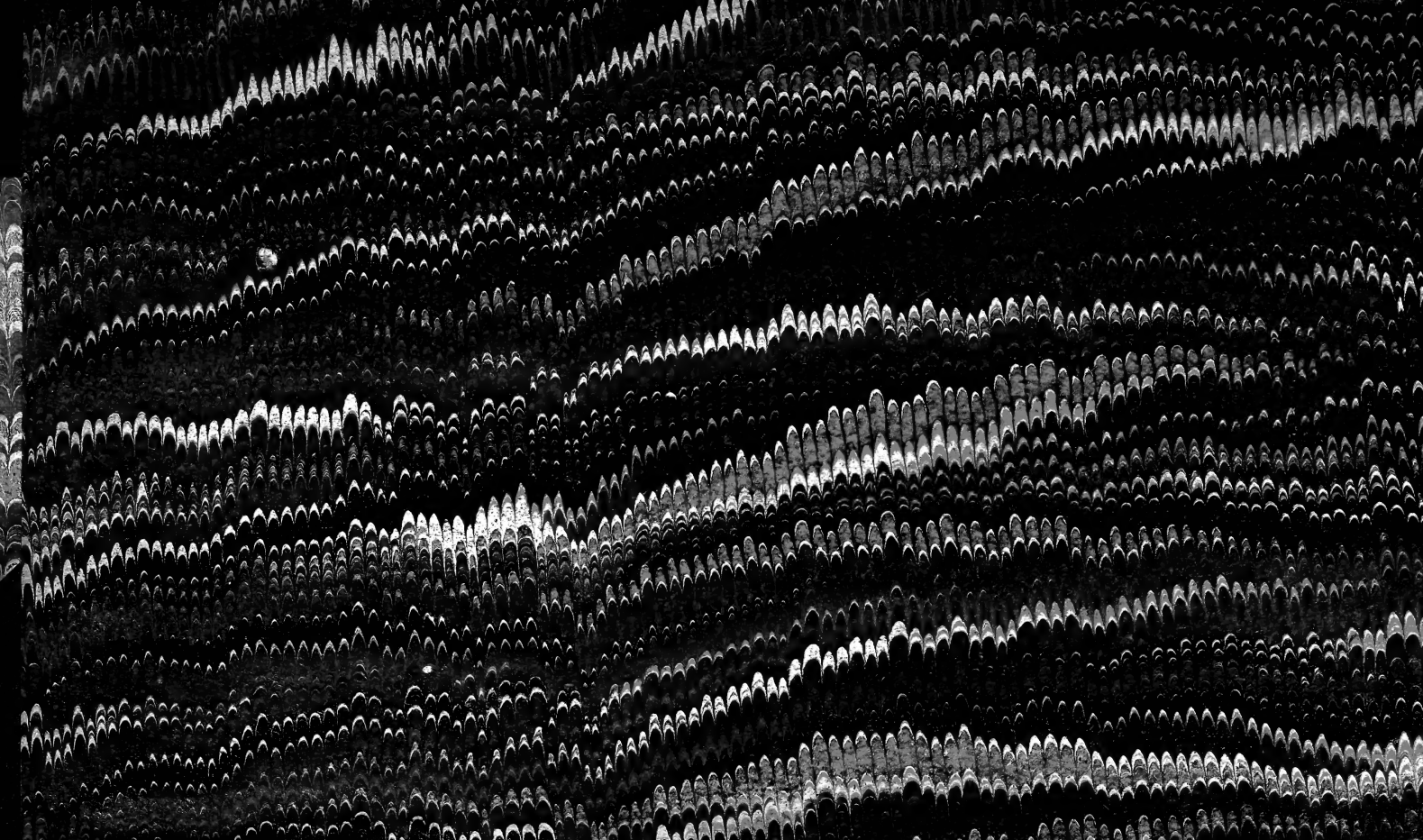

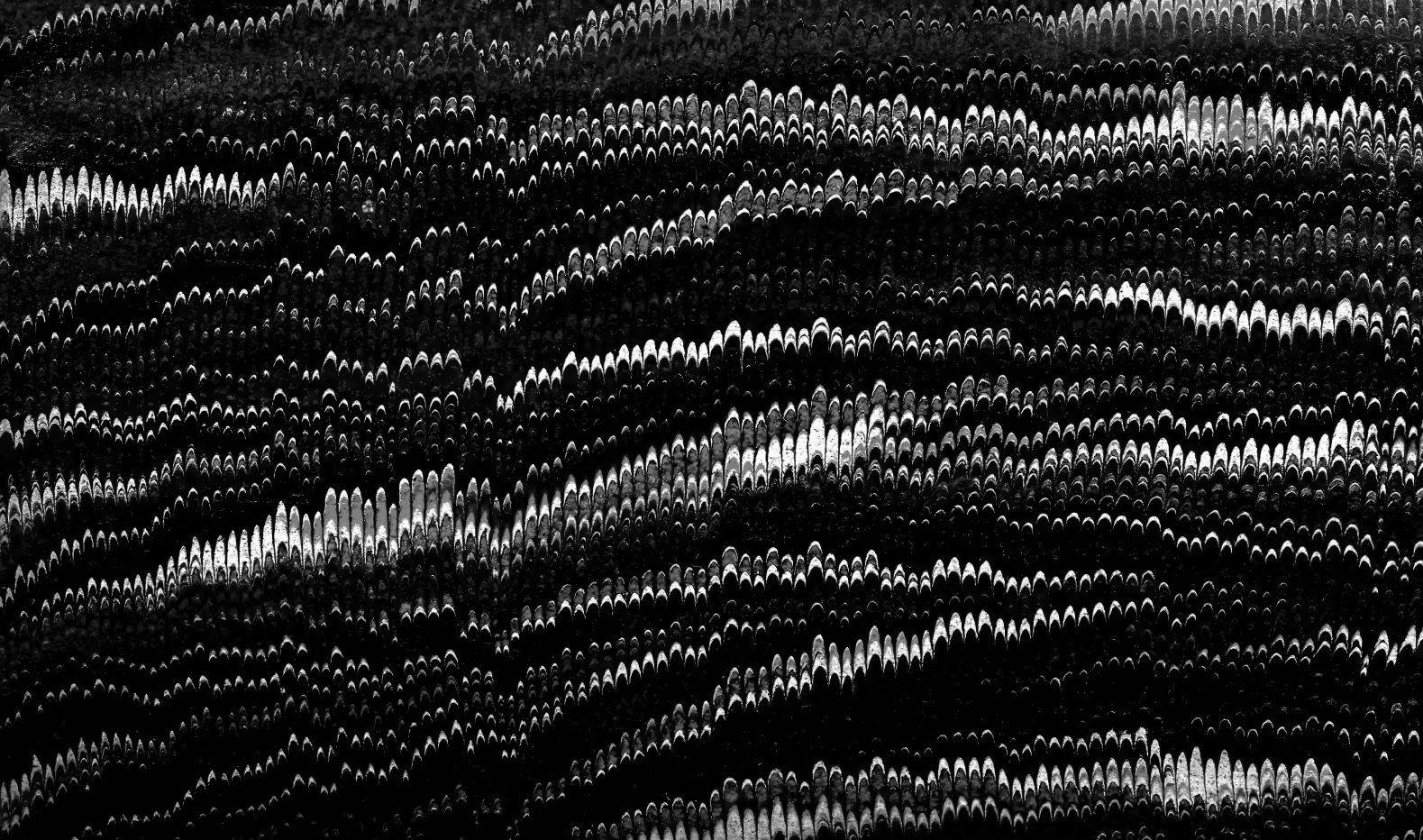

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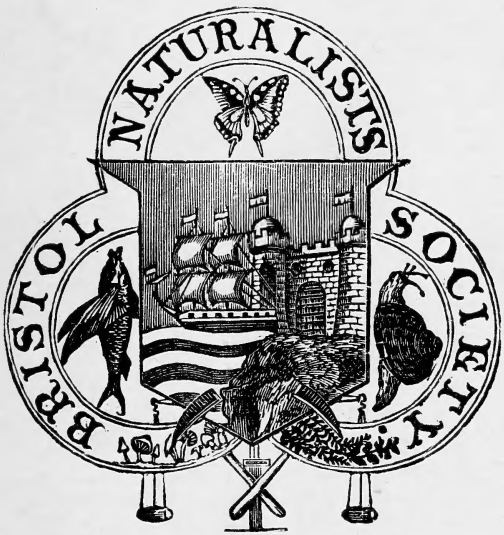

