this species makes a marked distinction between them; moreover, in *E. Kleinii* the base is concave, whilst in *E. ovalis* it is convex; the latter form is likewise flatter and more oval, and its apical disc more excentral than in *E. Kleinii*.

Stratigraphical position.—Collected at Malta, from bed No. 2, where it is very rare. It is found, according to Goldfuss, in the Miocene beds at Bünde, Osnabruck, Astrapp, and Merminghüfen, in Westphalia.

History.—Admirably figured and well described by Goldfuss. The only Maltese specimen we have seen of this species is that collected by the Earl Ducie, which is in his lordship's museum.

Echinolampas Deshayesii, Desor, sp. Pl. IV. fig. 3 a-d.

SYN. *Echinolampas Hayesiana*, Agassiz and Desor, Cat. raisonné, Ann. Sc. Nat. tom. vii. p. 166.

Test oval, depressed; ambulacral areas narrow; the poriferous zones contracted, without apparent connecting transverse sulci; apical disc small and nearly central; base convex; mouth and anus large.

Dimensions.—Antero-posterior diameter $2\frac{1}{10}$ inches, transverse diameter $1\frac{9}{10}$ inch, height $\frac{3}{10}$ ths of an inch.

Description.—The form, size and structure of the ambulacral areas afford the best guide to a knowledge of the numerous species of this group. The Urchin before us has an oblong form, depressed at the dorsal surface, convex at the base, and slightly produced posteriorly. The ambulacral areas are narrow at their widest part; they are about one-sixth the width of the posterolateral interambulacra at the border. The poriferous zones are narrow, and extend rather more than half-way down the dorsal surface; the pairs of pores are placed closely together, and the slit or sulcus, which in general unites the inner and outer series of pores together, is absent in this species, or at all events is not apparent in the individuals before us; the holes of both rows are nearly of the same size. The interambulacral areas are wide; the antero-lateral are the narrowest; the single interambulacrum is slightly produced in the region of the anal opening. The apical disc is small, and situated near the centre of the test,

rather nearer the anterior than the posterior border. The disc consists of a central madreporiform spongy body, around which the genital and ocular plates are arranged in a circle; their sutural lines of union, however, are concealed, and can only be seen in weathered specimens. The base is convex; the mouth is very large, and lies in a deep depression opposite the vertex; it is surrounded with five oral lobes of small size, with intervening petaloidal depressions, perforated with holes in pairs. The interambulacrum is slightly produced posteriorly. The anus is a large transversely oblong opening, situated near the margin. The border of the test is rather obtuse. The tubercles are of uniform size on the dorsum, and are larger and less numerous than in *E. Kleinii*.

Affinities and differences.—This species resembles much *E. scutiformis*, but is distinguished from it by the greater narrowness of the ambulacral areas, and the absence of the transverse slits or sulci by which the pairs of pores in these avenues are in general united. The tubercles are more abundant on the dorsal surface in *E. Deshayesii*, and the dorsal surface is not so much elevated in that species as it is in *E. scutiformis*.

Locality and stratigraphical range.—This species was collected from bed No. 2, the yellow sand, at Malta. Desor gives the “Tert. moyen. d’Oran (Algérie) et de Carthagène (Catalogue)” as his localities; and we have received from M. Michelin of Paris a specimen from the Miocene terrain of Balistro, Corsica, which has enabled us to identify the Maltese Urchin, and make out the preceding description, the first given of this pretty form.

Echinolampas Richardi, Desmarest.

SYN. *Scutum ovatum Issyaviense*, Klein, Echinodermatum, tab. 20. fig. a, b, § 77. p. 29 (?).

Clypeaster Richardi, Desm. Dict. Sc. Nat. t. liv. tab. 5. p. 12, spec. ined. in litt.; Grateloup, Mem. Echin. Foss. tab. 1. fig. 8 a, b, p. 44.

Echinolampas Richardi, Desmoulins, Etudes sur les Echinides, p. 342. no. 4.

Echinolampas Laurillardii, Agassiz and Desor, Ann. Sc. Nat. t. vii. p. 165.—Scilla, Corp. Mar. tab. 11, top figure, showing the base only.

Test oblong, produced posteriorly, rounded before, flattened laterally, caudate posteriorly; dorsal surface convex, elevated; base concave; mouth central; anus inframarginal, lodged in a caudal process of the interambulacrum; ambulacral areas narrow, with contracted poriferous zones.

Dimensions.—Antero-posterior diameter $1\frac{7}{10}$ inch, transverse diameter $1\frac{9}{20}$ inch, height $\frac{17}{20}$ ths of an inch.

Description.—The specimen before us is so much injured on the dorsal surface, that we are unable to give a detailed description of this species, which appears to be not uncommon at Malta. The ambulacral areas are narrow; the pores lie in contracted zones, and the pairs are unconnected by sulci; the avenues extend more than half-way down the sides of the test; the dorsal surface is elevated and convex, rounded before, and sloping gradually from the vertex to the posterior border; the apical disc is very excentric, and placed near the anterior border; the circumference of the test is of an irregular oblong figure, round before, flattened on the sides, and produced behind: the base is undulated by the elevations of the interambulacra and the depressions of the ambulacral areas; the single interambulacrum is prolonged backwards, and is truncated at the sides and at the posterior border, which gives it a caudate form. The mouth is nearly central, and is sunk in a deep depression; it is transversely oblong, and is surrounded by five oral lobes, having five petaloidal depressions of the ambulacral areas, with three pairs of pores in each petal between them; the anus is larger than the mouth-opening, and is situated at the inframarginal border of the caudate process of the interambulacrum; it has a transversely oblong form, and is more convex before than behind. The Urchin figured by Grateloup is much larger than the Maltese specimens that have come under our notice; but the central mouth-opening and the form of the interambulacrum induce us to think that it is only a gigantic variety of *E. Richardi*, and not *E. Kleinii*, as supposed by Desmoulin. The identity of this species with Klein's *Scutum ovatum Issyaviense* may or may not be correct, as the figures of fossils in that work are not in every case to be depended on.

Affinities and differences.—*E. Richardi* has some resemblance to *E. Kleinii*, but the narrow ambulacral areas, the flattened sides, and produced caudate interambulacrum in *E. Richardi* afford points of distinction by which these allied forms may be readily distinguished from each other. In *E. Kleinii* the base is more concave, the mouth nearer the anterior border, and with larger oral lobes than in *E. Richardi*. The dorsal surface presents other points of difference: in *E. Kleinii* the posterior half of the test is the most elevated, whilst in *E. Richardi* it slopes rather abruptly downwards from the vertex to the truncated posterior border.

Locality and stratigraphical range.—It was collected from bed No. 2, at Malta; the specimen before us is the only one in Earl Ducie's cabinet. The Geological Museum in Jermyn Street possesses an interesting series of this form, which are all from the same island. Grateloup found the large variety at Dax, in

the "faluns bleus de Narrosse," and adds that it is found likewise at Paris, Montpellier?, Bordeaux, and the Vicentin: Desmoulins adds St. Paul-trois-Châteaux (Drome) as another locality.

Genus CONOCLYPUS (Agassiz, 1839).

Test thick, hemispherical or oval, and always much elevated; ambulacral areas above long, wide, converging at the summit, a little contracted below; mouth median, symmetrical, pentagonal, and surrounded by five large lobes; base flat, basal portion of the ambulacra with poriferous zones around the mouth-opening; anus inframarginal, sometimes transversely oblong. The species are all fossil, and belong mostly to the tertiary rocks: one is found in the Macstricht chalk. This genus is nearly allied to *Echinolampas*. The character upon which M. Agassiz relied as diagnostic between *Conoclypus* and that genus, the direction of the anus, which is stated* to be elongated in the antero-posterior diameter in *Conoclypus*, and in the transverse diameter in *Echinolampas*, does not hold good in all the species.

Conoclypus plagiosomus, Agassiz.

SYN. *Conoclypus plagiosomus*, Agassiz and Desor, Cat. rais., Ann. Sc. Nat. 3rd series, tom. vii. p. 168.

Test thick, large, highly convex; border acute; outline round, inclining to oblong, being slightly compressed on the sides; ambulacral areas narrow, even with the interambulacra; poriferous zones very narrow; the inner and outer pores nearly equal in size, and extending through three-fourths of the areas; base concave; mouth nearly central, with large oral lobes; anus large, transversely oblong and inframarginal.

Dimensions.—Antero-posterior diameter 6 inches, transverse diameter $5\frac{8}{10}$ inches, height 3 inches.

Description.—This noble Urchin has been mistaken for *C. conoideus*, Lamk., as in form, size, and some of its general characters it resembles that type species; but the eye of the practised zoophytologist detects, in the structure and narrowness of the poriferous zones, an organic character sufficient to enable him to separate it from that species. The general outline of the base is round, inclining to oval from the gentle compression of the sides thereof; the dorsal surface is much elevated and highly convex, and the vertex is situated in front of the centre of the dome; the ambulacral areas are nearly one-fourth the width of the interambulacral areas at the border, and are level with them; they are nearly of a uniform width throughout, becoming lan-

* Ann. Sc. Nat. tom. vii. p. 167.

ceolate at their upper fifth : the poriferous avenues are very narrow, and extend three-fourths of the distance between the apex and the border : the pores in the avenues are only about one line apart, and are united by short slits directed obliquely upwards and inwards at nearly equal spaces apart from the base to the apex ; the pores in the outer and inner series in each zone are about the same size throughout : the narrowness of the poriferous avenues forms a very important character in this species, by which it is distinguished from an allied form, *C. conoideus*. The interambulacra are of a triangular form ; the antero-lateral are the smallest, and the postero-lateral and single interambulacrum of about the same size are the largest : the apical disc is small, and situated nearer the anterior than the posterior border, which occasions a slight difference between the angle of inclination of the anterior and posterior sides of the test : the centre of the disc is occupied by a prominent button-like spongy madreporiform body, around which the genital and ocular plates are arranged, but their lines of suture can only be distinguished in weathered specimens, or by removing the superficial layer of the plates. The entire surface of both areas is covered with tubercles, very much alike both as regards size, form, and irregularity of arrangement ; the only parts exempt from tubercles are the interporiferous septas of the avenues : the base is concave : the mouth is situated in the centre of the disc, and is surrounded by five large prominent lobes : the ambulacra form petaloid depressions between the oral lobes, in which a number of pores are clustered together in pairs. The anus is a large, transversely oblong opening, placed immediately beneath the posterior margin ; from it to the mouth an elevated ridge of the test runs : the single interambulacrum is slightly produced posteriorly where the anus terminates : the tubercles are larger, and placed at greater intervals apart on the base than on the dorsal surface : the marginal fold of the test forms an acute angle, and on the border thereof the tubercles are clustered closer together in greater numbers, with smaller interspaces between them, than in any other part of the skeleton.

Affinities and differences.—This species very much resembles in form and size *C. conoideus*, but it is readily distinguished from it by the following characters : the ambulacral areas are smaller, the poriferous zones are narrower, and the outer and inner pores of each pair are nearly of the same size, whilst the septas between the pores are thicker ; the dorsal surface is not so much elevated, the base is concave, the anus is large and transversely oblong, and the mouth possesses very prominent oral lobes.

Locality and stratigraphical range.—This Urchin was collected at Malta, from bed No. 2. The fine specimen before us belongs

to the Bristol Institution ; we possess one, through the kindness of M. Michelin, from the celebrated Urchin bed of Balistro (Corsica) ; it is found likewise in the " Molasse du Cap Couronne près Martigues." (*Michelin.*)

Family SPATANGIDÆ.

The general outline of the Urchins of this family is oval, oblong or cordiform, and they satisfactorily exhibit the bilateral symmetry of the *Echinidæ*. The mouth is anterior, bilabiate, and edentulous. The anal opening is posterior and supramarginal, and is closed by a complicated series of small plates. The apices of the ambulacral areas are united at the summit of the test. The anterior single ambulacrum has a different structure from the antero- and postero-lateral pairs, and is in general lodged in a depression of the test, which extends to the anterior border forming the anteal sulcus ; the test is extremely thin, and is covered with small tubercles which support hair-like spines ; besides these there are some larger crenulated and perforated tubercles which support large spines. There are two or four genital pores which are sometimes placed close together, but are in other genera apart. The eye-plates are five in number, and are placed at the apices of the ambulacra in a pentagonal form around the genital plates. We observe on the surface of the test of some *Spatangidæ*, certain delicate lines called *fascioles*, having a smoother appearance than the tubercular surface of the test ; they are furrows which are strewed with microscopic tubercles destined to carry very delicate spines, which, when seen under the microscope, appear to have the same structure as the *Pedicellariæ*. The fascioles have a different disposition in each genus, and afford a good character in giving definitions of the same ; when the fasciole surrounds the ambulacral petals like an undulating groove, as in *Hemiaster*, *Schizaster*, &c., it is said to be a *peripetal* ; when it surrounds the single ambulacrum, as in *Amphidetes*, it is *internal* ; when it extends along the sides, as in *Schizaster*, it is *lateral* ; when it surrounds the circumference of the test, as in *Pericosmus*, it is *marginal* ; when it is limited to the base of the anal opening, it is *subanal*. We find sometimes in the same genus more fascioles than one ; thus the subanal and peripetal are frequently associated together.

Genus SPATANGUS (Klein, 1734).

Urchins, in general large with a thin test, a convex dorsal surface, and the antero-lateral and postero-lateral ambulacral areas composed of larger petals than in other *Spatangidæ*. The ante-

rior ambulacrum is lodged in a deep anteal sulcus; the upper part of the anterior border of the antero-laterals is obliterated towards the summit.

Numerous very large crenulated and perforated tubercles are scattered over the surface of the ambulacral plates. They have a deeply grooved subanal fasciole; only four genital pores, the anterior pair more closely approached than the posterior pair.

Five perforated ocular plates, arranged in the form of a pentagon, around the genital pores. A tube or hollow cone at the internal part of the single interambulacrum. A large vertical plate passing into a cone arises from the internal surface of the test upon the left side of the mouth, and is directed obliquely upwards and backwards.

The species are living or fossil in the tertiary rocks.

Spatangus Hoffmanni, Goldfuss.

SYN. *Spatangus Hoffmanni*, Goldf. Petrefacta, Band i. p. 152. tab. 47. fig. 3 a, b, c; Desmoulin, Etudes sur les Echinides, p. 398. no. 35; Grateloup, Mém. Echinid. Foss. tab. 1. fig. 8. p. 73; Agassiz and Desor, Ann. Sc. Nat. tom. viii. p. 7.

Echinus (petrefactus), Scilla, Corp. Mar. pl. 10. fig. 1.

Test convex, depressed anteriorly, elevated and carinated posteriorly; antero-lateral and postero-lateral interambulacra with numerous large, perforated and crenulated tubercles, surrounded by deep sunken areolas; base convex, the postero-lateral areas with large tubercles; interambulacrum forming a tumid projection at the base; mouth and anus large; marginal fold acute; the pores in the zones large, disposed in wide-set pairs.

Dimensions. — Antero-posterior diameter $2\frac{2}{10}$ inches, transverse diameter 2 inches; height anteriorly $\frac{7}{10}$ ths of an inch, height posteriorly $\frac{1}{2}$ ths of an inch.

Description. — The characters of this form of *Spatangus* are so prominent and well defined, that one is astonished that between the time of Scilla, who first figured it, and that of Goldfuss, who first described it, no zoophytologist should have become its historian. The dorsal surface of the test is broad, convex, and depressed anteriorly, and narrow, elevated, and carinated posteriorly; the ambulacral areas are well defined, the single ambulacrum with its rudimentary pores is lodged in a wide but shallow anteal sulcus, and there is a flattened plateau between the sulcus and the apical disc; in this region the obsolete pores are clearly seen: the antero-lateral ambulacral areas extend outwards at an angle of 24° from a transverse line drawn through the apical

disc*: the posterior poriferous zone extends two-thirds of the distance between the disc and the border; the anterior zone commences much farther from the disc above, but extends as far as the posterior zone below; thus in the specimen before us, there are fourteen pairs of pores in the posterior, and only nine in the anterior zone: the postero-lateral ambulacral areas extend backwards, and towards their termination they curve gracefully outwards; the angle they form at the transverse line at the disc is 62° , and there are twenty pairs of pores in each of the zones. Each of the interambulacral areas presents peculiar characters; the antero-lateral pair are the smallest, and the postero-lateral are the largest; they are both remarkable for the tubercles they support on their dorsal surface; in the anterior pair there are nine, and in the posterior pair there are fourteen of these tubercles on each side of the test, which are sculptured out of the substance of the plates; as they do not project beyond the general surface of the shell, each tubercle is seated on a cylinder, which is surrounded by a deep, wide depression: as these perforations are not arranged with much regularity, the test has the appearance of having been bored by some marine mollusk. The tubercles themselves, in proportion to the size of the supporting cylinder and encircling entrenchment, are small and perforated; the single interambulacrum is narrow and elongated, and rises in the mesial line into a prominent elevated ridge; the posterior border is obliquely truncated downwards and inwards, in the upper part of this space the large anal opening is situated; below, the interambulacrum forms another prominence marked by two concave depressions on each side thereof, from which a wide, gently sloping central space occupies the middle of the ventral surface, having the large transversely-oblong mouth-opening with its projecting posterior lip occupying the anterior third of the base; on the sides of this sloping central space the basal portions of the postero-lateral interambulacra are thickly studded with large slanting perforated tubercles, arranged with much regularity in this region, and a few smaller tubercles are scattered over the basal portion of the antero-lateral pair; the crescentic depressions below the anus have each a group of perforated tubercles, and between them and the smooth central concave portion of the base is the subanal fasciole, which forms a transverse band in the middle, and a crescent on each side, the upper

* It may be as well to state, that we have adopted this mode of measuring the amount of divergence of the antero-lateral and postero-lateral areas rather than the vague expressions formerly in use. The angle is measured from a transverse line which cuts the longitudinal axis at right angles at the apical disc; we have found the degree of divergence to be very uniform in each species.

cornua of which approaches the anal opening ; below the fasciole there is another group of small perforated tubercles and a copious granulation ; the crescentic depressions, subanal fasciole, and this group form together a triangle, the base of which lies before the anus, and its apex points towards the mouth ; around this opening five pair of short poriferous zones indicate the termination of the ambulacral areas.

Affinities and differences.—The form of the ambulacral areas, the shortness of the anterior poriferous zone, and the size and depth of the areolar spaces around the cylinders of the large tubercles, together with the carinated elevation in the middle of the interambulacrum, form a group of organic characters which sufficiently distinguish this species from its congeners. In *Spatangus Desmarestii*, which is found with *S. Hoffmanni* in the same beds in Westphalia, the size of the test, the absence of very deep areolas on the dorsal surface, the equal length of the poriferous zones of the anterior ambulacra, and the much smaller tubercles at the base, easily enable us to distinguish it from *S. Hoffmanni*.

Stratigraphical range and localities.—It is found at Malta in bed No. 4, the calcareous sandstone, and in Westphalia ; it has been collected from the Miocene at Doberg near Bünde, and at Astrapp near Osnabruck.

Spatangus De Koninckii, Wright, n. sp.

Test cordate, depressed before, elevated behind by the development of dorsal and basal median carinæ on the single interambulacrum ; ambulacral areas short and broadly petaloid ; anteal sulcus slight ; depression of the single ambulacrum inconsiderable ; several large tubercles between the petaloidal ambulacra ; posterior border obliquely truncated downwards and forwards ; anal opening large and circular ; basal tubercles of moderate size ; basal portions of the postero-lateral ambulacra form two smooth tracks destitute of tubercles between the posterior border and the mouth.

Dimensions.—Antero-posterior diameter $1\frac{6}{10}$ inch ; transverse diameter $1\frac{4}{10}$ inch ; height at the interambulacrum $\frac{1}{2}$ ths of an inch.

Description.—An imperfect specimen of this Urchin was at first mistaken for a small variety of *Spatangus Desmarestii*, Goldf., and entered under that name in the list of fossils from bed No. 2. Having lately obtained a better specimen of this form, we are now enabled to give a description of it, which will be found to differ in many essential points from that species, to which it was at first referred. The test is regularly cordate,

slightly flattened at the cheeks, bulging out at the sides, and from thence tapering abruptly towards the posterior border, where it is truncated obliquely downwards and forwards; the anterior part of the test is flattened and depressed, and the posterior portion much elevated, from the circumstance of the single interambulaerum forming two prominent ridges, one on the dorsal, and the other on the basal surface, which gives increased depth to the test, tilts it up, and forms an inclined plane of the dorsal surface. The petaloidal ambulaera are short, broad and leaf-like; the anterior pair are slightly flexed forwards and form an angle of about 15° ; their anterior poriferous zone is nearly as complete as the posterior zone, which contain respectively sixteen and eighteen pairs of pores; the posterior pair form two oval leaflets, the bases and apices of which are nearly equally curved, and closed with pores, having about eighteen pairs of pores in each zone; they describe an angle of about 60° . The single anterior ambulaerum makes a very slight depression on the upper part of the anterior region, and the antecal sulcus formed by it is inconsiderable when compared with other congeneric forms; the anterior and lateral pairs of interambulaera carry a few large erenulated and perforated tubercles on the upper part of their dorsal surface; on the anterior pair there are from seven to eight, and on the posterior pair from four to five of these tubercles, which are neither so large nor yet have such deep areolas as their homologues in *S. Hoffmanni*. The single posterior interambulaerum is narrow, but greatly developed in the vertical diameter; above, a blunt prominent ridge commences near the apical disc and extends to the posterior border; below, another ridge commences a short distance from the truncated portion of the border, and extends to the centre of the mouth; the base is slightly convex from side to side, besides being raised in the middle of its posterior part by the ridge just alluded to. The tubercles on the basal portions of the anterior and posterior interambulaera are not very large, but are disposed with great regularity; those on the ridge-like prominence of the single interambulaerum are arranged in lines which radiate in all directions from a point; those on the pairs gradually decrease in size from the mouth to the border; between these two groups of tubercles there is on each side a smooth track, corresponding with the course of the postero-lateral ambulacra from the border to the mouth: the anus is large and circular, and occupies the upper part of the posterior border; the subanal fasciole is denuded; the mouth is likewise large and transversely oval, and is situated near the antecal sulcus. The apical disc is excentral, being situated about the anterior part of the middle third of the test; it is small, and is perforated with four genital holes. The

superficial layer of the calcareous plates, which carries all the fine sculpture of the test, is almost entirely denuded from the dorsal surface; one or two fragments alone remain to show that the tuberculation was minute and close-set.

Affinities and differences.—This species is distinguished from *S. Hoffmanni* by the excessive elevation of the posterior part of the test; by the shorter, wider and more oval form of the petaloid ambulacra; by the poriferous zones of the anterior pair being more complete; by the large dorsal tubercles being smaller and fewer in number; by having a less impressed anteaal sulcus; a convex base, with smaller tubercles; a ridge-like projection, with a regular tuberculation of the basal portion of the interambulacrum, with smooth naked ambulacral tracks on each side thereof. From *S. Desmarestii* it is distinguished by its short, broad, petaloidal ambulacra, which are long and attenuated in *S. Desmarestii*; by the greater size, number and regularity of the large dorsal tubercles, which are few, small and scattered in *S. Desmarestii*; the posterior region is not at all elevated in *S. Desmarestii*, and the anus is transversely oblong, whilst in *S. De Koninckii* the posterior part is much elevated, and the anal opening is round.

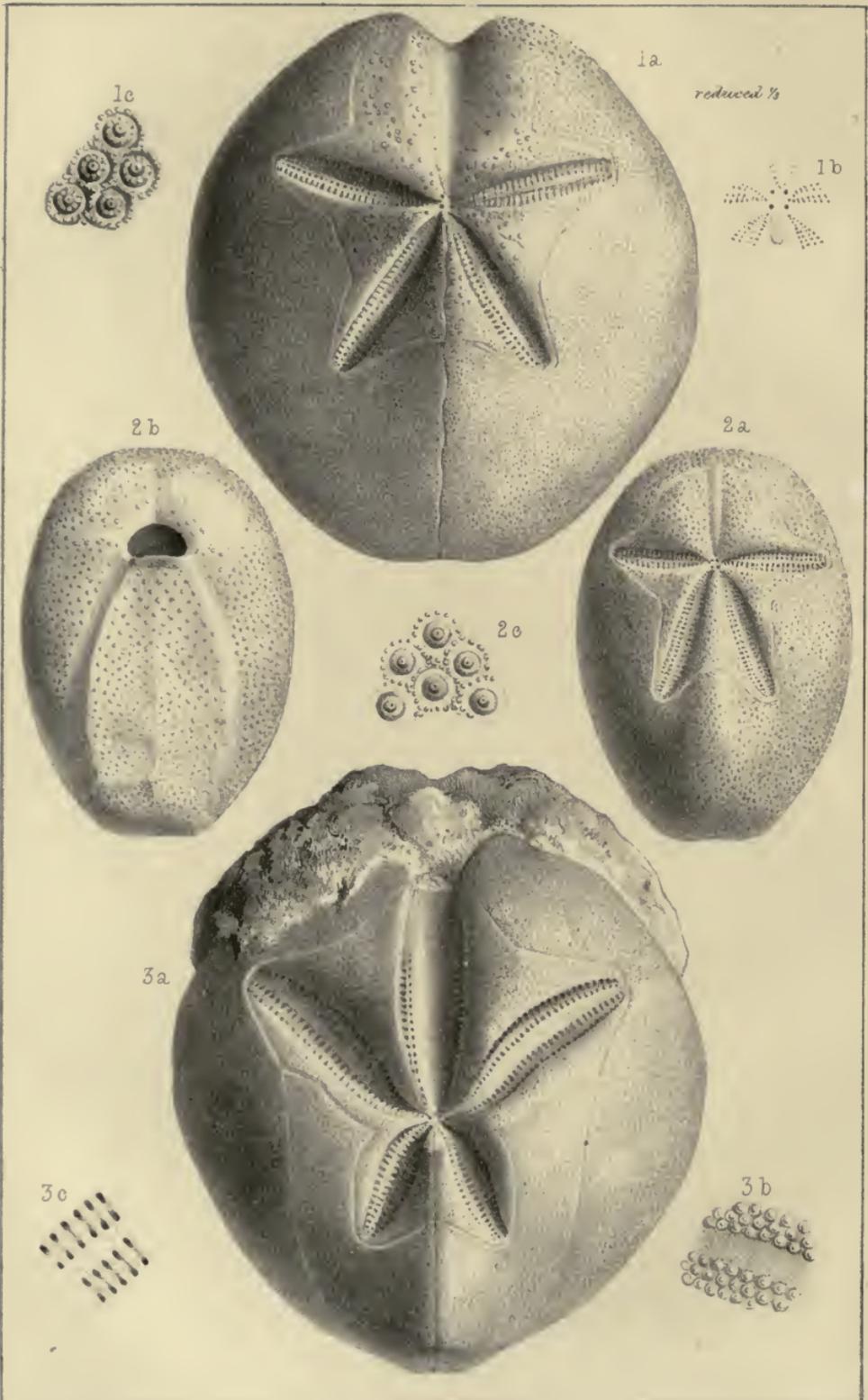
S. Desmarestii has a few groups of large tubercles on the upper part of the single interambulacrum, which are entirely absent both in *S. Hoffmanni* and *S. De Koninckii*. The basal region is so much covered up with matrix in the specimen of *S. Desmarestii* before us, that we cannot institute a comparison between this portion of its test and that of *S. De Koninckii*.

Locality and stratigraphical range.—The two or three specimens we have seen in the Earl Ducie's cabinet were collected from the clay bed No. 2 at Malta; they have all a deep ferruginous colour, and are not well preserved. We dedicate this species to our friend Dr. De Koninck of Liège, the learned author of several memoirs on the palæontology of the carboniferous rocks of Belgium.

GENUS BRISSUS (Klein, 1734).

Form oval; the ambulacral summit excentral, and situated near the anterior border; the antero- and postero-lateral ambulacral areas straight, and lodged in shallow depressions of the test; the anterior pair are nearly transverse, the posterior pair deviating slightly from the longitudinal direction. The single ambulacrum very simple in structure; no anteaal sulcus; the peripetal fasciole very sinuous; mouth large, labiate, and near the anterior border; anal opening large, situated in the middle of the posterior surface; the subanal fasciole approximated close





reduced 1/3

1c

1a

1b

2b

2a

2c

3a

3c

3b

1 a - c *Brissus latus*, Wright
 2 a - c *Brissus oblongus*, Wright
 3 a - c *Schizaster Parkinsoni*, DeFrance

to the anus. Four genital pores, the anterior pair smaller and nearer each other than the posterior pair. The madreporiform tubercle situated between the posterior genital openings; five perforated ocular plates placed before the genital pores and alternating with them. This genus contains a greater number of living than of fossil species; the existing forms are limited to the seas of warm latitudes; the fossil species are found only in the tertiary rocks.

Brissus latus (Wright, n. sp.). Pl. V. fig. 1 a-c.

Test convex and much depressed above; transverse and antero-posterior diameters nearly equal; ambulacral areas of nearly equal length; the single ambulacrum lodged in a deep antean sulcus; antero-lateral pair curved gently forwards; peripetal fasciole very zigzag and angular; apical disc $\frac{3}{10}$ ths of an inch before the centre of the disc; base slightly convex; sternal process of the single interambulacrum raised before the anus, having a central elevated ridge and numerous large tubercles arranged in regular order on its surface; subanal fasciole enclosing a space $1\frac{7}{10}$ inch in diameter; anus situated in an oblique truncation below the margin; mouth $\frac{7}{10}$ ths of an inch from the anterior border; the large tubercles of moderate size.

Dimensions.—Antero-posterior diameter $4\frac{1}{2}$ inches, transverse diameter $3\frac{9}{10}$ inches; height at the vertex 1 inch.

Description.—This *Brissus* is readily recognized by its broad and depressed dorsal surface; the ambulacral areas form deep depressions in the test; the single ambulacral area lies in an inconsiderable valley on the dorsal surface, but forms rather a deep antean sulcus; the antero-lateral pair curve gently outwards and forwards, forming an angle of 21° , with the transverse line at right angles with the longitudinal axis of the test; the postero-lateral pair are directed obliquely backwards at an angle of 55° ; both pairs lie in rather deep valleys, and the poriferous zones contain from twenty-eight to thirty pairs of pores in each avenue. The peripetal fasciole (1 a) makes an angular zigzag track, closely embracing the apices of the ambulacral areas. In the space which it bounds on the fore part of the shell, having for its base the antero-lateral areas, and its apex the antean sulcus of the single ambulacrum, a number of large perforated tubercles set on crenulated eminences are arranged in groups (1 c), the areolas of these tubercles are surrounded by small granules, and amongst them smaller tubercles are interposed; a few large tubercles occupy the angles between the apices of the antero-lateral and postero-lateral pairs, and likewise in the angle formed between the pos-

tero-laterals themselves; the rest of the dorsal surface is covered with small tubercles closely set together; each tubercle is perforated and raised on a crenulated eminence (1 c), and surrounded by a smooth depressed areola; the base is slightly convex; the sternal portion of the single interambulacrum is rather prominent behind, but slopes gently towards the mouth; it has an elevated ridge in the centre, and is covered with tubercles of a larger size than those of the upper surface, and which are arranged in regular rows. The subanal fasciole is of considerable extent, it forms a semicircle which passes across the most prominent part of the base, and sends its cornua upwards at a considerable distance from the anus; the basal portions of the pairs of the interambulacral areas are covered with tubercles similar to those on the sternal part; a naked track corresponding to the postero-lateral areas separates these tuberculated portions of the base. The mouth is situated near the anterior border, it is widest in the transverse diameter, and has a thick projecting under lip; the terminations of the ambulacral areas surround the mouth, and form poriferous zones around that opening: the anus is situated beneath the margin in an oblique truncation of the posterior border; the opening is much crushed in our specimen, so that its form is not discernible. The apical disc (1 b) is placed near the centre of the back, about $\frac{3}{10}$ ths of an inch before that point: the madreporiform tubercle is small and pyriform, and is situated behind the four genital pores: the margin of the shell is thin and acute.

Affinities and differences.—The breadth of the test and the depression of the dorsal surface thereof, with the curve forwards in the ambulacral areas, and the depth of the antecal sulcus, form a group of characters by which *Brissus latus* is readily distinguished from its congeners. Out of the seven fossil species, registered but not described in Agassiz and Desor's Catalogue, two only are figured, and for this reason we are unable to make a comparison with them.

Locality and stratigraphical range.—Only one specimen of this species, in the Earl Ducie's cabinet, was collected from bed No. 1, the Gozo marble, at Malta, so that we conclude the species is rare, as it is not contained in either of the other collections of Maltese Urchins examined by us. The Jermyn Street Museum contains a specimen, which is supposed to be identical with this form.

Brissus imbricatus (Wright, n. sp.).

Test oblong, much depressed; no antecal sulcus; peripetal fasciole narrow, lodged in a groove; rest of the dorsal surface fractured; base convex; mouth large, and situated near the ante-

rior border; sternal portion of the interambulacrum with a regular ornamentation. The subanal fasciole very near the anus is heart-shaped and narrow; it encloses rows of tubercles which are arranged in radii in regular order; before the fasciole the test forms a projection, and from the summit thereof, rows of tubercles arranged in straight lines extend towards the mouth, increasing in size as they approach that opening; the basal portions of the other interambulacral areas are covered with scale-like imbricated plates, each carrying an oval eminence with a crenulated summit, and a tubercle placed at the anterior side of the oval eminence; these tubercles are all regularly arranged in rows which have a direction forwards and outwards: the postero-lateral ambulacra form a naked space, which separates the imbricated basal portions of the pairs of interambulacra from the ornamented sternal portion of the single one. The anus is large and situated at the posterior border; both this opening and the mouth are much injured.

Dimensions.—Antero-posterior diameter $3\frac{5}{10}$ inches, transverse diameter 3 inches, height $\frac{8}{10}$ ths of an inch.

Description.—The detailed diagnosis given of this species contains nearly all that we can describe of this *Brissus*, for, with the exception of a small portion of its anterior part preserving a portion of the peripetal fasciole, all the rest is absent; the regularity in the arrangement of the tubercles at the base constitutes a characteristic feature of this form, and the imbricated style of the basal plates, resembling the tegumentary membrane of a placoid fish, gives value to the specific name.

Affinities and differences.—The order and symmetry of the decoration of the sternal portion of the interambulacrum, the heart-shaped subanal fasciole, with its broad band of microscopic granules, and the leaf-like tuberculated expansion which extends from the apex of the fasciole, are very characteristic of this species; if to these we add the imbricated style of the plates occupying the sides of the base, and the oblique way the tubercles are set on their oblong bases, we have an assemblage of organic characters by which *B. imbricatus* may be readily distinguished from its congeners. The form of the test, the size of the tubercles, the symmetry of the subanal rosette, formed by radii of tubercles, and encircled by a broad fasciole, readily separate it from *B. latus*, with which it is associated in the same stratum.

Locality and stratigraphical position.—This species was collected from bed No. 1, the Gozo marble, at Malta: it is the property of the Bristol Institution.

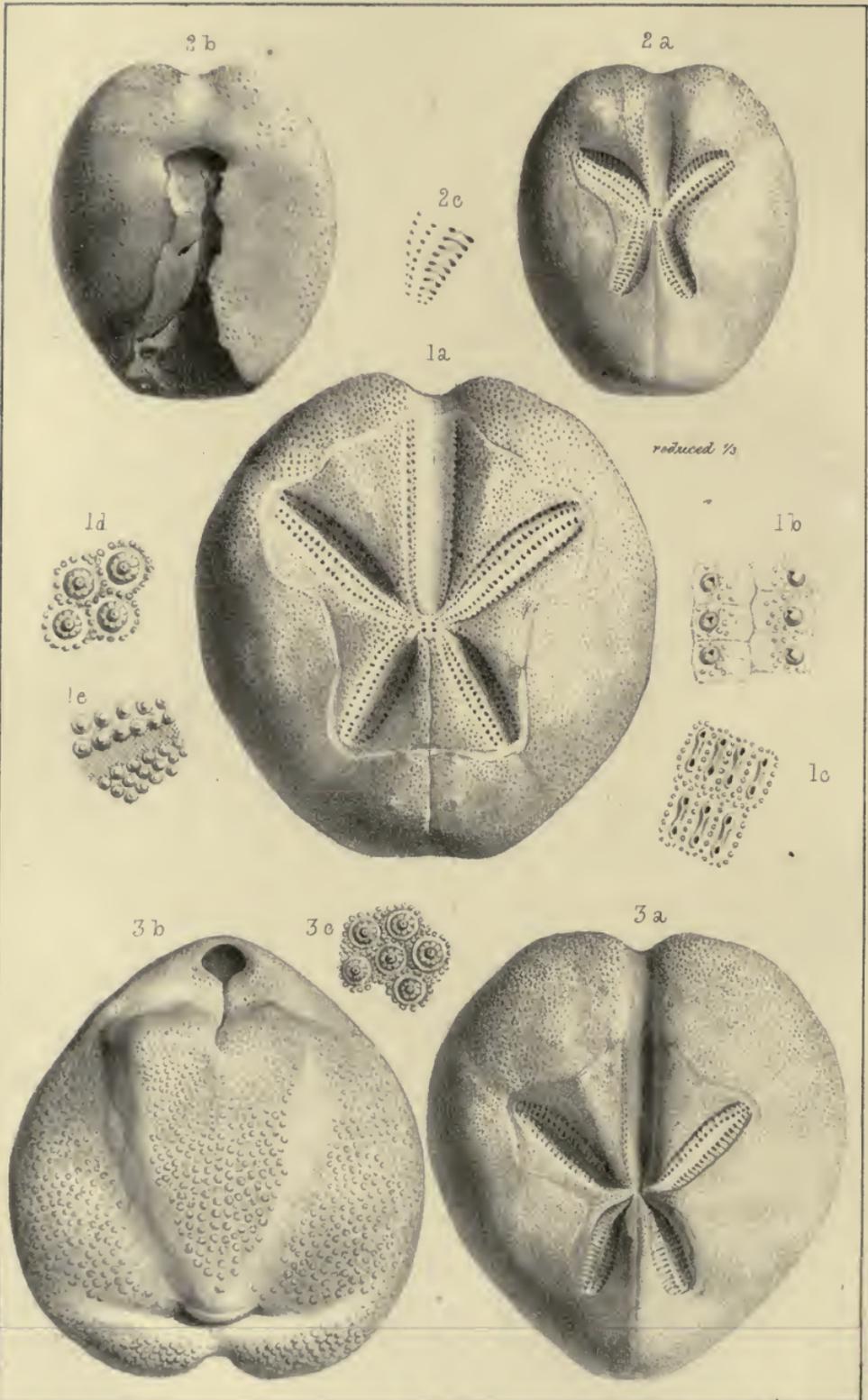
Brissus oblongus (Forbes MSS., n. sp.). Pl. V. fig. 2 a-c.

Test oblong, depressed before, elevated behind; dorsal surface convex; anterior border rounded, with a slight antea sulcus; antero-lateral ambulacral areas slightly bent forwards, and nearly forming right angles with the longitudinal axis; postero-lateral ambulacra make an angle of 68° ; the anterior are shorter than the posterior pair; posterior border produced and truncated: anus large, oval, and placed high up: base convex, sternal portion prominent, greatest width across the base of the postero-lateral ambulacra.

Dimensions.—Antero-posterior diameter $2\frac{1}{10}$ inch, transverse diameter $1\frac{9}{10}$ inch, height $1\frac{1}{10}$ inch.

Description.—This small *Brissus* has an oblong form, and is rounded before and truncated behind; the anterior half of the test is more depressed than the posterior half; the single interambulacrum rises into a ridge-like eminence on the back, and the sternal portion thereof is much inflated at the base, so that the greatest height of the test is in this region. The antero-lateral ambulacra (2 a) are shorter than the posterior pair, and are extended across the test nearly at right angles to the longitudinal axis; the postero-lateral ambulacra are longer than the anterior, and form angles of 68° ; the petaloid portions of both areas are depressed; the anterior pair have eighteen pairs of pores, the posterior pair have twenty-four pairs of pores in their poriferous zones: the single ambulacrum is not lodged in a rudimentary antea sulcus, and is nearly on a level with the contour of the test, the front and cheeks of which are convex, with four groups of larger tubercles in this region; the sides slope obliquely downwards to the border, which is obtuse: the single interambulacrum is raised into a ridge above, and produced into a blunted caudal process, obliquely truncated behind: the base (2 b) is convex, chiefly from the arched form which the sternal portion of the interambulacrum assumes: the mouth is large, near the anterior third of the base: the anus is of an elliptical form, and occupies more than the upper half of the truncated portion of the posterior border. The peripetal fasciole (2 a) closely embraces the ambulacral pairs, and makes three angles in passing over the anterior interambulacra; the subanal fasciole (2 b) describes a heart-shaped outline, its base is near the anus, and its apex touches the prominent point of the sternum; the space thereby circumscribed is filled with tubercles having a definite arrangement. The apical disc is small, with four genital pores, the posterior pair being much larger than the anterior pair; the tubercles (2 c) on the anterior interambulacra are much the largest, those on the rest of the back are small and very uniform in size, whilst those on the sternum and the sides





C. R. Bone del et lith.

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- 1 a - e *Brissopsis Duciei*, Wright.
- 2 a - e *Brissopsis crescenticus*, Wright.
- 3 a - e *Schizaster Desori*, Wright.

of the base are intermediate in size; the basal tracts of the ambulacral areas are destitute of tubercles; as they approach the mouth they are again perforated with a single row of holes; those of the antero-laterals extend as far as the border, whilst the single and posterior pair have only two or three pairs of their plates perforated.

Genus BRISSOPSIS (Agassiz, 1840).

Form elongated, subcylindrical; ambulacral areas straight, short, and wide, converging near the summit of the test; peripetal fasciole flexuous, closely surrounding the ambulacral areas; two or four genital pores, the posterior larger than the anterior pair; five ocular plates disposed nearly equally apart in a pentagonal form around the genital openings; subanal fasciole wide, and situate at a considerable distance below the anal opening; single ambulacrum lodged in an antecal sulcus; the basal portions of the ambulacra are wide and naked; the tubercles are very uniform in size, and are crenulated and perforated. Three living species; the rest are fossil in the tertiary rocks.

Brissopsis Duciei (Wright, n. sp.). Pl. VI. fig. 1 *a-e*.

Test oblong, depressed anteriorly, elevated posteriorly; apical disc central; ambulacral areas forming concave depressions; single ambulacrum the longest and widest; antero-lateral pair straight, angle of inclination 34° ; postero-lateral shorter, angle of inclination 55° ; peripetal fasciole broad and undulating; anus oval, large, situated high on the border; base concealed; dorsal tubercles small, nearly of a uniform size, except on the sides and the anterior part, where they are larger.

Dimensions. — Large specimen. Antero-posterior diameter $3\frac{4}{10}$ inches, transverse diameter $3\frac{2}{10}$ inches: height cannot be accurately measured.

Small specimen. Antero-posterior diameter $1\frac{9}{10}$ inch, transverse diameter $1\frac{17}{20}$ inch; height over the middle of the single ambulacrum $\frac{9}{10}$ ths of an inch, at the highest point of the dorsal region $1\frac{1}{10}$ inch.