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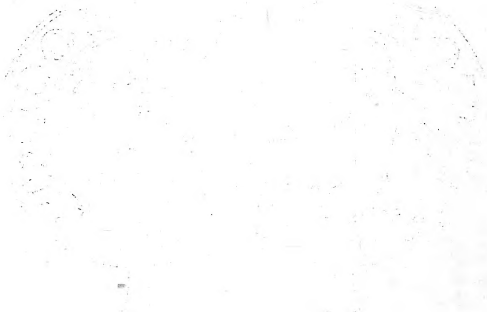

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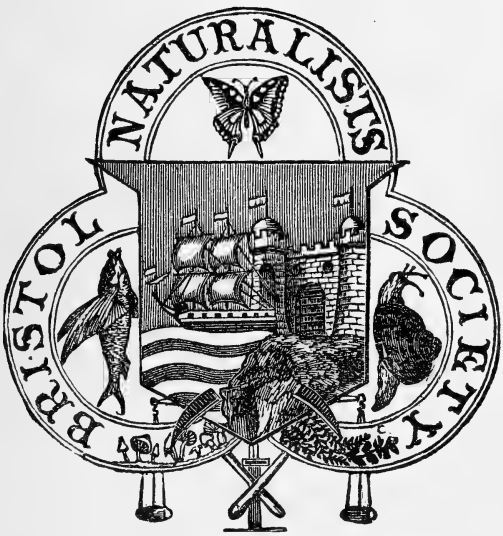

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Prof. Lloyd Morgan, F.G.S., F.R.S.

ALTHOUGH the Bristol Naturalists' Society as a body may have little claim to be considered noteworthy for original research, it has had the good fortune to be able to honour itself by the election of several presidents highly distinguished in scientific investigation. During the past fifteen years no less than three of our presidents have been Fellows of the Royal Society, and a fourth obtained that distinction shortly after the expiration of his three years' term of office. To these must now be added our present president, Prof. Lloyd Morgan, who has kindly consented to act in that capacity for a short period a second time. In his recent election to the Fellowship of the Royal Society, and the recognition of his high standing in the scientific world which it indicates, we feel that we, as a Society, are in some measure recipients of honour.

Prof. Lloyd Morgan was born in the West End of London in 1852. He was the son of J. A. Morgan, Esq., F.G.S., a solicitor, and great-grandson of John Nicholls, Esq., F.S.A., the historian of Leicestershire. Prof. Lloyd Morgan was educated at the Royal Grammar School, Guildford, under the Rev. H. G. Merriman, a Wykehamist. Although at school he gave indications of ability and industry and

obtained a good place in the sixth form, yet like so many Englishmen who have been successful in the various walks of life, as a boy Prof. Lloyd Morgan was better known for success in games and athletics than for love of work. In his last year he won all the senior events in the athletic sports, a remarkable achievement, as any one who has been a schoolboy knows. At this time an interest in Natural History had already been aroused, partly through the influence of his uncle Woodyer Buckton, Esq., a brother of George Buckton, F.R.S., but his school education had included no science, being almost entirely classical. When therefore the Royal School of Mines was entered, in October, 1869, the various branches of study that then required his attention must have been singularly new, but to a mind like that of Prof. Lloyd Morgan were probably none the less stimulating. However that may be, the Murchison prize for geology was obtained, as well as the De la Beche medal for mining, the Duke of Cornwall scholarship, and the Associateship in mining and metallurgy. On leaving the Royal School of Mines it was the intention of Prof. Lloyd Morgan to practise as a mining engineer, and in order to acquire experience of the methods of dealing with ores underground and at the surface some months were spent in Cornwall. A life, however, more purely scientific than that of the mining engineer was to be his lot. About this time an opportunity arose of visiting the United States and South America in the capacity of a tutor. This had the effect of strengthening his desire to learn more of geology, and an interest in biology became at the same time deepened. In pursuit of the former study three or four visits were paid to the Alps, and in 1875 an ascent of the Matterhorn was made. But the interest of Prof. Lloyd Morgan was not limited to geology

and biology. Even as a boy he had been drawn to the study of philosophical subjects. Apparently he was accustomed to especially enjoy the perusal of speculative works in the neighbourhood of a quiet river stream, and would often abandon his fishing-rod in order to read Herschel's "Discourse," or the works of Berkeley, Descartes, Hume and Whewell. He also read with eagerness the works of Darwin and Huxley.

On his return from South America Prof. Lloyd Morgan took Prof. Huxley's course at South Kensington, and definitely decided to devote himself to teaching and scientific investigation. A conversation with Huxley sowed the seeds of his work on comparative psychology, and to that end he read extensively in human psychology and allied subjects. With a view to a degree he matriculated at London University, after a few weeks' preparation, while he was engaged in teaching at a school in Ramsgate. But his further studies for the science degree were prevented by his appointment to a post at the Diocesan College, Rondebosch, South Africa, where, in addition to teaching science, he lectured on English literature and language. After five years at the Cape he returned to England in 1883, and was appointed to the post at University College, Bristol, rendered vacant by the appointment of Prof. Sollas to the chair of geology in Trinity College, Dublin. In 1884 he was made Professor, and in 1887 was chosen for the position of Principal of the College, the position which he now so well occupies.

As already mentioned, Prof. Lloyd Morgan has this year been elected a Fellow of the Royal Society. The following expressed opinion of those men of science who recommended him for this honour is of interest in this connection: "As a geologist Prof. Lloyd Morgan has done a consider-

able amount of original work in Pembrokeshire and the Bristol district. His chief claim to scientific distinction, however, rests upon his careful experiments and observations on the habits, instincts, and intelligence of animals, and his critical study of the true biological significance of the facts and their bearing upon some of the most fundamental problems of organic evolution. The three volumes which he has published on these subjects are of very high merit, and in the opinion of the signers of this certificate place their author in the first rank as a philosophical biologist." [1]

In 1882 Prof. Lloyd Morgan published a little work entitled "Water and its Teachings," now out of print. In 1885 appeared his "Springs of Conduct," and in 1887 a text-book on Animal Biology, of which a third edition is now in preparation. His chief works, however, are "Animal Life and Intelligence," of which the third edition is in preparation, "An Introduction to Comparative Psychology," and "Habit and Instinct," a work based upon his Lowell Lectures in America. He is writing a series of philosophical papers for the *Monist*, which, when complete, will probably be republished in a collected form. Prof. Lloyd Morgan has also written several papers on geological subjects in the Quarterly Journal of the Geological Society and in the Proceedings of the Bristol Naturalists' Society.

From 1890 to 1892 Prof. Lloyd Morgan filled the post of President of the Bristol Naturalists' Society, and has kindly allowed himself to be elected again for this year. In such a capacity Prof. Lloyd Morgan displays other qualities than those generally associated with the student of science. His business ability and the readiness with which

[1] *Nature*, May 11, 1899.

he is willing to devote his attention to matters that might be considered trivial, his lucidity of expression and power of giving interest to subjects that popular opinion may term dry, combined with patience and modesty, reveal his value as the head of a society which, like all societies of the kind, is composed mainly of members desiring to learn, with a small admixture of those who wish to discuss.

"Journal of an Excursion to Eastbury and Bristol, etc., in May and June, 1767."

By SIR JOSEPH BANKS, BART.

[*With Preface and Notes by S. G. Perceval.*]

AS a fitting tribute (!) to his memory, on April 14th, 1886, by order of his great-nephew, Lord Brabourne, the Correspondence and Letters of Sir Joseph Banks were put up to auction at Sotheby's, with the result that they were scattered amongst the dealers. Apart from some lots put into the sale, the collection was divided into 198, which realised the sum of £180 5*s.*, less than a pound per lot, 26 lots fetching but two shillings each, 14 only one shilling each. Greatly as it was indebted to Banks, not a single lot was rescued by the British Museum, though the Letters and Journals were of surpassing interest and importance.

In 1896 appeared the "Journal of the Right Hon. Sir Joseph Banks, Bart., K.B., P.R.S., during Capt. Cook's First Voyage in H.M.S. *Endeavour*, 1768–71," edited by Sir Joseph Hooker. From the review of this Journal in the *Athenæum* of December 26th, 1896, it appears that "the late Mr. Knatchbull-Hugessen, created a peer by Mr. Gladstone in 1880, under the title of Lord Brabourne, claimed all the

Banksian documents in the Botanical Department of the British Museum and carried them off and offered them for sale." The original MS. of this Journal formed lot 176, and was bought by an autograph dealer for the paltry sum of £7 2*s.* 6*d.*, who apparently sold it to J. Henniker Heaton, Esq., M.P., who disposed of it to a gentleman in Sydney, N.S.W. In consequence of its disappearance, Sir Joseph Hooker had to avail himself of a transcript which fortunately existed in the British Museum, or the contents might have been lost to science.

The following additional facts in connection with the sale may interest the readers of these Proceedings, showing how this invaluable Correspondence was literally thrown away, apart from the circumstance of the letters I am about to mention being of men connected with Gloucestershire.

Lot 65, which contained "28 Letters of (the Rev.) John Lightfoot to Banks on interesting subjects, 1773 to 1784," was bought by "Cash" for the absurd sum of two shillings! John Lightfoot, the author of the *Flora Scotica*, was born at Newent in Gloucestershire in 1735, went to Pembroke College, Oxford, and took orders. His taste for conchology and botany, and agreeable manners, recommended him to the Duchess of Portland, whose Librarian and Chaplain he became. After her death in 1785 he drew up the Sale Catalogue of her celebrated Museum in one volume, 4to, which was dispersed by auction in 1786. He died at Uxbridge, of which place he was Curate, in 1788.

Lot 98, consisting of 31 interesting letters to Banks,—including two of Walter Honywood Yate of Bromesberrow Place, near Gloucester, which I fortunately afterwards secured,—was bought by a dealer for the absurd sum again of two shillings. One of these letters had accompanied the copy of the Catalogue of his Museum at Bromesberrow

Place, which he presented to Sir Joseph Banks, and which may be seen in the Banks Library in the British Museum.

This curious Catalogue, which is excessively scarce, was printed in 1801 by R. Raikes of Gloucester, and consists of a thin 8vo volume, dedicated to Banks.

The following Journal, which consists of 22 pages, came out of lot 5, which sold for fifteen shillings, and which also included a "Copy of Some Account of Lisbon, and the adjacent country, &c." For this Journal I offered a high price to the collector into whose hands it passed, and fortunately secured it. It is in the handwriting of Banks, in size small quarto, and is stitched in a cover of coarse whitish paper, which is pasted with a square label, neatly inscribed with its title by Sir Joseph, as given above. I have preserved the spelling throughout, and as stops are entirely omitted, and capitals not used to distinguish the commencement of sentences in the course of paragraphs, I have therefore supplied both. The date of Sir Joseph's birth has been incorrectly given by some,—even in the *Dictionary of National Biography* a date has been repeated the inaccuracy of which had been pointed out in the *Penny Cyclopædia*,—but in the latter publication it will be found that the exact date is January 4th, 1743. He was therefore in his 25th year when he made this excursion.

S. G. P.

May 29th, 1899.

JOURNAL OF SIR JOSEPH BANKS.

May 15.—Set out this day for Eastbury in Dorsetshire, on a visit to my Aunt M^rs^ Grenvile. It is situate about 100 miles from London. As I traveld post and arrivd there the same night I made but few observations upon the Road. I saw however through the Windows of my Chaise, Myrica

Gale growing in Plenty upon a Bog near the 21 mile Stone on Bagshot heath.

16.—This morn hard rain. Amusd myself by looking over the house. Found it exceeding large and possibly one of the heaviest piles of stone S^r^ J^no^ Vanbrugh ever erected. The inside is fitted up magnificently with a great deal of gilding and Ceilings painted after the antique. Upon the whole the inside is much more convenient as well as more elegant than the outside gives any hopes of. The Countrey about it is Pleasant, consisting cheifly of open Downs and sheep walks, except towards the west and N.W., where the town and enclosures of Tarent Gunvil and the Woods of Cranbourn Chace give an agreable variety, contrasting with the open countrey on the other sides. At twelve Cleard up, went in Search of a Barrow which the Bishop of Carslisle had informd me was somewhere in this neighbourhood. Found it at the N. Corner of the Park, its construction very singular, being a Bank of about 60 paces in Lengh and 15 broad, N.E. b N. [N.E. by N.] and S.W. b W. A small part of one end was within the pail that had been opend, and a grotto made in the hollow. We were told that when it was opend a number of Bones were found. I was exceedinly desirous of opening the other end, which was in a sheep walk without the pails, but upon inquiring whose property it was, had the mortification to be told that it belongd to an estate now upon sale, the Owner of which was in London; was therefore obligd to give over all thoughts of it. Went to Look at the Village. Found nothing in it remarkable but the name Tarent Gunvill, the name of Tarent being affixd to several little villages which stand on a little Brook or torrent.

17.—This morn also Rainy and disagreable: venturd out towards Chittle[1] in which Parish is situate a tolerable

house, the property of a M[r] Chafin,[2] whose father was sometime Member for the County: was agreably surprizd by finding within two feilds of the house, another Barrow[3] of exactly the same construction as that found yesterday, only Larger, it being 100 paces in lengh: its bearings also were different, it being pretty near East and West. It had visibly been opend in two places, which made me curious to enquire what had been found. Upon my asking, the Young M[r] Chafin inform'd me that his father had opend it about forty years ago. One opening at the Eastern extremity he carried down a little way below the surface of the real Ground, when he found many Bones, Brass heads of Spears and some Coin, all which were sent up to L[d] Pembroke. The other, situate about one third of the whole Lengh of the Barrow, more to the westward, was never carried deep enough, so nothing was discoverd in it. On the side of the Barrow found Thesium linophyllum and Othonna integrifolia [Senecio campestris].

18.—This morn exceeding fine; went with the family to see M[r] Portman's, situate upon the River Stour, just at the entrance of the town of Blanford. It has from the Road, all the appearance of a very pretty Place, but upon our finding M[r] Portman at home, for Reasons of Ceremony, we were not permitted to see it. In the way, however, discoverd a third Barrow like the other two, which certainly is what the Bishop meant, being situate upon the Downs. My time however is now so short, that it is impossible to get men together to open it.