Description. — This beautiful Urchin is one of the most typical forms of the group to which it naturally belongs. The test is oblong and inclined, from the height of the anterior third being less by $\frac{2}{10}$ ths of an inch than the posterior third; the ambulacral areas are all well developed, and arranged in the form of a St. Andrew's cross; as the apical disc is situated near the centre of the body, the regularity of their arrangement forms a conspicuous character of this species. The anterior ambulacrum (1 *a*) is concave, and makes an inconsiderable antecal sulcus; there is a

single row of pores, flanked by a row of tubercles on each side, with a space between filled by a microscopic granulation; it is abruptly bounded below by the fasciole, and terminates at the disc in a blunt lancet-shaped apex. The antero-lateral ambulacra in the large specimen are $\frac{3}{10}$ ths of an inch longer than the posterior pair, and form an angle of 37° with the transverse line through the disc; they are round at the base and blunted at the apex, and the anterior side is more rounded off than the posterior for the reception of the apex of the ambulacrum; in the anterior zone there are twenty, and in the posterior zone twenty-four pairs of holes. The postero-lateral pair describe an angle of 55° ; both pairs form concave valleys; the pores in the zones are of the same size, and are pierced so wide apart (1 c) that the pores of each pair are nearly as distant from each other as the width of the space which separates the two avenues; in the anterior ambulacral avenues there are twenty in the anterior and twenty-four in the posterior zone; in the posterior pair the numbers are twenty-two before and eighteen behind. The peripetal fasciole (1 e) has an unequal width in different parts of its track; it is narrow where it passes over elevations of the test, or is bent into angles, and becomes wider in other parts of its course. The apical disc (1 a) is small, heart-shaped and central; the two anterior genital holes are smaller and placed closer together than the posterior pair; the five eye-holes as usual are situated at the summit of the ambulacral apices: the madreporiform tubercle occupies the surface of the posterior triangular genital plate. The anus is a large oblong opening, situated in the upper half of the posterior border, at the distance of $\frac{7}{20}$ ths of an inch from the fasciole in the small individual. The base in both specimens is concealed; the tubercles (1 d) are small, crenulated and perforated, and nearly of the same size; a few larger ones occupy the sides of the anterior ambulacral sulcus; the sides of the ambulacral areas and as much of their basal portions as is exposed are destitute of tubercles.

Affinities and differences.—*Brissopsis Duciei* is readily distinguished from the other forms of this genus met with in the Maltese beds, by the full development of its ambulacral areas, their straightness, width and depth. The double crescent formed by the ambulacral areas in *B. crescenticus* is a sufficient character by which it may at a glance be distinguished from *B. Duciei*.

Locality and stratigraphical position.—This species was collected from bed No. 1, the Gozo marble, at Malta, where it is rare; the two specimens before us are the only ones we have seen. We dedicate this fine species to the Earl Ducie, whose valuable collection of Maltese fossils has added to our previous knowledge of the palæontology of the island, and whose geological map of

Malta so well exhibits the distribution of the various beds with their faults and denudation.

Brissopsis crescenticus (Wright, n. sp.). Pl. VI. fig. 2 a-c.

Test oblong, rounded before and truncated behind; flattened on the dorsal surface, and deeply indented by the ambulacral areas; the ambulacrum forms an antecal sulcus; the anterior and posterior ambulacra on each side form two lateral crescents that abut at the longitudinal line; the antero-lateral pair are the longest and widest, they curve forwards and backwards, and the posterior pair curve backwards and forwards; the anterior pair form an angle of 45° , the posterior pair an angle of 65° ; the apical disc lies in a depression formed by the confluence of the apices of all the ambulacra; the posterior border is squarely truncated, with the anal opening in its upper angle; the base is convex, with few tubercles and wide naked spaces formed by the basal portions of the ambulacra; the mouth is situated in the anterior third.

Dimensions.—Antero-posterior diameter $1\frac{6}{10}$ inch, transverse diameter $1\frac{4}{10}$ inch, height $\frac{8}{10}$ ths of an inch.

Description.—The most remarkable feature in this species consists in the mode of arrangement of the ambulacra; the anterior and posterior areas of each side curve in opposite directions and form crescents, the convexities of which are directed towards the middle line of the test, and give value to the name proposed. The antero-lateral pair form an angle of 45° ; they are about the same length as the posterior pair, but are a little broader and are more divergent: there are nineteen pairs of holes in the external zone, and fourteen in the inner; the posterior pair are nearly parallel with each other, and have a slight curve forwards to form the posterior horn of the crescent; they are not so much developed as the anterior pair; the external zone of holes contains fifteen pairs, but the inner zone (2 c) is imperfectly developed, from their close approximation to those of the opposite area: the apical disc is small; the four genital holes are large, the anterior pair being more closely approximated than the posterior pair; it is situated nearer the anterior than the posterior border and lies in a confluent depression, in which the apices of all the areas freely converge. The single ambulacrum is rather longer, but not so wide as the anterior pair; its lateral row of single holes, with their accompanying tubercles, are small and indistinctly seen, and it forms an inconsiderable antecal sulcus: the posterior border is squarely and obliquely truncated, and in its upper part near the dorsal surface is the large anal opening: the base is rather convex; the sternal portion of the single interambu-

lacrum is slightly prominent, and ornamented with a few rows of rather larger tubercles disposed in zigzag lines: the basal tracks of the ambulacral areas are entirely naked, and where they terminate around the mouth five petaloid poriferous radii are observed. The mouth, of moderate size, is in the anterior third; the peripetal fasciole is narrow and indistinct; the subanal fasciole is much broader, and remote from the anus, but the test is unfortunately broken in this region; the tubercles are nearly all of the same size, but a few larger ones occupy the sides, front, and base.

Affinities and differences.—The flatness of the dorsal surface, the deep depressions made by the petaloid portion of the ambulacral areas, and the double crescent formed by them, readily distinguish *B. crescenticus* from its congeners. So few fossil species of this genus have been figured or described, that we can only compare it with the other forms obtained from the same bed, from both of which it differs in many well-marked characters.

Locality and stratigraphical position.—It was collected from bed No. 4, the calcareous sandstone at Malta, where it is rare.

Genus HEMIASTER (Desor, 1847).

Urchins with a high and much inflated test; ambulacral summit nearly central; the petaloid portions of the ambulacral areas situated in depressions more or less deep; the antero-lateral are in general much longer than the postero-lateral pair; the peripetal fasciole only surrounding in an angular manner the ambulacral star. This genus differs from *Micraster* in all the species having a more inflated body with a peripetal fasciole; from *Brissopsis* in having the postero-lateral ambulacra in general much shorter, and the anterior and posterior pairs more unequal in length, and likewise in having no subanal fasciole. A very few species are found in the tertiary, the majority belonging to the cretaceous rocks.

Hemiaster Grateloupi (Sismonda sp.).

SYN. *Schizaster Grateloupi*, E. Sismonda, Echin. Foss. Piem. p. 27. tab. 2.

Hemiaster Grateloupi, Desor, Ann. Sc. Nat. tom. viii. p. 19.

Test orbicular, convex above and below, with tumid inflated sides: the single ambulacrum short, shallow and narrow; the antero-laterals long, deep and diverging; angle of inclination 25° ; the postero-lateral pair slightly curved inwards; angle of inclination 62° ; both pairs lie in deep depressions: the peripetal fasciole broad and undulating; the single interambulacrum forming a dorsal ridge: posterior border abruptly trun-

cated: anal opening high near the upper surface: apical disc small and central.

Dimensions.—Antero-posterior diameter $2\frac{8}{10}$ inches, transverse diameter 3 inches, height $1\frac{8}{10}$ inch.

Description.—The orbicular form and inflated sides of this Urchin, with its large, deep, diverging ambulacra, and greater diameter in the transverse than in the longitudinal direction, impart to it an air which widely distinguishes it from other Hemiasters. The single ambulacrum is narrow and shallow, and forms an inconsiderable anteal sulcus, which measures $1\frac{1}{40}$ inch in length from the apex to the fasciole; it has a single row of lateral holes and accompanying tubercles of small size placed near each other within, and the holes only at considerable distances apart without the fasciole. The antero-lateral ambulacra are rather wider and much deeper than the single area; they are $1\frac{2}{10}$ inch in length, and are directed forwards and outwards, forming an angle of 25° ; the walls of the depression are formed by the poriferous zones, and the base by the intervening smooth space between them: the postero-lateral ambulacra are directed obliquely backwards and gently curved inwards; they are 1 inch long and form an angle of 62° : the peripetal fasciole closely embraces the base of the areas, and maintains a nearly uniform width throughout its course: the test is very much inflated anteriorly and laterally, and its posterior border is abruptly truncated: the single interambulacrum is elevated into a ridge, which rises between the two posterior ambulacra, at the termination of which the anal opening is situated: the test is covered with small, nearly equal-sized tubercles, which are larger on the fore-part, cheeks, and sides than elsewhere: the apical disc is small, and lies in a depression at the centre of the test, the apices of the interambulacra rising into little eminences around it: the base is entirely concealed by the matrix.

Affinities and differences.—This large species differs so much from its congeners in its breadth, in the depth and divergence of the antero-lateral ambulacra, which are likewise slightly curved forwards, in the length and depth of the posterior pair, which equal the single ambulacrum in length, in the breadth and extent of the peripetal fasciole, and the perpendicular truncature of the posterior border, with the general tumidity of its sides, that it is readily distinguished from them.

Locality and stratigraphical position.—It was collected from bed No. 4, the calcareous sandstone at Malta, and is one of the few tertiary Urchins in our cabinet; it is the only specimen of the species we have seen.

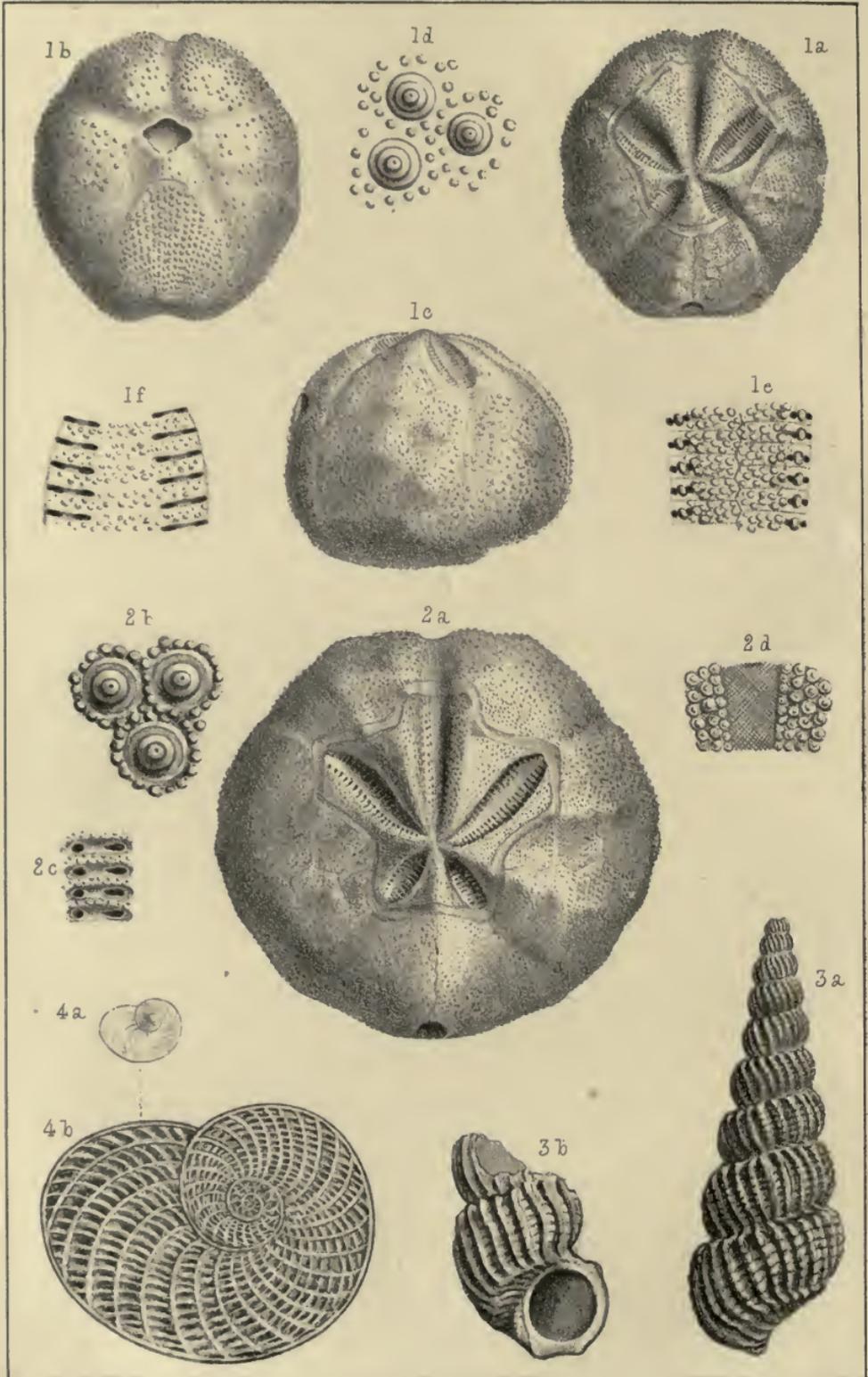
Hemiaster Cotteaui, Wright. Pl. VII. fig. 2 a-d.

Test orbicular, globose, much inflated, declining anteriorly, elevated posteriorly, the interambulacrum forming a prominent carina which terminates in a tail-like process above the anus; posterior border obliquely truncated; ambulacral areas deeply sunk; an antecal ambulacrum forms the sulcus in the anterior border; antero-laterals long, and inclined to 45° ; postero-laterals one-half the length of the anterior pair, inclined to 57° ; apical disc nearly central; peripetal fasciole broad and undulating; anus high under the carinal process; tubercles larger on the sides and base than on the dorsal surface; mouth labiate near the anterior border.

Dimensions.—Antero-posterior diameter $1\frac{1}{2}\frac{9}{10}$ inch, transverse diameter $1\frac{1}{2}\frac{9}{10}$ inch, height $1\frac{1}{2}\frac{1}{10}$ inch.

Description.—This Urchin has a globose form, and is much inflated at the sides; the dorsal surface is convex, and declines much more rapidly from the apical disc to the anterior border, than from the disc to the posterior border. The ambulacral areas (2 a) are all deeply sunk; the single ambulacrum is the longest, and forms a considerable antecal sulcus; the antero-lateral pair have a gentle double curve; they are $\frac{7}{10}$ ths of an inch in length, and form an angle of 45° . The number of pores (2 c) in the avenues is twenty-two pairs in the inner, and twenty-four in the outer zone; the postero-lateral pair are scarcely half the length of the anterior pair; they incline at 57° ; their number of pores is ten and twelve pairs. The peripetal fasciole (2 d) closely embraces the ambulacral star; a naked track proceeds from the base of the antero-laterals to the mouth, indicating the course of the imperforate portion of the ambulacral areas: the rapid declivity of the anterior part of the test strongly contrasts with the inflated condition of the sides and the elevation of the interambulacrum; from the centre of this area a ridge rises which is produced into a tail-like process, and beneath, the posterior border is scooped out, and truncated obliquely downwards and inwards. The anus is situated high up, immediately beneath the caudal prolongation; the base is convex, and a partially naked space on each side of the sternal portion of the interambulacrum, indicates the track of the basal portions of the posterior ambulacra. The tubercles of the upper surface (2 b) are smaller and more closely set together than those on the sides and base, where they are larger, wider apart, and more fully developed. They are perforated and uncrenulated, and surrounded by a circle of small tubercles. *H. Cotteaui* resembles *Spatangus (Hemiaster) acuminatus*, Goldf., but it is more globose, and its posterior half is neither so elevated, nor yet so wedge-





W. H. Barry, del et lith.

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- 1. a-f Hemiaster Scillae, Wright.
- 2. a-d Hemiaster Cotteaui, Wright.
- 3. a-b Scalaria Duciei, Wright.
- 4. a-b Lenticulites complanatus, DeFrance.

shaped as that species; the single ambulacrum is larger and wider, and the antero-lateral pair are more developed in the German than in the Maltese form; they resemble each other in the interambulacrum in both possessing a tail-like terminal process, and in having the posterior border obliquely scooped out; they are both, likewise, Miocene Urchins, *S. acuminatus* being found in that terrain near Cassel and Düsseldorf (Germany), and at Bordeaux and Blaye (France).

Affinities and differences.—The depth and length of the ambulacral areas, with the great declivity of the anterior side of the test, and the post-discal carina, with its caudate-like process, serve to distinguish this species from *H. Scillæ*.

Locality and stratigraphical position.—Collected from bed No. 4, the calcareous sandstone at Malta. We dedicate this species to our friend M. Cotteau, the learned author of 'Études sur les Échinides Fossiles du département de l'Yonne,' who has most generously aided us in our studies, by contributing the types of many of his species to our cabinet for comparative investigations.

Hemiaster Scillæ, Wright, n. sp. Pl. VII. fig. 1 a-f.

SYN. *Spatangus crassissimus*, Desmoulin, Études sur les Échinides, p. 394. no. 30.

Echinus, Scilla, Corp. Mar. pl. 10. fig. 4.

Test globular, higher behind than before; ambulacral areas short; single ambulacrum the longest, forming a deep sulcus on the anterior border; antero-laterals wide, diverging at an angle of 44° ; postero-laterals not half the length of the anteriors, forming an angle of 56° ; both pairs form sulci on the sides of the test: posterior border squarely truncated downwards and outwards: the anus high near the dorsum: base convex: mouth at the anterior third, with a large projecting under lip.

Dimensions.—Antero-posterior diameter $1\frac{9}{20}$ inch, transverse diameter $1\frac{7}{20}$ inch, height $1\frac{4}{20}$ inch.

Description.—Much confusion has arisen as to the identity of this Urchin, occasioned probably by the circumstance of Scilla having figured only the base of the test, and neglected to give either its profile or the dorsal surface. In M. Agassiz's 'Prodromus' it was entered as *Micraster Goldfussii*, but has been omitted from Agassiz and Desor's 'Catalogue raisonné.' M. Desmoulin identifies it with the *Spatangus crassissimus* of DeFrance, but on referring to the original description* of that species, we find that DeFrance's species came from "la craie

* Dict. Sc. Nat. tom. 50. p. 96.

chloritée near Havre," and as no species of Urchin known to us passed from the secondary to the tertiary epoch, we must reject the high authority of this most accurate naturalist, and consider the Urchin before us as distinct from *S. crassissimus*. The test inclines to an oblong form (1 c); it is higher behind than before, and declines more rapidly from the disc to the anterior border than from the disc to the anus. The ambulacral areas lie in deep depressions; the single ambulacrum (1 e) is the longest, and forms an inconsiderable anteal sulcus; the antero-laterals are $\frac{4}{10}$ ths of an inch in length, and form an angle of 44° ; the number of the pores (1 f) in the zones is fifteen and twenty: the postero-laterals are scarcely one-half the length of the antero-laterals; they form an angle of 56° ; the number of pores in them is respectively seven and ten: the peripetal fasciole is broad, but feebly marked, and closely embraces the bases of the areas: four sulci (1 a), nearly destitute of tubercles, mark the course of the ambulacra from the side of the fasciole to the mouth: the lateral interambulacra are rather inflated, and marked by five or six angular elevations (1 c) of the test: the single interambulacrum is elevated on the dorsum (1 a), squarely truncated on the posterior border, and convex beneath: the small oval anus is situated very high up, about $\frac{6}{10}$ ths of an inch from the disc: the sternal portion of the interambulacrum (1 b) is convex and prominent, and is covered with close-set tubercles, arranged in lines, proceeding like radii from a central point of the base: the mouth has a large projecting under-lip. The upper part of the shell is covered with small close-set uncrenulate tubercles (1 d), which are larger and irregularly disposed on the front and base: the apical disc is small and nearly central: there are only two genital holes at the apices of the lateral ambulacra: the five eye-holes are very small. Whether one pair of genital holes may be a generic character of *Hemiaster*, we have not the means at present of determining, as most of our specimens of this group have the disc concealed; but about the beautiful *H. Scillæ* now before us there can be no question.

Affinities and differences.—The absence of the dorsal carina and caudal process serve to distinguish *H. Scillæ* from *H. Cotteauii*; the latter is likewise a more globose and less elegant form of Urchin, and has the truncature of the posterior border downwards and forwards, whereas in *H. Scillæ* the direction is downwards and backwards.

Locality and stratigraphical position.—Collected from No. 4, the calcareous sandstone at Malta, from whence the original specimen figured by Scilla was obtained: this reason will suffice for the name we have given it.

Genus PERICOSMUS (Agassiz, 1847).

In addition to the general characters of *Hemiaster*, these Urchins have an arched arrangement of the peripetal fasciole and a narrow marginal fasciole, which can be traced round the anterior border, extending along the sides, passing beneath the anus, meeting its fellow from the opposite side, and thereby encircling the test. All the species of this small group have been obtained from strata of the Miocene age.

Pericosmus latus, Desor.

SYN. *Micraster latus*, Agassiz, Cat. Syst. p. 2.

Pericosmus latus, Agassiz and Desor, Cat. raisonné, Ann. Sc. Nat. tom. vi. pl. 16. fig. 1, & tom. viii. p. 19.

Test cordate, broad, convex above, flat below; petaloidal ambulacra straight, deep-sunk and narrow; the posterior nearly as long as the anterior pair; apical discs central; peripetal fasciole closely embracing the ambulacra, with three arches across the single ambulacral depression; marginal fasciole narrow, entirely surrounding the upper part of the border of the test.

Dimensions.—Antero-posterior diameter $2\frac{7}{10}$ inches; transverse diameter $2\frac{7}{10}$ inches; height $1\frac{3}{10}$ inch.

Description.—This rare type of one of the extinct genera of *Spatangida* was at first mistaken for a *Micraster* by Agassiz, and entered in his 'Catalogus Systematicus' under the name *Micraster latus*; the peripetal fasciole, however, readily distinguishes it from *Micraster*, and the marginal fasciole from *Hemiaster*. No doubt many mistakes will be committed regarding this Urchin, as these fascioles are exceedingly delicate, and not always preserved: when they are absent, it then greatly resembles a *Micraster*; but when the marginal fasciole is effaced, and the peripetal remains, it then may be mistaken for a *Hemiaster*; fortunately, in one of the specimens before us, the fascioles are both preserved, and their entire course can be traced. The test has a uniformly curved dorsal surface, with a regular cordate form, the base is slightly convex, and the posterior border is truncated. The petaloid portions of the ambulacral areas are straight, and lodged in rather deep depressions, extended obliquely outwards on the middle of the dorsal surface, in the form of a St. Andrew's cross; the single ambulacrum lies in a deep wide depression, and forms a considerable anteal sulcus; at its apical portion only, there are from ten to twelve pairs of ambulacral plates, each perforated in the centre with a single hole; in all the other plates in the area the perforations are obsolete;

the antero-lateral ambulacra, $\frac{1}{2}\frac{5}{8}$ ths of an inch in length, are nearly straight, having only very slight *f*-shaped flexures, which curve forwards and outwards, making an angle of 35° : the two poriferous zones lie close together, in deep narrow depressions; in each zone there are from twenty-four to twenty-six pairs of holes; the space between the pairs of pores is only a little more than that which separates one row of pores from another, so that the pores lie nearly equidistant from each other in the sunken areas; the postero-lateral ambulacra are $\frac{1}{2}\frac{5}{8}$ ths of an inch in length, and are extended backwards and outwards at an angle of 60° ; there are from twenty to twenty-two pairs of holes in each zone, the rows of which, like those on the anterior pair, are nearly equidistant: the peripetal fasciole closely surrounds the posterior ambulacral pair, makes two angles on their sides, and crosses to the anterior pair, where it in like manner forms two angles, then sweeps round the base, and passes in a straight line along the anterior side; from it three branches proceed inwards, which arch over the single ambulacrum, describing angles as they advance to meet the branches from the opposite side; the marginal fasciole is a narrow line, which passes above the fold of the border and entirely encircles the test, dipping into the antea sulcus in its course, but its position in relation to the anus is not clearly shown in either of our specimens. Agassiz figures it as passing under the anus; in his figure the remarkable arches on the anterior part are not drawn: the apical disc is small, and occupies the centre of the test; it has only two genital holes like a *Hemiaster*, and five small ocular holes; the upper surface of the test is covered with small, nearly equal-sized tubercles, those on the anterior side are a little larger; the base is slightly convex, the lateral interambulacra carry large tubercles on their basal plates, and the sternal portion of the interambulacrum is likewise covered with a regular tuberculation; the basal tracks of the posterior ambulacra are smooth between the border and the mouth; the anus is situated high up on the posterior border, and the mouth lies very close to the antea sulcus.

Affinities and differences.—The central position of the apical disc and the depth and straightness of the ambulacra distinguish this form from *P. excentricus*; the generic affinities of this small genus have been already pointed out. The rarity of *Pericosmus*, and the small number of species and individuals at present known, limit our comparisons to the forms we have cited.

Locality and stratigraphical range.—This is one of the few Urchins found in the clay bed No. 2 at Malta: we have before us a specimen from Balistro, Corsica, from the miocene beds of

that island, sent us by M. Michelin of Paris; we consider the peculiar arch-like arrangement of the peripetal fasciole, with the marginal, as good generic characters whereby to form a distinct genus.

Pericosmus excentricus, Wright, n. sp.

Test oblong, highly convex above, slightly so below; apical disc very excentral, near the anterior border; ambulacra in shallow depressions; single ambulacrum slightly grooves the anterior border; antero-laterals nearly transverse; postero-laterals incline at 55° ; peripetal fasciole narrow and undulating; marginal fasciole narrow and low on the border; tubercles on the upper surface small, close-set, and nearly all of the same size; a few larger ones on the anterior interambulacra; anus large and situated high on the border; mouth-opening wide in the anterior third, surrounded by five poriferous petaloid zones; sternal portion of the interambulacrum convex, with close-set imbricated tuberculigerous plates; basal portions of the interambulacral pairs with larger tubercles, wider apart, and more irregular than those of the dorsum.

Dimensions.—Antero-posterior diameter 2 inches, transverse diameter $1\frac{8}{10}$ inch, height 1 inch?

Description.—This Urchin is so much crushed that it is impossible to describe its outline. The ambulacral areas form shallow depressions, and the single area slightly grooves the anterior border: the antero-laterals are nearly transverse, their inclination being forwards; they are $\frac{8}{10}$ ths of an inch in length: the postero-laterals form an angle of 55° ; they are $\frac{5}{10}$ ths of an inch long. The crushed state of the test makes it impossible to count accurately the pores, or give the breadth of the areas; the apical disc, with four genital pores, is very small and remarkably excentral, being very near the anterior border; the peripetal fasciole is narrow, angular and undulating, and instead of surrounding the anterior part of the antero-lateral ambulacra, as in *P. latus*, it descends from them and joins the marginal fasciole below their base, so that the anterior sides of the antero-laterals, and the single ambulacrum, want the peripetal fasciole. The specimen before us is so much crushed, that we cannot trace the band continuously all round the test, so as to describe its course with accuracy; it is possible that this species may form the type of a distribution of the fascioles distinct from any that is yet known. We have stated enough to show, that at least in this form there is a considerable deviation from the normal arrangement. The anus is large and oval, and near the dorsum; the mouth is wide and bilabiate, and situated near the border; the sternal portion of the interambulacrum is slightly convex, and thickly covered

with an imbricated arrangement on the plates, on each of which a perforated tubercle is raised. The basal portions of the inter-ambulacral pairs are covered with wider-set tubercles of the same size, and the entire upper surface of the test is crowded with small tubercles closely set together, and very uniform in size and arrangement. The mouth is surrounded by five petaloid poriferous ambulacra.

Affinities and differences.—The excentric position of the disc, with its four genital holes, and the petaloid poriferous ambulacra around the mouth, establish an affinity between this form and *Brissus*. The way in which the peripetal joins the marginal fasciole is similar to what exists in *Schizaster*, whilst the marginal fasciole, entirely encircling the test and passing round beneath the anus, is found only in *Pericosmus*. The excentral position of the apical disc and the shallowness of the ambulacral star form a sufficient diagnosis between this species and *P. latus*.

Locality and stratigraphical position.—Collected from bed No. 1, the Gozo marble at Malta, where it is rare.

GENUS SCHIZASTER (Agassiz, 1834).

Urchins with a cordiform test, broad and depressed before, narrow and elevated behind; the ambulacral summit excentral and nearer the posterior border; the petaloid ambulacra lodged in very deep depressions, the antero-lateral much longer than the postero-lateral pair; the single ambulacrum long and deeply sunken in the anteal sulcus; the peripetal fasciole surrounds the ambulacral star, and from one of the antero-lateral angles thereof, a second postero-lateral fasciole arises, which passes downwards and backwards along the sides and under the anus, where it joins its fellow of the opposite side; the genital pores are two in number from the fusion of the anterior and posterior pairs; the five ocular plates are small and lodged in depressions; the eye-holes are microscopic. *Schizaster* differs from *Hemiaster* in possessing a postero-lateral fasciole, and in having the antero-lateral ambulacra less divergent and lodged in deeper depressions; the anteal sulcus is also much deeper.

Schizaster eurynotus, Agassiz.

SYN. *Echinus Spatangus compressus et lapidescens in Melitensi topho*, Scilla, Corp. Mar. tab. 7. fig. 1.

Echinus gladius vestitus et nudus Imperati, Klein, Echinod. p. 35. tab. 27 A.

Spatangus lacunosus, Leske, no. 77. p. 227.

Spatangus canaliferus, Lamarck, Anim. sans Vert. 2nd ed. tom. iii. p. 327; Grateloup, Foss. Ours. Dax, p. 67.

Schizaster eurynotus, Sismonda, Mem. Echin. Foss. Nizza, tab. 2. fig. 3. p. 31; Agassiz and Desor, Ann. Sc. Nat. tom. viii. p. 21. série 3.

Spatangus Scillæ, Desmoulins, Etudes sur les Echin. no. 24. p. 392.

Test heart-shaped, depressed and rounded anteriorly, elevated and pointed posteriorly; ambulacral areas deeply excavated; the single ambulacrum long, deep, wider in the middle and narrower at the anterior border, which is deeply grooved by it: antero-laterals slightly *f*-shaped; angle 52° ; length $1\frac{5}{10}$ inch: postero-laterals, angle 72° , short, $\frac{7}{10}$ ths of an inch; apical disc with two genital holes near the posterior third; single interambulacrum elevated into a prominent carina terminating in a caudal hooked process.

Description.—This Urchin resembles *Schizaster canaliferus* now living on the shores of the Mediterranean, and for which it has been mistaken by some naturalists, but an attentive study of the living and fossil species discloses characters by which they may be distinguished from each other. The test in *S. eurynotus* is cordate, depressed before and elevated behind. The ambulacral areas are deeply depressed; the odd or anterior ambulacrum is nearly twice the width of the pairs, it swells out in the middle, is blunted at the apex, and most contracted at the anteal sulcus, which is deep and narrow when contrasted with the width it attains above. The poriferous zones lie at the base of the walls of the sulcus; the very narrow plates that compose the floor of this area are each studded with a row of small granules. The antero-lateral ambulacra diverge at an angle of 52° ; they are slightly *f*-shaped, and are $1\frac{5}{10}$ inch in length: the numbers of holes in the zones are thirty-six and thirty-four. The postero-lateral pair are short, and make an angle of 72° ; they are $\frac{7}{10}$ ths of an inch in length, and have respectively twenty-six and twenty-four holes in their zones. The peripetal fasciole passes close to the base of the posterior pair, dips slightly into the space which separates the anterior from the posterior pair, runs at some distance from the anterior pair, passes close by the base thereof obliquely towards the anteal sulcus, into which it dips, and meets its fellow from the opposite side: the very narrow postero-lateral fasciole is directed obliquely downwards and backwards, and unites with its fellow at some distance below the anus. The test is depressed anteriorly and sloped away at the cheeks, whilst behind it is much elevated. The interambulacrum forms an elevated ridge between the posterior ambulacral pair, and is produced into a caudal-like process behind, beneath which the circular anus is pierced; the sternal portion of the odd interambulacrum is tumid and convex; the

basal portions of the lateral and anterior pairs slope gently towards it; the tracks of the ambulacra are nearly naked as they approach the mouth, and are here perforated with buccal pores. The mouth is at the anterior third, and has a projecting underlip; the tubercles on the upper surface are small and of a uniform size; those on the sternum are larger, and are perforated and set on crenulated summits; they are arranged in lines radiating from a postcal point; the tubercles of the interambulacral pairs are the largest.

Affinities and differences.—This species very much resembles the living *S. canaliferus*, but it may be distinguished from it by the following characters:—*S. eurynotus* is broader and more depressed before, and is not proportionally so high behind as *S. canaliferus*; the antero-lateral ambulacra are more divergent, and the postero-lateral pair are proportionally longer in *S. eurynotus* than in *S. canaliferus*. The single ambulacrum is about the same depth as the pairs, and has the pores in a single file in *S. eurynotus*, whereas in *S. canaliferus* this area is much deeper, and the pores are not in single file, but are crowded together, so that they form three rows in a part of the zone; the tubercles of the base are much larger in the living than in the fossil species. *S. eurynotus* is distinguished from *S. Parkinsoni* by its *f*-shaped ambulacra being less divergent, and the position of the apical disc, which is much nearer the posterior border in *S. eurynotus*; the anterior ambulacrum is likewise much wider and deeper in that Urchin than in *S. Parkinsoni*: the great development of the single interambulacrum, and breadth of the posterior border in *S. Desori* sufficiently mark that species as widely distinct from *S. eurynotus*.

Locality and position.—Collected in bed No. 4, the calcareous sandstone at Malta; we have it also from Santa Manza, Corsica, sent us by M. Michelin; it has likewise been found in the Ter. moyen de Perpignan, Cagliari.

Schizaster Desori, Wright, n. sp. Pl. VI. fig. 3 *a-c*.

Test cordate, broad and much depressed before, narrow and much elevated behind; ambulacral areas long, straight, and very divergent; peripetal fasciole forms an acute angle on the anterior interambulacra; apical disc situated at the posterior third of the dorsum; angle of the antero-lateral ambulacra 44° ; angle of the postero-lateral pair 60° ; posterior border truncated obliquely downwards and inwards; sternal portion of the interambulacrum tumid and prominent at the base, amounting almost to a deformity.

Dimensions.—Antero-posterior diameter $2\frac{8}{10}$ inches, transverse diameter $2\frac{7}{10}$ inches, height at the deepest part $1\frac{8}{10}$ inch.

Description.—This remarkable Urchin wants the symmetrical proportions of the other Schizasters met with in the same rocks ; it is rounded and broad before, and tapers into a narrow wedge-shape process behind ; the dorsal surface inclines forwards at an angle of 17° ; the ambulacral areas are long. The single anterior area compared with *S. eurynotus* is narrow, and of a uniform width ; it is $1\frac{5}{10}$ inch in length from the apical disc to the fasciole ; there are twenty-four pairs of pores in the avenues, the external being much larger than the internal row, although this is properly speaking a generic character. The antero-lateral ambulacra diverge nearly straight outwards at an angle of 44° ; they form deep depressions in the test $1\frac{3}{10}$ inch in length, and the zones contain thirty pairs of holes in each : the postero-laterals are slightly petaloid, and gently flexed outwards ; they are $\frac{1}{2}\frac{5}{10}$ ths of an inch in length, and diverge at an angle of 60° . The zones contain about twenty pairs of holes ; the test being nearly as broad as it is long across the termination of the antero-lateral ambulacra ; the anterior border is gently rounded, and has a rather deep anteal sulcus for the ambulacrum ; from the same point to the posterior extremity it tapers suddenly, which gives a wedge-shaped appearance to the test when viewed from above. The most remarkable feature in this Urchin is the curious form which the single interambulacrum assumes, owing to the great development of this area ; the dorsal surface forms an inclined plane having an inclination of 17° ; the anterior part is therefore very much depressed, and the posterior part much elevated. The single interambulacrum forms a prominent beak-like process, beneath which the posterior border is broad, and inclined downwards and forwards ; the sternal portion of this area is prominent and convex, towards which the basal parts of the lateral interambulacra slope suddenly forwards and inwards. The anus is pyriform, and placed high up underneath the beak-like process. The mouth is situated near the anterior border ; it has a large under-lip, but is crushed in the small specimen, and covered up in all the others before us. The small apical disc lies concealed at the posterior third of the dorsum by the prominent apices of the lateral interambulacra. The peripetal fasciole takes a zigzag course along the outer borders of the ambulacra, and from the base of the antero-laterals it passes nearly at right angles across the anterior interambulacra to the external side of the single ambulacrum, where it makes another angle, then passes down the side thereof $\frac{5}{10}$ ths of an inch, dips into the sulcus and unites with the opposite fasciole. The lateral fasciole commences at the angle near the base of the antero-lateral ambulacra, and passes downwards and backwards nearly in a straight line over the angle of the posterior border at some distance from

the anus, and meets the one from the opposite side, at the middle line near the base; in the triangle thus formed, the caudal process and anus occupy the base, and a depression lies beneath which is filled with tubercles somewhat larger than those on the dorsum, but smaller than those on the base; the tubercles are perforated and raised on prominent crenulated bosses (fig. 3 c); the sternal and basal portions of the test, as well as the anterior border, being furnished with much larger tubercles.

Affinities and differences.—The straightness of the pairs of ambulacra, and the narrowness of the single anterior ambulacrum, are alone sufficient to distinguish *S. Desori* from *S. eurynotus* when viewed only from above, but when we add to these the remarkable oblique truncation of the posterior border (fig. 3 b), the great tumidity of the sternum, and the sloping character of the sides of the base, we discover how widely different these two forms are from each other. The same group of characters serves to distinguish it from *S. Parkinsoni*, but in this species the apical disc is much nearer the centre of the test; the antero-lateral ambulacra are arched outwards, and the postero-laterals are proportionately longer.

Locality and stratigraphical position.—Collected from the calcareous sandstone bed No. 4, at Malta; the large specimen belongs to the Bristol Institution, the others form part of Earl Ducie's collection. We dedicate this species to M. Desor of Neufchâtel, one of the learned authors of the 'Catalogue raisonné des Echinides.'

Schizaster Parkinsoni, DeFrance sp. Pl. V. fig. 3 a-c.

SYN. *Spatangus Parkinsoni*, DeFrance, Dict. Sc. Nat. tom. 50. p. 96; Desmoulin, Etudes sur les Echinides, p. 394. no. 29.

Spatangus lacunosus, Parkinson, Organic Remains, vol. iii. tab. 3. fig. 12.

Schizaster Parkinsoni, Agassiz and Desor, Cat. raisonné, Ann. Sc. Nat. tom. viii. p. 22.

Test cordate, depressed anteriorly, elevated posteriorly; apical disc nearly central; sides expanded and tumid; cheeks sloping and contracted; single ambulacrum rather wider than the anterior pair, of the same diameter throughout, except near the apex; antero-lateral ambulacra diverge at an angle of 35° ; length 1 inch; postero-lateral make an angle of 65° ; length $\frac{6}{10}$ ths of an inch; posterior part of the back raised into a long prominent carina; posterior border obliquely truncated; base convex; mouth near the anterior border; anteal sulcus narrow and of moderate depth.

Dimensions. — *Adult.* Antero-posterior diameter $2\frac{1}{2}\frac{3}{0}$ inches, transverse diameter $2\frac{1}{2}\frac{1}{0}$ inches, height $1\frac{1}{2}\frac{3}{0}$ inch.

Junior. Antero-posterior diameter 2 inches, transverse diameter $1\frac{9}{10}$ inch, height $1\frac{3}{10}$ inch.

Description.—We have identified this Urchin with that figured by Parkinson in his ‘Organic Remains,’ not however without much hesitation, inasmuch as that figure is without details, and is moreover drawn from a distorted specimen. We have in vain endeavoured to find out the original, and have therefore, from the central position of the apical disc and the great divergence of the ambulacra, and from its being at the same time the most common of all the Maltese Schizasters, and the one most likely to have been sent to Parkinson, adopted DeFrance’s identification. The test is heart-shaped, its widest part being at a line drawn across the disc; from this imaginary line the back slopes obliquely forwards, and the border is rather bevelled away at the cheeks; from the same line backwards there rises a prominent ridge which bends over into a short tail-like process. The ambulacral areas (3 *a*) are deeply sunken, the single ambulacrum has a tapering lanceolate form, and the antecal sulcus is deep and narrow; the poriferous zones lie in the angle of the depression; they consist of twenty-five pairs of holes, of which the outer series is the largest; the length of the petaloidal portion of this area from the apex to the fasciole is $1\frac{1}{20}$ inch. The antero-lateral ambulacra (3 *a*) are more divergent in this species than in the other Schizasters met with in the same rocks; they are $1\frac{1}{20}$ inch in length and are slightly curved outwards and backwards; they make an angle of 35° ; the number of pores (3 *c*) in the zones is respectively thirty-six and thirty-four, the apical eight pairs being almost microscopic: the postero-lateral pair are $\frac{6}{10}$ ths of an inch in length and slightly *f*-shaped; they are directed backwards at an angle of 65° , and are proportionately narrower than the anterior pair; there are twenty-two pairs of holes in each of the zones, the upper six pairs of which are microscopic. The peripetal fasciole (3 *b*) is distinctly defined and passes close to the bases of the petaloid portions of the ambulacra, but at a short distance from the sides thereof it describes a curve inwards in passing over the anterior interambulacra, and dips obliquely into the antecal sulcus where it unites with that of the opposite side. The lateral fasciole is large and very distinct; it takes a backward and downward course towards the base of the posterior border, and joins its fellow at some distance below the anus; the two fascioles form the letter V in their *trajet* on the test. The apical disc is situated very near the centre of the back, removed a little nearer to the posterior than the anterior border; it is perforated with four equal-sized genital holes. The anus is oblong, situated high up in the obliquely truncated posterior border, in which is a triangular depression limited on

the sides by the fasciole, and above by the anal opening and caudal process; the base is convex; the sternum is not very prominent, and has lines of tubercles proceeding in radii from a point near the border; the basal portions of the posterior ambulacra are naked, and around the mouth buccal pores are seen, which extend at considerable intervals along the *trajet* of the posterior pair. The mouth is situated in the anterior fourth of the base and has a projecting under-lip; the basal parts of the interambulacra glide into the general convexity of the floor of the test; the lateral pair have a regular tuberculation, but on the anterior pair the tubercles are larger and more irregular.

Affinities and differences.—The nearly central position of the apical disc and the greater divergence of the antero-lateral ambulacra distinguish this Urchin from its congeners; the narrowness of the odd ambulacrum and the absence of the swelling-out in the centre of the same, serve to separate it from *S. eurynotus*; the blunt caudal process, the small posterior border, and the general tumidity of the sides distinguish it from *S. Desori*.

Locality and stratigraphical position.—Collected from bed No. 4, the calcareous sandstone at Malta, where it is common; it is found likewise in the Molasse, middle tertiaries, of Martigues, Bouches-du-Rhone. Fine specimens are contained in the British Museum, Jermyn Street Museum, and that of the Bristol Institution.

Since the preceding sheets of this memoir have been passing through the press, we have had the opportunity of examining the Maltese fossils belonging to the Geological Society, and some that had escaped our notice in the British Museum collection; from these new materials the following notes are now added:—

Clypeaster Reidii, Wright, n. sp.

Test large, broadly pentagonal, and much elevated; border abrupt, margin thin and undulated, rising with steep sides at angles of 60° , and with a very little curve towards the vertex, which is nearly central; petaloidal portions of the ambulacral areas large, nearly equal in width, and extending over nearly three-fourths of the sides; base quite flat; mouth small, pentagonal, nearly central; basal ambulacral sulci proceeding from the angles of the mouth, narrow, and sharply defined; anus round, near the posterior margin; tubercles on the upper surface small and closely set together, those on the base a little larger; apical disc nearly central and prominent, with an outer circle of genital holes, and an inner circle of eye-holes having the madreporiform tubercle in the centre.

Dimensions.—Antero-posterior diameter $5\frac{6}{10}$ inches, transverse diameter $5\frac{2}{10}$ inches, height $2\frac{8}{10}$ inches.

Description.—This large *Clypeaster* has been mistaken for one of the varieties of *C. altus*, but a careful study of its test discloses characters by which it is readily distinguished from that common form. The circumference is nearly pentagonal; it is rounded before, undulated on the sides, and nearly straight behind; the sides of the pentagon are of unequal length, those forming the front of the test are the shortest, those of the middle are somewhat longer, and the posterior single side is the longest. There is scarcely any margin to the test in this species, as the sides rise abruptly from the border to the apex, making angles of 60° with the base, and being only slightly curved inwards; the dorsum is therefore very small in proportion to the diameter of the base. The petaloidal portions of the ambulacral areas extend over nearly three-fourths of the sides; they form long elegantly-shaped petals, narrower in proportion to their length than those of *C. altus*, and consequently allowing of a greater development of the interambulacral areas than in that species; the petaloidal ambulacral areas are nearly all of the same length, width and structure; the centre of each petal is arched and costated, and forms a considerable relief on the surface of the test. The poriferous zones lie in slight depressions on their sides; each zone contains sixty-two pairs of pores set widely apart; in the inner row the holes are round, in the outer row they are oblong, and both are united by straight oblique sulci; the external surface of the partition-wall between each pair is covered with a row of small tubercles. The bases of the ambulacra are open, but not so widely as in some other congeneric forms. The interambulacral areas are nearly flat, of moderate width, and very uniform in their structure. The apical disc occupies the centre of the dorsal surface; it consists of two circles of holes; the outer is formed of five small genital holes, the plates of which are not distinguishable, and the inner of five small perforated ocular plates, which are distinctly visible at the apices of the ambulacra. The madreporiform tubercle occupies the centre, and forms a button-like prominence there; the border is thin and undulated, and this portion of the test presents a striking difference to the obtuse marginal fold seen in *C. altus*. The base is quite flat; the pentagonal mouth is small and nearly central; the oral lobes are curved inwards at an acute angle, and the five ambulacral sulci are sharply defined as they radiate from the sides of the pentagon to the border. The anus is round, and is situated near the posterior border: the tubercles on the upper surface are small and closely set together; those on the base are a little larger.

Affinities and differences.—*Clypeaster Reidii* very much resembles *C. umbrella* both as to height, width, and the smallness of its tubercles; it is distinguished from that species by the following characters: *C. Reidii* is more elongated; the petaloidal ambulacra are longer and narrower; the interambulacra are flattened and slightly curved; the base is quite flat, and the oral lobes are curved acutely inwards. In *C. umbrella* the interambulacra are arched and costated, the base is concave, and the oral lobes slope obliquely inwards. Compared with *C. altus*, the differences are found to be still greater: in *C. Reidii* the test is broader in proportion to its length; the petaloid ambulacra are narrower; the poriferous zones are not so open at the base. The apical disc is convex and prominent in *C. Reidii*, and depressed in *C. altus*. In *C. Reidii* the border is thin and sharp, and the base is flat. In *C. altus* the border is thick and rounded, and the base is concave. In *C. Reidii* the mouth is small, and the oral lobes curve acutely inwards; whilst in *C. altus* the large mouth lies at the bottom of a concave depression formed by the gradual inward sloping of the interambulacra. The distinctions between our species and that of *C. scutellatus* and *C. marginatus* are so well defined, that it is unnecessary to make a comparison with them.

Locality and stratigraphical position.—This species is apparently from bed No. 1, the Gozo marble, but this we cannot with certainty state. Fine specimens are in the Jermyn Street Museum, and in the collection of the Geological Society of London. We dedicate this species to his Excellency Sir William Reid, Governor of Malta, whose laudable efforts to form a public collection of Maltese fossils have greatly contributed to our knowledge of the palæontology of the island.

Genus PYGORHYNCHUS, Agassiz, 1839.

In the dismemberment of the genus *Nucleolites* of Lamarck, M. Agassiz has not been so fortunate as in other groups of *Echinida*: the characters on which, for example, *Catopygus* and *Pygorhynchus* are distinguished from *Nucleolites* are not satisfactory, as they undergo important modifications in the different species grouped together in each of these new genera. If we take a type specimen of each genus only and compare them together, we admit the distinctions pointed out; but when we examine several species of each of these genera, we observe the characters gradually blending into the primary type form: as representatives *in time*, the grouping is valuable, but the zoological characters in our judgment are too indefinite to found genera thereon. With these remarks we refer provisionally the

small Nucleolite before us to the section *Pygorhynchus*, which is thus characterized by Agassiz:—"Form elongated; ambulacra distinctly petaloid, often costated as in *Echinolampas*. Mouth central or subcentral, pentagonal, surrounded with five large lobes, and a distinct rosette of buccal pores. Anus posterior, nearer the superior than the inferior border." All the species of the genus *Pygorhynchus* belong to the nummulitic and tertiary rocks; those of the genus *Catopygus*, with one exception, are cretaceous forms.

Pygorhynchus Vassalli, Wright, n. sp.

Test oblong, wider behind than before; interambulacrum produced into a caudal elongation; petaloid portions of the ambulacral areas narrow and short; sides tumid; anus small, round, nearer the inferior border than the dorsum, with a projecting beak-like process arching over its upper border, and an oblique truncature of the lower part of the border below; base slightly concave; mouth pentagonal, nearly central; oral lobes small; rays of the poriferous star around the margin short.

Dimensions.—Antero-posterior diameter $1\frac{3}{20}$ inch, transverse diameter $\frac{7}{10}$ ths of an inch, height nearly $\frac{6}{10}$ ths of an inch. Most of the specimens average only from one-half to two-thirds of these dimensions. The large specimen before us is the most perfect we have examined.

Description.—This small Urechin has an oblong form; it is rounded before, a little enlarged towards the junction of the middle with the posterior third, which is produced into a caudal process. The sides are tumid, and the upper surface is flattened; the petaloid portions of the ambulacral areas are narrow and short, and form only a star on the dorsum; the single and postero-lateral areas are nearly alike in width and length; the antero-lateral pair are rather wider and shorter, they are $\frac{7}{20}$ ths of an inch in length, and are slightly curved forwards and outwards; their poriferous zones contain eighteen pairs of pores, arranged in narrow rows, and not united by any apparent slit. The postero-lateral areas are $\frac{8}{20}$ ths of an inch in length, and their zones contain twenty pairs of pores; these areas are directed much backwards, which makes the width of the lateral interambulacra proportionally greater. The apical disc is nearly central, but nearer the anterior border; it has four large genital pores, and five well-marked eye-holes. The single ambulacrum is almost identical in length and width with the posterior pair; the apices of all the ambulacra are rather rounded than lanceolate. The lateral interambulacra we have said are very wide, but the single

interambulacrum is narrow, and forms a conspicuous prolongation or beak-like process, which arches over the upper border of the round anal opening, situated rather below the middle of the posterior border, in an oblique truncature of the test: this beak-like process is not seen in the small specimens before us; it would therefore appear to be a character of the adult condition only. The base is slightly concave towards the mouth, which is situated nearer the anterior border; it has a pentagonal form, with five small oral lobes covered with tubercles; between them, the terminations of the ambulacra form five short poriferous petals. The tubercles on the upper surface are small and irregularly disposed on the plates; those on the base are a little larger, especially in the vicinity of the mouth.

Affinities and differences.—This species resembles *Catopygus fenestratus* from the upper chalk of Ciply, Belgium, but is distinguished from it by having the sides more tumid and the upper surface flatter; the posterior border is likewise more produced; it distinctly differs from it however in having the base slightly concave, and the oral lobes less developed. It differs from *Nucleolites (Pygorhynchus) subcarinatus*, Goldf., from the middle tertiaries of Bünde, in having more tumid sides, a less concave base, and a different form of the anal opening. From the very brief notice of *Catopygus conformis*, Desor, from the tertiaries of Orglande, it is impossible to form any idea how far it may resemble that form, as it is neither figured nor described, but merely entered in the 'Catalogue raisonné' with this remark: "Mais l'anus est un peu plus bas, et la face supérieure plus surbaissée."

Locality and stratigraphical position.—Collected from bed No. 1, Malta, where it is extremely rare. Specimens are in the collection of the Geological Society, the Jermyn Street Museum, and the cabinet of Earl Ducie. We dedicate this species to Dr. Vassallo of Malta, under whose judicious care and continued research the public collection of Maltese fossils has been greatly enriched.

Spatangus Desmarestii, Goldf.

SYN. *Spatangus Desmarestii*, Goldf. Petref. p. 153. tab. 47. fig. 4 a-c;
Agassiz and Desor, Cat. raisonné, Ann. Sc. Nat. tom. viii. p. 7.

Test cordate, arched and carinated; anteal sulcus broad; petaloid portion of the antero-lateral ambulacra long, narrow, and curved outwards and a little backwards, angle of inclination 18° ; postero-laterals long and narrow, angle 60° ; only a few moderate-sized tubercles on the interambulacral plates between all the ambulacral areas; border slightly obtuse; posterior part truncated; anal opening transversely oblong; base plano-

convex; tubercles moderate in size; mouth transversely oblong, situated at the junction of the anterior with the middle third; tubercles on the upper surface very small.

Dimensions.—A German type specimen. Antero-posterior diameter $2\frac{7}{10}$ inches, transverse diameter $2\frac{6}{10}$ inches, height $1\frac{6}{10}$ inch.

A Maltese specimen. Antero-posterior diameter $1\frac{8}{10}$ inch, transverse diameter $1\frac{7}{10}$ inch, height $\frac{1}{2}\frac{7}{10}$ ths of an inch.

Description.—This Urchin is well known from the admirable figure in Goldfuss. Its upper surface is more convex and inflated than in the other congeneric species; it is higher behind than before, and has a blunt ridge which passes backwards from the disc to the border. The antero-lateral petaloidal ambulacra, $\frac{1}{2}\frac{9}{10}$ ths of an inch in length, curve a little outwards, forming an angle of 18° ; their zones contain from twenty-two to twenty-four pairs of pores, separated by rather thick partitions of the test. The postero-lateral areas are narrower than the anterior pair, and rather more than an inch in length; their zones contain from twenty-eight to thirty pairs of holes, and they form angles of 60° . The interambulacral areas are wide and largely developed in this species; the upper plates in these areas, lying between the ambulacra, support only very small perforated tubercles, arranged in groups of threes and fours, and disposed on all the areas; this character serves to distinguish *S. Desmarestii* from all its congeners at present known: the small tubercles on the dorsal surface are very small, and closely set together. The single ambulacrum is lodged in a broad shallow valley, which forms however a considerable antecal sulcus; the pores in this area are so much covered up with matrix in our specimen, that we are unable to count their number. The posterior border is truncated, and the large transversely oval anal opening occupies the upper part of this region. The shelly matrix entirely conceals the course of the subanal fasciole. The sternal portion of the interambulacrum is slightly convex, and covered with small tubercles that radiate in lines in all directions from a central point; the basal portions of the anterior and lateral interambulacra are covered with larger tubercles, and the naked intermediate spaces indicate the *trajet* of the basal portions of the postero-lateral ambulacra from the border to the mouth. The mouth is situated at the junction of the anterior with the middle third; it is much elongated transversely, and has five poriferous petals surrounding it. The apical disc is small and nearly central; it has four genital holes and five small eye-holes.

Affinities and differences.—The inflation of the test, the small-

ness of the large tubercles on the upper surface, and their presence on the interambulacrum, serve to distinguish this species from its congeners.

Locality and stratigraphical position.—Found with *S. Hofmanni* in bed No. 4, the calcareous sandstone at Malta, where it is rare. The Maltese specimens we have seen are small, and do not exceed the dimensions given; they are contained in the collections of the British Museum and the Geological Society. In Germany it is found in the middle tertiaries at “Duberge bei Bünde, and at Astrupp bei Osnabrück.” The admirable figure given by Goldfuss of this species is all that can be desired.

Genus EUPATAGUS, Agassiz, 1847.

Spatangoid Urchins, with a cordate or elliptical form, more or less depressed; the petaloid portions of the antero- and posterolateral ambulacral areas are wide; the single area is lodged in a shallow anteal sulcus, and the entire ambulacral star is closely surrounded by a broad well-defined peripetal fasciole, which undulates round its margin; within this fasciolar space, the interambulacral plates carry very large perforated tubercles raised on crenulated bosses, and surrounded by wide smooth areolas, like those in the genus *Spatangus*. The heart-shaped shield, beneath the anal opening, is likewise surrounded by a well-defined subanal fasciole. The basal portions of the posterolateral ambulacra form broad, naked bands, between the posterior border and the mouth. The other characters resemble those of *Spatangus*, from which it differs however in possessing a *peripetal fasciole*.

Eupatagus De Koninckii, Wright, n. sp.

SYN. *Spatangus De Koninckii*, Wright, Ann. of Nat. Hist. vol. xv. p. 178.

The test of the original specimen of *Eupatagus De Koninckii* having had the external layer of its shell and consequently its fascioles denuded, we are now enabled to correct our determination of this species from a specimen in the collection of the British Museum, in which these important parts of the anatomy of the skeleton are well preserved. For the description of this Urchin see our article *Spatangus De Koninckii*, to which we subjoin the following note:—The peripetal fasciole is rather broad, surrounding with little undulation the ambulacral star, and forming a well-defined boundary between that portion of the upper surface with large perforated tubercles, and that part with very small tubercles; the subanal fasciole heart-shaped, rather broad, and enclosing a shield-like space filled with larger

tubereles; it extends from the prominent point of the base to near the lower part of the anal opening.

Scalaria Duciei, Wright, n. sp. Pl. VII. fig. 4 a, b.

Diagnosis.—Shell turriculated, imperforate; spire gently tapering; whorls ten, with transverse prominent plates and longitudinal elevations. The transverse plates, nineteen in number on the body-whorl, are formed of numerous thin shelly laminae, closely united where they proceed from the whorl, but outwardly they expand and form a rather irregular undulated surface; each plate describes three curves; two of these, the anterior and posterior, are short, and the central one is long, forming an arch over the whorl; the posterior, at their junction with the central curve, form angles, from whence blunt spiny processes proceed; these form a conspicuous ridge on the posterior upper part of the whorls; the junction of the anterior with the central curves forms a carina on the body-whorl, which commences at the posterior border of the aperture, and terminates at the anterior part thereof, at a distance from the umbilical ridge. The longitudinal elevations form a kind of cellular structure; between the plates they are seven or eight in number, and on them and the intervening surface of the shell, delicate longitudinal lines are sculptured. The aperture is entire, and is round or inclining to an oblong.

Dimensions.—Length $2\frac{2}{10}$ inches, diameter of the body-whorl $\frac{1}{2}\frac{5}{10}$ ths of an inch.

Collected from the calcareous sandstone No. 4, at Malta.

Lenticulites complanatus, DeFrance. Pl. VII. fig. 4 a, b.

Genus LENTICULITES, Lamarek. (Subkingdom *Radiata*. Class *Foraminifera*. Order *Hélicostègues*, D'Orb. Family *Nautiloidæ*.)—Shell nautiloid, equilateral, spire rolled on the same plane, compressed, sublenticular, multilocular; whorls apparent, opening narrow, triangular, prominent, against the penultimate turn of the spire.

Diagnosis.—Shell oblong, lenticular, much compressed; septa convex, with longitudinal partitions, growth lines very apparent. Long diameter $\frac{4}{10}$ ths of an inch.

This beautiful Foraminiferous shell occurs in great abundance in No. 2, the yellow sand with blackish grains; in fact it forms large masses of rock in this bed. As it is constantly associated with the Echinoderms, we have added a drawing thereof. DeFrance noticed, but did not figure this fossil; he collected it at "Anvers près de Pontoise, à Dax, à Loignan près de Bordeaux,

à Boutonnet près de Montpellier, et en Italie dans les couches, qui paroissent appartenir au calcaire coquillier grossier*.”

EXPLANATION OF PLATES IV. V. VI. AND VII.

PLATE IV.

- Fig. 1. Cidaris Melitensis*: *a*, the upper surface; *b*, side view of the ambulacral and interambulacral areas, natural size; *c*, an interambulacral plate, and a portion of an ambulacral area with the poriferous zones, magnified.
- Fig. 2. Echinus Duciei*: *a*, upper surface; *b*, side view, natural size; *c*, the form of the mouth-opening, showing the disposition of the marginal notches; *d*, the five jaws and teeth “*in situ*,” imbedded in a mass of rock; *e*, the apical disc, showing the arrangement of the genital and ocular plates; *f*, two interambulacral plates, and a portion of a poriferous zone, magnified.
- Fig. 3. Echinolampas Deshayesii*: *a*, the upper surface; *b*, the under surface, natural size; *c*, a portion of the test, showing the tubercles, magnified; *d*, a portion of an ambulacral area, and poriferous zones, magnified.

PLATE V.

- Fig. 1. Brissus latus*: *a*, the dorsal surface, reduced one-third in size; *b*, the apical disc, magnified; *c*, the perforated tubercles, with their crenulated bosses and encircling granules, magnified.
- Fig. 2. Brissus oblongus*: *a*, the upper surface, showing the petaloid ambulacral star and peripetal fasciole; *b*, the under surface, showing the subanal fasciole, natural size; mouth, and the *trajet* of the naked basal portions of the ambulacra; *c*, the tubercles, and their circles of granules, magnified.
- Fig. 3. Schizaster Parkinsoni*: *a*, the upper surface, showing the petaloid ambulacral star, the peripetal and lateral fascioles, the natural size; *b*, a portion of the peripetal fasciole, with the boundary granules, magnified; *c*, a portion of the poriferous zones, magnified.

PLATE VI.

- Fig. 1. Brissopsis Duciei*: *a*, the upper surface, showing the petaloidal ambulacral star, surrounded by the peripetal fasciole, reduced one-third; *b*, six plates with small poriferous tubercles from the anteal sulcus; *c*, form of the pores, and arrangement of the tubercles in the poriferous zones; *d*, the larger perforated tubercles, and their crenulated bosses with their circlets of granules; *e*, a portion of the peripetal fasciole, showing how distinctly it is defined from the rest of the surface by rows of granules.
- Fig. 2. Brissopsis crescenticus*: *a*, the upper surface; *b*, the under surface, natural size; *c*, the arrangement of the pores, near the apical portion of one of the zones.
- Fig. 3. Schizaster Desori*: *a*, the upper surface; *b*, the under surface, natural size; *c*, the perforated tubercles, with their circlets of granules and crenulated bosses, magnified.

* Diet. Sc. Nat. tome xxv. p. 453.

PLATE VII.

- Fig. 1. Hemiaster Scillæ*: *a*, the upper surface, showing the ambulacral star and peripetal fasciole, natural size; *b*, the under surface of the same test; *c*, a lateral view, to show the great height of this species; *d*, the perforated tubercles and encircling granules, magnified; *e*, a portion of the single ambulacrum, showing the arrangement of the pores; *f*, a portion of a poriferous zone.
- Fig. 2. Hemiaster Cotteauii*: *a*, the upper surface, natural size; *b*, the perforated tubercles, with their circles of granules; *c*, portion of a poriferous zone; *d*, portion of the peripetal fasciole, with its boundary granules.
- Fig. 3. Scalaria Duciei*: *a*, shell, the natural size; *b*, a fragment showing the mouth.
- Fig. 4. Lenticulites complanatus*: *a*, natural size of this Foraminiferous shell; *b*, a section magnified, showing the cells:—large rocky masses of this fossil occur in the yellow sand associated with the Urchins of that deposit.

On Perna quadrata, Sow. By JOHN LYCETT, Esq.

READ 30TH JANUARY 1855.

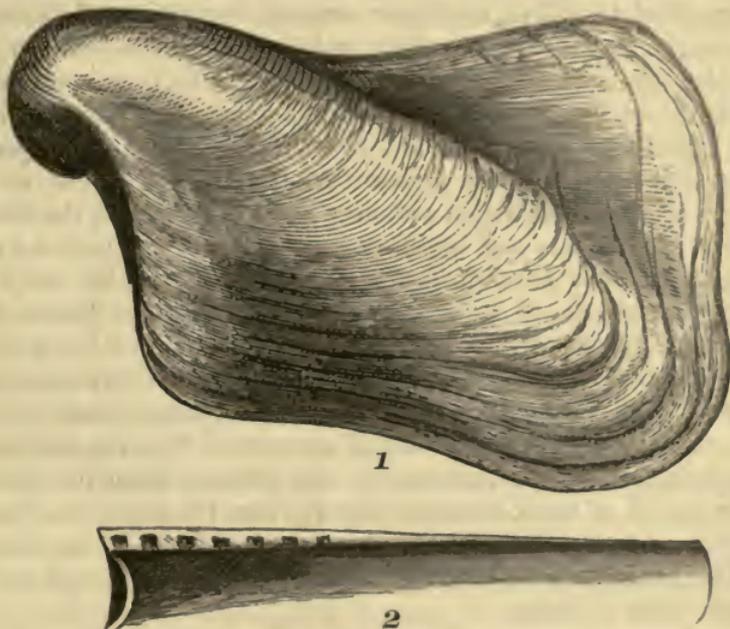
THE present notice of a fossil shell, which has already been figured and described, requires some explanation.

The *Perna quadrata* of the 'Mineral Conchology,' t. 490. f. 2, represents a very inequivalve *Perna*; but as the specimen figured appears to have been somewhat imperfect, and as it was placed by the artist in an unfortunate position and is seen only from a single point of view, it affords a very insufficient aid to a description which is substantially correct as far as it refers to the only specimen which appears to have been at the disposal of the author. With such an illustration it will not afford surprise to find that Phillips in his Geology of Yorkshire, t. 9. f. 24, represented a second and very different shell under the name of *Perna quadrata*; and as the latter work contains no descriptions of species, Goldfuss was in turn also misled to figure a third *Perna* distinct from both the others under the same name (*Petrefacta*, t. 108); upon the same plate however is *Perna rugosa*, which is identical with the *quadrata* of Phillips; the latter is an equivalve, squamous, thick shell, well known to collectors of British Inferior Oolite fossils. There is another inducement to acquire a correct knowledge of the original *Perna quadrata*, inasmuch as the species is a very remarkable one, constituting a departure from the typical forms of the *Pernæ*, and approaching to others of the kindred genus *Inoceramus*. The diagnosis of this shell in the 'Mineral Conchology' is as follows:—"Quadrilateral, one side shorter than the other three; valves gibbose, unequal, the shorter side very concave, bounded by two obtuse carinæ."

The figure in the 'Mineral Conchology' has the right or flattened valve facing the spectator; the contour of the larger or convex valve therefore is not seen: the shell is not placed upright upon the page, the lower border forming the right-hand side of the figure: even the outline is not perfect, as there seems to be a portion of the lower border wanting, and thus forming an angle at its anterior extremity, which would be rounded were that part entire.

The typical *Pernæ* are equivalve or subequivalve; their fibrous tests are squamous externally, and acquire great thickness with

advance of growth; the valves are so much flattened, that their attenuated apical extremities have not more thickness or convexity than the corresponding parts of the *Pinnae* and *Mytili*; the hinge-plate is always broad, the greater length of the valve being always perpendicular to, or in the opposite direction to the line of the hinge-plate. *Perna quadrata*, on the contrary, is very inequivalve, and with advance of growth it becomes almost gryphoidal; the umbo of the larger valve is very prominent, straight and incurved; the anterior side of the valve is steep, with a large excavation, byssal aperture and corrugated border; the posterior side is much compressed, and extended into a kind of imperfect wing; the hinge-plate is narrow, its border is much lengthened, so that the greater length of the valve is in



Perna quadrata, Sow.

1. Exterior of the convex valve. 2. Hinge-plate of the flattened valve.
(Reduced one-fourth.)

that direction, and the shell is transverse; the narrow hinge-plate renders the ligamental grooves very short, their diameter laterally being equal to their length, as is often seen in the genus *Gervillia*; they diminish rapidly, so that the posterior half of the hinge-line is destitute of hinge-plate and grooves. The byssal aperture is formed by the larger valve only. In both valves the test is very thin, excepting at the prominent umbo and anterior side of the larger valve; the surface, unlike that of the typical *Pernæ*, is smooth; the right valve has little convexity, and its umbo little prominence; its anterior border is thickened as in the other valve.

In the *Pernæ*, as in the *Inocerami*, much variability exists in

specimens of the same species, the result not only of different stages of growth, but also of individual peculiarities. All the specimens of *Perna quadrata* differ more or less from each other and from the figure in the 'Mineral Conchology,' so that the identity of these specimens with Sowerby's shell has not been ascertained without the examination of a considerable number of examples. The contrast which *Perna quadrata* presents to the typical *Pernæ* is therefore very great; its general aspect is in fact that of an *Inoceramus*, more especially of the subinvolute forms of the latter genus, from which it is distinguished only by the anterior excavation and aperture; but as this feature is one only of subordinate value when viewed singly, there would seem to need the addition of some other distinctive features ere we are enabled to affirm the clear generic separation of *Perna* and *Inoceramus*. The oblong flattened figure of the smaller valve and the thinness of the test might cause it to be mistaken for a *Crenatula* when the hinge-plate is not exposed. *Perna quadrata* may therefore be regarded as the type of a group of inequivalve transverse shells, whose relation to the typical *Pernæ* may be compared with that which certain aberrant species of the kindred genera *Inoceramus* and *Gervillia* bear to their respective typical groups. Of the Jurassic forms may be instanced the large *Gervillia Hartmanni* and *G. tortuosa*, compared with the flattened sub-equivalve species of the same genus; in these and other instances the inequality of the valves becomes more marked with advance of growth. The very perfect preservation of the hinge-plate, together with the condition of the tests of associated bivalves, forbids the supposition that the thinness of the test has been produced by the removal of thick nacreous layers from the inner surface.

Dimensions.—Length of our largest specimen in the direction of the hinge-line $5\frac{1}{4}$ inches, height $3\frac{3}{4}$ inches, convexity of the larger valve 2 inches.

Geological position and localities.—The specimen figured in the 'Mineral Conchology' is from the Cornbrash of Bulwick; our own specimens are from the freestone portion of the Inferior Oolite near Nailsworth, from a quarry in Woodchester Park, worked for the purposes of the Roman Catholic Monastery; specimens have also been obtained in the freestone quarries of Scar Hill in the parish of Minchinhampton, thus affording an additional instance of that general resemblance between the Testacea of the Cornbrash and the Inferior Oolite, which has been noticed by Prof. Buckman in a paper on the Cornbrash of Cirencester, and which forms a part of the Proceedings of the Cotteswold Naturalists' Club. The exact position of *Perna quadrata* in the freestone is the two uppermost beds of that rock, immediately underlying the Oolite marl, or in its absence, the cream-coloured hard argillaceous limestone with *Nerinaeas* which replaces it in the valley of Nailsworth.

On a New Genus of Fossil Cidaridæ, with a Synopsis of the Species included therein. By THOMAS WRIGHT, M.D., F.R.S.E.

NOTWITHSTANDING the many new generic sections introduced into the classification of Echinoderms, by MM. Agassiz and Desor, and the important light thrown by these savans on our knowledge of the numerous species of this class contained in European collections, still the progress of discovery renders it imperative on palæontologists to modify from time to time many of the opinions put forward by these authors in their 'Catalogue raisonné.' When the amount of real work done by them is taken into account, in a field which was then comparatively unknown, the wonder is, not that mistakes or oversights should have been committed, but that so much good work under the circumstances should have been attained, which will bear the most severe criticism, and remain as it was left, a monument of the genius and industry of the authors.

In our memoirs on the Cidaridæ of the Oolites, we have figured and described three species, *Goniopygus perforatus*, *Pedina Etheridgii* and *Pedina Bakeri*; the true generic position of these forms seemed to us uncertain at the time our papers were passing through the press, as they exhibited characters which did not assimilate with either of the generic divisions of the 'Catalogue raisonné.' Our materials did not then justify us in proposing a separate genus for their reception; the discovery, however, of an interesting series of new congeneric forms has now enabled us to rectify our determination, and propose the genus *Hemipedina* for the group, to which we have added a synopsis of the species included therein.

HEMIPEDINA, Wright, 1855.

This new genus is composed of small, neat, and highly ornamented Urchins, much depressed on their upper surface, and with a flat or slightly concave base. The ambulacral areas are narrow and straight; the pores in the poriferous zones are arranged in single pairs; the interambulacral areas are in general more than double the width of the ambulacral, with two, four, or six rows of tubercles in general arranged abreast on the same tubercular plate. The tubercles are perforated, and set on mammillary eminences with smooth uncrenulated summits; one row of tubercles in general only extends from the peristome to the disc; the other rows, when there are four and six rows in the

area, stop short at the equator, or between the equator and the disc; the intertubercular space on the upper surface of the test is therefore in general wide, and covered with a small miliary granulation. The apical disc is large; the genital and ocular plates are expanded and foliated. The mouth-opening is of moderate dimensions, and the peristome is divided into ten nearly equal-sized lobes. The spines are long, slender, and needle-shaped; those that are known, equal at least the diameter of the test, and their surface is sculptured with delicate longitudinal lines.

Hemipedina is related to *Diadema* in having the pores arranged in the zones in single pairs and the tubercles perforated; but it is distinguished from *Diadema* by the absence of crenulations on the summits of the mammillary eminences. It is related to *Pedina* in possessing perforated and uncrenulated tubercles; but it is distinguished from that genus in having the pores in the zones in single pairs (*Pedina* having the pores in triple oblique pairs like *Echinus*), in having the elements of the apical disc more largely developed, and in the species being nearly all small and depressed forms. *Hemipedina* is related to *Echinopsis* in possessing uncrenulated and perforated tubercles, with the pores in pairs; but it is distinguished from the latter by the narrowness of the ambulacral areas, the depressed form of the test (*Echinopsis* being high and inflated), the form of the mouth-opening, and the deep decagonal lobes of the peristome (that of *Echinopsis* being almost deprived of these incisions), together with the greater size and development of the elements of the apical disc.

Hemipedina, as far as we at present know, is composed of Jurassic species, which commence in the lower Lias and extend into the Coral Rag, each stage possessing its own specific forms. The following synopsis of the British species now before us will be figured and described in detail in our Monograph on the British Oolitic Cidaridæ.

A. Species from the Lias.

Hemipedina Bechei, Wright.

Cidaris Bechei, Broderip, Geol. Proc. ii. 202.

Diadema Bechei, Agassiz, Morris's Catalogue of British Fossils, 1st ed. p. 51.

Test small, much crushed, and covered over with spines; ambulacra with two rows of tubercles; interambulacra with four or six rows of tubercles; spines long, slender and needle-shaped, $\frac{9}{10}$ ths of an inch in length, with longitudinal lines on

the surface. This appears to be identical with the type-specimen in the Museum of the Geological Society.

Locality.—Lower Lias, Lyme Regis.

Coll. J. S. Bowerbank, Esq.

Hemipedina Bowerbankii, Wright, nov. sp.

Test crushed, $1\frac{1}{2}$ th of an inch in diameter; ambulacral areas narrow, with two rows of marginal tubercles rather smaller than those in the interambulacra, a tubercle on every alternate plate; interambulacral areas wide, with six rows of tubercles abreast, surrounded by a delicate scrobicular circle; spines shorter and thicker ($\frac{1}{2}$ ths of an inch in length) than those of *H. Bechei*, although the test is much larger, deeply sculptured with longitudinal lines.

Locality.—Lower Lias, Lyme Regis.

Coll. J. S. Bowerbank, Esq.

Hemipedina Jardinii, Wright, nov. sp.

Test small, much depressed; ambulacral areas wide, with two rows of marginal tubercles which extend from the peristome to the disc; interambulacral areas with two rows of tubercles set near the poriferous zones, from eleven to twelve tubercles in each row, a delicate scrobicular circle of granules around each, and a naked intertubercular space in the centre; mouth-opening small, situated in a depression; peristome decagonal; base finely radiated in consequence of the size and regularity of the interambulacral tubercles.

* *Locality*.—Marlstone near Ilminster, Somersetshire, and Bredon Hill, Gloucestershire.

Coll. of the late H. Strickland, Esq., and Dr. Wright.

Hemipedina Etheridgii, Wright.

Pedina Etheridgii, Wright, Annals of Nat. Hist. S. 2. vol. xiii. p. 315. pl. 1. fig. 5 a-d.

Test small, circular, depressed; ambulacral areas narrow, with six small perforate tubercles below, and a double row of marginal granules above; interambulacral areas with two rows of tubercles, seven in each row; apical disc large and petaloidal; mouth-opening small; peristome decagonal; lobes nearly equal.

Locality.—Upper Lias, Ilminster.

Coll. Dr. Wright.

B. *Species from the Inferior Oolite.**Hemipedina Bakeri*, Wright.

Pedina Bakeri, Wright, Annals of Nat. Hist. S. 2. vol. xiii. p. 312.
pl. 1. fig. 4 a-c.

Test circular, depressed; ambulacral areas very narrow, with two rows of small tubercles set so far apart that they form a zig-zag row; interambulacral areas with two rows of rather large prominent tubercles, five in a row; apical disc with a prominent anal rim; mouth-opening large; peristome deeply decagonal.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.

Coll. Dr. Wright: a single specimen.

Hemipedina perforata, Wright.

Goniopygus? perforatus, Wright, Annals of Nat. Hist. S. 2. vol. viii.
p. 267. pl. 6. fig. 5 a-b.

Test small, circular and depressed; ambulacral areas with two rows of small tubercles which extend from the peristome to the disc; interambulacral areas with two rows of tubercles, seven to eight in each row, three or four secondary tubercles between the primary rows at the base; surface of the plates covered with numerous coarse miliary granules; mouth-opening large; peristome rather deeply decagonal; lobes nearly equal in size; apical disc large and foliated.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.

Coll. Dr. Wright.

Hemipedina tetragramma, Wright, nov. sp.

Test circular, $\frac{9}{10}$ ths of an inch in diameter; ambulacral areas narrow, with two marginal rows of small nearly equal-sized tubercles extending from the peristome to the disc; interambulacral areas with two rows of primary tubercles, about fourteen in each row, and two rows of secondary tubercles, ten in each row, extending from the peristome to nearly the upper surface; mouth-opening small, situated in a depression; peristome decagonal, unequally lobed.

Locality.—Pea-grit, Crickley Hill.

Coll. Dr. Wright.

Hemipedina Waterhousei, Wright, nov. sp.

Test small, pentagonal, rather inflated at the sides; ambulacral areas with two rows of small tubercles extending from the peristome to the disc; interambulacral areas with two rows of

tubercles, eight in a row; scrobicular circles neatly defined; mouth-opening small; apical disc narrow and prominent.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.

Coll. Dr. Wright.

Hemipedina Bonei, Wright, nov. sp.

Test small, pentagonal, depressed; ambulacral areas with two marginal rows of close-set tubercles; interambulacral areas with one entire row and four short rows of tubercles, which extend only as far as the equator; tubercles of both areas about the same size; base flat; mouth moderate in dimensions; peristome unequally decagonal; apical disc absent.

Locality.—Pea-grit, Crickley Hill.

Coll. Dr. Wright.

C. *Species from the Great Oolite and Cornbrash.*

Hemipedina Davidsoni, nov. sp.

Test much depressed, 1 inch in diameter; ambulacral areas with two rows of marginal tubercles very regular in their arrangement throughout; interambulacral areas wide, with two rows of primary tubercles, fourteen in a row, and two rows of secondary tubercles which extend beyond the equator, between the former, and two rows of smaller tubercles between the main rows and the poriferous zones, so that at the equator there are six rows of tubercles abreast, whilst on the upper surface there are only two rows; mouth-opening small, in a concave depression; peristome decagonal and nearly equally lobed; apical disc absent.

Locality.—The sandy beds of the Great Oolite, Minchinhampton.

Coll. Dr. Wright: only one specimen known.

Hemipedina Woodwardii, Wright, nov. sp.

Test circular, much depressed; ambulacral areas narrow, with two rows of small tubercles below and extending as far as the equator, diminishing to granules on the upper part of the areas; interambulacral areas with two rows of rather large primary tubercles, eight in a row, and two rows of secondary tubercles, three to four in each row, which scarcely reach the equator, the upper part of the intertubercular space being filled with a small, abundant miliary granulation; apical disc

large, anal rim prominent ; mouth-opening small ; peristome decagonal, nearly equal-lobed.

Locality.—Cornbrash, Wiltshire.

Coll. British Museum, from Dr. Smith's collection ; Dr. Wright.

Hemipedina tuberculosa, Wright, nov. sp.

Test elevated, subconoidal ?, the precise form unknown ; ambulacral areas with two rows of basal semitubercles raised on very prominent bosses diminishing rapidly in size into coarse granules above ; interambulacral areas with two rows of large tubercles set on very prominent bosses, with scrobicular circles of coarse granules surrounding the areolas ; two rows of small secondary tubercles close to the poriferous zones from the peristome to the equator, and three or four at the base of the intertubercular space ; upper surface enveloped in the matrix ; apical aperture large.

Locality.—Coral Rag, Wiltshire.

Coll. British Museum.

Foreign Species of the genus Hemipedina.

Hemipedina seriale, Wright.

Diadema seriale, Agassiz ; Leymerie, Mém. de la Société Géologique de France, tome ii. p. 330. pl. 24. fig. 1, 1839 ; Agassiz and Desor's Cat. raisonné des Echinides, 3 sér. tome vi. p. 348.

Test hemispherical, subglobose above, flat below ; ambulacral areas with two rows of tubercles nearly as large as those of the interambulacra ; interambulacral areas with six rows of tubercles abreast at the equator, diminishing to four and two rows above ; a few secondary tubercles unequally distributed ; mouth-opening small ; peristome slightly decagonal.

Locality.—Inferior Lias, France.

Coll. M. Michelin.

Hemipedina Woodwardii, Wright.

This species occurs in the Cornbrash of the Marquise, near Boulogne-sur-Mer. In one of the specimens before us the spines are preserved ; the primary spines are not very long, scarcely the length of the diameter of the test ; the secondary spines are short and needle-shaped ; the surface of both kinds is covered with fine longitudinal lines.

Locality.—The Cornbrash near Boulogne-sur-Mer.

Coll. British Museum.

Hemipedina Nattheimense, Wright.

Echinopsis Nattheimense, Quenstedt, Handbuch der Petrefactenkunde, p. 582. pl. 49. fig. 37.

Locality.—White Jura, Nattheim.

Coll. British Museum. At this moment the specimen is not at our disposal. We shall give a diagnosis of this species in our Monograph.

Hemipedina Sæmanni, Wright, nov. sp.

Test small, hemispherical; ambulacra with two rows of tubercles; interambulacral areas with one row of primary and two rows of secondary tubercles, the primary tubercles alternating with the secondary tubercles, not placed abreast as in most of the species; tubercles of both areas nearly the same size.

Locality.—Coral Rag, Commercy, Meuse.

Coll. Dr. Wright: sent by M. Louis Sæmann of Paris.

On some new Species of Hemipedina from the Oolites.

By THOMAS WRIGHT, M.D., F.R.S.E.

SINCE the publication of our paper in the August Number of the 'Annals and Magazine of Natural History,' on the new genus *Hemipedina* and the Synopsis of the species included therein, our friend S. P. Woodward, Esq., has kindly sent us three new English forms of this group, one found in the calcareous grit of Berkshire, and two in the Kimmeridge clay of Bucks; our friend Thomas Davidson, Esq., has likewise communicated a figure of one found by M. Bouchard Chantercaux some years ago in the Kimmeridge clay of Boulogne-sur-Mer; we lose no time therefore in recording these additions to the Oolitic fauna, at the same time returning our hearty thanks to the kind friends who have so liberally communicated the specimens.

A. Species from the Calcareous Grit.

Hemipedina Marchamensis, Wright, nov. sp.

Test large, and depressed; ambulacral areas narrow, with two rows of marginal tubercles, nearly as large as those of the interambulacra, extending regularly and without interruption from the peristome to the apical disc, and separated by a zig-zag line of small granules down the centre, the areas retaining a nearly uniform width throughout; poriferous zones form a slightly waved line, from every three pairs of pores being set slightly oblique to the line of the zones; interambulacral areas four times the width of the ambulacral, with eight rows of tubercles at the equator, each tubercular plate supporting four nearly equal-sized tubercles abreast; bosses prominent; areolas surrounded with incomplete circlets of small granules; mouth-opening less than one-third the diameter of the test; peristome unequally decagonal; five jaws, *in situ*, each jaw having two broad flat central ridges, and two oblique marginal ridges with two intervening depressions; teeth long, and obliquely truncated at the points.

Dimensions.—Transverse diameter $2\frac{9}{10}$ inches; height $1\frac{5}{10}$ inch?

Locality.—The calcareous grit of Marcham, Berks.

Coll. The Hon. R. Marsham.

B. *Species from the Kimmeridge Clay.*

Hemipedina Morrisii, Wright, nov. sp.

Form and size unknown; test small; ambulacral areas with two rows of regular prominent marginal tubercles gradually diminishing in size from the base to the apex of the areas, and separated by a zigzag line of small granules down the centre; poriferous zones slightly waved; pores large, the pairs separated by thin septa; interambulacral areas more than three times the width of the ambulacral, with six rows of tubercles at the equator, each plate supporting three nearly equal-sized tubercles abreast; bosses prominent; areolas surrounded by incomplete circlets of small granules.

Spines referred to this species long, round, slender, and sculptured with delicate longitudinal lines; articulating cavity small, with a smooth rim; head thick, with a thin prominent finely milled ring; body long, much more slender than the head.

Locality.—Kimmeridge clay, Hartwell, Bucks.

Coll. Professor Morris.

Hemipedina Cunningtonii, Wright, nov. sp.

Form unknown, upwards of an inch in diameter; ambulacral areas with two marginal rows of very small tubercles rather irregular in their mode of arrangement; poriferous zones nearly straight; interambulacral areas three times the width of the ambulacral, with two rows of tubercles situated on the zonal half of the tubercular plates, leaving thereby a wide intertubercular space which is filled with 8 to 10 rows of small granules; the bosses large and prominent, and the tubercles of a proportionate size; areolas surrounded by a complete circlet of small granules the same size as those filling the middle of the areas.

Locality.—Kimmeridge clay near Aylesbury. Collected by Professor Morris.

Coll. British Museum.

Foreign Species from the Kimmeridge Clay.

Hemipedina Bouchardii, Wright, nov. sp.

Test large, depressed; ambulacral areas with two rows of regular marginal tubercles extending without interruption from the peristome to the apical disc, and separated by a median zigzag line of small granules; poriferous zones straight; interambulacral areas three times the width of the ambulacral, with

ten rows of tubercles at the equator, each tubercular plate having five tubercles abreast; areolas surrounded by circlets of small granules; spines slender, sculptured with longitudinal lines.

Dimensions.—Transverse diameter $2\frac{4}{10}$ inches?

Locality.—Kimmeridge clay, Boulogne-sur-Mer. Collected by M. Bouchard Chantereaux.

Coll. M. Bouchard Chantereaux at Boulogne.

In the present state of our knowledge it would be premature to suggest subdivisions, but it is clear that we have two distinct types in the genus *Hemipedina*: 1st, those with two rows of large tubercles, and a wide intertubercular granulated space in the middle of the interambulacral areas; and 2nd, those with four, six, eight or ten rows of nearly equal-sized tubercles in these areas at the equator.

Note on the Subgenus Limea, Bronn.

By JOHN LYCETT, Esq.

READ 28TH AUGUST 1855.

THE present note is intended to direct attention to a peculiarity connected with the external surface of *Limea*, trivial in its zoological importance, but which is calculated from its persistency to be a useful aid to the palæontologist in the absence of hinge characters.

The subgenus *Limea* has hitherto been distinguished from *Lima* solely by the presence of a series of parallel teeth upon each side of the hinge-plate, a feature which cannot be ascertained in the majority of specimens; and the only British species of *Limea* hitherto described has so little in its general aspect to separate it from the young condition of *Lima duplicata* (a shell which is associated with it in the same beds), that any clear external distinction which can be ascertained between them is worthy of notice, more especially when it will also be found to characterize *Limea* as a subgenus.

It is in the auricles that the distinctive feature resides, and it is immediately connected with the hinge-plate beneath: it will be found that the radiating lines which usually ornament the surfaces of the auricles in the *Pectens* and *Limæ* also exist in *Limea*, but that in the latter they abruptly disappear towards the outer angle of each auricle, leaving a small triangular smooth area, which is traversed transversely downwards and inwards by a few elevations; these are placed immediately over and correspond to the grooves which separate the teeth upon the hinge-plate. In all well-preserved specimens this kind of surface is visible upon one or both of the auricles, its distinctness depending upon the condition of the specimen with reference to fossilization and the greater or less prominence of the internal features.