19.—Went this morn to Kinston Hall in the Vale of Winbourne, to see M[r] Banks,[4] my namesake, an old Batchelor of 70 and more. His house is an exceeding good one, but quite of the last age, as there is not one sash in the whole. Its furniture, however, of Pictures is very Capital;

a Collection of S[r] Peter Lellys portraits very fine; two Spanish boys eating fruit by Morellio [Murillo], a Lanscape by Bergem, a copy or original of Rembrants Rabbi. But four pictures are Remarkably Capital, perhaps Guido: they represent Pope Gregory the Great, the Great St. Augustine and two more of the fathers: but M[r] Banks has no Catalogue and knows very little about them. In returning home this Morn, just at Blanford Horse Course, saw two Remarkable Birds seeming to be of the genus of Cheradrias. Some Shepherds informed me that they came here to breed but are exceeding difficult to shoot. I could make no particular observation but that they were near as large again as grey Plover,[5] had a white spot in each wing and whistled exceedinly shrill, not unlike a man: the shepherds also informed me that they Laid 2 eggs. I had almost omitted that we saw near M[r] Banks's, upon the top of a hill, a regular entrenchment, consisting of three Banks raisd one above the other: had not an opportunity of going near it, but at a distance it much resembled one of those famous ones at Whitnam[6] near Dorchester in Oxfordshire.

20.—Went to visit M[r] Stert[7] at Critchill, who carried us to another house he has at Horton about two miles beyond it, where he shewd us the finest peice of artificial water[8] perhaps in England. It covers 280 acres, winding between two hills, so that one end is Generally out of sight. It has also an additional beauty, a wood of very fine oaks which come down quite to the Banks. It is well stockd with Carp, which M[r] Stert sells to people who carry them to London, by which method he receives more money for the water than ever the Land brought him in. It is drawn once in three years and all the fish of a certain size sold. The last time 16000 weight were taken and sold for 6 pence a pound, which is 400 pounds. I should not forget

to mention one very remarkable circumstance which occurrd in Raising the Head of this water. 35 feet was the hight requird, 25 feet of which they raisd without any difficulty, but when that was compleated, were much surprizd to find that after several days work they had not raisd it an inch. This put them upon inquiring the cause, and they found that any quantity of Earth they put, sunk in 48 hours to the original 25 feet. Mr Stert not discouraged by this disheartining circumstance resolvd to back the head with piles in hopes that they might hinder it from sinking any farther. This he did with trees 23 feet in Lengh, which he drove down with an Engine constructed for the purpose, at the same time taking account of the quantity of Earth that sunk by measuring the hight of what he layd on. His piles did no manner of service. The Earth continued to sink, and now he found the feild about twenty yards below where they were drove in began to rise, raising with it trees, particularly an Ash and an Oak, each of them Containing some tons of timber. The top also Crackd into deep chasms, plainly shewing that it was raisd by some lower stratum which the weight of the head forcd under it. Mr Stert still perseverd. After some time his head began to rise and was then very soon compleated. The Quantity that had sunk was then cast up, and it was found that the head had sunk 87 feet, beside what was Lost before they even guessd at the Cause which hinderd them from raising it. The Soil on which the head was erected has not been examind deep, but what has been seen is Sandy Gravel, under which is a solid blue Clay containing most singular impressions of fish, resembling them by Mr Stert's account most exactly, not only in shape, but in a silvery Colour like that of fish, very thinly spread over them as the whole interior was clay. In that however was the prints of their bones.

They were of several sorts, but cheifly whitings and Dories, very plainly to be distinguishd. They were so much impregnated with Vitriolick Salt that they could not be preservd. Several that M^r^ Stert carefully brought home wasted in Less than 12 hours.

From hence we returnd to dine at Critchill. The house there is pretty good, much more chearfully situate than the other; a great deal of the best Planted Oak. I have seen one of them, nine feet in circumference, carrying up, I dare say, fifty feet of Boll. M^rs^ Stert keeps here several kinds of Birds and animals, particularly a Sanguin which she has had a year. It lives constantly in a small Deal box filld with wool and hay, had no particular care taken of it. Here is also a favourite of a very extrordinary nature—a Bull, the finest I have seen. He was bred in Lincolnshire, and tho only 4 years old and very lean, the Butcher Guessed his weight to be between 70 and 80 score. He is a well-made beast and beautifully spotted. M^r^ Stert always uses him to draw by himself, for he will not do it with any other Beast, but singly will do as much work and draw as large a weight as two or three horses.

21.—This morn rains very hard, venture however out upon the downs to Observe the Long Barrow between the house and turnpike road in the way to Blanford: Find it like the first I examind, only Larger, its greatest lengh being about 100 paces, its breadth 20, bearings N.W. b N. and S.E. b S: On the side of it one and only one plant of Othonna integrifolia, which is very scarce in this countrey, as I have only found it on this and one other Barrow.

I have now seen three of these long Barrows all within a circle of about 2 miles in diameter. What the occasion of making them in that shape is difficult to guess. Possibly

they are the Common place of interment of the slain in a Battle, as their Long shape seems to indicate that they cover more than one Body: but this is vague conjecture. I hope however some time or other to have an opportunity of Opening one or more of them, by which alone it can be determined for what use and when they were erected.

Observd to-day in the Garden a very strong Plant of Mellitis melissophyllum. As it is the only plant of any degree of curiosity in the whole garden, it seems more than probable that it came originally from the woods somewhere in this neighbourhood.

22.—Set out this morn for Bristol. At night arrived there, comeing through Shaftesbury, Warminster and Bath without any occurrence worthy of note.

23.—This morn crossd Aust Ferry. Came to Chepstow about 12. Went to see the Castle, which is really a very fine one built on the edge of a very high cliff, hanging over the Wye, its outworks stronger than any I have seen in so old a Castle.

After dinner went to Pearcefeild, which is much improvd since I saw it Last. Have no doubt of Pronouncing it the finest place I ever saw. The transition here from very fine Lawn to naked rocks is very often seen by turning yourself round in the very spot on which you stand. The romantick in which the cheif beauty of the Place consists is formd by a semicircle of rocks coverd with wood, the front of which is washd by the Wye, the opposite side of which is formed sometimes by Rocks over which you see the Severn: at other times by the Richest cultivated land in the world, coverd with Corn and Pasture. On the Top of Windcliff, a hill at the Farthest Extremity of the Improvements, you have an immensely extensive view of the countrey. On the uppermost Knowle I found Achemilla vulg: Hippocrepis

comosa, Geranium hæmatodes [sanguineum]. Near the cave where the gunns are planted Rubia Anglica [peregrina].

24.—Remain to-day at Chepstow: went to see the Bridge,[9] where there is supposed to be more tide than anywhere in England, as it rises in the springs 48 feet, some say 60, but How they make out the possibility of such a rise, unless they measure from the bed of the river, I cannot guess. The Bridge is wood Built upon starlings, the highest I believe in England, yet spring tides sometimes rise a foot above its floor, for which Reason the Plank with which it is covered is not naild down, Least the Pressure of the water against them, if they were, should Carry away the Bridge. On the Banks just above high water mark grows Cochlearia Anglica and Lepidium ruderale. About Half a mile below the Bridge is the old town wall, which Plainly shews that the town was full three times Larger than it now is: indeed it is wonderful that a town so conveniently situated for trade should be so much neglected. I believe there are few places have so extensive an inland navigation, as it has the command of the Wye, which is navigable as high as the Hay and the Severn. In the Wye, close under the town, the Largest ships may lie with ease, as there is 23 feet at low water and soft mud on the town side where ships may be unloaded immediately on shore. On the contrary at Bristol a ship of 300 tons is obligd to discharge half her lading in Kingroad, which must be brought up in lighters at great expence.