Limea duplicata is abundant in the shelly oolite of Leckhampton Hill; there is also another more ornamented but undescribed species higher in the same formation, and found at many localities in the upper Ragstones of the Cotteswold Inferior Oolite. The peculiarity of the auricles is observable equally in both these species.

Remarks on the Inferior Oolite and Lias in parts of Northamptonshire, compared with the same Formations in Gloucestershire.
By the Rev. P. B. BRODIE, M.A., F.G.S.

HAVING, at a late meeting of the Cotteswold Naturalists' Club, given a *vivá voce* account of the Inferior Oolite and Lias in a part of Northamptonshire; at the request of the Secretary, I have prepared a more detailed description for our 'Proceedings.' It is well known that certain beds in the Inferior Oolite in the neighbourhood of Northampton have been extensively worked for the ironstone which largely prevails in it thereabouts, though I believe it is not now so generally used for æconomical purposes as it was formerly. This was certainly the case with those quarries which I examined near Blisworth. They are not worked to any great depth, and occupy the higher ground in the district; the strata consist of sandy ferruginous oolitic stone containing a few imperfect casts of shells, though the greater part of the mass is unfossiliferous: the top beds are coarse, and contain impressions of shells; the lower ones are more compact, and are composed chiefly of ironstone. The Inferior Oolite here appears to be of no great thickness, and differs materially from that of the Cotteswolds. The hills which are occupied by it near Blisworth are comparatively low, and form a striking contrast to those in Gloucestershire partly composed of the same formation. The fossils I obtained were a large *Cardium*, a *Trigonia*, a *Pecten*, *Terebratulæ*, and a few Univalves. Fossils are much more abundant at Northampton, though only occurring there in the form of casts.

Upper Lias.—From the position of the Inferior Oolite, the Upper Lias was to be looked for at a low level at the base of these hills, and I accordingly found it in a brick-pit in the valley at Bugbrook between Weedon and Blisworth, below the level of the Railway at no great distance from the Kilsby tunnel. Beds of Lias clay and shale are used for brick-making with the usual Upper Lias fossils, among which *Ammonites serpentinus* and *Belemnites* were very prevalent. The clay is traversed by a thin, continuous layer of limestone, which, as I anticipated, turned out to be the 'fish bed,' identical lithologically with the same band in Gloucestershire, and full of innumerable fragments of fish (though I could discover none entire) and coprolites, with some specimens of *Inoceramus dubius* and traces of *Sepia*.

This 'fish bed' has been noticed by Mr. Morris in parts of Lincolnshire and Northamptonshire on the Great Northern Railway, and it is very probable that it will be detected in other places where the Upper Lias occurs *in situ*, since it is rarely wanting, in its course through Somersetshire and Gloucestershire, at the lower part of this deposit. In fact, this 'fish and insect bed' seems as persistent in the Upper Lias as the 'Insect limestone' is in the lower.

The section at Bugbrook is as follows in descending order:—

	ft. in.
1. Rubbly white limestone in detached bits, in dark blue shale, with numerous fragments of <i>Ammonites</i>	} 4 0
2. Thin-bedded limestone ('fish bed'); white externally, inside has a green tinge with white specks; it has a laminated fracture, and splits readily when weathered; it does not occur in nodules, but in a regular thin band in the clay	} 0 3
3. Thin, coarse, dark-coloured slaty stone, very rough, covered with spines, teeth and plates of Echinoderms, resting on the marlstone.	

The thickness of the Upper Lias visible at this spot did not exceed a few feet; it is succeeded by the Marlstone with the usual fossils. I could not determine the total thickness of the Upper Lias, as there was no section exposed, but there must be a considerable mass of clay between the Inferior Oolite and the small section at Bugbrook, though probably not half so thick as the Upper Lias in Gloucestershire, which, according to Mr. Hull of the Geological Survey, amounts at least to 200 feet in many parts of the Cotteswolds.

These strata, as well as those of the Inferior Oolite, are perfectly horizontal. When the Railway was in progress, the top beds of the Lower Lias just below the Marlstone were exposed at Kilsby, and were as usual very rich in fossils, similar for the most part to those found in the equivalent strata at Campden, and Hewlett's Hill near Cheltenham.

The summit of Edge Hill in Warwickshire is capped by the Marlstone, the Upper Lias having been denuded; but small boulders of the 'fish bed,' containing scales of fish and '*Inoceramus dubius*,' are of frequent occurrence in the vale below, showing that it formerly occupied its normal position above the Marlstone in that district.

At Alderton, in Gloucestershire, the following strata were exposed below the 'fish bed' in April 1856, which seemed to be richer in fossils than usual, and therefore I have noted them here, which will enable the reader to compare them with those at Bugbrook above mentioned.

Brown and dark shales with many *Ammonites*, *Inoceramus*

dubius, *Rostellaria* (abundant), *Cidaris**, *Nucula*, *Avicula*, and *Aptychus*. These are succeeded by two or three blue marly bands divided by shale, which contain a univalve like a *Cerithium*, *Avicula*, *Nucula*, *Pholadomya*, *Pecten*, *Astarte*, and *Ammonites*. A light blue, slightly indurated marl reposes immediately upon the Marlstone. The total thickness of these clays and marls forming the base of the Upper Lias is about 30 feet.

* A similar small species of *Cidaris* (*C. minuta*) occurs abundantly with spines attached in the Upper Lias shale at Gretton near Winchcomb, where a fine specimen of a *Lepidotus* was lately discovered in the 'fish bed,' and is now in the collection of my friend Dr. Wright.

Notes on the Genus *Quenstedtia*. By JOHN LYCETT, Esq.

READ 16TH SEPTEMBER 1856.

THIS genus of Lamellibranchiate Conchifera, described in the Great Oolite Monograph of the Palæontographical Society, was founded upon two shells figured in Prof. Phillips's 'Geology of Yorkshire,' under the names of *Pullastra oblita* and *Psammobia lævigata*, the former of them being chosen as the type of the genus.

Of *Pullastra oblita*, I have succeeded in clearing and exposing the hinge of each of the valves in many instances, and am perfectly conversant with its characters, which will be found correctly described in the Monograph alluded to. The siphonal, pallial and muscular scars were ascertained in a cast from the Yorkshire Dogger, and upon the characters supplied by these satisfactory materials the genus was founded. Specimens with the test preserved, and which admit of the hinge characters being exposed, are obtained in the upper portion of the Inferior Oolite of the Cotteswolds; a single young example of the species only having been afforded by the Great Oolite of Minchinhampton. In the Great Oolite Monograph it was stated to be allied to *Psammobia*, but distinguished from it by the dental characters of the hinge, and by the absence of an elevated nymphal plate to sustain the ligament. The general resemblance which the aspect of this shell presents to the *Mactromya mactroides* of Agassiz had not been overlooked, but as the figures of *Mactromya mactroides*, in the 'Etudes critiques' of that author, consist for the most part only of casts, which afford no information respecting the hinge, it was considered inadvisable to allude to the probable identity, as it was certain that *Quenstedtia* possessed no affinity either with *Mactra* or with the family of the *Myada*, and the shells of Phillips had priority as species. This supposed identity of *Quenstedtia oblita* with the *Mactromya mactroides* of Agassiz, has recently been fully confirmed in the publication by M. Terquem of an elaborate work, with plates, entitled, 'Observations sur les Etudes critiques des Mollusques fossiles, comprenant la Monographie des Myaires de M. Agassiz.' In this work the author has figured and described the *Mactromya mac-*

troides; the figures representing the shell and cast of the interior under different aspects: upon the same plate (No. 5) are placed figures of the recent *Psammobia vespertina* for comparison; the conclusion drawn by the author from this comparison is that *Mactromya mactroides* is a *Psammobia*. It will be observed that in these figures, the author has altogether omitted one of the most essential points of comparison necessary to establish a generic identity, the hinges not being exhibited; he has, however, given casts of the interiors of the valves in both the shells, including the siphonal, pallial and muscular scars, but these afford no information respecting the hinge. The author arranges *Mactromya mactroides* with *M. tenuis*, *M. brevis* and *M. litterata*, all of which group he believes to be *Psammobia*; he also states that the group has a small cardinal tooth in each valve, which he regards as an abnormal variation from the dentition of *Psammobia vespertina*, which has two teeth in each valve. As the author does not state expressly that he has cleared and exposed the hinge in each valve of *Mactromya mactroides*, and as he is careful to record similar facts relating to other genera, I am led to infer that his knowledge of the hinge in the shell in question has been derived either from the partial exposure exhibited by the valves when in contact, or from other imperfect evidence. However this may be, it is certain that the hinge is altogether unlike that of *Psammobia*: to avoid the trouble of reference, I subjoin the hinge characters of the fossil shell:—

QUENSTEDTIA. *Hinge in the left valve consisting of one obtuse, oblong and transverse tooth, slightly compressed from above, situated beneath the umbo and received into a corresponding oblong pit in the hinge-plate of the opposite valve.*

There is therefore no tooth in the right valve and consequently no pit in the left valve. This kind of hinge, which so nearly resembles that of the fossil genus *Myoconcha*, is altogether distinct from that of *Psammobia*, with its two grooved, diverging hinge-teeth in each valve.

The ligament is received into a narrow, lengthened and deep area posterior to the umbones;—the shell is therefore destitute of the elevated nymphal plate of Psammobia.

The siphonal flexure, as may be observed in the figure given by M. Terquem, is less considerable than in *Psammobia*, and, unlike that genus, it is united posteriorly to the pallial line *only at its extremity*, so that with the pallial line it forms a narrow tongue, the upper and lower borders of which are limited by the gradual convergence of the two lines: in *Psammobia* the siphonal and pallial lines are united in a position nearly vertical beneath the umbo, and proceed posteriorly united into a single line. The

aggregate of these characters, it must be admitted, fully justifies the separation of *Quenstedtia* from *Psammobia*; and it yet remains to be demonstrated that true *Psammobia* are found in any rocks older than the Tertiary system, none of the so-called Jurassic *Psammobia* having hitherto exhibited the characters of that genus free from ambiguity.

Remarks on the Lias of Barrow in Leicestershire, compared with the lower part of that Formation in Gloucestershire, Worcestershire, and Warwickshire. By the Rev. P. B. BRODIE, M.A., F.G.S., Vice-President of the Warwickshire Naturalists' Field Club.

READ 27TH JANUARY 1857.

DURING a late visit to the well-known Lias quarries at Barrow-on-Soar, I was able to compare the various sections there exposed with those in the equivalent beds in Warwickshire, Worcestershire, and Gloucestershire; and, although I could detect no remains of Insects, nor even a trace of them*, the position of the strata, and their lithological characters, are identical with the true *Insect limestones* in the counties above mentioned.

As Mr. Jukes has already described the lower Lias at Barrow and the neighbourhood in 'Potter's Charnwood Forest,' it will be needless for me to repeat those sections; but it will be necessary to give one not referred to by him, taken from an upper quarry of Mr. Lee's, in order to identify the beds,—where we have, in descending order,

	ft.	in.
1. Alluvial drift, sand and red clay, with rolled boulders of Lias	8	0
2. Blue shale.....	3	0
3. { Hard blue limestone (<i>Rummels</i>), with young <i>Plagiostoma gigantea</i> , <i>Lima rudis</i> , and numerous Ammonites, similar to the <i>Plagiostoma-bed</i> in Gloucestershire.....	0	9
4. Thick blue shale	4	0
5. Blue limestone (representative of <i>Insect-bed</i>)	0	6
6. Black shale	1	2
7. Limestone (representative of <i>Insect-bed</i>)	0	6
8. Black shale	1	0
9. { Blue nodular and crystalline limestone (<i>top hurls</i>)—a very peculiar band, resembling a bed near to the ' <i>firestone</i> ' of Warwickshire, as at Grafton in that county.....	0	6
10. Shale.		
Bottom of quarry.	19	5

As Mr. Jukes truly observes, the strata vary considerably even in adjacent quarries—certain beds thin out and others come

* Although, in the short examination I was able to give the Barrow limestones, I could discover no Insect remains, nor could hear of any ever having been found, it is possible that a closer research would detect them.

in; thus, in Mr. Ellis's large pit on the other side of Barrow, there is at least 30 feet of shale above the 'rummels,' No. 3 in section, and there are more courses of limestone, especially those which appear to represent the *Insect limestone*. It is worthy of note, that while the *Rummels* No. 3 is evidently the equivalent of the *Plagiostoma-bed* in Gloucestershire and elsewhere, it is succeeded at once by the beds of *Lias*, which in Gloucestershire, Worcestershire, and in some portions of Warwickshire, occur much lower in the series, the intervening strata being entirely wanting in that part of Leicestershire. Most of the quarries do not exceed 30 feet in depth, but some have been opened to a depth of 42 feet, the lowest stratum being a bed of blue marly clay. The limestones are used in Leicestershire for the same economical purposes as the Warwickshire 'paving-stones,' and are equally adapted for this object; but they do not seem to be employed for making hydraulic lime, as they are in the quarries belonging to my friends Messrs. Greaves and Kershaw at Wilmcote, near Stratford-on-Avon.

In places there are several small faults, and in one pit the lower strata were thrown up so as to form a complete saddle, of limited extent, at right angles to Mount Sorrel, not far off,—showing on a small scale what the effect of such a dislocation would be on a large one.

Except in No. 3 of section, shells are scarce; below this, I observed only a few *Ammonites planorbis* and *Aptychus*, and a long shell (*Meleagrina*?) common in the shale at Bockeridge Common, near Tewkesbury in Gloucestershire, and there associated with numerous and beautiful specimens of the same Ammonite.

The fine Saurians and Fish for which this district has been long famous occur more or less in all the shales and limestones, though some courses are richer than others; and for the last two years very few have been met with. In Mr. Lee's extensive collection, the genus *Dapedium* was by far the most abundant, many of which were quite perfect; and among several fine fish, I noticed one nearly 2 feet in length, belonging to a different genus, and in a remarkably fine state of preservation.

The only Crustacean I observed was the *Eryon Barroviensis* (M'Coy), which was small and ill-preserved, and by no means equal to the large and perfect specimens met with occasionally at Bidford in Warwickshire*.

I did not detect any remains of plants.

* This species is not uncommon in the *Insect limestone* at Strensham in Worcestershire (where the finest Insects have been obtained, but the pits are now, unfortunately, closed), and Forthampton, near Tewkesbury, where they are generally well preserved, though invariably of small size.

At Wilmcote in Warwickshire there are indications of numerous faults (which were lately pointed out to me by Mr. Kershaw), in all directions round the district, more than are generally supposed. Thus the 'firestone,' which is the lowest and hardest stratum worked, crops-out at various points and dips at a considerable angle, on the higher ground; and the several bands of 'Insect limestone' and shale lie in a basin formed by the outcrop of this lower bed. The 'Plagiostomabed,' containing *P. gigantea*, *Cardinia ovalis*, and *Astarte lurida*, occurs in places in its normal position; but there appears to be no trace of the underlying Saurian beds, which are of considerable thickness in Gloucestershire, and their absence is to be noted both at Wilmcote and Barrow, which implies a great thinning-out of the lower Lias in that direction. This holds good, at all events, with respect to the lower Lias at the latter place, where there are fewer bands of 'Insect limestone;' but at the former they are more numerous, not less than eight courses divided by thick shale; and as the 'Insect-bed' in Gloucestershire is often confined to one, or at most two layers, only a few inches thick, the increased number of 'Insect-beds' in Warwickshire may represent the 'Saurian beds' in Gloucestershire and other places, with which they were perhaps coeval in point of time.

The 'firestone' above referred to is a hard, crystalline limestone, full of oysters and spines of *Echini*, from 3 to 7 inches thick. In Warwickshire it always underlies the last bed of 'Insect limestone,' but does not occur in Leicestershire.

I have only seen two specimens of the large *Eryon* from Warwickshire, one of which is in my own collection, and the other in that of my friend Mr. Kershaw. I am indebted to his kindness for another fine but apparently distinct species of this genus.

The largest measures 6 inches in length from the top of the head to the extremity of the tail, and a little more than 2 inches in breadth in the widest portion of the body.

On the Sands intermediate the Inferior Oolite and Lias of the Cotteswold Hills, compared with a similar Deposit upon the Coast of Yorkshire. By JOHN LYCETT, Esq.

READ 28TH JULY 1857.

MY friend Professor Buckman having invited me to throw together some geological conclusions to serve as a foundation for a discussion, I select a subject which has already received some consideration at the hands of the Club, and which, from its local position, and a difference of opinion which has arisen with respect to the zoological affinities of its fauna, seems to claim some further examination. I allude to the series of micaceous sands and marls which are situated intermediate the Inferior Oolite and Lias, and which are known to English geologists generally as the Sands of the Inferior Oolite, and to continental cultivators of the science as the Jurensis marls; the Grès Supraliassique; the Hydroxyde Oolithique; the superior portion of the Upper Lias; the Lias *Zeta* of Quenstedt, &c. Dr. Wright* and Mr. Hull† have each recently exemplified this deposit in copious and well-known memoirs; but as regards the Cotteswold Naturalists' Club, the present is the first communication which has been presented to it in a written form. The conclusions arrived at by the authors above referred to are based solely upon zoological evidence, and are therefore liable to be affected by subsequent additions, which may tend to alter the relative proportions of Oolitic or of Liassic species found in the deposit; and as some interesting accessions to its fauna have recently been made, more especially in the lower fossiliferous zone, which was but little known until within these few months, I present a notice of them, with the remark, that although as contributions they possess some value, they by no means afford a triumph to any foregone theoretical conclusions;—that they may be compared rather to a portion of the materials forming a part of the structure of a buried edifice whose proportions are not yet fully developed, and of whose full history so much yet remains to be

* "On the so-called Sands of the Inferior Oolite." Journ. Geol. Soc. 1856.

† Mem. of the Geol. Surv. of Gr. Brit. "The country around Cheltenham." 1857.

ascertained, that at present it would be injudicious to indulge in absolute conclusions respecting it. This sandy deposit must be seen to be fully appreciated: presenting much variability in its thickness throughout its long course in the Cotteswolds, it is everywhere readily recognized, and even the approximate position of any small exposures of it may be predicated with tolerable exactness. Unfortunately, nearly the whole of the Cotteswold sections are of a small and imperfect character, consisting chiefly of cuttings of rock upon deep lane-sides, or upon the banks of water-courses; and although these in the aggregate exhibit the entire physical features of the deposit, they do not enable us to ascertain the thickness of the whole, in particular localities, with any near approach to accuracy. We can therefore only estimate the thickness by tracing upwards the beds upon hill-sides, and occasionally by examining the rock brought up during the process of well-sinking. From information obtained in this manner, it would appear that the thickness of the sands varies in the middle Cotteswolds from 35 to 80 feet; and Mr. Hull has shown that over the northern and southern Cotteswolds they present even a greater amount of variability in thickness. My own observations lead to the conclusion, that, like the mass of the Inferior Oolite generally, the thickness is greater upon the outer western escarpment of the Cotteswolds than in the interior valleys, where they are far remote from the outer range. In tracing upwards the beds from the Lias there occurs the following general order of succession:—

- A. Upper Lias clay, grey or blue, soft, and clearly distinguished from
- B. Brown or chocolate-coloured, marly, micaceous sandstone, with frequent red ferruginous stains between the lamination; occasionally the stone is more argillaceous, and buries the hammer when struck; in other instances, from the presence of portions of shells, it is more hard, but is peculiarly irregular and uncertain both in hardness and colour, varying from a blackish-grey to a bright foxy or reddish hue, everywhere glittering with micaceous particles. At about 4 feet from the base are usually one or two thin bands charged with fossils, the greater number of which are very imperfectly preserved: this may be designated as the lower shelly zone, and may be studied in small lane-side sections at Nailsworth and at Brimscombe. In the Yorkshire exposition of the deposit, I shall subsequently show that a shelly zone occurs in a similar position. Passing upwards from 10 to 20 feet, there occurs a general diminution of compactness in the rock, and of its marly structure; there gradually sets in

- C. Micaceous, foxy-coloured or yellowish, incoherent sands, seldom much compacted, but locally becoming soft sandstone, from 20 to 40 feet, abruptly terminated upwards by
- D. Concretionary marly bed, usually darker in colour than the sands, but varying much in structure and aspect within short distances, and everywhere more or less fossiliferous; the tests of Mollusca are less frequently preserved than in the lower zone. A constant mineral feature is the presence of small oval grains of hydrate of iron disseminated through the rock; a structure which, however, is not peculiar, as it is present in the Inferior Oolite at Dundry and in the Lias of France. From 2 to 4 feet is the thickness of this bed in the Cotteswolds.

Immediately overlying this upper Ammonitiferous bed are several others of hard brown or yellowish calcareo-siliceous sandstones, in which fossils are usually very sparingly distributed, and, from the evidence these afford, the beds have by universal consent been assigned to the Inferior Oolite.

In Yorkshire, the lofty iron-bound coast at the Peak and at Blue Wick exhibits the same remarkable deposit in considerable thickness, and slightly modified in its mineral character from the Cotteswold Sands. In a visit which I recently made to this coast, in company with my friend Professor Morris, the identity of the lower portion of the Dogger or Inferior Oolite of Phillips with the Gloucestershire Sands was strongly impressed upon my mind. At Blue Wick the Dogger is altogether about 80 feet in thickness, and rises in successive beds in descending order from the rocky beach into the face of the lofty cliff, the lower 40 feet representing the sands of the Cotteswolds. Beneath these succeed the hard beds of the Upper Lias Shale, 200 feet thick, followed by the Middle Lias, nearly equal in mass; ultimately, at the Peak, facing Robin Hood's Bay, these great deposits are all exposed in one vast unbroken section, forming a lofty mural cliff, nearly 400 feet in height and three miles in length, in the course of which the Dogger attains the summit of the cliff. Words are scarcely adequate to express my admiration of this grand exposition of the lower Jurassic rocks, which for extent and completeness can scarcely be paralleled. Proceeding northwards, the upper 40 feet of the Dogger loses more than half its thickness, and the lower portion, or representative of the Sands, thins out altogether; a great fault then succeeds, by which the Middle Lias is upraised to the summit of the cliff.

The highest bed of the Upper Lias consists of black, finely laminated shale, the transition to the sandstone above being abrupt and very distinctly marked. The sands are here compacted into thick-bedded, dark grey micaceous sandstones in

the lower part, and into brownish or foxy-coloured micaceous sandstones in the upper part, so that the whole nearly resembles the Cotteswold Sands, and differs chiefly in its greater compactness. Fossils are distributed very sparingly throughout the mass of the sandstones, but they are present more abundantly, as in the Cotteswolds, in two calcareo-argillaceous zones, situated in like manner, the one at the top, the other near to the base of the series. The lower fossiliferous zone is a dark grey concretionary band of rock crowded with valves of *Lingula Beanii*; in smaller numbers are *Orbicula reflexa*, *Vermetus concinnus*, *Avicula inæquivalvis*? and another *Avicula*, a small smooth *Pecten*, *Cerithium*, &c. Belemnites are not uncommon, but Ammonites are rare, and are obtained singly and at intervals throughout the sandstones; these are, *A. variabilis*, var. *Beanii*, *A. striatulus*, and *A. Aalensis*; the latter form has not been observed in the Cotteswolds, but occurs in the same stage (Lias Zeta of Quenstedt) in the Jura. *Vermetus concinnus* occurs at intervals throughout the sandstones in small groups, and usually isolated. The dark grey colour of the lower beds of sandstone changes upwards to a foxy hue, and at the summit is the upper fossiliferous zone, from 14 to 18 inches thick, concretionary and dark-coloured; altogether it nearly resembles the Cotteswold bed at Haresfield Hill, with Cephalopoda. In like manner, each abounds with a Terebratula, which is its predominating fossil; the Yorkshire shell is the *Terebratula trilineata* of Young and Bird, *T. ovoides*, Sow., a larger form than the *subpunctata* of Haresfield, but which very much resembles the latter shell when collected indiscriminately at each locality, and without preference to presumed typical forms: unfortunately, the Blue Wick specimens are more frequently compressed and distorted. Other fossils recognized are, *Pleurotomaria subdecorata*, D'Orb., which also occurs at Nailsworth; *Belemnites compressus*, *B. irregularis*, and portions of Ammonites. *Rhynchonella cynocephala* has occurred very rarely, and several specimens of *R. bidens* are also recorded. The thick sandstones of the Dogger which overlie this zone abound with small quartzose pebbles, which are never seen beneath the *trilineata* bed.

In Gloucestershire, the lower zone at Brimscombe and Nailsworth has produced the Liassic *Orbicula reflexa*, *Avicula inæquivalvis*?, *Lima Galathea*, *Ammonites Raquinianus*, which is the *crassus* of Phillips, and another tumid form which much resembles it, and may be only a distinct variety. These have not been found to pass into the upper zone; but the oolitic element is fully represented in this lower zone by certain Conchifera, as *Myoconcha crassa*, *Perna rugosa*, *Trigonia striata*, *Pholadomya fidicula*, *Modiola cuneata*, *Goniomya angulifera*, *Mytilus*

lunularis, *Modiola unguina*, *Gresslya abducta*, and *Modiola compressa*. The upper zone contains in addition the following Oolitic species:—*Cypricardia cordiformis*, *Hinnites abjectus*, *Astarte excavata*, Sow., var., *A. detrita*, *Macrodon Hirsonensis*, *Modiola Sowerbii*, *Gervillia Hartmanni*, *Gresslya conformis*, *Homomya crassiuscula*. *Pecten textorius* and *Turbo capitaneus* appear to have a considerable stratigraphical range, as they are found from the Upper Lias to the Inferior Oolite inclusive. Of the eighteen Ammonites, which appear to include fifteen distinct species, several are undoubtedly derived from forms which occur in the higher beds of the Upper Lias shale of the counties of York and Somerset; others seem to be proper to the stage, and not one of the Ammonites passes upwards into the Inferior Oolite. The Brachiopoda appear to be entirely Liassic derivatives; and even *Rhynchonella cynocephala*, which, from its abundance and wide diffusion, seems to offer a good designation for the stage (Cynocephala-stage), is perhaps nothing more than a variety of *R. acuta*,—the number of plaits, whether anterior or lateral, affording no constant or reliable distinctive character; in other respects the general figure of both is absolutely the same. The single Nautilus, *N. latidorsatus*, is also Liassic. On the other hand, in the numerous Conchifera the Liassic element nearly disappears altogether, and we find a considerable infusion of the Oolitic, leaving, however, no inconsiderable number of species which appear to be proper to the stage. It is indeed a very striking but undoubted fact, that of the very numerous Liassic Conchifera and Gasteropoda, not more than four or five are continued into the Cynocephala-stage, and even of these two only are found in the upper zone. The more common Upper Lias Ammonites (Lias *Epsilon*) are equally absent in the Cynocephala-stage, as *A. communis*, *A. serpentinus*, *A. bifrons*, *A. annulatus*, *A. exaratus*, *A. elegans*, Y. & B., *A. fimbriatus*. *A. striatulus* is strictly identical with the Liassic form; but the common Cotteswold form of *A. variabilis* var. *dispansus* offers well-marked distinctions from the Liassic variety, which, as it is the *A. Beanii* of Simpson, may be termed the variety *Beanii*. The variety *dispansus* is more compressed, the volutions more enveloped; both the fasciated tubercles and the ribs are smaller, less prominent and more numerous; the ribs being much more curved near to the keel. The Liassic variety, however, occurs very rarely at Frocester Hill. *Ammonites opalinus* I have omitted altogether, as the single specimen found lying upon the ground at Haresfield Hill may have been derived from those superincumbent Inferior Oolite beds to which it has been referred by Quenstedt and Oppel. The species alluded to is the *opalinus* of Reinecke, Zieten, and Quenstedt, but not the *primordialis* of

Schlotheim and D'Orbigny, which is sometimes confounded with it. *A. primordialis* is an Upper Lias species. Two forms of these Cotteswold Ammonites appear hitherto to have been undescribed; these will shortly appear, under the names of *A. Moorei* and *A. Leckenbyi**; the former is allied to *Aalensis*, the latter to *hircinus*.

The statement that these Ammonites all cease with the highest bed of the stage, needs some little qualification: a single specimen of *A. striatulus* and *A. variabilis* has occasionally been detected in the lowest of the hard brown beds which overlie the Cephalopod-bed at Frocester Hill; *Belemnites* and *Rhynchonella cynocephala* are more frequent. Whether, however, these Testacea may have been washed into the newer bed, or may for awhile have lingered there as living denizens, is of little moment, as it is certain that the occurrence is of a local nature, and extends only to the lowest bed of the Inferior Oolite.

In assigning to the Sands the provisional rank of a distinct zoological stage, my conclusions are founded upon a review of its fossils compared with those of the Upper Lias "*Epsilon*" on the one hand, and of the Inferior Oolite on the other, to each of which they offer certain approximations, in some instances amounting to absolute identity, in others to the more distant affinities of varieties; after deducting these, a considerable number still remain, which appear to be proper to the stage. This view is to some extent in accordance with that of Quenstedt, who, in his 'Jura,' has separated the Jurensis marls from his Lias "*Epsilon*," or Upper Lias shale, into a distinct subdivision or stage of the Lias, under the name of Lias "*Zeta*." It may be preferable for the present to allow it to remain as an independent stage until more extended observations shall have been made,—more especially until the Testacea of the Lias "*Epsilon*" shall have been more fully figured and described. In this respect it may rank as of the same stratigraphical value as the Cornbrash or the Kelloway Rock, a theoretical arrangement which will leave the problem to be determined by future researches, viz. to which of the two great formations bordering it, its fossils offer as a whole the nearest approximation. Considerable as the list of these has now become, it is evident that much still remains to be done; other localities require to have their fossils better collected and examined. How insufficient is our list from Dorsetshire; how few species have been distinctly assigned to the stage in Yorkshire; how short a time has elapsed since the fossils of the lower zone have been collected in the Cotteswolds; how meagre is the list of M. Eugène Deslongchamps from Cal-

* The Cotteswold Hills: Handbook to their Geology and Palæontology.

vados; and, in the Mozelle, how considerable a number of the species remain undetermined! The recollection of these deficiencies should induce us to discourage for awhile all decisive conclusions, and lead us rather to compare our acquisitions from time to time, carefully and rigidly subjecting them to the necessary comparisons, free from the bias of preconceived opinions.

In the Cotteswolds, 56 Testacea have been obtained in the upper, and 54 in the lower zone; in all, 81 species,—divided into, Cephalopoda, 22; Brachiopoda, 4; Gasteropoda, 9; Conchifera, 46.

The following amended list of fossils from the Cynocephalastage of the Cotteswolds offers some additions and corrections to those previously published, and is divided into two distinct zones.

Upper Zone at Frocester Hill, at Haresfield Hill, and at various other smaller sections.

- | | |
|---|---|
| Anmonites variabilis, <i>D'Orb.</i> , var. | <i>Opis carinatus</i> , <i>Wright</i> . |
| <i>Beanii</i> . | <i>Trigonia Ramsayi</i> , <i>Wright</i> . |
| — <i>variabilis</i> , var. <i>dispansus</i> . | — <i>striata</i> , <i>Sow</i> . |
| — <i>striatulus</i> , <i>Sow</i> . | — <i>costata</i> ? |
| — <i>radians Orbignianus</i> , <i>Schlot</i> . | <i>Astarte complanata</i> , <i>Ram</i> . |
| — <i>radians Dewalqueanus</i> , <i>Rein</i> . | — <i>excavata</i> , <i>Sow.</i> , var. |
| — <i>comensis</i> , <i>De Buch</i> . | — <i>detrita</i> , <i>Goldf</i> . |
| — <i>insignis</i> , <i>Schub</i> . | — <i>lurida</i> , <i>Sow.</i> , short, gibbose var. |
| — —, var. with compressed back. | <i>Macrodon Hirsonensis</i> , <i>D'Arch</i> . |
| — <i>subinsignis</i> ?, <i>Op</i> . | <i>Gryphæa plicata</i> , <i>Lyc</i> . |
| — <i>Jurensis</i> , <i>Ziet</i> . | <i>Hinnites abjectus</i> , <i>Phil.</i> , sp. |
| — <i>discoides</i> , <i>Ziet</i> . | <i>Lima Electra</i> , <i>D'Orb</i> . |
| — <i>Boulbiensis</i> , <i>Y. & B</i> . | — <i>bellula</i> , <i>Mor. & Lyc.</i> , var. |
| — <i>Levesquei</i> , <i>D'Orb</i> . | <i>Modiola Sowerbyi</i> . |
| — <i>torulosus</i> , <i>Schub</i> . | <i>Pecten textorius</i> , <i>Schlot</i> . |
| — <i>Moorei</i> , <i>Lyc</i> . | <i>Gervillia Hartmanni</i> , <i>Goldf</i> . |
| — <i>Leckenbyi</i> , <i>Lyc</i> . | <i>Pinna fissa</i> , <i>Goldf</i> . |
| <i>Belemnites tripartitus</i> , <i>Schlot</i> . | <i>Goniomya angulifera</i> , <i>Sow.</i> , sp. |
| — <i>irregularis</i> , <i>Schlot</i> . | <i>Pholadomya fidicula</i> , <i>Sow</i> . |
| — <i>compressus</i> , <i>Voltz</i> . | — <i>arenacea</i> , <i>Lyc</i> . |
| <i>Nautilus latidorsatus</i> , <i>D'Orb</i> . | <i>Gresslya abducta</i> , <i>Phil.</i> , sp. |
| <i>Turbo capitaneus</i> , <i>Münst</i> . | — <i>conformis</i> , <i>Ag</i> . |
| <i>Cerithium papillosum</i> , <i>Desh</i> . | <i>Myacites arenacea</i> , <i>Ag.</i> , sp. |
| <i>Cypriocardia cordiformis</i> , <i>Desh</i> . | —, species undet. |
| — <i>brevis</i> , <i>Wright</i> . | <i>Homomya crassiuscula</i> , <i>Mor. & Lyc</i> . |
| <i>Cucullæa ferruginea</i> , <i>Lyc</i> . | <i>Terebratula subpunctata</i> , <i>Dav</i> . |
| <i>Tancredia</i> , n. sp. | <i>Rhynchonella cynocephala</i> , <i>Rich</i> . |
| <i>Cardium Hullii</i> , <i>Wright</i> . | — <i>Jurensis</i> , <i>Quenst.</i> , var. |
| <i>Opis lunulatus</i> , <i>Sow.</i> , var. | |

Lower Zone at Nailsworth and Brimscombe.

- Ammonites variabilis*, var. *dispansus*. *Nucula Jurensis*, *Quenst.*
 — *Raquinianus*, *D'Orb.* *Cardium Hullii*, *Wright.*
 —, species allied to *Raquinianus*. *Unicardium*, sp. indet.
 — *Jurensis*, *Ziet.* *Myoconcha crassa*, *Sow.*
 — *radians Orbignianus*, *Schlöt.* *Perna rugosa*, *Münst.*
 — *striatulus*, *Sow.* *Goniomya angulifera*, *Sow.*, sp.
 — *subinsignis*?, *Op.* *Gervillia Hartmanni*, *Münst.*
 — *concaus*, *Sow.* — *forficata*, *Lyc.*
Belemnites compressus, *Voltz.* *Avicula inæquivalvis*?, *Sow.*
 — *tripartitus*, *Schlöt.* *Modiola cuneata*, *Sow.*
Nautilus latidorsatus, *D'Orb.* — *Sowerbii*, *Sow.*, sp.
Turbo capitaneus, *Münst.* — *compressa*, *Münst.*
Trochus duplicatus, *Sow.* — *ungulina*, *Y. & B.*
Pleurotomaria subdecorata, *D'Orb.* *Mytilus lunularis*, *Lyc.*
Chemnitzia lineata, *Sow.*, sp. —, sp. indet.
 —, species undet. *Lima Electra*, *D'Orb.*
Natica adducta, *Phil.* — *bellula*, var., *Mor. & Lyc.*
 — *Oppelensis*, *Lyc.* — *Galathea*, *D'Orb.*
Orbicula reflexa. — *ornata*, *Lyc.*
Astarte lurida, *Sow.* —, n. sp.
 — *complanata*, *Ræm.* *Pholadomya arenacea*, *Lyc.*
 — *rugulosa*, *Lyc.* — *fidicula*, *Sow.*
Trigonia striata, *Sow.* —, sp. indet.
Cypricardia brevis, *Wright.* *Myacites arenacea*, *Lyc.*
 — *cordiformis*, *Desh.* —, sp. indet.
Cucullæa ferruginea, *Lyc.* *Rhynchonella cynocephala*, *Rich.*
 — *olivæformis*, *Lyc.* — *plicatella*, var.

On the Discovery of Cnicus tuberosus at Avebury, Wilts.
By Professor BUCKMAN, F.L.S., F.G.S., F.A.S. &c.

READ 6TH OCTOBER 1857.

IN reporting upon our meeting at Avebury, Wilts, on July 15, 1856, I took occasion to remark upon some interesting plants which I had obtained from the Druidical Circle; and amongst notes upon others, will be found the following:—

“*Cnicus acaulis*, Stemless Thistle, with—anomalous as it appears—stems several inches high. This is one of the forms which has given rise to the many synonyms by which the true species is surrounded*.”

In July of the present year, I found myself at the Avebury Circle, in company with my friend Edwin Lees, Esq., F.L.S., F.G.S., when this Thistle was more minutely examined by us; and, upon carefully getting some specimens up by the roots, we were pleased to find that it agreed in this and other respects with the *Cnicus tuberosus*, Willd., Tuberosus Plume Thistle,—a specimen of which appears to have been sent by A. B. Lambert, Esq., to Sir J. E. Smith, and is figured in ‘English Botany,’ t. 2562, to the description of which is appended the following *habitat*:—“A copse-wood, called Great Ridge, on the Wiltshire Downs, between Boyton House and Fonthill, abundantly:” and Smith states that he there gathered it in 1819†.

For many years, however, this form appears to have become extinct in this its original habitat; and it was thought to have been entirely lost to our flora until within the last few months, when my friend Mr. W. Cunnington of Devizes fortunately discovered that a nurseryman in his neighbourhood had propagated the plant from its original stock presented to the nurseryman by Lambert himself. The two or three specimens thus handed down are now in Mr. Cunnington’s possession; and upon paying him a visit at Devizes, on our way from Avebury to Stonehenge, I was gratified to see a specimen in full flower in his garden, as well as two dried examples in his herbarium; from an examination of these, I am enabled to declare their complete identity with those I had so recently gathered at Avebury.

Here, then, we have a curious example of a plant having been

* Address to the Cotteswold Naturalists’ Club, by Prof. Buckman, Jan. 27, 1857, p. viii.

† English Flora, vol. iii. p. 393.

lost for many years in one locality, and subsequently occurring in another; and yet, though the collecting botanist may perhaps felicitate us upon restoring this to the British flora, I have myself great hesitation in receiving it as a true and undoubted species, the grounds for which I would shortly sum up as follows:—

It occurs sparingly at Avebury, surrounded by the true *Cnicus acaulis* and *Cnicus acanthoides* in great abundance.

Its most important distinctive character will be found in the radical tubers, which, in full-grown examples, are somewhat large and fleshy, and unilaterally placed on the rhizome. In smaller specimens the roots are long and flexile, but not expanded into tubers,—which is just the state in which they occur in the *Cnicus acaulis*.

It is true that it cannot be described as *acauline*, as the stem is more than a foot in height; but this is also often the case with the true *acaulis*, as we have now before us examples of this species several inches high.

From these circumstances, in connexion with the rarity of the tuberous form in a plant that seeds so abundantly, each head of flowers being capable of perfecting as many as 150 seeds,—taking also into consideration the well-known sporting propensity of this genus,—I cannot help thinking this to be a *hybrid*; and from the fact of the abundance of the two forms before indicated in its immediate vicinity, we may not unreasonably look upon them as the origin of our tuberous type.

There is perhaps no genus of plants more perplexing to the botanist than that of *Carduus*, which is now made to include *Cnicus*; hence the variation in the number of species in our different floras; and thus Babington heads his descriptions of them with the following significant note—"many hybrids occur in this genus*;" and my friend Lees has kindly furnished me with the following note upon another disputed species, which bears directly upon this question:—

"In August 1856, I found the *Cnicus Forsteri* of Smith, in a field near Crowle, Worcestershire. In the same marshy field was a considerable quantity of *Cnicus pratensis* and a very numerous growth of *C. palustris*. The position of Forster's Thistle was between the *C. pratensis* and *C. palustris*, so as to give rise to an immediate suspicion of its hybridity; and, upon examination, the characters shown by *C. Forsteri* were exactly intermediate also. The leaves were much like those of *C. palustris*, while the stem and flowers were in small clusters, instead of being single as in the latter. Indeed, the result of my examination convinced me that *C. Forsteri* could be only a hybrid; and

* Manual of British Botany, 3rd edition.

this I stated in an account I sent to the 'Phytologist,' and which appeared in the September Number of that Journal for 1856."

For the present, then, I must content myself with having offered presumptive evidence of the non-specific character of what is, after all, a decidedly distinctive form; and as I have brought home some specimens and planted them in my botanical garden, where I shall also introduce the *acaulis* and *acanthoides*, I shall look forward to the results of experiments with these with no little degree of interest, as in all probability, like so many other experiments which I have been enabled to perform in the same direction, these may serve still more to perplex the question "What is a species?"

Cirencester, July 1857.

Note on the Presence of the Fossil genus Isodonta, Buv., in the English Jurassic Rocks. By JOHN LYCETT, Esq.

To James Buckman, Esq., Hon. Sec. to the Cotteswold Naturalists' Club.

DEAR SIR,

Will you have the goodness to communicate to the Club, at their next meeting, that we may claim the genus *Isodonta*, Buv. (*Sowerbya*, D'Orb.), as an addition to the fauna of the English Jura?

The sole species hitherto described is the *Isodonta Deshaysea*, Buv., from the ferruginous Oolite of the Oxfordian beds of the Department of the Meuse. Recently, my good friend Mr. Leckenby presented me with a fine specimen of the so-called *Cucullæa triangularis*, Phill., from the Cornbrash of Scarborough. The resemblance in the general aspect of this shell to the *Isodonta* of Buvignier was at once apparent; but it was only upon an inspection of specimens in the British Museum, collected by M. Tesson, that their identity with the Yorkshire shell became a conviction to my mind. Individual specimens vary in their elongation and in the degree of angularity at their infero-posterior extremity: little differences of this kind form the sole distinction between the British fossil and that of the Meuse, and the Normandic specimens in the Museum differ from each other at least to an equal extent. The *Cucullæa triangularis*, Phill. Geol. York. i. tab. 3. fig. 31, is from the Coralline Oolite of Malton; it is somewhat less elongated than my Cornbrash specimen, and agrees more nearly with the figures of Buvignier, 'Paléont. de la Meuse,' Atlas, pl. 10. figs. 30-35, except that the figure of Phillips is somewhat more inequilateral from the shortness of the posterior slope: in the Cornbrash specimen, as in those from Normandy and from the Meuse, this feature is less conspicuous; but there can be no doubt that the anterior side is always somewhat more produced than the other; the surface is smooth, but with two distant and strongly-marked folds of growth. The very tumid figure and incurved umbones are the external characters whereby it may be distinguished from *Tancredia*; the test is likewise thicker than in the latter genus. At present it does not seem that the Cornbrash shell can be separated as a species either from that of the Yorkshire Coralline Oolite, from the Normandic specimens, or from those

figured by Buvignier from the Department of the Meuse; but it is desirable that additional British examples of this rare form should be examined. I need hardly suggest to you the expediency of making a rigorous search in the Cornbrash and the Kelloway rock of the vicinity of Cirencester; and believe me to remain, dear Sir,

Yours, &c.,

JOHN LYCETT.

Minchinhampton, October 19, 1857.

On some Sections of the Upper Lias recently exposed at Nailsworth, Gloucestershire. By JOHN LYCETT, Esq.

READ 21ST JULY 1858.

So few opportunities are afforded for examining the Upper Lias of the Cotteswolds, so small are the artificial exposures of the stage occasionally made, so limited their extent and depth, that its fossils are almost unknown, and even the thickness of the stage has been very variously estimated. During the author's experience of more than twenty years, the Upper Lias has only been known to him by small sections in clay-beds used for brick-making, and these are usually quite destitute of fossils; some cuttings, therefore, recently made, which exposed the entire thickness of the stage and many of its fossils, have induced him to prepare the present brief notice.

The only authorities for the Upper Lias of the district are—'Outlines of the Geology of England' by Conybeare and Phillips, 1822; 'Outline of the Geology of the Neighbourhood of Cheltenham,' by Sir R. I. Murchison, 1834; the enlarged edition of the latter work by J. Buckman and H. E. Strickland, 1845; 'Memoirs of the Geological Survey of Great Britain;' 'The Geology of the Country around Cheltenham,' by E. Hull, Esq., 1857. In the first of these works the Upper Lias is only distinguished from the other members of the same formation by a useful section given at page 252, exhibiting the succession in the beds upon the western slope of the Cotteswolds at Painswick Hill, by the late Mr. Halifax of Standish; but their thickness is not given.

The following is the section, to which figures are here added, to mark the superior divisions:—

Inferior Oolite	1
Very micaceous sand	2
Sand, with beds of unctuous, slaty, bluish clay	3
Blue clay with septaria.....	4
Thin beds of grey Lias-like marlstone.....	5
Lenticular balls of indurated marl with Ammonites and parts of Fishes	6
Marly sandstone, a yellowish-brown sandstone, spangled with mica, blue at the heart, abounding with large Belemnites, Pectens, &c.....	7
Marl and clay	8
Clay, with veins of foxy earth containing ferruginous nodules concentrically formed round a nucleus of Lias.....	9
Lias.....	10

1. The lower portion of the Inferior Oolite; thick beds of coarse, calcareous, shelly gritstone, more or less tinged with oxide of iron.

2. The sands of the Cynocephala-stage, with a shelly band at the top, some flaggy argillaceous sandstones in the middle, and a shelly band at the bottom.

3, 4, 5, 6. Upper Lias; no fossils visible in this section.

7. Marlstone or Middle Lias.

8, 9, 10. Lower Lias; but little exposed.

In Sir R. I. Murchison's little sketch of the 'Geology of Cheltenham,' the thickness of the Upper Lias is estimated at 60 or 70 feet; and the following fossils were collected by him from a road-side cutting near Sandywell Park:—*Ammonites bifrons*, *A. undulatus*, *A. annulatus*, *Belemnites acutus*, *B. tubularis*, *B. penicillatus*, *Inoceramus dubius*, *Plicatula spinosa*, *Trochus bisectus*, *Arca*, *Gervillia*, *Lucina*, ?*Modiola*, *Nucula*, *Nautilus*, *Pholadomya*. In the second and enlarged edition of the same work, the authors

estimate the general thickness of the Upper Lias at 100 feet to the fossils given in the former edition are added the following:—*Ammonites falcifer*, *A. Strangwaysii*, *Belemnites Bruquierianus*, *Trochus bisertus*, *Nucula rostralis*, *Æschna Brodiei*, *Astacus*, *Hippolita*, *Cidaris minuta*. In the memoir by Mr. Hull, the Upper Lias is stated to be upwards of 230 feet thick at Leckhampton Hill; it is estimated to be 300 feet at Cleeve Cloud; in the hills further northwards, at from 80 to 100 feet; it constantly declines in thickness towards the Oxfordshire boundary of the county, so that at Burford its thickness is only 6 feet. In the southern portion of the Cotteswolds it is stated to be only 10 feet thick at Wootton-under-Edge, and about 30 feet at Stroud; but I shall have to show that at Nailsworth, a spot situated between the two latter places, the thickness of the Upper Lias is upwards of 105 feet. The only additional fossils mentioned by Mr. Hull are *Nautilus inornatus* and *Belemnites abbreviatus*.

The sections upon which the present remarks are founded were made in forming several deep drains and a cutting for a carriage-drive upon a steep hill-side preparatory to building a villa and laying out the surrounding ground for ornamental purposes, upon the western side of the valley, and immediately adjoining the village of Nailsworth; it also happened about the same time that a cutting was made along the whole course of the turnpike road in the same valley, towards Stroud, for the purpose of laying down gas-pipes; another small section was also afforded by some alterations made in the mill-stream at Holcomb Mills, about half a mile higher up the valley. The deep-drain sections afforded a view of the higher beds of the stage, even to their junction with the micaceous marly sands of the *Cynocephala*-stage; the other cuttings exposed the lower beds, but less perfectly than the upper ones, and also some portion of the Marlstone series. But although a portion of nearly the whole of the beds was uncovered, the entire area from which fossils could be procured was very inconsiderable. In descending order occurred—

Several feet of blue clay, with intercalated thin layers of dark-coloured shale.

A thin stratum of grey, finely laminated shale, with clusters of valves of *Posidonia Bronnii*.

Brown and blue clays and marly bands containing some irregular layers of hard shale, and of thin bands of blue argillaceous limestone.

Fossils were moderately abundant in the bands of limestone.

Ammonites bifrons was the most conspicuous; *A. communis* was in much smaller numbers; the few other Ammonites obtained consisted of *A. falcifer*, *A. heterophyllus*, *A. cornucopiæ*, *A. crasus*, *A. Lythensis*, *A. Jurensis*, and a new species near to *A. Humphriesianus*; a few fragments occurred apparently of *Nautilus sinuatus*, and a single specimen of *N. latidorsatus*. *Belemnites* were comparatively few, as were also Gasteropoda and Conchifera; the latter included two undescribed species, one of *Tancredia* and one of *Placunopsis*.

In the lower beds bluish-grey clays predominated; but the sections were insufficient to expose an unbroken sequence of the lower beds, although the entire thickness of the stage was ascertained with a near approach to accuracy; the measurement gave a thickness of 105 feet, the beds being free from disturbance. Some few layers of limestone nodules occurred, but their amount was not comparable with those obtained from the Upper Lias of Somersetshire. To the same general deficiency of lime, as exemplified in the paucity and thinness of the limestone bands, may probably be attributed the general scarcity of fossils when compared with the Upper Lias of Somerset; here the chief mass of the deposit consisted of brown and blue clays which were quite destitute of fossils; no remains of Saurians or of Fishes were observed. These conditions present a remarkable contrast to the same stage at Ilminster, with its pale yellow limestone charged with Saurians, Fishes, and a multitude of Mollusca of all classes, numbering probably more than 150 species, notwithstanding that the entire thickness of the stage is only a few feet at that place. To study these, the extensive collection of Mr. Moore, in the Bath Museum, should be visited.

The occurrence at Nailsworth of finely laminated shales with the little *Posidonia Bronnii* in the upper portion is interesting, as identifying the stratum with the continental representative of the same shale: this fragile bivalve appears to be limited to the single stratum indicated.

The large *Tancredia* is the first recorded example in the Lias of England, although upwards of eleven species are distributed throughout our Lower and Upper Oolites; in France and Germany, on the other hand, nearly all the recorded species are Liassic. It is probable, however, that some, or even all of the shells referred to *Tellina* in the "Étage Bathonien" of D'Orbigny belong to the genus *Tancredia*, excluding the two species in his "Étage Bajocien," which belong to the genus *Quenstedtia*.

The following is the limited list of Upper Lias Testacea procured at Nailsworth:—

Cephalopoda.

- Ammonites bifrons*, Brug.
 — *falcifer*, Sow.
 — *communis*, Sow.
 — *heterophyllus*, Sow.
 — *cornucopiæ*, Y. & B.
 — *Jurensis*, D'Orb.
 — *Lythensis*, Y. & B.
 — *crassus*, Phil.
 — *annulatus*, Sow.
 — *Ilminstrensis*, n. sp.
Belemnites compressus, Voltz.
 — *tripartitus*.
Nautilus latidorsatus, D'Orb.
 — *sinuatus*, Sow.

Gasteropoda.

- Pleurotomaria*.
Turbo capitaneus, Münster.
 Conchifera.
Astarte lurida, Sow.
Lucina?
Tancredia læviuscula, n. sp.
Posidonia Bronnii, Münster.
Placunopsis sparsicostatus, n. sp.
Nucula Hausmanni, Ræm.
Pecten.
Gresslya gregaria, Ræm. sp. (G. Anglica, Ag.)
Lima gigantea, Sow.
 — *bellula*, Mor. & Lyc.

Notes on the Testacea.

Ammonites bifrons. A variety with compressed sides, in which the falciform ribs are but little prominent. A few examples occurred of the ultimate condition of growth, in which state it may readily be mistaken for a distinct species, and probably constitutes the *A. Hildensis* of Simpson. The costæ have disappeared upon the whole of the last volution, which presents only densely arranged fine falciform lines which pass over the back and the keel; the lateral sulcation has become indistinct through the flattening of the sides of the volution; the back has lost its rectangular figure and become rounded, sloping obliquely upon each side from the keel, and the two dorsal grooves have disappeared; the keel itself has become more elevated and conspicuous. The inner or smooth portion of each volution overlaps and conceals the costated portion of the preceding volution, so that the entire aspect of the shell is smooth, and it is only by breaking away a portion of the last volution near to the suture that the ribs of the next volution can be exposed and the identity of the species proved. It occurred abundantly.

A. communis. Specimens were indifferently preserved, but exhibited some of those varieties in the arrangement of the dorsal ribs, and in the general figure, which perplex collectors who desire to separate them into the forms named *A. communis*, *A. Hollandrei*, and *A. Braunianus*,—a perplexity which is in no degree lessened by the study of numerous specimens. Further investigations into these forms are desirable.

A. heterophyllus. Badly preserved examples, and few.

A. cornucopiæ (*A. fimbriatus*, Sow.). A single fine example in one of the higher beds. Some casts of young forms, apparently of this species, have been procured in the lower zone of the *Cynocephala*-stage at Nailsworth.

A. Jurensis. Fragments only in the higher beds.

A. crassus (*A. Raquinianus*, D'Orb.). Evidently the same shell as in the lower zone of the Cynocphala-stage at Nailsworth and in the Upper Lias of Yorkshire.

Ammonites Ilminstrensis, n. sp.

In its general figure it is scarcely to be distinguished from *Ammonites Humphriesianus*; the style of its ornamentation is also very similar to that of the latter species; there are, however, some well-marked differences. In *A. Humphriesianus* the lateral costæ form, with the dorsal, a curvature more or less marked; in the Lias shell, the ribs pass from the suture straight over the sides and back. Usually two, but sometimes three, dorsal ribs unite with one lateral rib. In *A. Humphriesianus* the number of dorsal ribs is somewhat greater; but the most conspicuous distinction consists in the form of the dorsal ribs, which in the Lias shell are much more narrow, elevated, and acute, so that there is a wide space left between each rib. In the young shell the lateral ribs are likewise much elevated and acute, so that they are little larger than the dorsal ribs; there is also some little distinction in the figure of the volutions, and consequently of the aperture, the portion near to the suture overhanging the preceding volution more than in the Inferior Oolite shell.

The septa consist of three large principal lobes, much produced, and of two small accessory lobes. The dorsal lobe is much lengthened, with a single, terminal, very elongated and pointed digitation upon each side of the mesial line; there are two smaller lateral digitations; all the digitations are indented. The superior lateral lobe has its termination trifurcate, the mesial digitation being pointed, and of immense length; but the lobe altogether is less lengthened than the dorsal lobe. The inferior lateral lobe is similar in figure to the superior lobe, but is much smaller and shorter. The two accessory lobes are very small and simple, the second being nearly concealed by the convexity near to the suture. The dorsal saddle is of great width, consisting of two principal divisions, of which the outer is much the larger; each division has two principal branches with numerous indentures. The lateral saddle has two principal portions, of which the outer is the smaller; the indentures are smaller and less conspicuous than in the dorsal saddle. The accessory saddles are small and simple, almost without indentures.

Ill-preserved specimens occurred rather abundantly at Holcomb, associated with *A. bifrons* and *Astarte lurida*. My friend Mr. Moore has favoured me with fine specimens from the pale-yellow bed of the Upper Lias at Ilminster, and smaller

forms of the same species occur in the lower shelly zone of the Cynocephala-stage at Nailsworth. The largest specimen in my possession has a diameter of $2\frac{1}{4}$ inches; the height of the aperture is 6 lines, the opposite diameter 10 lines.

A. falcifer. A few specimens. At Stroud, when the railway was being constructed, a thin band of pale grey limestone was crowded with fine specimens, to the exclusion of all other species.

A. annulatus, Sow. Few, and ill-preserved.

A. Lythensis, Y. & B. Smaller forms than occur at Whitby. It is not the *A. Lythensis* of Quenstedt; the latter is a very different Ammonite.

Belemnites compressus, Voltz. Large specimens in the upper bed, associated with *B. tripartitus*.

B. tripartitus, Schl., agrees with specimens in the Cynocephala-stage at Nailsworth and at Frocester Hill.

Nautilus latidorsatus, D'Orb. (*N. Toarcensis*, D'Orb.; *N. Jurensis*, Quenst.). A single fine specimen.

N. sinuatus, Sow. Fragments only.

Pleurotomaria. Species undetermined, with elevated spire, narrow convex volutions, mesial siphonal rib, and fine, densely arranged, equal encircling lines.

Turbo capitaneus, Müntz. Its aspect agrees with specimens from the Cynocephala-stage in the neatness of the ornamentation.

Gresslya gregaria, Røem. A large tumid species, well separated from congeneric forms. A single specimen.

Tancredia læviuscula, n. sp.

A large elongated species, with an oblique dorsal angle and the posterior border nearly closed. Compared with allied forms, it is more lengthened and less convex than *T. donaciformis*; the anterior extremity is more rounded; the umbo is but little elevated, the posterior side being much extended and its extremity pointed; the height being only equal to $\frac{6}{10}$ ths of the length. It is distinguished by the same features from *T. Deshayesea* and *T. compressa*. A single fine specimen.

Lima gigantea, Sow. This well-known shell occurs both in the Lower and Upper Lias of Gloucestershire. D'Orbigny has separated the older form under the name of *L. edulis*. I do not perceive that the latter possesses any sufficient specific distinction.

Lima bellula, Mor. & Lyc. Delicately preserved, and exhibiting the finely ornamented surface, which is rarely seen in Inferior Oolite specimens. Some of the latter attain larger dimensions and have a somewhat shorter figure, but do not possess any other distinguishing feature.

Placunopsis sparsicostatus, n. sp.

Shell flattened, suborbicular, oblique; umbo raised, submarginal, the surface with numerous irregular, unequal, concentric plications, and a few raised, equal, linear, distant, undulating and radiating ribs, sometimes slightly knotted where they pass over the plications. Diameter 12 lines. A single good specimen.

Nucula Hausmanni, Rœm. Nearly allied to *Nucula Erato*, D'Orbigny, an Inferior Oolite shell both of Yorkshire and Gloucestershire; but the latter species is less angular, less pointed at the extremities, or more ovate and smaller. A single fine specimen.

Posidonia Bronnii, Münst. A delicate papyraceous and somewhat irregular shell, usually indifferently preserved, but occurring throughout a thickness of about two inches in tender, thinly laminated shale. Impressions are abundant, but the test is rarely preserved.

Astarte lurida, Sow. So numerous are the Jurassic species of *Astarte*, and in many instances so nearly allied are they to each other, that the utmost care and precision is necessary, both in descriptions and figures, to convey clear and correct ideas of them in the absence of the fossils; nor under any circumstances can the varieties of aspect which they assume, and the boundaries between species, be in every instance sufficiently defined. The figure of *Astarte lurida* in the 'Min. Conch.' accurately represents a short specimen in the young state, before the arrests of growth had produced irregularity and inequality in the encircling ribs, the verbal description appended being very concise. The following description is the result of an examination of a multitude of specimens in every stage of growth:—

Shell oblique, ovate, moderately convex; umbones anterior, pointed, and incurved; anterior side very short; lunule large, striated, elliptical, excavated, its margin slightly rounded; ligamental margin lengthened, its outline somewhat curved, forming with the other valve a lengthened, smooth, but not deeply excavated area with acute borders; lower margin elliptically curved, internally crenulated. Surface with elliptical costæ, regular in the young shell, subsequently degenerating into irregular and unequal elevations, more especially when the surface exhibits arrests of growth; the costæ are not much raised, rounded, and fully equal in breadth to the interstitial spaces (about thirty-two in a full-grown specimen); the entire surface has fine striations, which follow the direction of the costæ.

Specimens vary much in their length and obliquity; but none are comparable to the Oxford Clay shell figured in the 'Illus-

trations of the Geology of Yorkshire' under the name of *Astarte lurida*: the large anterior side and the small lunule mark the latter as a distinct species.

Several examples of *Astarte lurida* were obtained in the upper portion of the Upper Lias in a mill-stream cutting at Holcomb; it has also occurred very abundantly a little higher in the geological scale, in the lower zone of the Cynocephala-stage at Nailsworth. D'Orbigny ('Prodrome') places it in his "Étage Bajocien," which is probably an error; the English localities cited by him (Fox Hill and Taunton) are not Inferior Oolite; nor does it appear that the latter formation, although so rich in the genus *Astarte*, has ever produced *A. lurida*.

*Annual Address to the Cotteswold Naturalists' Field Club, read by
T. B. LL. BAKER, President, at Gloucester.*

READ FEBRUARY 16, 1859.

AGAIN my friends have we met, and again does it fall to my duty to record, however briefly and imperfectly, the transactions of our Club.

You will forgive me, I am sure, if, on this occasion, I go back somewhat farther than usual, to the time when Sir Thomas Tancred—who, though he never would take any other title than that of Secretary, so long as he staid with us, was the real author and manager of our Club, first called together, in July, 1846, a small party at the "Black Horse" on Birdlip Hill, and in the course of a walk through Witcombe Woods, the Roman Villa, and Cooper's Hill, shewed us how much enjoyment and instruction might be gained by a simple ramble through beautiful scenery, in company with several men who are all more or less skilled; but at least, all interested in that glorious study of nature, in whose honour our meetings are held. On that day, when the sun shone fairly on us, and all went smoothly, we first felt the charm of such meetings in fine weather. But, on our next meeting, when we essayed a Forest ramble, and spite of torrents of rain—such as the skies of the Forest can produce when they please—spent a really enjoyable day, then, indeed, we felt that our love for nature was not a mere fair weather fancy, but one that would stand the test of winter and rough weather.

From that time, for now thirteen years, have we enjoyed our five or six meetings per annum. Our Club has been as full as we thought it prudent to allow; it has been the means of bringing together many men of eminent talents, and uniting them in a common band, and it has, I believe, also been the means of encouraging many

young students of nature, and, by introducing them to those who have been able and willing to assist them, has given a fresh spring and impetus to their zeal. It has given us many truly happy, enjoyable, and profitable days; and, which I consider by no means the least of its benefits, it has made us all better acquainted with the objects of most interest, whether of nature or art, in our own county. But much as this is—for a small rural Club to be thankful for—we may say yet more. We do not boast that Sir Thomas Tancred, or any here, originated the idea of such a Club. I believe that, in almost every point, it was a simple imitation of that founded in the North, by Sir William Jardine, Mr. Selby, and Dr. Granville. But, I believe that ours was the first of these field Clubs in the South of England, and that the Woolhope, Worcestershire, Malvern, Warwickshire—aye, and even Sussex and Kentish Clubs—have been encouraged to commence, from seeing how well ours has prospered, and we feel ourselves strengthened and encouraged by a bond of union with similar societies dispersed over all England.

But let us refer to our meetings of last summer, for, imperfect as my notices of our gatherings may be, I believe that even such a slight record of the principal objects of interest to be seen in the different localities, where we have met, is of value, as serving to call the attention of future visitors to the same spot.

On April the 27th, the Club gave both honour and pleasure to its President, by acceding to his request, and holding the winter meeting at Hardwicke. He had urged this experiment because he had long felt that there were, in different parts of the country where the Club might wish to meet, many gentlemen who would gladly exercise hospitality, were it not that the independent feeling (which I trust the Club will always maintain) forbids its being a burden to any one.

Your President was anxious to show that, if others were not too proud to follow his example, this difficulty might be easily overcome. He therefore requested the Club to dine with him, paying the usual 3s. 6d. each for dinner, and he had great satisfaction afterwards, in handing to the Secretary an account of the total cost of meat, bread, vegetables, servants to wait, &c., &c., of the dinner, shewing a balance of nearly a pound due to the Club funds. He would most gladly see this example followed.

The party, before dinner, walked through the grounds, and up Hawklow, Oakleigh or Hockley Hill, on the side of which a Tenant Farmer called their attention to some most hopeless-looking pasture. A slight examination at the time, led to a correspondence and a more careful analysis of the soil, on which a course of treatment was recommended. This is now being carefully carried out on certain marked spots of the field, and the result remains to be seen. If it fails—being only carried out on small portions—the risk is small. If it succeed, not only that Farmer, but many another Farmer and Landlord too, may feel grateful for the visit of the Cotteswold Club.

After dinner some papers were read, which will appear in our annals, and Mr. Jones exhibited a small and evidently simple instrument, which shewed such marvellous effects of the powers of extremely rapid rotation; that, although perhaps it was only an extension of the powers of the humming-top, yet it was so wonderful an extension, that no more business was done that evening, and the fixing of the meetings for that summer were postponed till our next Club day.

On May 18, a considerable party met at Stroud, and walked to the newly-erected Cemetery; where, in addition to a beautiful view of the Valley of Stroud, opening into the great Vale of the Severn, was found a very curious and interesting fault exposed (as all faults must be) by the levelling of the Graveyard. Nor were we less pleased or interested by a collection of curiosities at the house of the Keeper of the Grounds, which shewed that, where taste and ingenuity exist, wealth is not necessary to develop them.

We also visited another fault of about thirty feet in a quarry at Swift's Hill, and then walked to Stroud Glade, where, in a farmyard, we found the yet vigorous remains of a Wytch Elm, hardly to be matched in England. Alas! we were unprovided with measures, and determined to return at a future time better provided—which determination, like many others, has never been carried out. We decided, however, that it was about sixty feet in circumference, and though only a thin shell of wood was attached to the bark, yet the latter was entire, with the exception of a gap some three feet wide, by which we entered, and a hole cut in the opposite side, through which a handle had worked, when the hollow had been used as a convenient shed for a cyder-press. The shell, I think, was from fifteen to twenty feet high, and from thence rose a very vigorous growth of young wood, which is frequently lopped, to prevent its weight from breaking the thin shell of trunk. The manner in which the bark has rounded the edges of some of the small holes in the tree, and formed a complete rose in the hollow, is most curious.

On Wednesday, June 30, a very small party set forth from Tewkesbury to visit the quarries on Brockridge Common, hoping to find there some of our Members who knew the spot, and had promised to attend. After waiting some time, and seeing little, they walked to the neighbouring Church at Ripple, where there was much to please the archæologist, especially when shown by the kind Rector, and returned along the Valley to Tewkesbury. Some little time after they had sat down to dinner the missing and much missed portion of the party came in, having lost much time in hunting for the first detachment. After many regrets had been expressed, and much consultation had taken place as to how such *contre temps* might be avoided for the future, no better means could be suggested than that members should answer the Secretary's letters, and endeavour to reach the place of meeting at the time fixed.

On Wednesday, July 29, a large party of our Club, and a far larger party of Ladies and strangers, met at Gloucester, with the

programme of going by the "Wave" steamer down the Canal to Sharpness, and thence in the "Eagle" steamer to visit the Cliffs of Pennarth (which exhibit at one view the upper beds of the New Red Sandstone, and the entire series of the lower lias beds), and the generally interesting shores of the Severn, including the Bone bed at Aust. Down the Canal we chatted merrily. Boarding the "Eagle" on we steamed, talking of Pennarth, of its interesting Cliffs, and of the friends from Bristol, who had promised to meet us there, and it was only as we neared the Holms, that the truth oozed out, that so deep a bank of mud, impassable to human foot, lay between the water and the Cliff that our landing was impossible, and our scientific examination of the Lias dwindled away to an hour or two strolling about the Holms. However, in misfortune, the only thing to be done is to make the best of it, and so interesting a lecture did we get from the ever-ready Professor Buckman, that many of the less scientific of the party declared that they had gained more instruction and pleasure on the Holms than they could have hoped for at Pennarth.

On September 15 a meeting took place in the Forest of Dean. I myself was engaged with our Regiment of Yeomanry, at Cheltenham, and therefore was not much more than half wet through. But in the Forest I can quite imagine that there was no half-and-half wetting. Mr. Jones, Dr. Watson, and Mr. Ford are recorded to have stood it, and walked it, and, despite of the air and the water, to have taken good note of the earth where the cuttings of the railways and the mines displayed her heretofore hidden treasures. Honour be to the trio who braved the elements. Yet, had not other duties called him, I think that the trio would not have had it all to themselves, but would have been converted to a quartett by the presence of your President. And thus ended the Thirteenth year of our Club.

And now, my kind friends, I am about to resign my office into your hands; but not as usual with the will to resume it, should you, as you have hitherto done, kindly ask me to do so.

I have long felt that, for many reasons, I was unfit any longer to hold such a office. In good truth, I never was fitted for it; but I hoped that my good-will to the Club, my love (notwithstanding my want of knowledge) of the study of nature, and the time and attention I was able to devote to it, atoned in some degree for my deficiency in science.

But, of late years, another study has occupied me. One so engrossing that I have willingly given my heart and my health to the work. It has not, indeed, lessened my love for the glories of nature in any degree. It has not diminished my interest in the prosperity of the Club; but it has so absorbed my time and my strength, that frequently I am incapacitated from attending to any, but the one object of my thoughts. For a time I believed that the difficulty of organizing the system of Reformatories throughout England would soon be done. But as he who climbs a mountain,

when he has surmounted the highest point he could see from the valley, still finds other heights towering far above—so I see less chance than ever of being freed from my labours. Or rather, and more truly, let me say, I see more hope than ever, that so long as it may please God to use my services, there will be palpably more and more to be done.

The work of establishing Reformatories through the length and breadth of the land is indeed finished. Nay, more! Not only is the tree planted, but the fruit is ripening. The numbers of boys convicted throughout England is greatly diminished. But if we take the particular towns where they have been able to send to Reformatories *every* boy on a second conviction, the decrease is large indeed. I have now little doubt that, with our present Reformatories, we can not only keep all England, except London, clear of regular boy-thieves; but that ere next Christmas we can commence taking the worst of those of London, and if so, I have little doubt that we can produce a strong impression, in three years, even on the crime of the Metropolis. But then comes the great and important question of doing the same for adults. Forgive me, my dear friends, that I have been so long talking of my own shop matters. I meant merely to have explained why my time was more than heretofore occupied by other pursuits, and my pen has run away with me.

To return. I have long felt that I was unsuited for the office of your President. I now feel happy to think that you may, if you please, place that office in the hands of one—who both by rank and position, still more by high attainments and knowledge not only of one, but of many branches of that glorious study which we meet to cultivate—will do honour to your choice.

And now, my friends, I bid you not farewell, for I trust that my attendance at your meetings will not be more rare, and certainly my interest in the Club will not be diminished, but I beg you to let me resign the office of your President, only that it may pass into hands which will carry out more worthily and fitly (than I was ever able to do) the true objects of the Cotteswold Club.

Notes on the Inferior Oolite Beds in the neighbourhood of Bath, by
W. V. GUISE, F.L.S., F.G.S.

READ TO COTTESWOLD NATURALISTS' FIELD CLUB, FEB. 15, 1859.

I PROPOSE, in the following observations, to introduce to my associates of the Cotteswold Club a notice respecting the Oolitic deposits in the neighbourhood of Bath, with reference, more particularly, to some peculiarities presented by the Inferior Oolite beds in that district, and to the relations which they offer to those of the Cotteswolds.

In the course of the late autumn I was enabled to devote three weeks to the study of the Geology of the Bath district, in which I had the advantage of the frequent companionship of the well-known and accomplished Palæontologist, Mr. Charles Moore, to whose guidance I owe it that I was enabled to visit many points of interest and importance which would otherwise have escaped my observation.

My remarks having reference more particularly to the beds of the Inferior Oolite, it is not my intention to do more than to glance cursorily at the underlying clays, of the extent and peculiarities of which it is not easy to form a correct estimate; as, in the immediate neighbourhood of Bath, the Lias is rarely exposed to any extent, and, excepting in well-sinking or in digging the foundations of houses, few opportunities offer for its examination.

Lonsdale, in his Memoir on the Oolitic district of Bath, in the 3rd Volume of the Transactions of the Geological Society, estimates the entire thickness of the Lias in that vicinity at somewhat less than 300 feet, and probably this may be viewed as a fair approximate average; but the thickness of the deposit varies considerably in different localities. In the Charlecombe Valley, it certainly exceeds

that measurement considerably; while at the Hamlet of Meadgate or Medycat, seven miles S.E. of Bath, it cannot be estimated at more than from 40 to 70 feet, and may very possibly be less.

The presence of the "Middle Lias," or "Lias Marlstone," is one of the points most difficult of identification in the Bath district, and I must acknowledge, that during the few opportunities I had of studying the question, I was unable to satisfy myself of the presence of that deposit by any recognisable features. I am bound, however, to add that Mr. Moore has satisfied himself of its existence, though in an obscure form, and under altered conditions from those in which it presents itself in the Cotteswold range. At Charlcombe Hill, as well as on the north-western extremity of Dundry Hill, a considerable thickness of very adhesive ferruginous clay appear to occupy the position of the "Middle Lias," and may very possibly be its representative; but if so, its presence is not indicated by any fossils, in so far as I was able to discover, and at Meadgate the Upper and Lower Lias Marls appear to pass insensibly into one another, without any distinct line of demarcation, though the presence of "*Spirifer rostratus*" about the middle of the series would appear to mark the horizon of the "Marlstone." Lonsdale, in his Memoir, speaks of the "Marlstone" near Bath as containing numerous individuals of "a large *Pecten* with obtuse ribs," which might be attributed to *P. equivalvis*; but, inasmuch as he appropriates the term "Marlstone" to certain sandy beds, interposed between the Lias and the Inferior Oolite, it is plain that he refers to the "Sands" intercalated between these two deposits; in which, however, I was not fortunate enough to observe the *Pecten* in question, nor any other fossil organism whatever. These "Sands" are everywhere present in situ, and exhibit a series of alternating Sands and Sandstones to a thickness of from 60 to 80 feet, to which extent they are exposed at Charlcombe, the only spot at which I was able to trace them throughout their entire thickness, and as this Section presents some features of interest, I will proceed to review it in detail.

SECTION AT CHARLCOMBE.

It will be seen by reference to the map, that the village of Charlcombe lies due north of Bath, niched into the hollow of one of the numerous pretty combs scooped out by the action of the retiring waters, when the coast-line, of which it forms a part, was slowly emerging from the waves of the ancient "tertiary" ocean. The direction of the Valley itself is about N.W. and S.E., and is traversed throughout the greater portion of its length by a small rivulet, which takes its rise in a deep gully, not far from the Church, and it is this gully which affords the Section to which I have adverted.

After passing over the entire thickness of the Lias Clays, which at this point I cannot estimate at less than 600 or 700 feet, the gully intersects the highest beds of the Upper Lias Shales, which are here seen dipping downwards at a considerable angle, the result

apparently of subsidence, and overlaid by Oolitic drift, which covers all the superior deposits. About 25 feet of these Shales are exposed, distinguished by their well-marked character, no less than by the Liassic Cephalopoda, portions of which are abundant. The Shales are overlaid by the "Sands," a series of alternating micaceous Sands and Sandstones, from 60 to 80 feet thick, which appeared to be wholly unfossiliferous. To these "Sands" succeeds the Inferior Oolite rock, about 25 feet in thickness, and exhibiting the following succession of beds, which will be found to be remarkably persistent in character and extent throughout the Bath district:—

1. *Basement bed*.—A hard rock, full of fossils, and especially characterised by the prevalence of *Trigonia costata* and *Rhynchonella spinosa* } 4 to 5 feet.
2. *Coarse Bastard Freestones*.—Rubbly in their upper portions—slightly fossiliferous. } 20 feet.

Now, the point to which I particularly desire to invite attention, is to the fact of the *Trigonia* and *Spinosa Beds*, forming the *base of the series*, and to their being surmounted by 20 feet of freestones; thus apparently inverting the order of sequence exhibited in the Cotteswold sections, and I shall endeavour to show that this relationship holds good throughout the Bath district, extending even to Dundry Hill, where I found similar conditions prevailing.

INFERIOR OOLITE BEDS AT LYMPLEY STOKE.

On the line of railway between Bath and Bradford, and about three miles from the latter town, is the pretty village of Lympley Stoke, looking down upon the Valley of the Avon, whose green expanse is diversified by the frequent windings of the stream, and by the Trowbridge Canal, which traced along the foot of the hills forming the opposite boundary of the valley, is flanked for probably two miles of its course by the beds of the Inferior Oolite, which, emerging from beneath the clays of the Fuller's Earth, present a mural escarpment of extreme regularity until eventually lost beneath the overlying beds, under which they dip at a scarcely appreciable angle within a short distance of the town of Bradford. The extent and regularity of this section render it extremely valuable for the study of the Inferior Oolite series in this district, and it will be found to present characters in all respects similar to those exhibited by the same beds at Charlcombe.

The Canal is at this point hollowed out of the "Sands"—a sub-soil one would imagine, not very well adapted for the retention of water, and about two or three feet of the sands are exposed above the level of the Canal. Resting on these sands is the "basement-bed" of the Inferior Oolite, about three feet in thickness, charged with fossils, amongst which *Trigonia costata* and *Rhynchonella spinosa* are abundant. The texture of the rock is extremely hard and intractable, which renders it difficult to extract fossils in good condition. *Trigonia costata* is most frequently present in the shape of casts;

Rhyn. spinosa is plentiful, and in the crevices of the rock an occasional example may be observed with the spines attached, though not easy of extraction. To these "Trigonia and Spinosa grits" succeed about 22 or 24 feet of impure bastard freestones, very much fractured and disjointed, and more or less rubbly and disintegrated in their upper portions—these beds are comparatively devoid of fossils, a small form of Terebratula perovalis appearing the most frequent.

The following list of fossils from the "basement-bed" will serve in some degree as a guide to the character of the deposit:—

Lima proboscidea.	Ostrea.
Trigonia costata.	Turbo capitaneus.
Trigonia, 2 species.	Natica.
Pecten.	Rhyn. spinosa.
Gryphæa Buckmanni.	— obsolete.
Gresslya adducta.	— inconstans.
Pholodomya, 2 species.	Terebratula perovalis.
Trichites, abundant.	Serpulæ, abundant.
Nautili and Ammonites portions, but not common.	

For this list, which does not pretend to give more than a mere outline of the contents of the beds in question, I am mainly indebted to Mr. Moore; but doubtless a careful examination would yield a far larger series to any geologist who could spare time for their investigation.

Besides the sections just described in detail at Charlcombe and Lympley Stoke, I examined detached portions of the lower beds of the Inferior Oolite at several points around Bath, and at the village of Turley, about seven miles from thence, just above the quarries at Meadgate, and found the "Trigonia and spinosa grits" forming the *basement-bed*, and resting immediately on the "Sands."

The question that naturally presents itself to the mind of a Cotteswold Geologist, upon a review of the foregoing considerations, is,—what is the position occupied by these Bath Oolites, relatively to the great development of the same beds in the neighbourhood of Cheltenham and Gloucester? Our able colleague, Mr. Lycett, in his clear and intelligent work on the Cotteswold Hills, divides the Inferior Oolites in that district into three stages, distinguished by their characteristic Brachiopods; the *lowest* of which is designated as the *Cynocephala Stage*; the *middle* as the *Fimbria Stage*; and the *highest* as the *Spinosa Stage*. Hence, we should conclude, if this arrangement be generally applicable, that in the neighbourhood of Bath the two lower stages of the Cotteswold Oolites have thinned out, leaving a special development of the *Spinosa Stage*, as the representative of the entire group, and this may possibly prove to be the case; but, in order satisfactorily to ascertain this point, it will be necessary to trace out the beds of the Inferior Oolite, from their area of greatest development in the neighbourhood of Cheltenham, Stroud, and Gloucester, to the position of diminished importance which they occupy in the neighbourhood of Bath.

DUNDRY HILL.

The Oolites of Dundry Hill, near Bristol, have always presented a problem of some difficulty to Cotteswold Geologists, who have found it no easy matter to apply their own local subdivisions to the 30 or 40 feet of rags and freestones there developed, so as to bring the two sets of deposits into harmonious relations with one another.

Mr. Lycett, though evidently entertaining some doubts respecting the true correlation of these beds, offers a solution of the question as follows:—He says, “at Dundry the quarries are capped with rag-stones, which seem to belong to the *Spinosa Stage*; this is underlaid by useful building freestones, and by sandy Oolite, in all nearly 50 feet thick, which, probably, represent the *Fimbria Stage*. The *Cynocephala Stage* is here represented by only half-a-yard of ‘*Sands*’ overlying the Upper Lias Clay.” We have here the Cotteswold series apparently identified at Dundry, and I visited the quarries with the expectation of being able to recognise the equivalents of the three stages as laid down by Mr. Lycett; but I am bound to record as the result of my observations, my persuasion that the Dundry beds are a repetition and extension of those at Lympsey Stoke and Charlcombe, having the *Trigonia* and *Spinosa* beds at the base, and resting on the “*Sands*” as in the last-named localities, but with a greater extension upwards of the freestones, which likewise assume at Dundry a purer grain, and more even and regular characters.

The Freestones at Dundry occupy the eastern extremity of the hill, from which point, followed along their line of strike, they rapidly attenuate, so that within an area of less than a mile from their point of greatest extension, they cease to be any longer traceable. The principal quarries are near the Church, and in what is known as the “Upper Quarry” the following beds are exposed:—

1. Rubbly beds..... 4 feet.
2. Hard gritty rock9 ,,
3. Freestone beds.....6 ,,

In these beds fossils are by no means abundant, or of good differential type; but lying amongst the débris which surround the margin of the quarry, I found a block of stone precisely identical in characters with the “basement-bed” at Lympsey Stoke, and like that charged with *Trigonia Costata* and *Rhynchonella Spinosa*. Whence derived was the question, and an inspection of that and the adjoining excavations affording no satisfactory explanation, I awaited the return of the quarrymen from their dinner to obtain information on the subject; and learnt, in reply to my enquiries, that the rock in question lies *at the bottom of all*, and reposes upon a stratum of clay, which in its turn rests upon *Sand*. The clay was described as a water-bearing stratum, and in sinking a well for water in the quarry, the workmen had brought up the blocks of “*Trigonia* and *Spinosa* grit” from the position indicated. The clay band would appear to be a merely local and accidental deposit; and I heard a

story of a man whose well was supplied from this stratum, who not being satisfied with the quantity of water yielded, and desiring to increase the supply, penetrated to the underlying sands, and lost the pure element altogether. The following is the succession of beds as furnished by the quarryman:—

Rubbly beds	4 feet.
Hard gritty rock	9 „
Freestone beds	6 „
Hard coarse freestone	3 „
Rubbly stone	8 or 9 „
<i>Shelly-bed</i> , containing <i>Trigonia</i> and <i>Spinosa</i>	3 „
Blue Clay	4 or 5 „
Sand	

in all about 33 or 34 feet, exclusive of the clay band. I could find no example of *Trigonia*, or *R. spinosa*, in the overlying beds; though Mr. Moore informed me that he had taken *R. spinosa* in a young form in the Upper Rags, and had even met with it as high up as the Bradford Clay.

The considerations which present themselves on a review of the foregoing facts, are of a nature to prevent hasty conclusions; but I think I have shown sufficient reason to justify and call for a more complete and methodical investigation of the intermediate circumstances which mark the passage of the Bath and Dundry beds into those of the Cotteswold series, so as to ascertain how far, and to what extent the division of the latter series into different stages, characterised by special Brachiopods, can be maintained over a more extended area; or whether such subdivisions are not of merely *local value*, and, in that respect, rather an hindrance than an aid when applied to the definition of beds, in the deposition of which different circumstances have in all probability prevailed.

*Annual Address to the Cotteswold Naturalists' Field Club, read by
W. V. GUISE, F.L.S., F.G.S., President.*

READ FEBRUARY 23, 1860.

GENTLEMEN,—In compliance with the custom of the Club it becomes my duty to lay before you an outline of the general working of our Society, and of the progress of Science in connexion with it, during the past season. In doing so, I am happy to have it in my power to congratulate you upon the results. It is true that I cannot point to many written papers as evidence of our activity; yet, in proof that we have not been idle, the records of our meetings will shew a goodly array of facts established, and of doubts resolved, which are after all amongst the most valuable results within the reach of local contributors to Science.

In estimating the advantages of such an association as ours, it must be borne in mind that the good which we effect is not limited to the registration of facts in connexion with local phenomena, essential and important, though such functions undoubtedly are. Our gatherings in out-of-the-way nooks and corners; our rambles over hill and dale, by pool and stream, in leafy woodland, or on breezy down; the free interchange of thought and feeling between congenial minds; all these conditions and circumstances tend to promote that love of Nature and of Natural Science, which the Field Clubs in especial have done so much to foster and develop.

The chief danger to be apprehended, perhaps, from the social character of our meetings is lest we should degenerate too much into the habits of mere "pic-nickers." From this risk, however,

our Society has been hitherto redeemed, by the valuable and important work done by the able observers and skilful Naturalists it is our good fortune to rank amongst our members. It will suffice to mention the names of Wright, Buckmann, Jones, Lycett, Brodie, and Symonds, to recall at once names of writers well known in the scientific annals of the country, and of whom some have by their works obtained a more than European reputation.

To preserve such a Society in its full vigour and activity, is no light responsibility for any individual, let his accomplishments or fitness for the task be what they may; and it was with the utmost diffidence, and with a heavy sense of the importance of the charge, that I permitted myself to be nominated for the office of President at the commencement of our last season; and this sense of responsibility was in no degree lessened by the fact, that I was called upon to succeed in office, one of the most justly popular Presidents that ever conducted the affairs of any similar association. My predecessor, Mr. Barwick Baker, was at the birth and founding of this Society; indeed, I may say, that in conjunction with our amiable friend, Sir Thomas Tancred, he was our parent and founder—"fons et origo"—and during thirteen years, in the course of which, his supervision never relaxed, nor was his tact found wanting; he saw it grow and gather strength, until our reputation stood amongst the highest of similar societies, and our example becoming contagious, gave rise to vigorous off-shoots in the neighbouring Counties, of which the Field Clubs of Woolhope, Malvern, Worcester, and Warwick are living and flourishing evidences.

With the strong sense then that I entertained of the disadvantage of following such a predecessor, I may well be believed, when I assert that it was with hesitation and reluctance that I consented to accept the office of President of the Cotteswold Club. Relying, however, upon the kind support of the members, and on the invaluable assistance of our able and indefatigable Secretary, Mr. Jones, I undertook the duties of the office, and I am thankful to say, that thus sustained, I have found my task comparatively easy; and at this, the termination of my year of office, although, as I have said, our proceedings have not been illustrated to any extent by written contributions, yet I can point with satisfaction to the work accomplished, to the healthy and vigorous condition of the Club, to our increased numbers, and to the undiminished interest in our proceedings, as testified by the usually full attendance at the different places of meeting.

The annual Meeting of the Club was held at the "Ram Inn," Gloucester, on the 15th of February, 1859, when T. B. Ll. Baker, Esq., after reading an address reviewing the proceedings of the past year, to the regret of the Club, vacated the Presidential chair, Professor Buckman at the same time retiring from the post of Secretary.

W. V. Guise, of Elmore Court, was then elected President, and John Jones, of Gloucester, Secretary, for the ensuing year.

A discussion then ensued upon a proposition of the President, "that the Club should no longer be limited to 50 members," which proposed alteration was finally determined upon.