After dinner went by water up to Tintern Abbey. The Passage took an hour and $\frac{3}{4}^{\text{ths}}$: the Banks of the River everywhere most Beautifull, especialy under Pearcefeild, where you look up upon M$^{\text{r}}$ Morrices[10] improvements. Indeed through the whole Course of the River you have always, on one side of you at least, a high Rock featherd on the top with

woods. The abbey itself is a most noble Ruin, by far the Lightest Peice of Gothick architecture I ever saw, tho now indeed but the walls are standing. The Bottom is unpavd, yet it is kept constantly rolld and mowd, which adds more to the Beauty of the whole than so trifling a circumstance would seem to do. In rowing by Chepstow Castle observd upon the walls great Plenty of Brassica oleracea growing every where among the Rocks. I should not omit a singular variety of the Anas Boschas observd in M^r^ Fidels[11] Yard, who Bought them in the Market not above half grown and was told that it was a peculiar breed who were all so. They were white, but their Bills were very particuler, the under mandible being ½ an inch at least longer than the upper, which was raisd a little at the sides, not unlike that of a flamingo, tho not near so remarkably.

25.—Went this morn to the Top of a Rock calld Matlock Opposite Pearcefeild, where the view is indeed very good, afterwards dined with M^r^ Morrice and took leave of it more and more convincd that it is far the most beautifull place I ever saw. M^r^ Davis of this Place shewd me a Collection of Coins Left to him by Doctor Davis of the Devizes.[12] He means to sell them by auction. I had scarce time to look them over even in a cursory manner, but observd that the Greek Coins were very good and the Consular a very fine Collection. Among them was one Brass Otho, but I fancy, like all the rest I have ever seen, it was Counterfiet.

26.—This morn Returnd across the Old Passage, the wind Blowing fresh at N.W., in about ten minutes, in the small boat. Rode from thence to Bristol Wells, in a sweet countrey, admird particularly M^r^ Chesters House and the Town of Henbury, which in some points of view is extreemly Beautifull. Observd Lepidium petreum [Hut-

chinsia petræa] in great abundance on a wall on the Left hand side of the Road in Westbury town [Westbury on Trym]. In the evening walk to St. Vincent's Rock, find Peucedanum minus [Trinia vulgaris] in full bloom plentifull: just above the Rock house, Geranium hæmatodes in company with it. Nearer the River side Lepidium petræum among the Rubbish. Went to the Rooms: found only one Lottery table, which broke up by nine O'Clock.

27.—Search St. Vincent's Rocks again with M^r[13] Kaye. Found in a shrubby Bank near the New Well house Ophrys myodes, Hypnum [blank space]: in a wood almost as far as Jackson's Tower,[14] Rubia Anglica plentifully. Searchd the meadows under the Tower in hopes of finding Asparagus officinalis, but without success: fancy it is hardly yet sprung up. Found, however, great plenty of Trifolium maritinum, also Lepidium ruderale and Cochlearia Anglica.

The views of the River winding between steep Rocks sometimes wooded and sometimes bare are most beautifull: they would have well repaid our walk had we had less success in our Botanical amusements. One beauty of the woods here I cannot omit taking some notice of, which is the infinite variety of shades of which they are composd, formd by the great variety of trees of distinct sorts and consequently colours,—particularly Cratægus Aria grows here in great abundance and makes a spot of white visible at a great distance.

29.—This morn set out with M^r Kaye for Wells: arrive after a tedious drive. Go to see the Bishops Palace, nothing there worth seeing, except a Plant of Agave Americana, which has stood in the open ground some years. It looks tolerably well, tho' not remarkably healthy. The Cathedral

Rather Good, the Cheif front coverd with Statues. From the Quire, the Chappel of our lady which is Built behind the Altar has a most beautifull effect, as it is of most elegant gothick architecture, the Capitals and Key Stones very highly finishd. This was formerly hid by the Screen of Stone which was taken down at the instance of M^r^ Prowse.

From hence proceed to Okey hole, about two miles, a very Pleasant walk. The hole itself, a very fine Cavern, I think far superior to Pools hole near Buxton: in some parts very lofty. From the hole rises a spring or rivulet of water, which turns a mill almost as soon as it sees the light.

30.—This morn set out from Wells to see Cheddar Cliffs on horseback: found it a very Pleasant Ride, especially from the town of Easton to Westbury where the Road is a terrace overlooking the Moors which are flats, every here and there interspersed with hills, prettily coverd with wood. The Cliffs themselves are well worth the ride, some of the Rocks are extremely bold, particularly those beyond Harr-cliff,[15] but the Cave which the people there will carry you to, if you will Let them, has nothing at all in it worth the trouble of stooping, for in many parts of it you are not able to go upright. On the Rocks we found Dianthus glaucus, Papaver cambricum [Meconopsis cambrica], Saxifraga hypnoides, Marchantia, all of them in great abundance.

31.—This morn after having heard Cathedral Service very well and very decently performd at Wells, we proceeded to Glastonbury. Saw Tor hill, a very remarkable Point of view all over the Countrey, being a hill detachd from everything else, on the Top of which stands a tower which was the steeple of a church dedicated to S^t^ Michael, which is now totally demolishd and nothing but the shell of the Tower left standing. About the sides of this hill searchd for Lathyrus luteus, but without success — fancy it is

hardly yet come into flower. From hence proceed to bloody well, a Spring so Calld from the reddish rust colour with which it tinges the stones over which it Passes. It has a very mineral appearance, but very little taste. The people here hold it in great Repute for astma, scurvy and Dropsy telling of several cures it has and continues to make every day. Not far from this on the other side of the town, is the hill on which the Glastonbury thorn is said to have grown, but it has been dead several years, so long that we have not met with anybody who remembers it. The Tradition belonging to it is this, that Joseph of Arimathea Landed there and stuck up his Staff which immediately grew up to a tree that, in token of its Christian original, constantly used to flowr on Christmas Day. That the Sea formerly came to this Place there is very little Reason to doubt, tho it is at Present at Least 15 miles distant. The country that intervenes is quite flat and in the old Church on the wall is an inscription recording that in the year 1606 the Sea having broke its banks flowd up to the church yard. The old Church is Curious as it is certainly of Great antiquity, if you believe the people here, the first place in which the Christian religion was preachd in the Island. In it are several Escutcheons of arms very ancient, one bearing the five wounds of Christ bleeding, another on a Cross a heart bleeding between two hands in Cheif and two feet in base Pierced. Here are also several others in the same style, but I am by no means Learned enough in antiquities to Record them. From hence we went to the Abbey, which appears to have been a building of vast size as well as very great antiquity, tho very little of it is now remaining, but that which is, is coverd with the most venerable Ivy I ever saw, which is turnd to very good use, for the people to whom it belongs feed sheep there and fodder them in winter with its leaves,

which saves hay. The only Building in tolerable Preservation is the Kitchen, which shews the immense size of the whole. It is an octagon with four fire places in as many corners, each larger than most you meet with now. In the Rotten Root of a tree within the Abbey, by digging found a great number of Scarabæus paralelopipidus with Larvas of them, of all sizes, who feed upon the rotten wood.

June 1*st.*—Went down to the moors in Search of Plants, found that what they call moors in this Countrey, are like our fenns in Lincolnshire, I mean the Best Part of them, for the worst is like the Peat moss's in Lancashire. Of this kind of country there is an immense tract, Running through the countey of Sommerset. Agues, Gnatts etc. etc. etc. are as rife as in any Part of my Countrey, indeed we were almost bit to death by the Latter, Last night in Glastonbury Abbey. The weather being very Rainy, made my Search for plants very Short, or I imagine I might have found great variety of those that are usually found in such swampy places. The most remarkable I observ'd were, Drosera Longifolia, Myrica Gale, Utricularia major [vulgaris], Hypnum squarrosum and such like. Leave Glastonbury at one, pass through Bridgewater, a pretty good town with a River capable of Bringing up vessels of 2 to 300 tons, quite to the Bridge. From hence to Taunton, where are some Remains of Antiquity, a Cell to the Monastery of Glastonbury, at least a Building which we took for such by the Arms of Glastonbury—a Pelican being over the Door. Some walls and remains of a Castle said to have Been Defended by one of the family of Admiral Blake. Over the Door are the arms of the See of Winton: in another place under a sheild on which is five Roses, on a Cross P. Langton Winton.

From hence went to Hesticombe [Hestercombe], the seat of M^{r} Bamfeild, to see his Gardens,—found that tho

he is so remarkable for Drawing he does not succeed quite so well in Gardening, at Least in our opinions. His Cascade however seems to be a very good one as it falls down about thirty feet of natural rock, not at all assisted by art. We were unfortunate in not being able to see it Play as the water was turnd off that morning for some repairs. There is also a small Knowl where M^r^ Bamfeild means to build a summer house from which the Prospect is very pleasant, but upon the whole the Distant view is hardly varied enough.

2.—This morn walk'd out to see the town of Taunton, find it a Large town situate on a small [river] navigable for barges quite up to the town. In the Churches [*sic*] was nothing remarkable, but some Dates, which we could not Read, particularly on one side the door Ann: Dom: : on the other these figures 16ø8. In the Church on a grave stone [date given not readable]. From hence proceeded to Burton Pynsent in our way back to Bristol: find it situate on the edge of a hill commanding a prodigiously extensive prospect, but in my opinion Rather too near Sedge moor, containing 1000 or 1500 acres of as flat ground as any in Lincolnshire which is immediately below him, at the distance of half a mile or less. The house L^d^ Chatham has done a great deal to, considering his Lordship has not been more than two years in Possession. He has built several rooms, some very good ones, but has shewn that his Buildings in Brick are not more durable than in Administrations, as he has already found it necessary to pull down and alter what he himself set up. He has just finishd a Column in memory of S^r^ W^m^ It is of the Dorick order, about 200 feet in hight. It is very well situated as it is seen from and commands an immense tract of countrey. On the top is a small Building

in form of a Bell, not remarkably, and upon that an urn with a scroll Left upon it for an inscription which we were much disappointed in not finding upon it, as so great a man must certainly put a very elegant inscription on so great a monument on so great an occasion.

4th.—This day Walkd on the Rocks over the Ferry: found nothing which I had not seen before, except Asparagus officinalis. It grew in a salt marsh under a wood very near opposite to Jackson's Tower, just where the Wood closes down to the River, and the Path turns up into the Wood.

5th.—This morn went to Walmely to see M^r^ Champion's works: found several Branches carried on there in a very extensive way,—making of Brass, Battering, pinning, etc. Here is also a work for the making of Speltre, a kind of white metal which as our guide told us is made from Lapis calaminaris, without any addition, which is never shewn at all, as the method of doing it is a secret. The immense number of wheels which are employed in this work, are turnd by water, to supply which, as there is only a small Brook, M^r^ Champion has erected two of the Largest fire engines in England, or perhaps anywhere Else, which raise the water that has been made use of, again into the Reservoir. The cylinders of each of them are Six feet 2 inches in diameter; One of them works four pumps, each 30 inches the other only one, which is 60 inches in diameter as I measurd with my own hands, it being out of order and not working. That which workd made nine strokes in a minute, as the man told us sometimes ten or eleven, at each stroke raising 17 hogsheads of water. There is also in the garden at a small distance from M^r^ Champion's house a very surprizing Echo. Standing about ten or twelve yards from the Person who speaks, their voice seems to be repeated out of the Clouds in the softest tone imaginable, they

themselves not hearing the Repetition; but what is still more remarkable is that tho' it is confind to a small Gravel walk, not more than twenty yards in Lengh, it is not always in the same place, being sometimes at one part and sometimes at the other. The walk is close by the side of a semi-circular peice of water, walld in with a small Parapet, but I was told by the people there, that the Echo was there before that wall was built or water made.

10.—Went this morn to Bristol to see a very singular curiosity which was a woman[16] who had for reasons not yet well known been confined since August Last in a deal Box which I myself measurd and found the dimensions to be Lengh 2 feet 6 inches, Breadth and Depth each one foot 4. She was all that time supported by no other nourishment than Gritts and water as she herself says, but the tryal of the people who confind her and with whom she Lodgd will probably make things much clearer. She is at present a most miserable spectacle having Less flesh upon her bones than I could conceive possible to support a Living Creature and her knees and hipps forc'd by the smallness of the Box so much that she cannot in the Least stir them.

17.—Went this morn to see the views from Walkden[17] [Walton] Lodge and S^r^ Abraham Elton's Summer house: found them very Beautifull as many very different and very fine in a small compass of Riding as I ever saw; I mean in the Course of the Road from the Summer house through Walkden town to the lodge. The top of the hill on which the Summer house stands is marked with Lines of a very singular nature, the ruins of [omission] crossing each other which are now all but Level with the Ground, of different figures, some squares or Polygons, containing from half an acre to three or four, and sometimes more: some circular, some of which are very small. What they can have been I

do not at all conjecture, but about a mile from them in the way to Bristol is a very fine Encampment, with a double vallum, probably Roman.

18.—This morn Discoverd by accident an immense quantity of Bulbs, probably of Scilla autumnalis, growing on the very Brink of the precipice of S^{t} Vincent's Rock nearest the Limekiln on the sides of the Zigzag walk: also abundance of Ophrys apifera,[18] now in full Perfection. Went at noon to see M^{r} Catcot's[19] fossils at Bristol—spent two hours with him in Looking them over, perfectly agreably. His Collection tho small is Certainly the most amusing, possibly the Best as it is also the most instructing I have seen. His specimens, particularly of Extraneous, are all so Completely Good that you have not a moments doubt of their having existed in a recent state. The most capital are many of the Bones of an Elephant found bedded in Ocre on the Mendip hills, which are very little changd and a scleton [*sic*] of some land animal, Possibly Lemur Macauco, almost entire, the bones placed in their proper order, which was found in the same place.

19.—Got up this morn Early to go in search of the Veronica hybrida? which I heard from M^{r} Catcot had been found upon S^{t} Vincent's Rocks: found it sparingly on the Ledges of Rocks in my way down to Giant's Hole. I omitted mentioning yesterday that M^{r} Catcot shewed me a very good Specimen of Lycoperdon fornicatum, which was found on the other side of the water Last autumn. It was cut into no more than four Laciniæ, but from its whole appearance I could not but conjecture that it is no more than a L: stellatum, with its volva adhering to it, which is very seldom found as it is very Liable to be broke from it, the volva being fixd in the ground. I should in this Place also remember that I myself found one of the L: stellatum the

other day Lying Loose upon the ground on the Green hill Just beyond S[t] Vincent's Rock. After breakfast set out for M[r] Innis's[20] Garden at Redland, which I had heard a great character of—found it very trifling, scarce one good Plant in his whole Collection. M[r] Innis values himself cheifly upon officinal Plants, consequently is well stored with nettles, Docks etc.: yet were not able to puzzle out the name of Lysimachia nummularia, at Least so the Gardener told me who askd me the name and desird me to set it down on paper which I did. From hence set out for London and in my way to Bath was agreably surprizd by finding Ornithogalum Pyrenaicum in tolerable plenty on the right hand side, about a Quarter of a mile before I came to Kensham, on the beginning of the Descent.