A party was afterwards organised to visit the "Marlstone" quarries at Churchdown, in which several members joined; whilst others visited Highnam and Lassington, or inspected the Secretary's interesting Cabinets of fossils.

About 30 gentlemen sat down to dinner, which was served by "mine host" of the "Ram" in a style which drew forth well-merited encomiums.

After dinner the following new members were elected:—

J. J. Watson, Ph. D., F.G.S., &c.,
 Rev. F. Smithe, M.A., F.G.S., Churchdown.
 Charles Prentice, Esq., Cheltenham.
 Dr. Buchanan Washbourne, Gloucester.
 W. C. Lucy, Esq., Gloucester.

The President read a paper upon the "Oolites in the neighbourhood of Bath;" the purport of which was to shew, that throughout the Bath district, and extending even to the quarries at Dundry, the *Trigonia* and *Spinosa* beds, which occupy the upper zone of the "Inferior Oolite" in the neighbourhood of Gloucester and Cheltenham, and overlie the well-known freestone-beds in that district, are there found resting immediately upon the so-called "Lias Sands," and having above them beds of bastard freestone, which at Dundry, in particular, assume the form of a true freestone, and are worked as such.

The reading of this paper gave rise to an animated discussion, which assumed at length, to the regret of all listeners, the form of a personal altercation. Surely, it is not out of place here, to express the hope that, that most useful feature of our meetings, the discussion of points of scientific interest and importance may be conducted without acrimony and without "o'erstepping the modesty of nature." Let us remember that there can be *no dogmas in science*. The experience of every day is teaching us how dangerous it is to lay down laws, and to insist upon the adoption of theories as though they were incontrovertible truths, more especially in Geology. The vast book of Nature is open to all; but he only is a true philosopher and a worthy interpreter of her pages, who reads in a humble and teachable spirit, feeling after all, how small a portion the wisest among us can hope to have the privilege of contributing to the great ocean of Truth, the depths and boundaries of which lie all undiscovered beyond. "In Geology," says General Portlock, in his Address to the Geological Society, "there can be no partizanship, as the object is not to support the territorial rights of formations, but to arrive at truth."

With these observations, which I hope will not be deemed intrusive, I will proceed to give the substance of the remarks which fell from our able colleague, Dr. Wright, with reference to the beds referred to in the President's paper before-mentioned. He divides

the Inferior Oolite into three zones, whereof he styles the *lower* the zone of *Ammonites Murchisonæ*; the *middle* the zone of *Ammonites Humphresianus*; and the *upper* the zone of *Ammonites Parkinsoni*; these subdivisions having different degrees of development in different parts of the counties of Gloucester, Somerset, and Dorset, being thick, thin, or absent, as the case may be. The upper zone is, he states, the most persistent throughout England, France, and Germany. The middle zone is only feebly represented in the northern Cotteswolds, but fairly developed at Dundry; the lower zone having its best development near Cheltenham.

The Charlcombe and Limpley Stoke beds near Bath, are referred by the Doctor to the upper zone, the middle and lower zones being absent.

For a more ample and complete exposition of Dr. Wright's views upon this subject, I would refer enquirers to the very learned paper upon "The Subdivisions of the Inferior Oolite in the South of England," read before the Geological Society, in April, 1859, and now published in the February number for the present year of the *Quarterly Journal* of the same Society. It is a masterly resumé of the entire subject, conducted with admirable patience and research, and illustrated by an amount of learning both literary and palæontological, which must ever render the paper indispensable as a work of reference to all students of the Oolitic Series, whether they accept the Doctor's limitations and subdivisions or not.

May 11.—The Club met at the "Lamb Inn," Cheltenham, and mustered in considerable force. After breakfast, an omnibus conveyed the party to the foot of Cleeve Hill, where the Geological Section, under the direction of the late President, and Messrs. Brodie, Norwood, and Jones, proceeded by the lane which passes between the "Rising Sun" and Mr. Dobell's residence at "Cleeve Clouds," to investigate the stratigraphical position of the so-called "Roadstone" of the district, the characteristic fossil of which is *Terebratula Phillipsii*. While the Entomological Section, represented by the President, and the Rev. T. A. Marshall, took the lower ground through the village of Bishop's Cleeve.

To the Secretary, I am indebted for the following account of the proceedings of the Geologists, and for the very valuable list of fossils annexed, of which few could have furnished so ample and reliable a catalogue:—

These beds—those containing the "Roadstones"—are clearly much out of place, and must, when "in situ," have been superior to those of the *Fimbria Stage*, which now cap the hill immediately above them. Previously to having seen them, the Secretary, from the account given of their fossil contents by Messrs. Norwood and Bromby, ventured to assign to them a stratigraphical position, and the subsequent examination of their organic contents, as well as of their lithological characters, confirmed him in the opinion he had expressed; namely, that these beds are the equivalents of those, which at Ravensgate, Cooper's Hill, and Haresfield, immediately

underlie the well-developed "Gryphite grits," and contain the greater numbers of the fossils in the following list:—

Brachiopoda.

- Terebratula Phillipsii*.
 ————— *Buckmanni*.
 ————— *perovalis*.
Rhynchonella spinosa.
 ————— *quadriplicata*.

Monomyaria.

- Avicula costata*.
Gervillia tortuosa.
Gryphaea Buckmanni—in the more rubbly portions.
Hinnites tuberculosus—Goldf.
Lima proboscidea.
 ————— *bellula*.
Ostrea (Marshii)?
Pecten—Scarcely distinguishable from the *P. pleuro-*
nectes, and from the large smooth *Pecten* of
 the Lias Marlstone.
Trichites—Large fragments.

Dimyaria.

- Astarte rhomboidalis*.
Cardium ————— ?—Large casts.
Gresslya abducta—Very large.
Cucullæa ————— ?—Casts.
 ————— *oblonga*.
Lithodomus? fabella—Abundant.
Macrodon hirsonensis.
Modiola ————— ?—Hull.
Pholodomya fidicula.
Pholodomya ————— ?—A large species, apparently
 unnamed.

- Trigonia costata*.
 ————— *decorata*—Lycett.

Gasteropoda.

- Melania striata*.
 ————— *leckhamptonensis*.
Pleurotomaria—(Casts).

Cephalopoda.

- Nautilus*—Large species, broken and in casts.
Ammonites Humphresianus.

It may be observed that, at Cooper's Hill, good and typical specimens of *Terebratula Phillipsii* not unfrequently occur, as well as of *T. Buckmanni*, the latter most frequently, in a sandy-bed at the base of the "roadstone;" whereas at Cleeve, from one block of stone, may be obtained numerous specimens, which present every conceivable shape of character between *T. Buckmanni*, and what

would generally be considered immature forms of *T. Phillipsii*, the aged and typical form of the latter occurring most frequently in the upper and more rubbly portion of the quarry. These observations lead naturally to the inference that *T. Buckmanni* will eventually be pronounced to be merely a young form of *T. Phillipsii*, as we have only to produce—using the term in its technical sense—the outline of typical *T. Buckmanni*, to obtain the perfect form of the other species.

It is also worthy of remark, that in the *Trigonia beds* at Haresfield, which are no longer gritty, but flaggy in structure, and from which the contained fossils may be disembedded without much difficulty, a form of *Terebratula* abounds, which is generally called *globata*; but upon comparing it with its predecessors, to which the foregoing remarks apply, it will be seen at a glance that it quite as nearly resembles them, as the species to which it is generally assigned.

The entomological event of the day was the capture, by the President and Mr. Marshall, of six individuals of the rare rhynchophorous beetle *Platyrhinus latirostis*, taken upon decayed ash-pollards, feeding on *Sphaeria concentrica*—(Berkeley), *Sph: fraxinea*—Sow., with which their trunks were embossed.

On Thursday, 19th of May, the Club assembled at Apperley Court, by invitation from H. Strickland, Esq., to meet the gentlemen of the Malvern, Woolhope, and Worcester Nat.: Hist.: Field Clubs; and were entertained in a style of genuine old English hospitality, which well illustrated the high esteem and regard in which the kind-hearted host holds the cultivators of those delightful sciences, from which he has himself, during a long life, derived so much pleasure, and with which the name of his family will ever be honourably associated.

After dinner, by permission of our host, scientific discussion was invited, and the

Rev. W. S. Symonds, of Pendock, President of the Malvern Field Club, proceeded to announce the discovery of a *Pteraspis*, an "Old Red Ganoid" in the Lower Ludlow Rocks of Leintwardine, by Mr. Lightbody. This is a most important discovery, as fish-existence is thereby carried two steps lower in the geological scale than it had been previously supposed to range. In the words of Mr. Symonds, at a recent meeting of the Malvern Field Club, "this discovery greatly antedates the period during which fish have been proved to have existed; for the whole thickness of the 'Upper Ludlow Shales,' and the 'Aymestry Limestone' intervenes between the grave of the *Pteraspis* of the 'Upper Ludlow Shales,' and that of the *Pteraspis ludensis* (Salter) of the Lower Ludlow Rock of Leintwardine."

Mr. Jones then introduced to the notice of the meeting, the remarkable discovery made by Dr. Falconer, in the Cave of Maccagnone, near Palermo, of human implements in flint, together with

the fæces of a Hyæna, and the teeth and bones of extinct Mammals, cemented underneath a stalagmitic deposit to the roof of the cave; from which Dr. Falconer drew the inference, that the cave had been filled to the roof during the human period, so that a thick layer of bone-splinters, teeth, land-shells, and human implements, had been agglutinated together, and that, subsequently, and within the human period, such a change had taken place in the physical configuration of the district, as to cause the cave to be emptied of its contents, excepting the patches cemented to the roof.

This is only one of the many startling facts which have been of late brought to light; which, with accumulating force and volume, seem to constrain the admission that man was at one time contemporaneous, not only with animals now extinct, but with a conformation of surface, and a distribution of land and water, very different from that which now exists on the surface of the globe.

The occurrence of human implements associated with the teeth and bones of extinct species of Elephant, Rhinoceros, Bear, Hyæna, Tiger, Stag, and Ox, in stratified gravel on the Chalk-hills of the Valley of the Somme, near Abbeville, and at St. Acheul, near Amiens, together with the late discovery in Brixham Cave, in Devonshire, of flint weapons in company with the bones of extinct animals, have brought the co-existence of them with man prominently forward amongst Geologists, who seem to be arriving at the conviction, that man and the extinct mammals referred to, were at one time contemporaneous, and if so, and the physical facts in connexion be correctly interpreted, then it would appear to follow, that the existence of man upon the earth must be ante-dated to a period immeasurably far beyond the 6,000 years to which the human epoch has been usually limited.

These are indeed startling facts, and the wonderful conclusions to which they seem to lead, may well make us hesitate before we adopt them in their full extent. Nevertheless, howsoever our interpretation may be at fault, the facts of Nature are incontrovertible. They are the acts of *the Almighty Creator Himself*, and have been written by Him "for man's understanding," in characters as imperishable as the rocks on which they are inscribed; and we may feel perfectly satisfied that *if the facts be true*, and they be *truly interpreted*, we must accept the conclusions, no matter how much they may appear to militate against preconceived opinions, or against the apparent meaning of written records.

On Wednesday, the 15th of June, the Club met at Dursley. The President, Secretary, and the Rev. J. H. Deane, proceeded from the Berkeley-road Station through the Stinchcombe Marlstone quarries, where nothing worthy of record was found, to a quarry, on the top of the hill above Dursley, where the stratigraphical relations of the beds are well shown. In descending

order the *Trigonia grit* comes first into view, then a bed about eight feet in thickness, without any distinctive fossil, so far as we could discover, and then the "freestone," which is at that point about 60 or 70 feet thick. The *Fimbria bed* appears to be totally unrepresented. Below the "freestone," the *Cephalopoda bed*, and the upper portion of the subordinate "Sands," come into sight; but the beds, intervening between these and the base of "the freestone," are obscured by rubble.

The "Sands" were here tenanted by a colony of Mason-wasps, *Odynerus spinipes*, accompanied by their parasite *Chrysis bidentata*.

After breakfast the party, with a considerable addition to its strength, proceeded to Peakdown, in a road-cutting on which is displayed the best section of the Supra-liassic Sands yet visited by the Club, as they here attain to an estimated thickness of at least 200 feet. Upon these reposes, well-exposed, the "Cephalopoda bed" with all its characteristic Ammonites, with the addition of many other interesting fossils, of which the following list was made:—

- Ammonites jurensis.*
- *variabilis.*
- *radians* and var. *Thouarsensis.*
- *opalinus* and var: *Moorei.*
- Belemnites irregularis.*
- *abbreviatus.*
- Nautilus inornatus.*
- Trigonia Ramsayi*—(Casts).
- Opis.*
- Astarte.*
- Turbo capitaneus.*
- Pholodomya Zietheni.*
- Pecten demissus.*
- Cucullæa.*
- Gresslya abducta.*
- Modiola plicata.*
- Lucina.*
- Serpula.*

A large *Pinna* and *Ceromya bajociana*, with other fossils, were found in the upper portion of this bed; but, as at Haresfield and Frocester, these have all been found only in the upper zone, and as it was exceedingly doubtful whether they were here *in situ*, to say nothing of the very doubtful character of the matrix in which they were embedded, the Secretary decided upon rejecting them.

While the majority of the party remained here, the President, Secretary, and others crossed the intervening valley, and made for Uley-Bury. About half-way up the hill, and at about the middle of "the Sands" before referred to, the Secretary discovered an intermittent nodular band of brown stone, similar to that

described by Mr. Lycett, as occurring at the base of the same beds at Nailsworth, and containing a great number of the same fossils.

This most interesting discovery again raised the moot point respecting the relationship of these "Sands" to the beds immediately above and below them. The Secretary, in common with others of our most observant and skilful Palæontologists, deeming that the passage thus traced throughout these "Sands" of Oolitic forms of lamellibranchiate Molluscs in greatly preponderating proportions, intermingled, however, with true liassic forms, determines the transitional characters of the beds in question, and entitles them to have assigned to them a distinct position as an intermediate zone between the Lias and the Inferior Oolite. On the other hand, our learned colleague, Dr. Wright, arguing from the liassic type of the Cephalopods in the bed above, allocates the "Sands" with the liassic series below; this too being the position now generally assigned to them by the leading Continental Geologists. It is, however, but just to add, that English Geologists seem by no means as yet to have made up their minds upon the subject. It appears to me to be quite one of those points which a local society like ours may well set itself to clear up; though, in doing so, it must be borne in mind that the facts which we furnish, though most valuable, are strictly local, and must be considered, not merely with reference to the phenomena which they more immediately illustrate, but that they must be compared with facts, from other and more distant localities, carefully collected by competent observers, and all bearing upon the same point. Thus, and thus only, can we hope to arrive at truth, and by degrees to unravel the great mystery of the succession of life during the countless ages of geological development.

At this Meeting the question of the Cleeve Hill *roadstones* was again brought under discussion, when Dr. Wright fully assented to the position assigned to them by the Secretary, and proceeded to explain his views upon the subject by a lecture, which he illustrated by diagrams with chalk upon a black board.

Dr. Wright has favoured me with the substance of his remarks in writing, which I deem of sufficient value and importance to embody in this address. They are as follows:—

Remarks, by Dr. WRIGHT, on the "Roadstones" of Cleeve Hill

On leaving the Winchcombe road, about a quarter of a mile beyond the "Rising Sun," by the new stables, and ascending the escarpment at this point, the "Pea-grit" is seen in situ near the wall, containing *Terebratula simplex*, *Pygaster semisulcatus*, numerous fragments of Pentacrinites and other fossils of this rock. A few yards above, the Freestone, much displaced, crops

out. Southwards, and still higher up the hill, we enter the quarry called by the workmen the "Rolling-bank." In Sheet 44 of the Geological Survey this escarpment is marked "tumbled Oolite and undercliff," names which alike indicate the disturbed condition of the beds, produced probably by a slip of the Oolitic strata over the unctuous clays of the Upper Lias.

The *Lower Trigonía Grit*, which is seen in situ on the plateau above, has here rolled over and formed the glacis of the hill, it has thereby covered the beds of the "Humphresianus Zone" which immediately underlie it. Recent workings having more fully exposed these "Humphresianus" beds than formerly, I have collected therefrom, a series of fossils characteristic of the "Fauna" of this zone—and have lately ascertained the stratigraphical sequence of the beds composing this middle division of the Inferior Oolite in the northern Cotteswolds.

The "Rolling Bank Quarry" is capped by about 18 inches of the "Lower Trigonía Grit," composed of loose incoherent fragments of a light coloured Oolitic limestone, beneath which are exposed the uppermost beds of the "Humphresianus" zone, consisting of

No. 1.—The *Phillipsii-bed*—is a light buff coloured, compact earthy limestone. Many of the blocks are composed of the shells of *Brachiopoda*, of which that of *Terebratula Phillipsii* greatly predominates. The bed measures from two to four feet in thickness, and contains,

Lima proboscidea—Sow.
 Pecten —————?
 Terebratula Phillipsii.
 ————— perovalis,
 ————— carinata.
 ————— Buckmanni.
 Rhynchonella spinosa.
 ————— tetrahedra.

No. 2.—The *Roadstone-bed*—consists of a coarse brown ferruginous oolitic limestone, extremely hard and crystalline, in some parts traversed by sandy layers, in others, containing calcareo-siliceous concretions, which have a crystalline structure and uneven fracture; it forms a durable road-material, and is raised for that purpose. The bed varies from 10 to 15 feet in thickness, and contains a small assemblage of Mollusca, which are nearly all in a state of moulds; a few species have their tests preserved. The *Trichites* are very large, and sometimes well preserved in the rock, but cannot be extracted entire. *Pholodomya Heraultii*—Ag., attains likewise a gigantic size. The following species occur in the bed:—

Cephalopoda.

Ammonites d'Orbignana—Wr. *Brogniarti* d'Orb. non. Sow.

- Ammonites Humphresianus*—Sow.
 ———— *Broccii*—Sow.
 ———— *Braikenridgii*—Sow.

Gasteropoda.

- Chemnitzia Sæmanni*—Oppel.
Pleurotomaria fasciata—Sow.
 ———— *elongata*—Sow.
Turbo lævigata.

Conchifera.

- Ostrea flabelloides*—Lamk.
Hinnites tuberculosus—Goldf.
Lima proboscidea—Sow.
 ———— *Etheridgii*—Wr.
 ———— *nov. spec.?*
Trichites undulatus—Lyc.
Astarte excavata—Sow.
Mytilus explanatus—Mor.
Pholodomya Heraultii—Ag.
Homomya crassiuscula—Lyc.
Myoconcha crassa—Sow.
Pteroperna plana.
Trigonia costata—Sow.
 ———— *striata*—Sow.

Brachiopoda.

- Rhynchonella subtetrahedra*.

No. 3.—The *Ostrea-bed*, consists of a coarse brown ferruginous sandy marl, interstratified with inconstant layers of ragstone. The fossils are most abundant in the sand. This bed is about one yard in thickness, and contains,—

Conchifera.

- Ostrea flabelloides*—Lamk.
 ” ” var. *a.*
 ” ” var. *b.*
 ” ” var. *c.*
 ———— *pixiformis*—Wr. n. sp.
Pecten demissus—Goldf.
Lima proboscidea—Sow.
 ———— *Etheridgii*—Wr.
Gresslya abducta—Phil ?
Pleuromya tenuistriata—Ag.
Pholodomya Heraultii—Ag.
 ———— *ovulum*—Ag.
 ———— *media*—Ag.
 ———— *Davalqui*—Lyc.
Monotis tenuistriata—Wr. n. sp.

Annelida.

Serpula grandis—Goldf.

Echinodermata.

Clypeus Michelini—Wr.*Stomechinus germinans*.

No. 4.—The *Marl-bed*.—Beneath a thin band of clay underlying the “Oyster-bed” is a soft mud-stone which is only exposed at one or two points at the south end of the quarry; it contains many fossils with the shell preserved, but with the test in such a rotten state, that only a few species could be determined. From the position of the bed, and from its organic contents, it appears to be the upper part of the Oolite Marl, as this rock is in position and well-developed, within 200 yards of the “Rolling-Bank.” The following fossils were there noted:—

<i>Chemitzia</i> sp.	<i>Nerinea</i> sp.	<i>Modiola plicata</i> Sow
<i>Pecten lens</i> Sow.	<i>Cypricardia cordiformis</i> Desh.	
<i>Terebratula Etheridgii</i> Dav.		<i>Montlivaltia</i> sp.

From this Section it therefore appears that the Humphresianus beds at Cleeve Hill rest upon the Oolite Marl, and are capped by the Lower Trigonia Grit. The equivalent of the zone is only partially fossiliferous at Charlton Common, Leckhampton, Shurdington, and Cooper’s Hill. Doubtless if the rocks were worked the characteristic fossils would be found. For the grand development of the beds composing the zone of *Ammonites’ Humphresianus* the student must proceed to Dundry Hill where they are admirably exposed and richly fossiliferous, being capped by the beds forming the zone of *Ammonites Parkinsoni*, and resting on a thin bed of Upper Lias Sands.

In Somersetshire and Dorsetshire the middle division of the Inferior Oolite is likewise well developed and exposed.

With these notes by Dr. Wright I will bring to a close the question of the “Roadstones” of Cleeve Hill, the position of which may now be looked upon as definitively settled, all our local geologists having assented to the position laid down by the Secretary and Dr. Wright. This was the problem proposed for solution at our Cheltenham meeting, and it has drawn forth an amount of learning and research most creditable to the Geologists of our Club. It is in the elaboration of such local details that we can best serve the cause of science; and it seems to me most desirable, that keeping that aim in view, we should direct our attention as much as possible to special points of local difficulty and interest, whereby we shall be setting before us an object, the careful elucidation of which cannot fail to stimulate our individual energies, while at the same time it will secure well-merited honour to the Scientific Society to which we belong.

The next Meeting of the Club was held at Newnham, on the 13th of July.

The first point visited was Westbury Cliff, which has lately been carefully examined by the Secretary and Mr. Lucy, who have noted a section differing so materially from those already published, that by permission I will proceed to incorporate it in this resumé of our proceedings.

Section of Garden Cliff, Westbury, by J. JONES and W. C. LUCY.

Upon the Green and Red Marls of the "New Red Sandstone," dipping 2° S.S.E., which are here exposed to the depth of 70 or 80 feet, rest conformably:—

- 1.—A band of hard black Shale in which we first find coprolites which appears to be identical with those of the bone-bed above 2 feet
- 2.—A band composed partly of grit and partly of iron pyrites, its weathered surface exposing many teeth, coprolites, and shells of *Pullastra arenicola* .. 5 "
- 3.—Black Shale, like No. 1 2 "
- 4.—Band like No. 2, with *Pullastra arenicola* ... 8 inches
- 5.—Black Shale as Nos. 1 and 2 2 feet
- 6.—BONE BED, consisting chiefly of Pyrites, containing fine specimens of teeth, coprolites, palates bones, &c. 1 inch
- 7.—Black Shale as before, with coprolites, &c. ... 6 feet
- 8.—Pecten-bed 2 inches
- 9.—Black Shale 4 feet
- 10.—*Pullastra* bed 1 inch
- 11.—Shale 9 feet
- 12.—Grey nodular limestone of uncertain fracture, containing abundantly in places *Estheria* ... 1 foot
- 13 Clayey Shale 1 foot
- 14.—Limestone band containing, at its lower portion, a *Myacites*, probably *M. liassinus* of Quenstedt, and above *Monotis decussata* in great numbers. Brodie says also *Cypris* plants, *Cyclas*, and fish-scales ...
- 15.—Greyish blue Clay 2 feet
- 16.—*Bottom-bed* with *Modiola* and *Ostrea minima* ...

Although not traced at this particular spot, from other Sections in the neighbourhood, it is known that the beds distinguished successively by *Ammonites planorbis* and *Johnstoni*, *Ammonites angulatus*, *Bucklandi*, *abtusus*, *oxygnotus*, and *raricostatus*, and *Pentacrinus tuberculatus*, occur in due order, and accompanied to a great extent by the same fossils which are found in each of these beds of the same relative age in Germany.

The considerations arising from an examination of the preceding Section are of great interest, and suggest a subject for

investigation to which the Cotteswold Club may advantageously apply itself. As we have already seen in the case of the junction-beds between the Lias and the Inferior Oolite, so we see here exemplified, those mixed characters partaking of the features of two contiguous formations, which renders it very difficult to draw a line of demarcation, and to assign to each its exact share in the beds in question. Looking merely to mineralogical character, a casual observer would at once place his finger on the well-marked line of junction, where the "Red Marl" is opposed in strong contrast to the dark overlying clays in contact with it, and would, without hesitation, allot the one to the Trias, and the other to the Lias. But an examination of the fossil contents of the beds, as enumerated above, will lead to a very different conclusion.

The *Bone-bed*, which occurs about the middle of the series, is charged with vertebrate remains of a decidedly Triassic character; though in many localities the vertebrate remains of the bone-bed continue upwards in part into the blue stone of *Ammonites planorbis* above, and are even found in a separate liassic bed. Fossil remains of a similar type are met with at Westbury in the lowest band of the dark clay in immediate contact with the "Red Marl," and they are traceable upwards in the beds numbered 2 and 7 respectively. With No. 7, which immediately overlies the *Bone-bed*, we lose all further traces in this Section of these peculiar records of vertebrate existence, and after the interposition of eight feet of clay, the lighter colour of which may perhaps vindicate a mineralogical change in the circumstances of its deposition, we arrive at a very remarkable band which is characterised by the presence of *Estheria*, and from that circumstance is designated the *Estheria-bed*. This fossil, which was formerly considered to be a bivalve Mollusk, and as such received the appellation of *Posidonia minuta*, is now transferred to the Entomostraca, though with some doubts as to whether it be correctly referred to that Order of Crustaceans. Should such be the case, it may possibly suggest for it a freshwater habitat, a circumstance in some degree supported by the discovery by Mr. Brodie of Cypris, plants, and *Cyclas* in the limestone-band No. 13 which overlies it.

In the Journal of the Geological Society for November, 1856, Mr. Rupert Jones writing upon *Estheria minuta*, observes that, "Although the recent *Estheria* is a Marine Crustacean, yet since very closely allied forms are of fresh water habits, and since among bivalved Entomostracans, different species of a genus, and even the individuals of a species, occasionally live either in marine or in fresh water, there is no *certain* evidence afforded by the fossil in question whether the so-called *Triassic* deposits in which it is found were formed in rivers, lakes, or seas." According to Mr. R. Jones different species of *Estheria* are met with in

Devonian rocks and in those of the Carboniferous, Liassic, Oolitic, Purbeck, and Wealden. Nevertheless he is of opinion that "Although occurring so constantly in the different geological periods from the Devonian to the Wealden, and again in recent marine and fresh waters, yet it is in the Triassic deposits of England and the Continent, and in the plant-bearing beds of Virginia and Central India, that this little bivalved Entomostracan appears to be pre-eminently abundant, so as to serve probably as a faithful index of a peculiar geological horizon."

To the *Estheria-bed*, succeed about four feet of Clayey Shales, which are followed by the bed known as the *Monotis-bed*. This is one of the most remarkable in the district for the number of shells it contains of this species, in a beautiful state of preservation, with an occasional *Modiola minima* intermixed. The prevailing fossil on the under side of the slabs on which *Monotis* is found, is a *Myacites*, which much resembles, if it be not identical with *Myacites liassinus* of Quenstedt, and is interesting as being the first of that genus and family subsequently so extensively developed throughout the Jurassic period. *Monotis* seems properly to be considered a sub-genus of *Avicula*, differing no more from the species with prolonged bases or hinge-lines, which subsequently take its place, than do the *Meleagrine* from the *Aviculæ* of the present time. Considered then as an *Avicula* it is a form which is known to us in the "Caradoc" and probably lower still.

From a consideration of the foregoing circumstances it will be seen that in connexion with mineralogical characters entirely liassic, we have a zone of life which as certainly appears to have its affinities with the preceding period. How far it may be wholly assignable to the "Trias" as has been done by some competent geologists, may perhaps still admit of question. Many regard the entire zone, comprising on the Continent of Europe a succession of beds not less than 200 feet in thickness, as representing a truly transitional period, and as such entitled to a separate and distinct rank, having analogies with both the contiguous formations, yet strictly assignable to neither. Here at any rate is a field for study and observation which can only be successfully worked out by a careful comparison of the series of beds as displayed in our own county at Westbury, Wainlode, Aust, &c., with the same beds at Binton and other localities in Warwickshire, at Penarth near Cardiff, at Axmouth in Devonshire, and wherever else they may be exposed in the British Islands; and these again must be correlated with those on the Continent of Europe, where a more extensive development illustrated by a far larger series of fossil remains, will no doubt eventually enable geologists to determine with exactitude and correctness, the true value of the beds in the geological scale.

With reference to the upper beds of the "New Red," and in

illustration of what may be done by bringing local knowledge to bear upon particular facts, it may not be out of place here to introduce to the notice of the Club certain circumstances which have of late created a great sensation amongst geologists, and which serve again to warn us against accepting the dicta of even the most accomplished minds as though they were not only unquestionable, but as if it were heretical to question them.

The reptiliferous Sandstones of Elgin, in the North of Scotland, have been long celebrated as furnishing the fossil remains of certain reptiles of which the *Telerpeton elginense* and the *Hyperodapedon Gordoni*, both highly organised reptilian forms are the most notable. These Sandstones have hitherto been attributed to the age of the "Old Red Sandstone" by all geologists, including Sir Roderick Murchison, Professor Ramsay, and Hugh Miller. At the same time, however, there have not been wanting those, who looking to the type of the animal remains, have doubted their palæozoic character, though they hesitated in the face of such concurrent authority to admit their claims to a place in the mesozoic series.

Previous to the meeting of the British Association at Aberdeen, Mr. Charles Moore, of Bath, visited the neighbourhood of Elgin, and from his knowledge of the palæontology and geology of the Liassic and Triassic periods, completely changed the geologic history of these Elgin Sandstones. He discovered, by comparison of fossil evidences, that the so-called "Old Red Sandstones," were in truth attributable with all their contained reptiles and fishes to the age of the Trias, between which and the superimposed Lias, the intermediate junction-beds with the characteristic "bone-bed" are distinctly recognisable.

Upon the announcement of this discovery, the beds at Elgin were visited by the first physical geologists of the day, who have fully recognised and confirmed what the palæontological knowledge and acumen of Mr. Moore, had first afforded a clue to unravel, and I have authority for stating, that Sir Charles Lyell intends omitting the *Telerpeton*, and his companions from the list of Upper Devonian fossils in the forthcoming (6th) Edition of the "Manual."

The reptiliferous beds of Elgin are considered to be the equivalents of the *Rhncosaurus* "Sandstones" of Greenshill, near Shrewsbury, and of the "Waterstones" of Red Marley d'Abitot, and of Ombersley, in Worcestershire.

We will now revert to the proceedings of the Club after leaving Garden Cliff. The next point visited was a small isolated mass of "Upper Ludlow Rock," at the back of Flaxley School, which constitutes the lowest stratum displayed in that vicinity, of those beds, by the upheaval of which, the edges of the Forest Coal-basin have been formed. The "Tilestones" rest upon this boss, dipping inwards conformably, while the "New Red" rests almost

horizontally against their flank, having the same degree of dip as at Westbury, viz. : about 2° S.S.E. It is to be observed, that this point is not noted upon the Maps of the Geological Survey ; it has, therefore, probably hitherto escaped the notice of the staff of able and lynx-eyed Surveyors, by whose labours that magnificent national work has been so indefatigably and so successfully elaborated.

Wednesday, 17th of August. The Club met at Swindon ; the attendance was, however, but thin, not more than half-a-dozen presenting themselves at the rendezvous at breakfast ; of these, the majority proceeded on wheels to Abury, while the geological Section, represented by the President and Mr. Charles Moore, of Bath, the well-known palæontologist, addressed themselves to the geology of the district, which they traced from the quarries in the Portland Oolite above the Town, to the summit of the opposite chalk escarpment at Burdrop Park.

The *dirt-bed* in the Swindon quarry, which has yielded a very interesting series of fossils to the persevering industry and intelligence of Mr. Moore, was closely investigated ; but it does not yield up its treasures to every casual explorer ; and one valve of a *Cypris* was the sole, yet satisfactory result of much laborious examination.

In the course of the evening, Mr. Moore exhibited a beautiful series of minute organisms from this bed, concerning which he offered some interesting observations.

The band of dark sandy clay, marked No. 4 in the Section given in the Memoirs of the Geological Survey, Sheet 34, he considers to be the equivalent of the *dirt-bed* of the Swanage Section, and although he stated that he had as yet found no traces of Mammalia in it ; yet he has obtained teeth of *Macelodus Brodiei*, and of other reptiles found in the Purbeck strata of Swanage. But the remains of greatest interest are some minute vertebræ and articulated bones, which Professor Owen has decided to belong to a *perennibranchiate Batrachian*, an Order not previously known below the Tertiary beds.

Cypris is found in the same bed, and one or two species of *Chara*, with other fruits, and also a numerous series of Testacea.

This was a Ladies' Meeting, but I regret to say, that the Ladies did not respond to the invitation conveyed in the printed circulars, to the extent it was hoped they would have done. One only gracing the table with her presence. Let us hope this was due rather to the inconvenience of a somewhat distant locality, than to lack of sympathy with the object of our meeting. The occasional presence of the gentler sex at such gatherings of the Club, as may be favourable to their coming amongst us, should by all means be encouraged, as tending to exert a humanizing influence over the rougher nature of even the most intellectual of philosophers ; while the Ladies on their part, cannot fail of

imbibing some portion of the fervour and enthusiasm of the naturalist, at the same time that they derive benefit from the new sources of pleasure and interest opened up to them.

The last meeting of the Club for the season, took place at Cirencester, on Wednesday, 14th of September. The President was absent through ill-health, and is indebted to Professor Buckman for the report which follows:—

The Club met at the "Fleece Inn," Cirencester, but in consequence of the threatening aspect of the weather, few members were present. After breakfast, Messrs. Stronge and Bowly took the party assembled, in their carriages, to the old Church of St. Mary, Ashbrook, where the Norman tympanum of the north door, and a west window with peculiar flamboyant tracery, attracted great attention. Maiseyhampton Church was next visited, where the decorated east window, the sedilia and fine architectural morceaux of the early English period, much interested the ecclesiologists. In the Churchyard, under the south wall, were pointed out some specimens of the Elder-tree (*Sambucus nigra*), much sought after by the country-folks, for virtues supposed to exist in them, as set forth in Mr. Jones's paper upon "Certain superstitions prevalent in the vale of Gloucester," which was read to the Cotteswold Club at their meeting at Tewkesbury, in 1854. Poulton Church was next examined, the east window of which deserves attention. It is an early English 3-light window, plain outside, but with an elegant cinque-foiled hood, internally supported by semi-columns resting upon corbel-heads. A fine Section of the "Great Oolite" and "Forest Marble" was here examined, and explained by Professor Buckman.

After dinner Professor Buckman exhibited some fossil reptilian eggs found in the Great Oolite near Cirencester; and in the absence of papers gave a lecture upon the growth of *Carduus arvensis*, or Field Thistle, setting at rest the disputed point as to whether Thistles grow by seed, by exhibiting a pot in which eight seeds had come up out of ten sown. This furnishes us with some interesting facts in illustration of the history of thistle growth. It is known that these plants spread themselves below the surface by means of *Rhizomata* (underground stems), after the fashion of Couch-grass; and the knowledge of this fact has given rise to the widely disseminated impression that Thistles do not grow from seed. But this experiment of Professor Buckman shews that the seeds readily germinate; and such seeds being of the pappiform kind, and each flower producing about 150, while each plant on an average produces 20 flowers, it will readily be seen at what a frightful rate of increase this plant possesses the faculty of propagating itself— $150 \times 20 = 3000$ for a single plant, which if grown on a waste place may readily distribute seeds over an entire farm.

It will not be out of place here to notice the valuable results

of some further botanical experiments conducted by Professor Buckman in the Gardens of the Royal Agricultural College at Cirencester. The first has reference to the mode of growth of "Flax Dodder" seed, the method of its germination, and how it attacks its foster-parent and establishes itself. This has been made the subject of experiment, and a most elaborate article has been written thereon in the *Agricultural Gazette*. This, together with remarks upon about 200 experimental "plots," will be published in the reports to the British Association, which the Cotteswold Club may be pleased to know has made a grant of *Ten Pounds* towards defraying the expenses of these investigations in the Gardens of the Royal Agricultural College.

The next experiment by Professor Buckman is one of more than usual value and importance, as it has had for its object the ennobling of a wild root; and its complete success is of the highest interest, as bearing directly upon the intricate question of the origin of many of our culinary herbs and fruits, the descent of which, from their wild congeuers, has always been a subject of doubt and difficulty, it being by many believed that the wild plant, though cultivated for ever so long, will never produce an esculent variety. The Wild Carrot—*Daucus carrota*; and the Wild Parsnip—*Pastinaca sativa*, are amongst those whose absolute specific identity with the cultivated varieties appears to be indisputable, having all the characters in common excepting that of being fit for food. The Carrot, I believe, has hitherto resisted all attempts at civilization, and continues obdurate and intractable; though I do not despair of hearing that under Professor Buckman's superintendence and persuasive manipulation, the refractory nature of the plant has been overcome, and that a new variety of that useful esculent has been added to our list of culinary roots.

With the Parsnip, however, the learned Professor has been entirely successful, and the "ennobling" of Wild Parsnips has this year arrived at such perfection, that a new variety of the root has been established, and the seed of it can be obtained from Messrs. Sutton, of Reading, under the title of "The Student Parsnip," which is reported to be a most compactly formed root, of a clear unbranched outline, and of a fine flavour.

It will not have escaped observation how large a portion of the foregoing pages is dedicated to the records of Geology. This is no doubt a most attractive science. The objects which it embraces are amongst the grandest and most exciting to the imagination to which the intellect of man can apply itself. It has been remarked that Geology ranks next to Astronomy in the sublimity of the facts of which it takes cognisance. Looking, moreover, to the almost perfect development of the geological series in some of its most important epochs, as displayed in this county, and further at the vast bulk of geological history exposed for

investigation, from the "Upper Llandovery" beds at May Hill, to the Coral Rag and Oxford Clay in the neighbourhood of Fairford, illustrated throughout, in many parts profusely, by a series of fossil organisms, whose numbers and variety seem to increase the more the containing beds are examined—looking, I repeat, to all these circumstances, we cannot feel surprise that so many labourers should be attracted into such an absorbing and exciting field of investigation, and that so few, comparatively speaking, of our number should devote themselves to those other branches of Natural Science, the study of which, though perhaps yielding results less specious, yet forms the foundation of all sound geological learning, and offers to those who will dedicate themselves to the work, prizes at least as great, results quite as important, as those which have conferred distinction upon so many Naturalists from the days of Aristotle to the present time.

A consideration of the foregoing circumstances, and of the extreme desirability of extending the range of subjects of which the Club takes cognisance, induces me, whilst urging the increase of our numbers, to endeavour to establish among us Sections for the more especial study of Zoology and Botany, by whose accumulated labours we might hope gradually to amass a fund of materials, out of which a complete Natural History of the County might one day be elaborated. Such an aim seems to me a noble and a useful one; and one to which the Cotteswold Club may worthily apply itself.

The Botany of the County has found an able expositor in our colleague, Professor Buckman, who, sixteen years ago, published a little Handbook to the Botany of the environs of Cheltenham, which, as the first attempt to tabulate the plants of an interesting historical district, is of great value, and contains, within a limited compass, principles of arrangement capable of being adapted to the illustration of the Botany of the entire County. This is a study which should recommend itself especially to our Lady friends, whose co-operation I would earnestly solicit. It would afford them never-failing interest and pleasing occupation, while, as fellow-labourers with ourselves in the field of local science, they might greatly aid in carrying out the objects we have in view.

The Club numbers amongst its members two or three Entomologists, to whom we may look for good work among the Insects. I have already recorded upon the face of our proceedings the occurrence of the rare beetle *Platyrhinus latirostris*, to which I desire to add a few more Coleoptera worthy of notice which have come under my own observation.

Chrysomela distinguenda—Taken in a great Oolite Quarry, near Sherborne, in this County.

Anobium pertinax—Taken under the bark of a pollard willow in March.

Synaptus filiformis.—*Ctenonychus hirsutus*, Stev.—Hitherto esteemed rare; but taken by me in abundance on the bank of the Severn, in June.

Elater balteatus.

Ptinus imperialis.

Astynomus œdilis.

Sciaphilus muricatus.

Grypidius equiseti.

Of the beautiful and favourite order of *Lepidoptera*, there are many more students than of the less showy and more intricate *Coleoptera*. From one of these, Mr. Bingham, of Newnham, I have received the following notice, which I proceed to transcribe:—

“The Sallows last spring were very unproductive, for although I worked them well, they only gave the common species, such as *gracilis*, *cruda*, *stabilis*, *rubricosa*, &c. In 1858, I took two *leucographa*, and a friend met with *rubiginea*. In April, I took *Leiocampa dictæa* on a gas-lamp, for the first time in this district. In June, the woods were full of life. In company with a couple of entomological friends, 113 species were taken between the 7th and 11th of the month, of which the names were noted, as well as many others in the smaller groups of which we had no knowledge. Amongst those noted, occurred *Eupithecia debiliata*, hitherto supposed to be confined to Devonshire—*Aporia cratægi*—*Charocampa elpenor*—*Euthemonia russula*—*Hepialus vellela* (new)—*Hadena thalassina* (new)—*Hadena W-latinum* (new)—*Thyatira batis* (new)—*Macaria notata*—*Eupithecia pulchellata* and *coronata*—*Acidalia trigeminata*—*Asthena sylvata*—*Minoa euphorbiata*—*Melanippe hastata* and *unangulata*—*Roxana arcuella* (new)—*Saxmasia Wæberana*, &c. Those to which the adjective ‘new’ are affixed, are new to my local list.”

“During the five years that I have imperfectly worked this district, I have taken, within walking distance of Newnham, about 500 species of *macro-lepidoptera*, including the *Tortricinæ*, but exclusive of the *Crambidæ*.”

Procris globulariæ.

Sphinx convolvuli.

Acherontia atropos.

Stauropus fagi.

Pterostoma palpina.

Leiocampa dictæa.

———— *dictæoides*—(larva).

Notodonta ziczac—(larva).

Trichiura cratægi.

Pæcilocampa populi.

Prodelia literalis—An extremely rare insect, only the second instance of its occurrence in Gloucestershire, the other occurred at Bristol.

Geometra papilionaria.

Ennomos tiliaria.

———— *fascantaria.*

———— *erosaria.*

Macaria alternata.

———— *notata.*

Tephrosia extersaria.

Acidalia fumata.

Harpalyce—All except *picaria* and *sagittaria.*

Collix sparsata.

Asthena Blomeri.

“These are among the more noticeable insects that have come under my observation; and I have no doubt that where the Dean Forest well worked, it would rank with any district in England or Scotland as respects the number and variety of the ‘Lepidoptera’ indigenous thereto.”

I have now, I believe, Gentlemen, touched upon all those matters which seem to me to require notice; and in concluding this address, I will repeat my thanks for the support and assistance so freely accorded me, while at the same time I urge a continuance in that course of energetic perseverance, united with good feeling and brotherly kindness, which has so long characterised the proceedings of the Cotteswold Naturalists’ Field Club.

*Annual Address to the Cotteswold Naturalists' Club,
January 27, 1857.*

By Professor JAMES BUCKMAN, F.L.S., F.G.S., F.S.A., &c.

IN order to account for my presence before you at this period, it will be sufficient for our members to be told that, the President had requested me to prepare the annual address for this meeting. We all know how his slightest wish is *law*, and how attention to his laws has usually resulted in benefit to our community; if therefore the present instance of obedience to, and respect for, his high commands should end in disappointment, pray cut *me* up as much as you please—but, for our President, I only hope he may consider me a sufficiently *juvenile offender* to warrant him in extending towards me his philanthropic support and protection, when, in all probability, I shall by next year be so far reclaimed as not to venture upon the like offence again.