20.—Set out for London: observed between Silbury and Marlborough the Stones calld Grey weathers, which in one particular valley are scatterd about in great numbers on the surface of the ground. The people in that neighbourhood were breaking great numbers of them, either to mend the roads or build houses which gave me an opportunity of examining them and bringing away some peices which I found to be of a very hard and fine graind Sand Stone. Whether it is found in beds in any part of this countrey I will not venture to say, but Remember that some time ago in seeing Gen[l] Conway's place near Henly I saw a large heap of such stones, some of them of an immense size and on asking where they were got from was told that they were found scatterd all over that countrey, Laying on the stratum over the Chalk at Different Depths, and that those I saw had been got together at a large expence, for some work to be done in the General's Grounds, I think a bridge.

FINIS.

NOTES.

[1] **Chittle,** spelt Chettle.—A village about six miles N.E. of Blandford.

[2] **Mr Chafin.**—George Chafin, Esq., of Chettle, eldest son of George Chafin, who died in 1766. The son died in 1776, aged 59.

[3] **Another Barrow.**—The Barrows which Banks saw this day and the day before, are thus described in Hutchins' *History of Dorsetshire*, vol. iii., 2nd edition, 1813, p. 168.

"There are two Barrows about ½ mile distant from each other, one of them 100 yards in length, the other about 60. The latter stands partly in the parish of Chettle, and partly in that of Tarent Gunville: the boundary of the two parishes passes lengthways over the summit of the Barrow, and divides it in equal portions, one the property of the Marquis of Buckingham, the other of Mr. Chafin. One end of the Marquis's part was formerly taken into Lord Melcombe's park, and was excavated to make a grotto: many human bones were dug out, but immediately interred again by his lordship's orders.

"The other Barrow is situate in a cornfield, near Mr. Chafin's house, and he has been credibly informed that about the beginning of the last century, an opening was made in the side of this Barrow, and that beneath the level of the surface of the field a great quantity of human bones were found, and with them heads of spears, and relics of other warlike instruments, which were presented to the Earl of Pembroke, and are at this time at Wilton House."

[4] **Mr Banks of Kinston Hall.**—This was John Bankes, Esq., of Kingston Hall, who died in 1772.

[5] **Grey Plover.**—These birds were probably Norfolk Plovers which are still summer visitors to Salisbury Plain.—[Ed.]

[6] **Entrenchments at Whitnam.**—I am informed that this passage refers to the well-known Sinodun or Dorchester Clumps, on the opposite side of the Thames to Dorchester (Co Oxon.), and above the village of Long Wittenham; visible on the left, just after passing Didcot Station, on the way to London.

[7] **Mr Stert.**—This was Humphry Sturt, Esq., of Crichel. Henry Gerard Sturt, created a Baron in 1876 with the title of Lord Alington, is now the head of the family. Seat at Crichel.

[8] **Lake at Horton.**—At page 59 of Hutchins' *History of Dorsetshire*, 1st edition, 1774, vol. ii., is the following account of this lake:—

"Mr. Sturt has lately made near his seat one of the finest pieces

of water in England, occupying 200 acres. On digging to make an head to it, about twenty feet below the surface was found a stratum of oyster and other kinds of shells; the latter seemed strongly impregnated with ore, and appeared silvered over."

Mr. J. C. Mansel-Pleydell, F.G.S., F.L.S., of Whatcombe, near Blandford, has been so kind as to inform me, that the stratum Hutchins refers to, is the lowest bed of the Woolwich and Reading beds, which rest upon the chalk. The oyster is Ostrea Bellovacina, which is referred to on page xxxii. of his *Flora of Dorset.*

I regret to learn from the Rev. W. Blachford Hill, the rector of Chettle—who has most kindly investigated the locality—that the lake is no longer in existence, having been drained 90 or 100 years ago. I will quote a portion of his interesting letter:—

"I next enquired at a cottage, where the man told me that the posts of the flood gates that kept the waters in were still in their old places, and stood up 20 feet high. That was at the lower end of the lake. I went into the field, considerable part of which formed originally the bed of the lake. The yellow Iris I saw in full bloom where once the water spread. Afterwards I called at the Vicarage and saw the Vicar. He told me that the property about 200 years ago (*i.e.* from about 1690 to 1790 or thereabouts) belonged to the Sturts, and that they lived then in the great house. Then, from 1790 or thereabouts, the property belonged to the Shaftesbury family. They turned the great house, formerly occupied by the Sturts, into a farmhouse, and, land being considered more valuable to a farmer, drained the lake."

[9] **Chepstow Bridge.**—In reference to the peculiar construction of this Bridge, the following anecdote may be worth inserting:—

"The construction of the bridge at Chepstow is extremely curious; the planks that form the floor rise with the tide, which, at certain times, is said to attain the height of 70 feet. About twenty-four years since it was thought necessary to remove the floor of this bridge, which was accordingly done, and only one or two of the planks remained for the convenience of foot passengers. This was very well lighted, and a man placed at the end, to warn those that approached of their danger. But it so happened that one dreadful stormy night the lamps blew out, and the monitor, supposing that no one would in such a hurricane attempt to pass, retired to shelter.

"After midnight a traveller knocked at the door of an inn at Chepstow.

"'Who is there?' said the landlord (who had long retired to rest, and was now called out of bed).

"The traveller mentioned his name, which was well known.

"'It is you, is it? How did you come?' said the landlord.

"'How did I come? Why, over the bridge to be sure!'

"'What! on horseback?'

"'Yes!'

"'No,' said the landlord, 'that is impossible: however, as you are here, I'll let you in.'

"The host, when the traveller repeated his assertion, was staggered. He was certain that he must have come over the bridge, because there was no other way; but also knowing the state of the passage, he could only attribute the escape of the traveller to *witchcraft*. He, however, said nothing to him that night, but the next morning took him to the bridge, and showed him the plank that his horse must have passed over, at the same time that he pointed to the raging torrent beneath. Struck with this circumstance, the traveller, it is said, was seized with illness, from which he did not speedily recover."—*European Magazine*, Sept., 1806.

[10] **Mr Morrice.**—This was Valentine Morris. The following I quote from Taylor's *Shilling Illustrated Guide to the Banks of the Wye*, published at Chepstow.

"In 1736, Colonel Morris, of the island of St. Vincent, purchased Piercefield; and it was by his son, Valentine Morris, Esq., that these delightful walks were ordered to be constructed. He was a man of an extremely benevolent disposition, and hospitable beyond prudence. This, with an unsuccessful attempt to supplant the Morgan family, of Tredegar, in the representation of the county in Parliament, was the cause of his being obliged to break up his establishment here. He was greatly beloved, and when his embarrassed circumstances compelled him to sell Piercefield and leave the neighbourhood, his departure excited universal regret in the minds of all classes in the vicinity. He divided money amongst the poor assembled in the churchyard, was followed by a procession of carriages as far as the Old Passage, and the bells rung a muffled peel on the day on which he left Chepstow.

"To the honour of Valentine Morris, be it said, that he was a strenuous promoter of good roads in the county, and that brought him into opposition with many of the gentry of the county who opposed the Turnpike Act. Morris was examined at the Bar of the House of Commons; and being asked, 'What roads are there in

Monmouthshire?' he replied, 'None.' 'How then do you travel?' 'In ditches.'"

[11] **Mr Fidel.**—At page 278 of Manby's *Picturesque Guide through the Counties of Monmouthshire, etc.*, published in 1802, occurs the following passage:—

"Detached from the town, two houses are peculiarly attractive, from their situation, elegance, and neatness; and that on the left is the mansion of T. Fidell, Esq., M.P. for Boston."