Before reviewing the proceedings of our past session, I would call upon you to pay a tribute of respect to our departed associate the Rev. H. J. Bolland. I need not speak to you of his goodness of heart, of his kind and gentle manners, of his keen perception of natural beauties, qualities for which he was endeared to every one who had the good fortune to know him; yet I may say that, though no professed natural historian—no classifier of genera or species—yet was he a naturalist in the best sense of that term, as he was a lover of *nature*, who could draw from *her* contemplation abundant proof of God's Wisdom and Power, and the book of Creation was, in his hands, not a hindrance but a graceful help to the lessons drawn from the one he was ordained to teach.

The few secessions of the past session have been filled up by the election of Mr. Pierson, of Cheltenham, who will long be remembered for the active part he took (in conjunction with our talented associate Dr. Wright) in supplying and arranging the beautiful Geological Museum to which the British Association was welcomed at the Cheltenham meeting. An addition has also been made to our ranks by the election of Mr. G. F. Newmarch, solicitor, of whom it may be said that although his profession obliges him to pore over other *deeds*, even drier than the species list of the geologist or botanist, yet he chooses the study of nature as his relaxation, and to this end we hope he will frequently join the ranks of our field rambles.

In reviewing the field proceedings of the past session, I shall have to refer you to our places of meeting, premising that in no former year have we experienced a more regular attendance of members; and if, on review, it be found that our papers have not been so numerous as on former occasions, it could only arise from the always too brief interval between dinner and the departure of the train being amply and profitably filled up either in comparing notes of the ramble of the day, or in the discussion connected with some matter or object introduced by the members.

To begin with our annual meeting in this place, on the 29th of January last year. I find it recorded that after partaking of the hospitality of the Principal of the College, in the shape of a hearty breakfast, the Antiquarians visited the Corinium Museum, the tessellated floors of which had just been laid. On this occasion a hearty cheer greeted the noble Earl Bathurst, as a spontaneous thank-offering for his liberality in rearing so substantial a building for the protection and preservation of these works of the past. To-day you were again invited to visit this Museum, and I feel sure again to pay the tribute of respect, as since last year his Lordship has liberally allowed me to furnish the Museum with the necessary cases, &c. ; and at present we have seven handsome oak and glass cases, in which are arranged upwards of a thousand objects relating to the Roman occupation of the antient Corinium and its neighbourhood ; these I feel assured you were struck with, not from their intrinsic value, nor from their beauty of form, though there is much that is striking in this respect, but from the many articles they contain of domestic use ; a circumstance which you will understand if you examine a plan (suspended on the walls) of the dwellings which I excavated in 1852, as in these rooms were found the Statue of the Deity and his Altar. The living room with its valuable fictilia, some so prized as to have come down to us with the rivets by which its antient possessor had kept together its fractured portions ; its ornaments of *armillæ* and *fibulæ*, as perfect in form as when they first formed a tribute of affection or a sign of ostentation. The dividers (compasses) of the draughtsman—the shears, which did duty as scissors to the Roman matron—and the oyster knife, so like our own as to show us that we have now no better mode of opening the “refractory bivalves,” as Albert Smith calls them, than was to be found as much as 15 centuries ago. These, with cutlery, together with the hone-stones upon which it was sharpened, have only here been referred to, to show that the Collection of Antiquities in the Corinium Museum is particularly valuable as explaining to us some facts connected with the inner life of this interesting people, whilst, at the same time, we should feel thankful to them for having introduced to, and left among us, so many articles tending to advance our civilization.

Pardon this digression—if, as Mr. Bowly would say, we have been pursuing the wrong fox, we were soon led in the right direction by the Noble Proprietor of Oakley Park, who headed us through the park glades until we joined the Agricultural party at his Lordship's new farm buildings ; here the whole machinery was set in motion by the powerful engine completed last year, and the Geologists examined the well-sinking through the Great Oolite into the Fuller's Earth, a depth of 140 feet. The whole of this shaft was carried through beds of a more or less porous oolite, without a break either lithological or palæontological, a circumstance which gave rise to some discussion between Mr. Hull, of the Ordnance Geological Survey, and the Secretary—the

former gentleman considering a large portion of the shaft as representing the Forest Marble, the latter considering it as wholly belonging to the Great Oolite, and contending that certain clay beds, which occur higher in the series, where the true Bradford Clay is absent, present a natural division and one which can be carried out through a wide extent in this district. At a later period of the meeting, the Secretary presented a section of this well with others of the neighbourhood, and read a paper on the Geology of the water-bearing beds about Cirencester.

Having transacted the usual business of the Club, the members and friends, to the number of 40, sat down to a substantial dinner, which, from its abundance and small cost, was certainly a convincing proof that our dinner bill need not be extravagant when we have a liberal landlord to deal with; at the same time we must bear in mind that our long rambles make us good trenchermen, whilst our moderation in imbibition tends much to limit the usual profit, so that we may not wonder in these days of dearness that, even at the Lamb at Cheltenham, a petition was preferred after our last dinner there for additional pay.

Well, dinner over, after the usual toasts, and one to the health of the re-elected President and Secretary, followed by that of Professor Ramsay, the Director of the Ordnance Geological Survey, who honored us with his presence, a paper was read by Dr. Wright, on the section of Frocester Hill, the object of which was to show that a certain bed at the base of the Inferior Oolite, and formerly referred to that rock, should, in the Doctor's opinion, be held as part of the Lias; this view was supported by a reference more particularly to various Cephalopoda, (principally Ammonites and Belemnites,) most of which are peculiar to the bed itself, whilst others are such as belong to the Upper Lias, and at this meeting was introduced the *Ammonites bifrons*, which was triumphantly pointed out as proving the case; and indeed so startling was the production of this shell, as I understood from the bed in dispute, as in a great measure to stifle discussion upon the subject until the matter had been further looked into; and herein we have much to thank the learned Doctor for in directing our more particular attention to one of the most interesting sections in our county. The result, however, of my own labours at Frocester Hill, leads me to conclude that the *Ammonites bifrons* in question was obtained from a bed nearly 80 feet below what has been held to be the basement bed of the Inferior Oolite (the *Cephalopoda* bed of Dr. Wright), and as much as 20 feet from the top of the Upper Lias, and consequently that distance below the Inferior Oolite Sands of the Ordnance Surveyors. However, as this subject came before us at the Painswick meeting and again at Cheltenham, I shall shortly refer to it in another part of this address, only pointing out that the mistake is easily made, inasmuch as the steep scarp at Frocester has long been exposed to the action of the atmosphere, and hence its included iron has become

so oxidised as to render the clays and sands much of the same colour, and besides the upper sands have slipped down the slopes and become intermixed with the upper beds of the Lias.

The business, then, of our last College meeting concluded with the Secretary calling attention to a Section extending from the Vale of Gloucester, below Birdlip, along the Roman Road to Stratton St. Margarets; this, which was the result of the joint labours of our then Professor of Engineering, Mr. Armstrong, with a Class of Engineering Students, and myself with a Geological Class, had been carefully worked out in an Easter vacation; and I have at this meeting the pleasure of introducing to your notice another section, done in like manner, extending from the College through Moreton-in-Marsh to Shipston-on-Stour, in Worcestershire. The great interest of these Sections is that they have not been made hypothetically, but are the result of a systematic and combined survey, the Engineers taking the levels of the country surveyed, whilst the Geologists marked the strata, collected fossils, noted facts connected with quarries, wells, and the like, so that we hope these Sections may be satisfactorily appealed to for settling some important practical questions.

I cannot conclude my remarks upon matters connected with this meeting, and more especially in the presence of ladies, without referring to the charming wind-up of the day—and a most agreeable one too—afforded by an invitation to Mrs. Haygarth's tea-table. This kind lady evidently understands the natural history of naturalists, a fact which you will recognise more keenly when you know that the meeting of to-day resulted in the wish of Mrs. and Mr. Haygarth.

May 20.—The first summer meeting was appointed for the Painswick district, and we have to thank the managers of the Great Western Railway for depositing us at Haresfield, from whence we took the ascent of Beacon Hill, carefully examining the section there presented; ascending to the quarry we pass over an interesting fault, and at the very brow of the hill the strata have been washed away and the chasms filled up with oolitic debris and shingle, the former offering an example on a small scale of an undercliff, caused by subsidence resulting from the wearing away of the Oolitic Sands and Upper Lias by the Severn Sea, and the latter the result of that shingle deposit which may we traced along the Cotteswold scarps, as so cleverly pointed out by Mr. Hull. During this ramble we examined all the beds of the Inferior Oolite, being much assisted herein by the use of a beautifully detailed Section, worked out by our accomplished associate, Mr. Jones, and which, with his permission, I hope to publish in our proceedings.

June 17.—Mitcheldean was the place appointed for this month's meeting, and as I could not attend, I have to thank Mr. Jones, not only for making the necessary arrangements, but for a full

and most comprehensive report of the proceedings of the day, which I am sure you will thank me for giving you *verbatim et literatim*.

"Leaving Gloucester at 10.24, the party, consisting of Lord Ducie, J. H. Elwes, W. V. Guise, D. Bowly, and myself, and J. R. Wilton as a visitor, receiving the welcome addition of the Rev. W. S. Symonds, at the Grange, duly arrived at the Mitcheldean Road Station.

"The ascent of the Lea Bailey was immediately commenced, and the upturned edges of the Carboniferous Limestone, with its shales speedily found exposed for examination in the most satisfactory manner, and dipping from this position towards the centre of the forest basin, S.S.W., at an inclination of about 20 degrees. The Limestone appeared to contain very few fossils, but the shales yielded some slabs of a thin band of stone composed almost entirely of the shells of *Serpula* and *Spirorbis*, and of *Murchisonia*, and other small Gasteropods, interesting from the very great abundance in which they occurred. From this point the same stratigraphical line was followed to the neighbourhood of the Hawthorns, where, in a deep road cutting, may be seen the finest section of the transition beds between the Old Red Sandstone and the beds above mentioned, to be found in the district; no better could, in fact, be desired, from the high angle at which the beds are exposed. Descending the hill from the cutting to Drybrook, where the innermost of the two seams of coal laid down on the maps of the survey as below, or rather, at this point, outside the Grits which form the basin bed of the true coal measures is worked, the shale was found to be particularly rich in well preserved coal plants of the usual character. The vein of coal, locally known as the Coleford High Delf, was described by the miners as about five feet in thickness, of a quick burning quality, containing much sulphur, and therefore principally used for lime-burning and like purposes.

"The shaft open before us, was stated, upon the same authority, to be carried about seventeen hundred yards under the Grit which forms the bulk of the hill above it. Some sixty to seventy feet of this stone, which is familiar to all of us under its economic aspect of 'Forest paving,' is well exposed in a quarry immediately above the shaft, but the entire thickness of the stratum must be very much more considerable. These slabs, throughout their whole depth, as far as my observation extends, are more or less rich in impressions of *Calamites* and other plants, although these are probably more abundant in the lower than in the superior layers. An old quarryman here took some kindly interest in us, though manifestly sorely puzzled what to make of our pursuits and designs. He appeared finally to conclude that we were railway men, and was at some pains to point out to us the precise direction in which a certain projected 'stem road' was to go, and which has progressed to the point of having been, in Forest phraseology, 'dialled and pegged off.' (I consider the quaint conversion of

'theodolite' into 'dial' worthy of passing mention.) Discovering at this point that dinner, according to time, must be nearly ready, all faces were turned towards Mitcheldean, where at the George it awaited us.

"So much for the Geological section; and much it rejoiceth me to say, that I can upon this occasion refer to another which has not been heard of in the annals of the Club for many long days. Mr. Guise and your unworthy scribe, assisted by Mr. Wilton, devoted themselves principally to the entomology of the day, and verily their exertions were not all unrewarded. The Fern-chafer (*hiatus* for *swell* name, which escapes me at the moment), which is, like all his tribe, in some years exceedingly rare, and in others exceedingly 'de trop,' is this year very abundant.

"While halting in one of the openings in a woody lane, to admire the novel scenery—the Malverns, the Clee Hill, the Sugar Loaf, the Black Mountains, and other distant and unfamiliar eminences, which stood out in the distance with truly remarkable distinctness of outline and feature, an insect of unusual style of flight suddenly attracted the attention of scribe, and disappearing was by him, asserted to have taken refuge with Mr. Wilton, who, on his part disclaimed all knowledge of the stranger, or any desire to be converted into a sanctuary, nevertheless scribe was right, and detected in a fold of his coat a fine specimen of *Silpha quinque-costata*, the third he had seen in our district, both the others having been taken on May Hill. It here occurs to me 'passim' that this is the only *Silpha* I have ever taken upon the wing, and all three specimens known to me were so taken, while all its cousins must be sought for under stones, carcasses, or other effluvious matter, although there can be no more doubt of the necrophagous scavenger habits of the species in question than of those of its congeners.

"Another beetle of the same tribe was very shortly afterwards taken, which is also not very common in our vale, *Oiceoptoma ruficollis* and *Oteniceras pectinicornis*.

"I leave Mr. Guise to give his own account of the moths and other insects captured by him. On the summit of Mitcheldean Hill, in the attempt to capture some water beetles, it was found that the shallow mud of a small pond was literally one living mass of the *Pisidium pulchellum*. *Cicindela campestris* was here found in great force.

"The dinner was such as to call forth special encomium, and I really think would have contented, whether for variety, quality, or cost, any member of the Club, which is paying Mr. Yearsley, the host, no mean compliment.

"The Earl Ducie, in the absence of our President, took the head of the table, confronted by W. V. Guise, Esq. The Queen having been duly honoured, the Rev. W. S. Symonds read a paper in part explanatory of the Geological sections examined during the day, and called attention to the discovery in strata of the

Alps, of presumed Triassic age, of Orthoceratites and Belemnites together, forms hitherto supposed to have been widely separated in time and distinctive of systems, of which each was considered to be one of the most remarkable organisms.

(See President of the Geological Society's anniversary Address, in the *Geological Quarterly Journal*, May, 1856, page lxvi-lxviii.)

"These are 'hard lines' for those who will persist in drawing them, particularly when taken in connection with a proposition of Mr. Alfred Wallace (referred to in the same Address, page cxiii.) 'That every species has come into existence coincident both in space and time, with a pre-existing closely allied species.' Although Mr. Hamilton, the President, remarks that he thinks 'It may be doubted whether this assumed law can be maintained as a universal generalization,' this is a question which has not been and *must* be fairly worked out, and must therefore long remain an open one amongst Geologists and Palæontologists who are *worthy* Members of such Associations as ours, who humbly, reverently, and conscientiously, venture to approach the veil of the Shrine of the Great Designer, as nearly as the traces of His presence in His works, as revealed to their limited capacities may lead them, however distasteful the attempt may be to those, with whose little theories (the inflating power of their 'bubble reputations') it may interfere.

"'Let us pray' that *we* may be enabled to attach less importance, in all our undertakings as a body, to the gratification of petty conceits and personal vanities, the exhibition of mere low cunning and grumbling astuteness, than to the philosophical contemplation, the truthful appreciation, and thankful admiration of the works of the Creator.

"I fear I have somewhat Germanized some of my sentences, but really have not time to revise them, which pray excuse.

"At the dinner table our members were augmented by the presence of Mr. Lysons and party, who had met us at Drybrook.

"After the usual amount of pleasant discussion and interchange of ideas, a delightful day closed, and each one 'went to his place.'

"I ought, perhaps, to have inserted elsewhere in my report, but mention here, that an exceedingly good specimen of an *Astacus*, found by Miss Slatter, in the Great Oolite, of Stratton, near Cirencester, was exhibited by myself."

July 15th, 1856.—Journey to Avebury.—A small party, including the Rev. Canon Powell and Mr. Thomas Warner, met to breakfast at the Swindon Station Hotel, whence proceeding to the hospitable residence of the Rev. H. Light, after inspecting the many objects of interest he so kindly introduced to our notice, we wended our way to the far-famed Avebury Circles. Here Mr. Light having first made a ground plan of the Circles, marking both the existing stones and places of the absent ones, we were by this—assisted by the Rev. Gentleman's tact and local know-

ledge—enabled most clearly to make out the form of this ancient monument.

Silbury Hill, said to be one of the largest artificial mounds in the world, was then ascended by most of the party, and on returning to the village, the church—in which the rood-screen is the most interesting work—was carefully inspected, by which time it was found that the dinner hour had arrived.

After partaking of a well-served repast, Mr. Light offered some conjectures as to the manner in which the Avebury stones had been placed in position, which brought on a most animated conversation.

The Secretary then explained their Geology, and showed how portions—boulders—of the same rock had overspread the country nearly as far as Cirencester; in his short exposition he also took occasion to point out the physical features of the Upper Oolites and the succeeding Chalk Terraces, at the same time explaining the different agricultural practices to which these had given rise; and thus concluded a most pleasant and interesting day, which was rendered all too short in order to be in time for the inexorable train.

It may be interesting to know that the Avebury mounds afforded, among others the following plants:—

Hippocrepis camosa, Horse-shoe Vetch.

Asperula cynanchica, Quinsey Wort.

These plants are interesting as electing to grow on lime rocks, making however no distinction between Oolite, Chalk, or Mountain Limestone.

Orobanché major, Tall Broomrape, an interesting plant, here mostly parasitic on Thistles.

Onicus acaulis, Stemless Thistle, with—anomalous as it appears—stems several inches high, and presenting complete bunches of flowers. This is one of the forms which has given rise to the many synonyms by which the true species is surrounded.

Whilst on the subject of plants, I may mention the discovery of *Anacharis Canadensis*, in Cirencester Canal. I saw the first specimen of this plant in the fresh-water Vivarium of the Rev. J. C. Thring, and on recognising it I was informed by him that he got it from our canal; here I went in search of it, and succeeded in finding a large patch about 200 yards from the Cirencester head of the canal.

August 15th, Meeting at Cheltenham.—A party of 16 gentlemen met at the Old Imperial Hotel, from thence adjourning to the temporary Geological Museum, at the Philosophical Institution, when having examined the beautiful series of fossils—mostly of the district—therein contained, they wended their way to the great scarp at Leckhampton Hill.

Here they were enabled to make out the following section of the basement beds of the Inferior Oolite:—

	Feet.
1. Roestone (Buckman), Shelly Oolite of Brodie ...	...
2. True Pisolite, Pea-grit... .. about	10 0
3. Coarse-grained Oolite, containing much Silicious matter	13 0
4. Foxy-coloured Ferruginous Oolite, very Silicious to bottom of quarry	20 0
	43 0

This, which I had then no means of accurately measuring, I find to approximate so nearly with Mr. Strickland's detailed section, as given in the 6th vol. of the *Journal of the Geological Society*, that I am induced to think the section as now exposed reaches very nearly to the Lias; at all events when I saw the Lias and Oolite in contact at this very spot there was a sudden and abrupt transition from the Oolite to the Lias, there being at this place none of the Inferior Oolite Sands of the Ordnance Surveyors.

In reference to the basement bed of the Oolite, I quote from Mr. Strickland's paper the following remarks:—

“(7) Ferruginous beds, consisting of coarse Oolite in the upper part, and of a very peculiar large-grained Oolite or Pisolite ('Pea-grit') in the lower. A few miles to the south the Pisolite disappears, and is replaced near Painswick and at Haresfield Hill by strata containing ferruginous oolitic grains in a brown paste. This is the precise equivalent of the well known Oolite of Dundry, near Bristol, which may be recognized as far off as Bridport, on the Dorset coast. At Leckhampton the Pisolite rests upon a few feet of ferruginous Oolite and Sand; the total thickness of this portion of the series is 42 feet.”

The observations here made, coupled with a somewhat lengthened examination of these lower Oolite beds, both north and south of Leckhampton, induced me to venture to suggest to the meeting of the Geological section of the British Association, and again to our Cotteswold brethren at Leckhampton Hill, an opinion that the Silicious oolite, by which the Pisolite at Stow, Winchcomb, Leckhampton, and Crickley is underlaid, was the representative in time of the Oolite Sands of the Stroud and Painswick districts, an opinion which I am still inclined to favour; however, the details of this matter would be much too long for an address like the present, but I still hope to be able to find time to arrange the material I have got together on this subject before the close of the present session.

To recur to the doings at this meeting. At Leckhampton the party was joined by two ladies who kept up well with the field Naturalists along the top of Leckhampton Hill to Hartley Bottom and the Seven Springs.

Returning by way of Charlton Common and the Sandy Lane,

the agricultural gentlemen expressed themselves highly delighted at the improvement made in the Southfield farm by Sir William Russell, Bart.

It should be mentioned that on the top of the hill was found for the first time the *Caucalis daucoides* (Bur Parsley), probably introduced with foreign seeds in the cultivation now so rapidly spreading in this direction.

At Hartley Bottom the *Thesium linophyllum* (Bastard Flax), was met with in its old habitat, but it appears to be getting more scarce year by year.

The dinner was served at the Lamb, in good style, and our always loyal Club having done honor to the health of the Queen, next followed that of the strangers, which was responded to by Mr. Babington, the eminent botanical author.

The Rev. P. B. Brodie read a paper on the comparison of the Upper Lias Fish bed of Warwickshire, with that of our own county, which will be published in the next fasciculus of our proceedings.

A paper followed by the Secretary, on an abnormal growth in a Cedar tree from Oakley Park, which gave rise to an interesting discussion, in which the President took occasion to notice other curiosities in the growth of trees that had come under his notice.

Dr. White introduced to the attention of the meeting a curious ball which had been discovered some years since at Slymbridge, and figured and described in the *Journal of the Archæological Institute*; this it is proposed to further describe in the proceedings of our Society, to which end Dr. White promised to obtain the engraving if possible. An interesting discussion took place on the probable use and meaning of this curious relic, in which the President, Mr. Babington, Mr. Rumsey, and the Secretary took part, and with this terminated a most agreeable meeting.

Sept. 9th.—The last meeting of the past session took place at Stroud, when a large party of the members and friends accepted the kind invitation to breakfast of our much respected and hospitable associate, J. G. Ball, Esq., and if a kind welcome, good cheer, and hearty greeting of field companions, be capable of doing good, each must have felt himself better for that morning spent with Mr. Ball and his amiable family; the “sweet sorrow,” however, of “good bye” became imperative, as an omnibus was announced to be in readiness to convey us to Frocester Hill—up hammers, bags, and vasculums, and the party is off. Arrived at this famous section, the Geologists gathered new stores to back their discussions, and though one might imagine that they are going to fight, from the strange words they make use of in their arguments, yet we need never be afraid, as after all they do not throw the fossil itself into your teeth, but only its name.

The section at this place, which is an exceedingly interesting one, I hope to publish at some future time, but do not give it here

as I have not yet made an admeasurement with instruments, which I expect soon to do.

Advancing into the wood at the top of the hill, our President observed on the scrubby oak trees some galls, which proved to be those of the *Cynips quercus petiolata*, which could not have been introduced into our county more than two years. A few weeks after I found the same thing very sparingly in Oakley Park, and perhaps at present the park is the furthest easterly limit to which it has attained.

In the arable on the same hill was found several specimens of the *Avena fatua* (Wild Oat), which were taken to the hotel for comparison after dinner with specimens introduced by the Secretary from the College Botanical Garden, when he announced the fact of having produced two types of cultivated oats, viz. the *Potatoe* and *Tartarian* forms from the *A. fatua*, the result having been attained in five years, a circumstance of great agricultural interest, inasmuch as farmers had long maintained that in some land cultivated, degenerated in the wild, oat, which is one of our most troublesome weeds. Upon this matter experiments are still going on, and no doubt further facts of interest will be elicited in another season.

The dinner at the George was a nice affair, no paper however followed, as the time was fully occupied in discussing the Frocester Hill section, and indeed the proceedings terminated all too soon, train time obliging us to close the meeting somewhat abruptly.

And here, too, ends the *resumé* of our proceedings for the past session, from which, I think you will agree with me, we may safely conclude that in no former year have we had to record better meetings, they have been uniformly characterised by a good attendance, in which kindly feeling and earnest work have ever prevailed.

I cannot conclude this Address without referring to the important scientific gathering which took place in our county during the past year—I refer to the meeting of the British Association at Cheltenham—and while it must be gratifying to our Club to know how successful that meeting was, being indeed one of the best of this important scientific body, it will be doubly so to find the marked respect shown by that august assembly to our little band of naturalists; for while many of our members held important posts in the different committees, for which they were so well thanked both by the Association and the Town of Cheltenham. The Museum of Geology, got together by Dr. Wright, Mr. Pierson, and the Rev. R. Hepworth and others, will long be referred to as the best of its kind to which the British Association was yet ever welcomed.

It was my intention to have given an analysis of the different Natural History papers read at the Association, but I find that this Address is even now sadly longer than usual, and I shall therefore only just mention a few with which we are more immediately concerned.

Experiments in the Botanic Garden of the Royal Agricultural College.

Paper by Dr. Lankester on the Water at Cirencester.

Geological papers, by Messrs. Wright, Ramsey, and Hull (of the Ordnance Survey), Brodie, Etheredge, Moor, and myself; these will be found reported in the Transactions of the British Association; and as regards the experiments in the College Garden, they are being continued in an augmented and careful manner, and in obedience to the recommendation of the Committee of Section C., will be duly reported upon at the request of the General Committee of the Association at the forthcoming Dublin Meeting.

Brief Notes on Cirencester High Cross.

Read at a Meeting of the Cotteswold Club, Sept. 16th, 1856.

By CHARLES POOLEY.

As recently as the year of our Lord 1800, there existed, in the town of Cirencester, the vestiges of no less than six ancient crosses.

These structures, I have ascertained, were distributed over the town, and occupied the following positions:—

One stood in the open part of Dyer-street, where the pig-market is now held; another was placed in the Churchyard; a third, occupied the point where Sheep-street crosses Castle-street; a fourth was built near the southern extremity of the borough, hard by a stream of water running at the end of Dyer-street; a fifth marked the spot where Cricklade-street crosses Leuse-lane; and a sixth, called the High Cross, and which is the subject of this paper, was erected opposite the Ram Inn, in the Market-place.

The march of improvement, which has destroyed many of the picturesque gables of the old town, has also swept away these ancient relics, one after another, and with the exception of the last, not a fragment of either remains to reward the search of the archæologist. For the High Cross, however, though removed from its former site in the Market-place, a better fate has been reserved, a pretty situation having been found for it near the Wood-House in Oakley Park, the seat of the Earl Bathurst, where it forms a worthy object of attraction to visitors.

In *Rudder's History of Cirencester* is the following description of this cross:—"The High Cross stood upon a base of about ten feet square, with four steps on each side gradually diminishing from the lower to the uppermost. From the middle of the base rose an octangular column or pillar, supporting a capital which was much defaced and broken, but it appeared to have been ornamented with carvings, of which the subject could not be distinguished. It is supposed, however, to have been a very curious piece of workmanship, as more than ordinary care had been taken to preserve what remained of it. It was encompassed with an



THE MONUMENT TO THE BATTLE OF BUNEN
BUNEN, IRELAND



iron collar, from the side of which four bars proceeded to the upper steps, and thus it was supported on the column or pillar of the cross. Over this capital the cross was fixed. The whole being in a very mutilated state, and occupying a large space opposite the Ram Inn, it was taken down about the year 1785."

Brief as this account is, it obviously refers to the cross now standing in Oakley Park, and although since that period it has become still more mutilated, it fortunately retains, in its principal features, sufficient evidence to prove its identity. Assuming it to be a work of the fourteenth century, this cross affords a good illustration of the style of decorative art expended upon these ecclesiastical monuments. It is however by no means perfect. The only part of the original structure which has survived the ravages of time, being the more solid portions, such as the pedestal, shaft, and fragments of the capital.

Differing from the ordinary road-side, or churchyard crosses, which are so numerous in this county, it will be seen that this cross possesses an architectural beauty not at all common in such edifices.

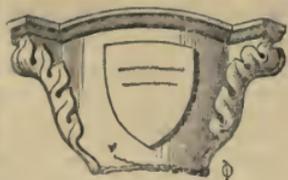
The pedestal is hewn out of a single block of stone, three feet square by two feet six inches in height, and presents on each of its sides, a facade, ornamented with four deeply chiselled gothic arcades, surmounted by pannelled quatrefoils, which are overhung by a deep moulded coping. It rests on a plinth which is placed on a heavy basement step, too heavy to be in character with the rest of the building. From the centre of the pedestal springs a remarkably fine octagonal shaft, a solid stone six feet four inches in height and one foot in diameter, having rounded flutings at the angles, and the remains of four broaches at the socket. It is conjectured, by the presence of these broaches, that originally the shaft was set in a smaller block, thus bringing the termination to a square; which supposition would render the design more harmonious, by taking off the apparent abruptness of so small a column rising from so large a pedestal.



With reference to the capital, what remains of it is too much broken and obscured by the growth of patches of moss, to allow the observer to do more than distinguish the mere rudiments of the carvings alluded to by Rudder. But I may remark, by way of example, that on the under side of, and as it were supporting the abacus, there are distinct indications of well-executed carvings of angels' heads and wings, of which the wood-cut gives a good idea; also in



the spaces between the corbels, which project at the four angles of the capital, the remains of escutcheons may be seen, but no trace is left of the emblazonments with which they were doubtless originally enriched. Judging from analogy, and after comparing the Cirencester High Cross with similar structures, I have come to the conclusion that the corbels once supported slender buttresses, which, being arched at the top, formed light canopied niches, in which figures were placed. The ponderous stone in the shape of a cross, now surmounting the capital, is no part of the original design, having been put up some few years ago.



We may infer that in its integrity this cross could not have stood much less than twenty feet in elevation, from the ground to the summit; and some idea may be formed of its handsome character, from the general effect of the chaste proportions of its remains, which are beautiful even in their decay. I have been unable to discover any record from which to determine that this cross was set up to commemorate a particular event.

There is a deed extant, dated A.D. 1413, in which it is called *NOVA CRUX*, which would approximately fix the date of its erection at a period corresponding with its architectural character, which, as before stated, is that of the fourteenth century. Presuming it to have been built just prior to the introduction of the perpendicular style in architecture, or towards the end of the reign of Richard II., we are carried back to the period of the abbacy of Nicholas d'Amenev, or about twenty-six years before Abbot Best procured the mitre for the Abbey of Cirencester, and a seat among the barons for himself and his successors.

List of Birds seen in Siddington, Gloucestershire, with Remarks.

By EDWARD BOWLY.

This List is strictly confined to the Birds seen in the Parish of Siddington; many other varieties have been observed in the immediate neighbourhood. Nearly the whole of the common Birds of prey have been shot in LORD BATHURST'S Woods, where also the Crossbeak and the Greater Red Pole have frequently been seen. A Hoopoe was shot this summer in the adjoining Parish of South Cerney. Phalarope has been shot at Bibury, and the Bittern at Latton within a few years. Some years since the Royston Crow was always to be seen at Aldsworth, as you travelled from Cirencester to Burford; they are now extinct in that neighbourhood. I have shot the Short-eared Owl when Partridge shooting.

RING DOVE.—Common. Always build in the avenue of lime trees close to the house. Often very numerous in winter.

STOCK DOVE. } Often seen.
ROCK DOVE. }

- TURTLE DOVE.—Always to be seen in summer. Breed in our hedges; nest consists of a few twigs, barely sufficient to confine the eggs.
- RAVEN.—Occasionally seen flying over.
- CROW.—Common. Breed in the trees adjoining the house.
- ROOK.—Abundant. Build at the Rectory.
- JACKDAW.—Always build in the elm tree opposite the Mill.
- MAGPIE.—Generally breed in the coppice adjoining Cerney road.
- JAY.—Breed in the coppice beyond the Windmill.
- STARLING.—Very numerous.
- BUNTING.—Common.
- REED BUNTING.—Ditto.
- YELLOW BUNTING.—Very abundant.
- CIRE BUNTING.—Very rare, never saw but one specimen.
- CHAFFINCH.—Very numerous.
- BULLFINCH.—Common. Often build in the thickest part of the Scotch wild rose.
- GOLDFINCH.—Common.
- GREENFINCH.—Very numerous in winter; a few breed here.
- CROSSBEAK.—Sometimes seen in winter.
- BRAMBLING.—Not uncommon in severe winters; never breed here.
- BROWN LINNET.—Common. Breed in the groves, and we have immense flocks in winter.
- SISKIN.—Only once seen.
- MOUNTAIN LINNET.—I have shot some of these in the flocks of the common Linnet in winter.
- HOUSE SPARROW.—Very numerous.
- TREE SPARROW.—Not uncommon in the winter, but they are principally male birds. I generally shoot some cocks, but very rarely a hen.
- NUTHATCH.—Not often seen. I frequently see one running up the trunk of a lime tree close to my dining-room window.
- CREEPER.—I may apply exactly the same remarks as to the Nuthatch.
- WRYNECK.—Constant summer visitant, arriving about the time of the Cuckoo, thence named by the country people the Cuckoo's Mate.
- GREEN WOODPECKER.—Common.
- CUCKOO.—Numerous; the trees above my house a favourite spot with them; during the breeding season they sing the whole night, in all kinds of key.
- GOAT-SUCKER.—I have seen them two or three summers, but do not regularly visit us.
- SWIFT.—Common.
- MARTIN.—Ditto.
- SWALLOW.—Ditto.
- SAND MARTIN.—Seldom seen.
- PIED WAGTAIL.—Plentiful.
- YELLOW WAGTAIL.—Ditto.
- HEDGE SPARROW.—Abundant.
- ROBIN.—Ditto.
- REDSTART.—Summer visitant, not so abundant as formerly.
- BLACKCAP.—Same remarks apply.
- STONECHAT.—Always to be seen.
- WHINCHAT.—Sometimes seen.
- WHEATEAR.—Although a constant frequenter of the Cotteswolds, I have never seen but one specimen in this parish.
- GRASSHOPPER LARK.—Once heard in Furzenlease Coppice.
- EDGE WARBLER.—Not uncommon.
- NIGHTINGALE.—Formerly abundant at Furzenlease, where many were snared and kept the winter in cages; we now have scarcely one in the parish.
- WHITE-THROAT.—Very numerous.
- LONG WILLOW WREN. } We have both these.
 SMALLER WILLOW WREN. }
- CHIT CHAT.—Frequently heard.

WREN.—Abundant.

GOLDEN CRESTED WREN.—Frequently seen in the larch close to the house.

SPOTTED FLYCATCHER.—Always breed close to my house.

SKY LARK.—Very numerous.

TIT LARK.—Common.

WOOD LARK.—Sometimes seen.

LONG-TAIL TIT. }

GREAT TIT. }

BLUE TIT. }

COLE TIT. }

MARSH TIT. }

BLACKBIRD. }

SONG THRUSH. }

MISTLE THRUSH. }

FIELDFARE. }

REDWING. }

PHEASANT. }

PARTRIDGE. }

LAND RAIL.—Breed here.

WHITE OWL.—Bred in the large elm near the Mill for upwards of twenty years, but have left four or five years, I believe from the Jackdaws having also taken possession of the tree; we often hear the young Owls trying to hoot, which is amusing.

BROWN OWL.—Often seen.

KESTREL.—Breed here, and is almost the only Hawk we have left.

SPARROW HAWK.—Rare.

HOBBY.—Once seen, some years ago.

GREAT BUTCHER BIRD.—Sometimes seen.

LESSER BUTCHER BIRD.—Generally have two or three pairs in the neighbourhood.

HERON.—Common. I have often seen eight or ten rise in the coppice near the Windmill, and they have occasionally bred here, my man once caught a young one unable to fly far.

LITTLE GREBE.—Breed here.

CRESTED GREBE.—One caught alive on the ice on the canal in the winter of 1854 and 1855; this specimen is now at Overthrow's.

STORM PETREL.—One seen in the Canal after two days of tremendous wind.

GREEN SANDPIPER.—Formerly to be always seen in one spot in the meadows, now not so frequently.

KITTY-WAKE.—Not unfrequently seen flying over. I once shot one so doing.

COMMON GULL.—Occasionally seen flying over. One shot last month, Feb. 1857.

SNIBE. }

JACK SNIBE. }

} Common in Winter.

WOODCOCK.—Always at Furzenlease after the first autumnal rain, and continue the winter.

LAPWING.—Breed here: collect in immense flocks in the autumn and disappear in very severe weather.

GOLDEN PLOVER.—Seldom seen.

COMMON CURLEW.—Three once seen.

KINGFISHER.—Common on the banks of the Churn.

WATER RAIL.—Breed here; not so common as formerly.

BALD COOT.—Only once seen. One caught alive on the Canal, April, 1857.

MOORHEN.—Breeds here, and is abundant in some of our meadows.

WILD SWAN.—Often seen in severe winters; several have been shot.

WILD GOOSE. }

WHITE-FRONTED GOOSE. }

} Often seen in severe winters; several have been shot.

TEAL.—Not uncommon in winter.

WILD DUCK.—Breed in our meadows.

Address read to the Cotteswold Naturalists' Club, at their Winter Meeting, held at the Royal Agricultural College, Cirencester, January 30th, 1856.

By T. BARWICK LLOYD BAKER, Esq., of Hardwicke Court, President.

FOR ten years, now, my friends, you have borne, without any serious resistance, the tyrannical sway of your President. During ten years the Club has increased in size, strength, and importance, and has seen others and similar clubs rise on all sides around it. But while you have grown from infancy to strength, your President has grown from strength to—if not absolute weakness—at least to considerably less strength, and feels not unfrequently so overwhelmed by his work (which would be mere play to many men) that he has this year paid far less attention than he was wont to the duties of his office; and had it not been for the zeal and attention of the Secretary, the business of the Club would, I fear, have been altogether neglected.

Do not, I pray you, misunderstand me, and suppose that my interest in the Club has diminished—on the contrary, there is hardly a day in the year that I enjoy so much as that of our Cotteswold meetings. But work of a most engrossing and absorbing interest has so much increased upon me of late, that my study of nature in general has of late contracted almost entirely to that of the genus *puer*—species *fur*.

Still, unfit as I am for the task, I cannot refuse at our annual meeting to give such account as I can, either—from what I myself had the happiness of seeing, or, far better for you—from the descriptions given by others who were present when I was obliged to be absent.

On Jan. 30, 1855, such members of the Club as did not object to early hours were hospitably entertained at breakfast, by the Principal of the Royal Agricultural College, at Cirencester, who has so often and so hospitably entertained us before. Having examined the Museum of the College, and been much gratified by the additions which we found, we adjourned to the Library for our business—discussion incident to this one meeting of the year.

The following resolutions were then passed, and we hope they may have resolved themselves ere this into facts. We will “pause for a reply,” after reading each resolution, to enquire how far this may be the case.

It was resolved, then, first, that Messrs. Jones and Buckman should be deputed by the Club to examine Deerhurst Priory, and make a report on the remains of that most interesting relic of antiquity, to be printed at the expense of the Club.

Resolved, secondly, that Messrs. Lycett and Buckman be requested to examine into the present mode of the publication of

the proceedings of our Club, and to report on the best plan to be adopted for the future.

I trust we may be fully assured that both of these matters have been fully considered, as the first is a point almost touching the honour of our Club, while the latter touches its private interests.

The President and Secretary were then re-elected, and the meetings for the ensuing year were fixed.

A paper was read by Mr. Lycett, on the *Perna Quadrata*; and another on the bones of Beaver, Deer, &c. found in Nailsworth valley. And by Professor Buckman, "A notice of the Oxford Clay, as found near Cirencester."

After dinner, in the hospitable Hall of the College, an animated discussion on that most interesting of topics—which has the great advantage of being an unceasing ground of battle, inasmuch as no two people can ever be brought to take the same view of it—viz. the nature and value of species—would no doubt have lasted till the crack of doom, had it not been far more agreeably cut short by a summons to tea.

On May 1st, although we make a general rule not to accept the hospitality of any of our members, further than an occasional and rare invitation to breakfast, yet we made, I may almost say, our one exception, and spent most of the day at Apperly Court, the seat of our kind friend, Henry Strickland, Esq.

After examining the beautiful specimens illustrative of different branches of natural history, and looking over the exquisite drawings of plants, by Miss Strickland, the members proceeded to Deerhurst Church, both to enjoy again the beauties of the Norman—or in part, as some hold, Saxon—architecture; and also to see the window of stained glass (by O'Connor) which our Club has been allowed to assist in putting up, in commemoration of our sincerely lamented friend and associate, Hugh E. Strickland, Esq.

Much satisfaction was expressed by the subscribers who were present at the manner in which their wishes had been carried out.

On returning to Apperley, the Club was entertained at dinner by Henry Strickland, with his usual hospitality; and if some sad thoughts intruded, we at any rate felt thankful to be allowed to meet again the family of one whom we had so loved and regretted.

June the 12th was appointed for a meeting of the Worcester, Malvern, Woolhope, and Warwickshire Clubs, with our own, at Malvern.

Yeomanry duties prevented my attendance, but, as I learn, the geologists, under the distinguished guidance of Sir Roderick Murchison, and the botanists under that of Mr. Lees, proceeded to the Warwickshire Beacon, where Sir Roderick delivered a most eloquent lecture on the geological formation of the country around that magnificent spot; after which Mr. Lees explained the principal features of the botany of his own loved hills.

The dinner, under the presidency of Sir Roderick, was most numerously attended, and the guests speedily adjourned, by the invitation of the ladies, to coffee, after which Mr. Buckman read a paper on one of the forms of *Terebratula* (*T. perovalis* var. *ampla*).

I do not know whether I may have been much to blame on many former occasions, for promoting discussions between the members of the Club. I certainly have often done so, and have greatly enjoyed the exhibition of the talent and knowledge that these discussions have called forth. Alas! must this pleasure cease—must we check at once all shew of a difference of opinion, for fear that it should degenerate into animosity? Can we not hear an opinion, even contrary to our own, expressed, without imputing an intentional wrong?

The meeting, alas, terminated with a feeling that a somewhat uncomfortable had occurred, and with an idea that for such small and unpretending affairs as ours, meetings of a moderate size were preferable to *very* large ones.

August 28th, the Club should have met at Berkeley, (so says Mr. Jones, to whose kindness I am indebted for the following able report,) but Purnell B. Purnell, Esq., having invited the most constant attendants of our meetings to Breakfast at his residence, the "venue" was laid at Stancombe Park, instead of the Berkeley Arms, whither, accordingly the Club repaired. Antecedent and posterior to, the usual commencement of the proceedings, that is a hearty and well-provided breakfast, in which Ladies were allowed to participate, some of the treasures of that Gentleman's collection were thrown open to inspection, the variety and costliness of which surprised many. Although not a professed geologist, rare specimens varying from all the specimens in his neighbourhood to the Mammalian Crag, invited the attention of the geologists of the party; and although not a professed antiquarian, the collection of personal ornaments of the Egyptian, Etruscan, Greek, Roman, and Medieval periods will not soon be forgotten by those who gazed with interest only, upon relics connected with the social progress of the human species.

The delight with which the party traversed the tastefully laid out grounds, can only be indicated, but not conveyed. Here a subterranean passage, opening out into one of those bursts of sylvan scenery which the "cwms" of the Cotteswolds alone can parallel. There a small classical building, replete with treasures of ancient art, derived from all the people already alluded to, and not excluding the wonders of Nineveh and Babylon. Here a pond, dilated by the exquisite taste which dictated its construction into all the landscape effect of a lake; there a receptacle of the rarest stuffed birds, paintings, models of fishes and fruits, from the universal Exhibition of 1851, and paintings of esteemed old masters, which divided attention with the artfully set scenery

revealed through the narrow strips of pure crystal in the stained glass windows. In various paddocks were seen Kangaroos, the Apis Deer, and other rare creatures disporting themselves, while in the park itself, enjoying perfect freedom, and upon terms of the most perfect familiarity with their visitors, ran a small herd of Llamas.

After spending some hours most agreeably in the contemplation of this beautiful spot, the Club adjourned to Berkeley, whither its members were conveyed and accompanied by their kind entertainer, and where dinner was served. After dinner Dr. Wright read a paper upon some unique Echinoderms of the Oolites, of which he exhibited specimens. Mr. Lycett had brought with him an exceedingly interesting series of *Gryphæa dilitata*, for the special purpose of correcting certain heretical opinions of our Secretary, Professor Buckman, but it appeared from the reports of some of his Cirencester neighbours that he was "not in condition," and consequently Mr. Lycett did not bring his paper forwards, and, much to the regret of "the fancy," there was "no fight."

In the absence of the President and Secretary, the chair was taken by the Rev. J. S. Haygarth, who, in addition to the usual toasts, proposed the health of the President and Secretary of the Club.

Those members who were dependant upon the train for home transit, were kindly driven there by their host of the morning, P. B. Purnell, Esq., thus terminating one of the most delightful days of which record has hitherto been placed upon the annals of the Club.

Sept. 25th, at Birdlip, as usual, a large meeting took place, a great point of attraction being Crickley hill, the interesting fossils of which locality, though picked up for the thousandth time, seem never to tire. Here the great height to which the Upper Lias creeps up the scarp, which latter bears such evidence of ancient water action, was commented upon by the Secretary, by whom the following section of Crickley hill was taken:—

	ft.	in.
1. Soil	0	8
2. Rubbly oolite (debris)	4	0
3. Red incoherent calcareous sands	6	0
4. Hard freestone in large blocks (building stone)	15	0
5. Pisolite, with but a slight admixture of oolite ragstone	5	0
6. Freestone, including pisolite & parted by seams of do..	9	0
7. Hard block of oolite, consisting in part of very indurated pisolite	35	0
8. Sandy oolite, containing large blocks of ragstone, occasionally very pisolitic, as traced to the outcrop..	25	0
Total...	99	8

Note.—Twenty feet of bed 7, consists of 7 layers of hard stone, some of which are as much as 3ft. 6in. in thickness, these are parted by thin seams of oolite sand. This rock presents also a fine example of the smooth-faced “lissens” of the quarrymen. The blocks of stone include large specimens of Lima, Gervillia, Belemnites, &c.

It will be seen that here is nearly 90 feet of rock more or less pisolitic at the point where the section was taken, namely, nearly in the centre of the Crickley hill scarp, below the Roman encampment.

Along the line of the slight dip of these beds, below the “Air Balloon” public-house, these are superimposed by a coralline bed, which has been erroneously pointed out as oolitic marl.

After partaking of alas! too sumptuous a dinner, at the Black Horse, the health of *Dr. Lanza*, of Spalato, was drunk with cordiality, when a paper was read by *Dr. Voelcker*, on the Chemistry of Recent Roman and Fossil Bones, with an addendum on the Mineral *Apatite*, which has lately been largely imported from Norway, and was referred to as likely to become of importance to agriculture, from the large percentage of *phosphorus* which it contains. Any discussion, however, upon this valuable and interesting paper, so nicely illustrated with specimens of fluoric acid etchings, together with all chance of any other paper, was at once put beyond all hope by a debate upon the dinner bill, which, alas, somewhat abruptly terminated our Summer Meetings.

Inundations in Antient Corinium.

By PROFESSOR JAMES BUCKMAN, F.L.S., F.G.S., &c.

“When found, make a note of.”

THIS injunction of the worthy Captain Cuttle, as its frequent quotation testifies, is capable of most extensive application; and if it be made to apply to our ordinary discoveries, where we find out a use for this or that, or indeed to any truth that is patent to us, to make a note thereof, not only fixes the matter in our memory, but it furnishes us with a storehouse of knowledge for frequent examination and comparison, like that which is presented in a Geological Museum or in the *Hortus Siccus*. In all cases these scraps are so many specimens, which in their single selves may tell us much, but conjointly may add to our knowledge in an ever increasing ratio.

It often happens with our notes as with our specimens, that a few slight conclusions may at one time be drawn from them, when suddenly, from the addition of a new truth or a new specimen, things that before were nearly idle, assumed a new life and

shape; and so, instead of acquainting us merely with the power and functions of A and Z, arrange for us all the letters between, and thus make out for us a consistent alphabet.

We have been led to make these remarks from having made extensive notes upon Roman remains in Corinium, during the progress of which appearances were observed, and methods of construction were demonstrated to have been adopted, for which there presented itself to us, until within the last few months, no sufficient solution. However, recent atmospheric phenomena have of late supplied the required note—the connecting link; and though the resulting conclusions are not perhaps of grave importance,—yet, as they not inaptly show the value of our friend the Captain's dictum, we shall at once give them a place in our proceedings.

In all the diggings yet made, proximity to our Roman pavements is at once manifested by a thin stratum, varying from three to six inches, of fine well washed gravel. Sometimes this gravel is hard and compact; partially cemented together, it would appear, by lime either in solution or suspension in water, or perhaps both; and the walls of the chambers have occasional markings around them, which seem to indicate the presence of standing water, at different periods, to different heights.

Now, this gravel is for the most part that which entered into the composition of the wall cement, added to which the finer particles of stone in the soil would have a tendency to sink lower and lower until arrested by a hard impassable stratum.

In many instances where rude concrete pavements have been formed, plastered walls have been noticed even below the bottom of the floor; while in the more general examples the concrete for wall and floor is continuous.*

In another case we had an arrangement in which the floor—a tessellated one—was raised on a solid concrete foundation, considerably above the bottom of the plastered and even frescoed walls, leaving what appeared a deep channel or drain all around the room.

Again, in digging the foundations for the houses at Watermoor (Chesterton Terrace), Roman masonry and a vast mass of reliquia of the same period was arrived at, much of which has been carefully preserved, and is now in the Corinium Museum.

It was on account of the loose materials collected here that the new foundations were dug to a considerable depth, during their whole progress exposing work of perhaps sixteen centuries previously; and in this digging, at the south end of the Terrace, two distinct floors were exposed, one above the other, in the section, at a distance of as much as four feet apart. Between the upper and lower floor was a filling up of rubbish, of which broken

* In this, the other examples adduced, we are sorry we cannot introduce our sketches, as these would doubtless explain the matter better than words.

bricks, bits of pottery, and gravel, formed the general mass. This is by no means uncommon here, as it often happens that one floor has been formed on the top of another, and at varying distances apart.

Now the season of 1852 was one of unusual wet, and Cirencester, like other places, was then inundated with water, and an examination of Roman sites in this place demonstrates that the ancient floors, like too many of our modern ones, was just then below the water level, and even at Chesterton Terrace there was nearly a foot of water in the cellars, the floors of which are a little below the level of the lower Roman floor just adverted to; so that the upper floor would be entirely out of the way even of a much higher inundation than the present one, whilst a few inches more of water would have also covered the lower one. From these notes, therefore, we seem justified in drawing the following conclusions:—

Firstly—That Corinium, like Cirencester, suffered from occasional inundations, and that the occurrence of one floor above another in our Roman works, show how the antients remedied the inconvenience,

Secondly—That these inundations were even deeper in antient than in modern times. This we shall have no difficulty in understanding, if we consider the greater facilities these days offer for carrying off water by draining and other improvements.

And, lastly, many of the appearances about our Roman sites seem to show that excess of water has been oftentimes repeated during the last fifteen hundred years, though at very distant and irregular periods.

NOTE.—*The Notes upon which the above Paper was founded were principally made in the wet season of 1852.*

*Address read to the Cotteswold Naturalists' Club at their
Annual Meeting, April 27, 1858.*

By T. BARWICK LLOYD BAKER, Esq. of Hardwicke Court,
President.

AGAIN, my friends, have we met for our Annual Meeting, to review the pleasant gatherings which many of us at least have enjoyed during the last summer, and to plan the excursions which we hope to enjoy in the present year.

Much do I, for my own part, regret that I have been able to attend so few of those of the past season, for slight as may be my knowledge of the sciences so ably followed by many members of our Club, I can safely say that few days in the year afford me so wholesome or enjoyable a relaxation from the work which more and more engrosses me, as the gatherings of the Cotteswold Club. My own lack of knowledge, however, I must supply from the accounts given by others of the meetings, I would fain have described as an eyewitness.

On Jan. 27th, a party of Ladies and Gentlemen met at what we may term our most hospitable head-quarters, the Royal Agricultural College of Cirencester, where, as always, we were most kindly received, took a walk to the Corinium Museum, Watermoor Church, and the City Walls, and returned *for business* to the College.

The said business consisted of the re-election of the President and Secretary, till such time as fitter men could be persuaded to take the offices; and the election of Edward Holland, M. P., of Dumbleton, and David Nash, Esq. the eminent scholar of Syro-Egyptian literature.

At the dinner (happily we had many good things to counter-balance it) was exhibited a jar of the *Anacharis alismastrum*, that most to be dreaded of water weeds, which threatens, if all we hear be true (fortunately for us, little more than half we hear is so) to choke every stream, navigable or not, and every canal in the kingdom, in a very short space of time. This fearfully rapid weed had been found only the day before in the Canal, near Cirencester, and now at the end of fifteen months (which brings us to the present time) we anxiously ask our friends from the neighbourhood of Cirencester, Is the Canal yet passable? Happily, for us, many evils which appear dreadful at first sight, are more bearable when we come to closer terms; and I trust we may find this the case with the *Anacharis alismastrum*.

The Rev. P. B. Brodie also read a paper which we trust to see recorded in our transactions, and the party separated with much gratitude to Mr. and Mrs. Haygarth.

On May 26th, a meeting did take place at Chipping Campden, but, alas, it could hardly be called a meeting of our Club, inasmuch as *our* only members who met there were our worthy Secretary and the Rev. P. B. Brodie, who came less as a member of the Cotteswold, than as President of the Warwickshire Club, who had agreed to meet there on that day. Never mind. While we can boast to have sent out so notable a scion from our Club to found another Club elsewhere—though we may regret that we meet him less often than heretofore—we count him anything but lost.

It appears that the party visited first the Church, and then the mounds left from the working of Mickleton tunnel, where a large collection of fossils were found—indeed most of those described in Mr. Gavey's work—with the addition of a fine specimen of the *Hippopodium ponderosum* (whose existence was questioned by Mr. Gavey), found by the Secretary of our Club, and presented by him to the Natural History Society of Warwick.

On June 23rd, a meeting had been fixed for Winchcombe. A small party met at the Ram, at Cheltenham, to breakfast, and proceeded in flys to the Rising Sun, the summit of the hill on the Winchcombe road. Here they separated: one section proceeding under charge of the Secretary, exploring the earth, found specimens of *Mytilus jurensis*,* *Ter. Phillipsii*, and *T. Buckmani*, amongst other shells of the inferior oolite; while another section, under the charge of W. V. Guise, Esq. searching the air, appear for some time to have caught no species except certain Diptera—a race of diminutive Tartars, the catching of whom is neither profitable nor pleasant. After a time, however, on the eastern slope towards Postlip, Mr. Guise had the satisfaction of taking the somewhat rare and local *Procris statices* (Green forester), with the *Pyrausta purpuralis* and *punicealis*, and found dead in the road (the coroner happily not having sat upon him) a fine specimen of the *Sphinx ligustri*, or Privet Hawk moth. After dinner, a paper was read by Mr. Guise, "On some rare Bats discovered in the county," the specimens illustrative of which were kindly presented by him to the Royal Agricultural College.

In July, a meeting, honoured by the presence of a large number of ladies, again took place at Cirencester, and again formed two sections. The one, under the charge of the Secretary, explored Oakley Wood, where they found specimens of *Epipactis grandiflora*, *E. latifolia*, *Convallaria majalis* in fruit (this locality for the Sweet Lily of the Valley was discovered by Miss Haygarth), and other plants; while others of the Club, under the direction of Mr. Pooley and Mr. Jones, went first to a cornbrash quarry at Siddington, where a very satisfactory series of fossils of that bed

* Dr. Wright maintains that he knows no such species as the *Mytilus jurensis*, but the Ammonite *Jurensis* does not exist in the Inferior oolite.

were found. Thence to South Cerney, the Church Steeple of which had been seriously damaged by lightning, the repairs of which, we trust, may spare the very curious Norman carvings (so resembling those of Quennington as to appear to have been the work of the same artist); and returning by Siddington, where the attention of the section was called to a Norman font, a memorial window of the Langley family, and to the very recent, but, to us who knew him, not less interesting object, the memorial window to the late Rector, the Rev. Henry J. Bolland.

I am glad to avail myself of Mr. Jones's Report of this section.

"Despite the combined attractions of the society of the ladies, the far-famed beauties of Oakley Park, and the *botanical** eloquence of a Buckman, certain members there were who decided upon visiting other localities. Mr. Pooley kindly took these individuals under his charge, and drove them to a Cornbrash quarry, at Siddington, in which a very satisfactory series of the fossils common in the bed were obtained by all—*Acrosalenia hemicidaroides* by Miss Slatter, and a fine fish palate by Mr. Jones. Two pits in which the Oxford Clay was worked for brickmaking were then visited, but both were found to be exceedingly unfossiliferous, furnishing only young specimens of *Gryphæa dilatata*, *Ammonites Lamberti*, fragments of another small *Ammonite* too imperfect for identification, and one good specimen of the upper valve of *Ostrea deltoidea*. One of the workmen exhibited two good specimens of *Ammonites macrocephalus*, hitherto supposed by English geologists to be a Cornbrash form, but maintained by Dr. Oppel, in his work on the Juraformation, now in course of publication, to be distinctive of the Kelloway group, and not to occur below the grey clay which rests upon the Cornbrash, and, according to his view, forms the basis of the Callovian.

In the ponds formed by the excavation of the brick-clay, the common Stickleback *Gasterosteus aculeatus* abounds, although no connection with any stream or watercourse could be discovered. It was suggested that some ingenious member of the Club might favour it with a paper upon this subject, not a whit inferior in interest to the celebrated treatise on the origin of tittlebats in the Twickenham ponds, by the renowned Mr. Pickwick. *Lymnæus auricularius* was there also in great force, appearing upon the Cotteswolds to take the place of *L. peregrin* in similar situations in the vale.

"Proceeding to South Cerney, Mr. Pooley called the attention of the party to the Church Steeple, which had been recently damaged by lightning, so much as, in the opinion of the incumbent, to render it unsafe for the performance of the usual services, and he is now in consequence seeking funds for its due restoration. It appears that the electric fluid first put to flight the weathercock from his proud position; so alarmed old Time in the personality of the clock that it retreated about four inches downwards; displaced

* Substituted for *flowery*.

most of the boarding of the clock-case, dislocated about twenty feet of the upper portion of the spire, finally passing out of a Norman window in the basement of the tower, driving out the glass and decently interring itself in the churchyard, first enlivening possibly some of the long smouldering ashes with 'unwonted fires.' The double arches which support the tower are interesting examples of the transitionary style from the Norman to Early English, the shafts of the columns being lighter than usual in proportion to the mass supported, nearer together at the base than at the mouldings of their capitals, as at Elkstone, and the arches lanceolate though ornamented with patterns of the most distinctive Norman character. Over the doorway, also Norman, which so much resembles the south entrance of Quennington church as to suggest the probability of both being the work of the same mason, is an artistic version of the same legend which forms the subject sculptured in the tympanum of the north entrance arch at the last named place, exemplifying the power of the patron saint of the church to deliver souls from the evil one, combined with the representation of the Trinity, &c. occupying a similar position in the south doorway. The symbolical forms adopted in both cases so entirely correspond as to warrant the conclusion above indicated.

"Returning through Siddington the section was met by Mr. D. Bowly, who 'prevailed on it to stop,' not a la Turpin, but by the very acceptable offer of some lunch. The curious Norman font here is a prize for those who study such special features of ecclesiology, but the attention of all appeared to be for a while concentrated upon the newest in the ancient church—the window in stained glass to the memory of its late rector, and our late associate, the Rev. Henry John Bolland. The subjects treated are illustrative of the life of St. Peter, to whom the church is dedicated.

"The memorial windows of the Langley family, which was long settled here, and of which Geoffrey was seneschall to Edward the First, have been removed to Cirencester. The brasses which were once inserted above the canopied altar tombs in their chantry have met with even a worse fate than the glass, having long since, doubtless by the cupidity of some ignorant curator, been consigned to the common limbo of old metals, though their outlines are still sufficiently well preserved to convey to the instructed eye their form and character.

"Portions of inscriptions still remain in the heads of the windows, though in so mutilated a state as to be unintelligible; monograms, also, of the family are upon the walls and the spandrils of one of the arches dividing the chantry from the nave, but our only information respecting its rank and status is to be derived from the almost obsolete art of the herald, whose hieroglyphical contributions to the history of an ancient race are still perfect, except that whitewash has eclipsed all the once varied tints of

blazonry. The principal quarterings are those of Acton of Iron Acton, and Tame of Fairford. Members of this family were sheriffs of Gloucestershire in 1294, 1303, and 1477, and Huntly of Boxwell is its present representative in this county. It may be remarked here that the arms given by Fuller, in his list of sheriffs belong to a very distinct family, long settled in his time at Bristol, and, as appears from the Visitation of 1621, in the Huntley pedigree should be corrected as follows: *Arg. a fess sable in chief three pellets.*

“Here the section subdivided, the majority going on to the quarries at Furzen Leaze, in search of “tracks” on the Forest marble slabs, which were found in abundance: the minority to Preston church, to sketch the campanile for three bells, of elegant proportions and arrangement, so unusual as to be almost unique.

“All arrived at the College in time for dinner, from which period their proceedings were precisely identified with those of the general meeting.”

In the evening, papers were read by Mr. Brodie, “On the Lias of Barrow-on-Sour, and the Inferior Oolite and Lias of Northamptonshire and Gloucestershire.” Mr. Lycett also read a paper, “On the Inferior Lias and Oolite of the Cotteswold Hills, compared with similar deposits on the coast of Yorkshire.”

On August 25th a very small party, consisting of the President, the Rev. S. Lysons, and Mr. J. Jones, with Mr. — Lysons as a visitor, met at Beckford Inn to breakfast.

As Dumbleton hill has become, through the labours of Buckman and Strickland, classic ground to the Jurassic geologist a great increase in number was only waited for by the next train, but to no purpose. The time, however, was not ill spent in an inspection of the Church and Beckford Hall.

The former presents many features of Norman architecture in a good state of preservation, which would lead us to place the date of its foundation in the reign of Stephen, the ornamentation and the legendary subjects represented in the tympanum of the doorway arches being precisely those described at Quennington, but more coarsely executed.

Beckford Hall is a seat of a branch of the Worcestershire Wakemans, long settled here, of which the last Abbot of Tewkesbury was a member. It is interesting from the fact that it does not appear to have been improved or added to since the period of its erection. In the cellars are some arches which probably formed part of a Priory founded here in the Saxon times, of which the revenues were estimated in the taxation of Pope Nicholas at £32. 16s.; and in the garden is a fine avenue of box trees. The thanks of the Club are due to Mr. Woodward, who now resides here, for his kindness, in anticipation of its visit, in providing vehicles to convey its members to Dumbleton.

At the base of Dumbleton hill, apparently turned up in the

course of draining operations, were found fragments of a white band of lias claystone, full of a small trochiform looking univalve, apparently unnamed.

On the summit of the hill was obtained a fine series of characteristic Marlstone and Upper Lias fossils, already enumerated by Buckman and Strickland.

The day was one of excessive heat, and never was proffered refreshment more willingly accepted than that at the residence of Edward Holland, Esq.

A brief visit was paid to the Church, in consequence of a wonderful account of the antiquity of the bells, upon which were said to be inscriptions in characters so ancient and difficult as to have perplexed all the literati of the vicinity. As the honour of the Club was somewhat at stake, an attempt at the solution of the mystery was hazarded, and *one* bell which was pointed out as a test was examined. It bore the well-known name of Rudhall, of Gloucester, with the date of 1729, and the following inscription:—

“I to the church the living call,
And to the grave do summon all.”

How often do difficulties of much more serious import to us vanish upon being boldly confronted!

Messrs. Woodward, of Bredon, with Mr. Woodward of Beckford Hall, joined the Club at dinner at Beckford Inn.

On September 15th, the Club met, after various alterations of the fixture, at the Tetbury Road Station, whence they proceeded to Sapperton tunnel, pausing for a while to examine and speculate on the interesting fault at Hailey Wood. At this point I particularly regret my own absence from the party, inasmuch as the origin of various faults (at least in the human race) has of late years formed the staple of my studies; and among so many learned men discussing the origin of one “very interesting fault,” who knows what valuable lights might have been thrown on my own studies? As far, however, as the Chronicles of Buckman inform me, no suggestion was made as to that point of principal utility in searching into faults, viz. the best mode of amending them; he tells me that even the faults of the geologist are interesting.

And here, my friends, while we end our account of the summer gatherings of last year, I have unintentionally given an instance of the mode in which a mind is always apt to return, in season or out of season, to the subject which usually engrosses it. Shall I cry *peccavi*, and promise not to offend in a like manner again; or shall I brazen it out, and maintain that I was right and my remarks not alien to our Club? I’ll take the latter line. I regret to say that but few days ago, a member of our Club intimated to me that he thought that an antiquarian subject, (he did not mean himself, for he is comparatively a young member,) was foreign to

the pursuits of a Club of *Naturalists*. Gentlemen, I stood aghast. I did not think that there had been one of our members so ignorant of the principles of a *Naturalist's Club* as not to recognize the fact that even all art is only founded on nature—that nature must be the base of operations in art—and that, therefore, the studies of a naturalist comprehend all possible studies.

On this view, forgive me if I touch for a few minutes on those studies which have of late called my attention from the pursuits which more commonly bear the name of nature, but which I find so cognate that I constantly trace how the thoughts on the one subject have fitted me for action on the other.

You, gentlemen, know the work on which I have been engaged, and which I have closely watched for some years. I will not attempt to give you an account of the spread of Reformatory Schools throughout England, (still less of their immediately expected rise in Ireland, Scotland, and Jamaica,) but I will simply state, as a matter, hard indeed to be believed without examination, but of which the hope appears more strong the closer we search into it, that—so fast and so surely is Juvenile Crime decreasing, in all places where the Reformatory System, as it is usually called, has a fair trial, I have great hope and trust that by Christmas, 1859, all, even the large cities of England, with the exception only of London, will be cleared of all *regular habitual premeditating* thieves under sixteen years of age; and if this be the case, I have no doubt that three years more will clear London. I grant that this appears so wild a hope as to be classed with impossibilities. What of that? Is it more *impossible* than the electric telegraph was twenty years ago? or than railroads were thirty-five years since?

No, my friends—when we have *completed our studies*, when we have worked out all the laws of nature, and can put definite bounds to them all—then may we be justified in saying that a thing is impossible—but, at present, so far is this from being the case, that the greatest glory and charm of our studies of nature consist in the fact that, deeply as we may search, and far as we may see, any increase of our knowledge only enables us to see more clearly the existence of farther fields beyond us, and thus proves the eternal truth of our studies, by shewing that they are blended with the Infinite.

Notes on Bisley Cross ; also a Communication on Friar Bacon.

By CHARLES POOLEY.

As no record has been preserved of the ancient crosses that are so numerous scattered over this county, it seems desirable that this department of the Archæology of Gloucestershire should not be left entirely unrepresented. Having had my attention called to the subject, I shall be happy to supply this deficiency by occasionally contributing papers to the Transactions of the Club, which shall embody as much information respecting them as I have been able to accumulate ; at the same time I may state that, in many instances, the paucity of materials at my disposal will oblige me to be content with a bare enumeration of the measurements of these monuments, and probable dates of their erection. This is the more to be regretted because an interest attaches to these crosses that enhances their value in the eyes of antiquarians. Many of them are the standing witnesses of events which at the period of their occurrence exercised a powerful influence over the destiny of this country ; while others, as in the case of the Cross of Amney Holy-Rood, illustrate in a remarkable manner the ancient custom and practice of ecclesiastical tenure.

The subject of the present paper is Bisley Cross, or, as it is sometimes spelt, Bislye, Biselie, and Bisleigh, which stands at the west end of Bisley churchyard, where it forms rather a striking object, and may be mistaken for a handsome sepulchral monument. Lysons has figured it as a cross of the 13th century. Why it should be called a cross, it is difficult to say, as an inspection must convince any one that the term is misapplied. The building consists of a circular basement, on which is erected an upright hollow hexagon, formed by six three-centred arches, supported on round columns with beaded capitals and square plinths. On this tier rises a hexagonal pyramid built on a corresponding number of smaller open arches, with very deep scolloped mouldings. A thick fillet runs half way up the pyramid at each angle and terminates by bevelling. The small Greek cross of modern date which surmounts the summit, I suspect has no business there, as it certainly is not in keeping with the rest of the building : its place was formerly occupied by an equally incongruous object, namely, the baptismal font which now stands in the church. The total elevation of the whole building, from the ground line to the apex, is about twelve feet six inches. In the absence of any definite information, we may conjecture that this is a specimen of a detached bell-tower or turret of the thirteenth century, but it is difficult to conceive on what grounds it claims to be called a cross. Not only is the style of architecture in nowise analogous to that seen in the remains of any of the early



From a Calotype by Charles Pooley

Day & Son, Lith^{rs} to The Queen

BISLEY CROSS .



churchyard crosses of this county, but it does not possess even a single member in common with them to indicate that it ever was intended as such, or was erected for the purpose to which churchyard crosses were dedicated. There is a tradition amongst the common people, who have nick-named it the "bone-house," that it leads by a subterranean passage to the interior of the church. The existence of some sort of chamber, communicating with the interior of the building, has been partially confirmed by the assurance of an old man whom I met there, that some years ago he "went down," and at the bottom found a large number of bones, and an excavation like a tomb "which ran some distance under ground." Should this prove to be the case, it would illustrate in some degree the ground plan of this mysterious building, and would dispose of the idea that the structure was ever intended for a cross. Where the excavation led to, and what was its purport, are questions for future explorers to decide.

Mr. Ball says that a tradition exists that a person was drowned in a well in the churchyard, that the well was ordered to be closed, that persons were forbidden to be buried in the churchyard, and that this erection was built over the spot.

Friar Bacon.

As an appendage to this note, but unconnected with the subject, I beg leave to lay before the meeting a copy of a letter I have received from Mrs. Clutterbuck, of St. Mary's Mill, Chalford, in reply to my enquiries respecting the tradition, that her house was formerly tenanted by no less a personage than the famous Friar Bacon.

The statement is to be found in *Sir Robert Atkins's History of Gloucestershire*, wherein it is related that "Friar Bacon was born at Todgmore Bottom, about a mile from Bisley, and that he was educated at St. Mary's Chapel, now St. Bury Mill, on Stroud river; where a room at this day is called Friar Bacon's study." The historian then goes on to state that "he was a very learned person, and wrote eighty books, and for his skill in mathematics was reputed a conjuror in those ignorant times," &c. "He died A.D. 1284."

Now all authentic English historians agree that Friar Bacon was born at Ilchester, in Somersetshire, about A.D. 1214, and that he was educated at Oxford, where he took the vows of a Franciscan in a convent possessed by that order at Oxford, and that he was buried in the church of the Franciscans about A.D. 1292. Nevertheless it is remarkable, that the traditional evidence which Mrs. Clutterbuck has obligingly furnished me with, corresponds with the statement of Sir Robert Atkins, and therefore will be read with interest.

Mrs. Clutterbuck says, "The house formerly had sunk into the name of Saintbury, but it has gone by the original name of St. Mary's for more than forty years. The account handed down to her thirty years ago, was, that Friar Bacon's room was the one which she made the nursery, and that that room and the closet adjoining, said to be his cell, has always borne the name of Friar Bacon's study. She also perfectly remembers that she was told, there had been a flight of steps, which communicated with the top of the house, but which were taken down when the house was altered, where there is still remaining a walk on the leads with a stone balustrade, which tradition said was that he made use of as a place for his astronomical observations."

It may be remarked that Sir Robert Atkyns makes Friar Bacon's death to have taken place A.D. 1284, which corresponds to the date given by some foreign writers, but our historians place the event eight years later.

The above communication I deem sufficiently curious to be preserved in the archives of our Club.

C. P.

Notice of some rare Bats, from the neighbourhood of Gloucester and Cheltenham.

By W. V. GUISE, F.L.S., F.G.S.

I have the pleasure of bringing to your notice to-day three Bats, which are deserving of registration upon the records of our Society, not only inasmuch as they may serve for the commencement of a series illustrative of our local Cheiroptera, but because they are all of somewhat unusual occurrence, and one, *V. mystacinus*, is amongst the rarest of our indigenous species.

The three examples to which I allude are *Vespertilio nattereri* and *mystacinus*, and *Rhinolophus hipposideros*. For the first-named species I am indebted to Nathaniel Skelton, the well-known taxidermist, of Cheltenham, who procured it in the neighbourhood of that town; while I had myself the good fortune to obtain the two others at Elmore, about five miles from Gloucester. Of these *V. mystacinus* is by far the rarest; and as but little is known of its habits, the story of its capture may not be without interest. In the beginning of the last month (May), I had for some days observed a small bat to issue from between the fissures of some old masonry which surrounds a pool in my garden, at Elmore, and, in the full blaze of the mid-day sun, to hawk over the surface of the water, flitting backwards and forwards with all the restless activity of its race. After several ineffectual attempts at capturing the little animal, I at length succeeded in enclosing it in my insect-net. A careful comparison with the descriptions and plates in Professor Bell's work on the British Mammalia seemed to justify me in referring the bat to the rare *V. Daubentonii*, of which only four examples are recorded in the above-named work as having been met with in this country. Being desirous, however, of obtaining the opinion of some naturalist more competent to form a correct judgment upon the matter than myself, I availed myself of the opportunity presented by a meeting of the Linnæan Society to submit my specimens to the inspection of Professor Bell himself, who returned them duly named and labelled, and accompanied by a note in which occurs the following passage:—"I have examined your bats with care, and feel confident I have rightly named them; they are not common. I was a little doubtful at first about *Mystacinus*, but I feel now almost certain that I am right in so naming the specimen—this is the rarest of them—but in so many respects it resembles *Daubentonii*, that, but for its smaller size, it might be mistaken for it."

Now, having regard to the advantage attaching to the identification of these bats by so eminent an authority as Professor Bell, and at the same time, keeping in view the object towards which it especially behoves us as local naturalists to direct our attention,

namely, the collecting and systematising facts in illustration of the Natural History of our own county, I propose to place these specimens in the hands of our able friend and Secretary Professor Buckman, for deposition in the Museum of the Royal Agricultural College, at Cirencester, where they may serve as a nucleus for the gradual accumulation of the entire series of *Cheiroptera* indigenous to the county of Gloucester.

ON

RHYNCHONELLA ACUTA

AND ITS

AFFINITIES.

BY JOHN JONES, ESQ., GLOUCESTER.

J. Jones.

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ON

RHYNCHONELLA ACUTA

AND ITS

AFFINITIES.

ONE of the most remarkable fossils assumed to be distinctive of a particular geological horizon, and which, from its very striking outline, most readily impresses itself upon the mind, is the *Rhynchonella acuta* of the Lias-marlstone, a Brachiopodous shell common at Stinchcombe, Churchdown, and other localities of this district, and well known elsewhere. Having paid considerable attention to the class to which it belongs, I have long abandoned the common practice of placing in the cabinet only those specimens which chance to accord with the forms figured and described as *typical*. Instead of doing this, I have selected, as good examples, those which manifestly have not been crushed or injured prior to their entombment and petrification; and these I have arranged in series illustrative of specific development.

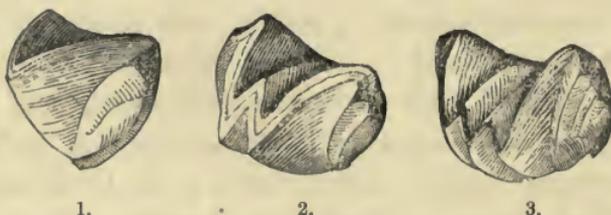
This mode of procedure has taught me that the species under consideration assumes forms varying from that under which it is most generally known; and it has led me to believe that several so-called species of various authors are, in reality, mere varieties of this.

All who have attentively studied the numerous Terebratulidæ of the Cotteswolds will have experienced the difficulty of assigning satisfactorily certain anomalous forms, occurring in beds ranging vertically from the Pisolite, or even lower, to the Cornbrash, to such well-established species as *Terebratula maxillata*, *T. perovalis*, *T. globata*, or *T. intermedia*, and will remember the remarkable varieties of individual character presented by other species, as, for example, *T. plicata*, *T. simplex*, *T. fimbria*, and *T. carinata*, sufficiently striking when studied in solitary examples, but, in an

extensive series, not suggestive of good and stable specific differences. The variability of character within recognized specific limits, then, being well known, I proceed to lay claim for *Rhynchonella acuta* to as great an amount of indulgence, in this respect, as for any of its congeners, referring in evidence to the specimens figured with this paper.

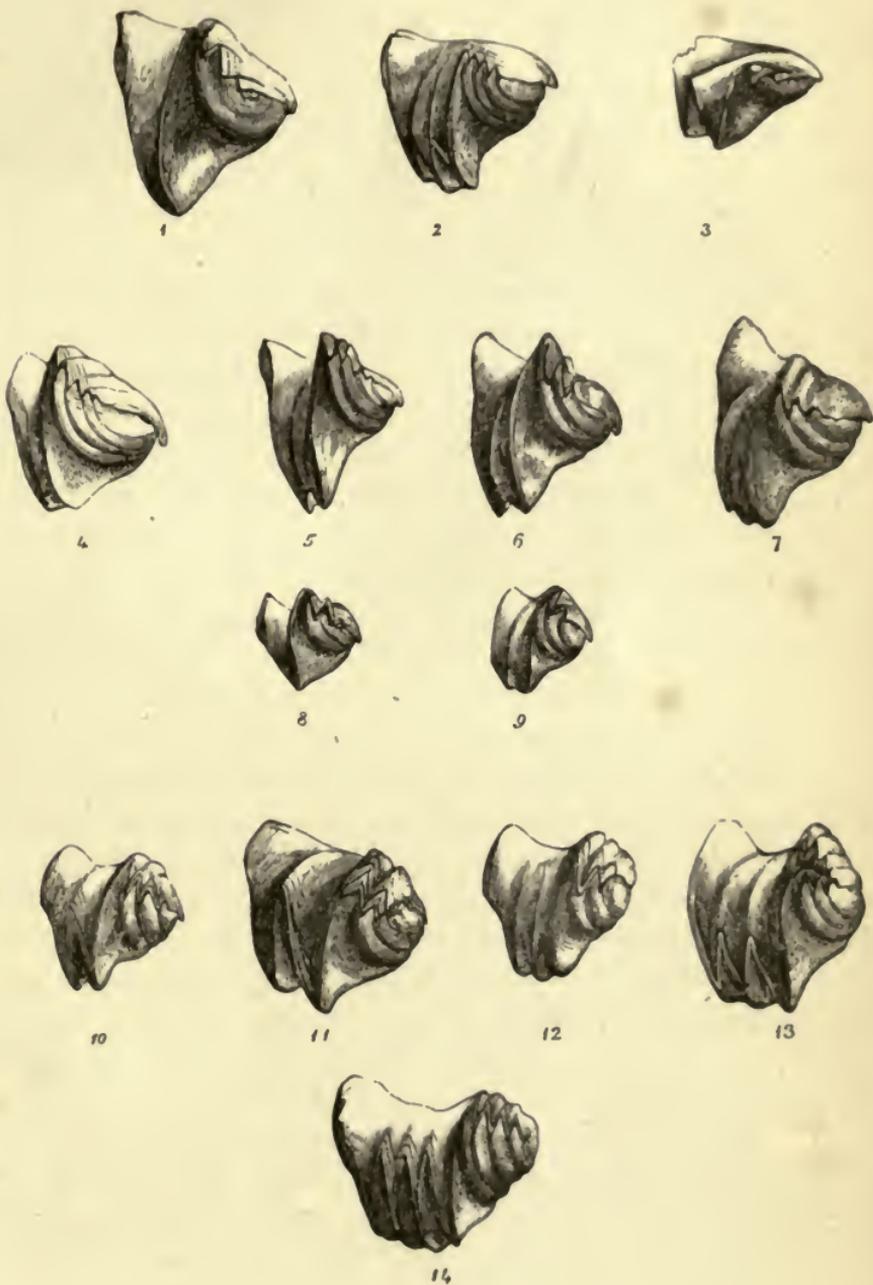
Its most common form is indubitably that figured by Sowerby and other authors, which occurs in the Lias-marlstone of Gloucester and Somerset, in the Lias-marlstone and ironstone-series of Yorkshire, in France, part of Germany, in the Macigno d'Aubange, the equivalent of those deposits in Belgium, &c.; but this I shall endeavour to show in the sequel to be an immature form, and that, in the succeeding stages, the species to which it belongs attains much larger dimensions, and a higher degree of development, than in the marlstone, although in that stratum it occasionally assumes characters of importance, as regards our present inquiries, which have not hitherto been formally noticed.

For example, it sometimes presents two mesial folds, as in Pl. I., Fig. 3, from Churchdown; and three mesial folds, as in Pl. I., Fig 2, from Stinchcombe. The scarcity of similar examples is, probably, not so much attributable to their rarity as to the intractable nature of the matrix in which they are imbedded, which renders the extraction of its most simple organic forms sufficiently difficult and laborious, and that of the more complicated still more so. A cursory examination will suffice to show that the examples referred to cannot be assigned to any other species than *R. acuta*, as they agree perfectly with the typical form in lateral outline, and differ from it in no other respect than in the number of mesial folds.

1. *Rhynchonella acuta*.2. *Rhynchonella bidens*.3. *Rhynchonella triplicata*.

(Copied from Plate XIII., Phillips' Geology of Yorkshire.)

On comparing these with the figures of *R. acuta*, *R. bidens*, and *R. triplicata*, of Phillips, from the marlstone and ironstone-series of



S. J. Mackie Del.

RHYNCHONELLE

In the Collection of J. Jones, Esq., of Gloucester.

Figs. 1-3. *Rhynchonella acuta*, from the Lias Marlstone.

Figs. 4-9. *Rhynchonella cynocephala*, from the "Cephalopoda-bed."

Figs. 10-14. *Rhynchonella cynocephala*, from the Upper Lias Sand.



Yorkshire, it appears to me that the author has merely represented more aged examples of the two varieties before us as species distinct from the first named.

Professor Morris, in the last edition of his "Catalogue of British Fossils," treats the difference of a plication, more or less, between *R. bidens* and *R. triplicata* as unimportant, although, instead of uniting these to *R. acuta*, and assigning to the three forms one specific name, he records them as synonyms of *R. variabilis*, one of the most widely-diffused brachiopods of the Lower Lias, and of which I doubt the occurrence in the marlstone of England at least.

In certain localities, as at Frocester, a young or dwarfed form of *R. tetrahedra* constitutes the principal bulk of large masses of marlstone, and has, I think, been mistaken for *R. variabilis*; but in neither of these species can I discover any features at all suggestive of affinity with that under consideration. That Professor Morris may be mistaken is not improbable, from the fact that the two most recent writers on the Jurassic formations of England and the continent, Opper and Quenstedt, have both found themselves somewhat perplexed as to the true affinities of these forms, perhaps, to some extent, in consequence of having adopted, without due examination, his views. Opper, in his observations on *R. variabilis* ("Juraformation," p. 187), after stating that it is found in the Middle as well as the Lower Lias, remarks, pertinently enough as regards the object of the present paper, that, "in Suabia it occurs particularly under the form of the biplicated variety (*R. bidens* of Phillips), which is found also at the base of the Middle Lias at Boll, Metzigen, Hinterweiler, and Balingen, with specimens possessing a greater number of folds (*R. variabilis* of Zieten, p. 42, f. 6, and *R. triplicata* of Phillips).

Bearing in mind the fact that *R. variabilis* of Zieten is not the typical form recognized by Schlotheim or Davidson, it is clear that Dr. Opper considers the forms just described as belonging to one species, and, in his observations on *R. variabilis* of the Lower Lias (p. 121), he appears disposed to limit its stratigraphical range to the Lower Lias only, in which case, of course, they are not varieties of the latter.

Professor Quenstedt, in like manner, in his recently-published "Jura," treating of *R. bidens*, Phillips, seems disposed to consider it and *R. triplicata* as varieties of *R. acuta*, distinctly pointing out their

general resemblances; although German authors generally agree in stating that this species does not occur in the Suabian Alps.

Not to needlessly multiply quotations, I may yet briefly state that Davidson, in his Monograph on British Jurassic Brachiopoda, figures what he considers to be the *R. bidens* and *R. triplicata* of Phillips as varieties of *R. variabilis*, which he believes to range through the Lower and Middle Lias;* but, unless his figures are taken from the original specimens of Professor Phillips (and these were very ill drawn by the last-named gentleman), I discover nothing in his observations upon either species to modify the conclusions at which I have arrived from a comparison of the observations of all these authors.

Labyrinthine as appears to be the confusion of ideas in the statements cited, the clue appears to me to lie within grasp. Let us remember that the three forms, in one case, occupy the same zone, occasionally occurring together, at other stages or places one or other numerically preponderating; that the difference between *R. acuta* and *R. bidens*, in the opinions of authors and observers in every way entitled to respect, is no greater than between the latter and *R. triplicata*, being one of degree only and not of kind. The suggestion, therefore, naturally arises that they may really pertain to one species. Assuming that we are justified in arriving at this conclusion, all difficulties vanish. We simply learn the not uninteresting facts in its natural history—that the geographical distribution of one of the most characteristic shells of the stage to which it belongs was co-extensive with that of many of its usual companions, from which it would otherwise appear to be somewhat unaccountably separated; and that, in particular portions of the area which it occupied, it attained to degrees of development denied to it in others.

Having pointed out instances of the confusion of these varieties with species of lower stratigraphical range, I will now direct attention to one instance of *R. bidens* having been recorded as occurring in a bed higher than that in which it is usually looked for.

In Phillips' "Geology of Yorkshire," this marlstone shell, there first figured and described, is stated, at page 157, in the list of organic remains of the Inferior Oolite, to have been found by Mr.

* In this monograph, Mr. Davidson gives his reasons from considering *R. bidens* and its synonym *R. triplicata*, as specifically different from *R. acuta*. His statements on this subject should be referred to.

Ripley in the Dogger, at Glaizedale. I have little doubt that, had Mr. Ripley's specimens been submitted to Cotteswoldian geologists, they would have been named *R. cynocephala*, and the close resemblance of certain forms of this shell to the former, which induced a practised observer to consider both specifically identical, suggests the expediency of inquiring whether they may not really be so.

Mr. Lycett finds *R. cynocephala* in the marly beds lying at the base of the sands which, in this district, usually rest upon the upper Lias, as at Nailsworth and elsewhere, although it has long been considered peculiar to the "Cephalopoda-bed" above those sands. It abounds at the Horsepools, Haresfield, and Frocester, where it presents three similar degrees of variety, attained to by those *R. acuta* in the marlstone. From the thin ferruginous earthy band dividing, at Haresfield, the "Cephalopoda-bed," into two portions, they are most readily extracted; the specimens are all more or less stunted in growth as compared with those from above or below; and there principally I have found the acute variety. The only recognizable feature of distinction between this and *R. acuta* is, that in the former the apex is not so much elevated, and is formed by a less acute angle than in the latter, approximating more nearly to its younger forms; although this difference of outline may partly be accounted for, by the fact that the marlstone, in the one case, only affords us casts, through the intractable nature of the matrix, while in the other the shells are exceedingly well preserved, exhibiting clearly lines of growth and perfect details of the states of maturity at which they had arrived.

With so great a constancy of form to a limited set of specific types as to perplex us, and to render essential the considerations of stratigraphical position in separating them, and with these derived from beds almost immediately following each other, it is not clear that valid grounds exist for their separation. All these forms indisputably have the same vertical range; they differ in no greater degree from each other than do the varieties of other universally acknowledged species. They appear and disappear simultaneously in strata of which they are everywhere some of the most remarkable fossils, and in which they are not associated with others that resemble them so much as to justify the confusion of nomenclature which has hitherto prevailed with regard to them. Why, then, should we make four, if