[12] **Dr Davis of the Devizes.**—According to the *Dictionary of National Biography*, James Davis was a Welshman, and became a satirical writer. He was a member of Jesus College, Oxford, where he took the degrees of B.A. and M.A., and in 1732 the degree of M.B. He practised as a physician at Devizes, and died July 13th, 1755. He was the author of *Origines Divisianæ* or the *Antiquities of the Divizes*, which consisted of some familiar letters to a friend, wrote in the years 1750 and 1751, 8vo, London, 1754, a well-written jeu d'esprit, aimed at the absurd etymologies of Musgrave, Stukeley, and others.

At page 333 of the 25th volume of the *Gentleman's Magazine* occurs the following obituary notice during the year 1755:—"July 13th, Dr. Davis, physician, at Devizes, Wilts."

On the south side of the chancel of the Parish Church at Chepstow is a monument, with the following inscription:—

M. S.
JACOBI DAVIS, M.B.
OXONIENSIS.
ΑΡΧΑΙΟΦΙΛΟΥ
Obiit decimo tertio Die Julii,
Anno Ætatis 49, DOM. 1755.

For this Inscription I am indebted to the Rev. E. J. Hensley, the Vicar of Chepstow.

In the Register of Burials occurs the following entry during the year 1755:—

July 17. Mr. James Davis, ye Doctor.

If he died at Devizes, he appears to have been buried at Chepstow.

There are five letters of James Davis in the British Museum, ranging from 1741 to 1753, all dated from Devizes.

The Devizes.—I am informed by Mr. H. A. Grueber, of the British Museum, that in the 17th and 18th centuries the town of Devizes was generally called "The Devizes." It is so on nearly all the 17th century tokens.

[13] **Mr Kaye.**—Lot 61 of the Banks Sale, which contained 34 Letters addressed to Banks, including 4 of Richard Kaye, was purchased by Mr. S. Timmins, of Birmingham. I have been unable to ascertain what has become of them, but Mr. E. L. Scott, of the British Museum, informs me that this Richard Kaye was Sir Richard Kaye, Bart., Dean of Lincoln, the well-known antiquary, and no doubt the Mr. Kaye mentioned by Banks. Sir Richard Kaye, was simply Mr. Kaye until the year 1789, when he succeeded his half brother in the baronetcy.

[14] **Jackson's Tower.**—I am informed that the Sneyd Park Estate long belonged to the Jackson Family, and after Cook left the city the tower, called his Folly, would likely enough get the name of Jackson's from the owners.

At pages 188–9 of *A Picturesque Guide to Bath, Bristol Hotwell*, etc., by Messrs. Ibbetson, Laporte and Hassell, London, 1793, 8vo, occurs the following passage:—

"Cook's Folly is an octagon building, on the highest point of the wood above the meadows; it is used only as a summer-house, and is the property of Miss Jackson, who has a house a few fields from it."

[15] **Harrcliff.**—I am informed that one of the cliffs at Cheddar is named High Cliff or Higher Cliff. Probably Higher Cliff was pronounced so as to sound like Harrcliff.

[16] **Woman Confined in Box.**—"The *Bristol Journal*, printed by S. Farley in Castle Green," of June 6th, 20th, and September 26th, 1767, contains the following accounts of this occurrence, which are reproduced in the *Bath Journal* of June 8th, 22nd, and September 28th.

June 6th:—

"The latter end of last week the shop of Mrs. Pearce, a poor widow woman, in Merchant Street, was broken open and robb'd of a considerable quantity of stockings, to the value of near £10. It was discovered in the night by John Lankford, a watchman, who not alarming the neighbourhood, and leaving the house exposed the remaining part of the night, some suspicion arose that he was concerned in it. A search warrant therefore was granted to search his house, and the chief and other constables of Castle-Precincts executed it on Monday last, but could find no part of the goods. In the course of the search, in a back room, a young woman near 19 years of age was discovered in a box 30 inches long and 18 wide, quite naked, and almost starved to death. Her limbs are much contracted, as she has lain there for six or seven months, during which time she had bread sometimes once a day, but at

other times not once in three days. She was taken out of the box, and 'twas imagined could not get in again, but on the constables sending for bread and cheese, and promising she should have it if she got in, she kneeled on a brick, rolled herself over the edge into the box, and eat it very greedily. They also found in the same house Hannah Rogers, about 23 years of age, naked except a small piece of rug round her middle, big with child, who lay upon shavings without any covering except vermin. She declares she had been in the house near 12 weeks, and notwithstanding for one-third part of that time she was all day long in the same room, yet she knew not what was in the box. When she came first to the house she had two changes of apparel and sixteen shillings in money, of which she was soon stripped by the mistress of the house and her daughter. She was promised her clothes from time to time to go out to swear to the father of the child, but instead of that 'tis since found these wretches had bespoke a small coffin, but for what purpose is not yet known, unless to receive the infant as soon as born. They are both taken proper care of in St. Peter's Hospital. Rogers has swore the child; and 'tis said the cruelty exercised on her was to force her to swear it to an innocent person. The mother and daughter (the latter of whom endeavour'd to make her escape) are both now in custody; and 'tis thought if Bryant ever recovers, a most horrid scene of iniquity will be laid open. The surgeons give it as their opinion that she has not been debauch'd; but 'tis supposed that, being well cloathed when first she went to lodge there, which was eighteen months ago, was stripped and kept in that barbarous manner to prevent their being punish'd by her friends, she being an orphan, though brought up by the Quakers in this city."

June 20th:—

"Mary Langford, the person charged with having kept Jane Bryan confined in a box some months past, has discovered where said Bryan's clothes were pawned to the amount of several pounds, which are since redeemed."

September 26th:—

"At the Bristol Quarter Sessions, September 21, Sarah Lankford, for assaulting, confining naked in a box, and starving Jane Bryant, as mentioned in a former paper, was found guilty and sentenced to pay a fine of thirteen shillings and four pence, and to suffer twelve months' imprisonment. Her daughter was tried for stealing part of the wearing apparel, but for want of sufficient evidence, acquitted.

Separate accounts are given in "Felix Farley's *Bristol Journal*,

published at the Printing Office in Small Street," of June 6th and September 26th, but corresponding on the whole with S. Farley's Journal of the same dates. I will, however, give the additional facts mentioned by "Felix Farley." John Langford (*sic*) is described as the Night Watchman in the *Quaker's Friars*, and Jane Bryan (*sic*), a girl of about 18 years of age, is stated to have been "a lodger in the house near 20 months, but had not been confined to the narrow limits of the box more than eight months." She is described as *tall*, but her limbs so contracted as to be useless, and "perhaps ever will be." John Langford and his wife were secured, "the daughter has since been taken up, but the man pleading ignorance of the whole matter and the girl confirming it, he was released."

The *London Evening Post* of June 9th, reproduces Felix Farley's account of June 6th.

[17] **Walkden Lodge and S^r^ Abraham Elton's Summer-house, etc.**—In reference to Sir Joseph's observations on this day, Mr. Ambrose Elton has been so kind as to write: "With regard to the workings, and stone circles on the top of the hills, from Clevedon to Cadbury Camp, I do not know if you are aware that there exists in the MSS. Department of the British Museum a number of excellent Indian ink sketches of the same, taken just about the date you mention (that of this Journal). The ruins are now entirely covered by mould and grass, though one can easily trace their configuration at the present time. The drawings are by S. H. Grimm, and are in the Kaye collection, vol. iv. (Somerset). They include pictures of the Court, the Summer-house, Cadbury Camp, and other places of interest in the vicinity; whilst Nos. 327, 8, 9, 30, 1, refer to the stone circles themselves."

The drawings above mentioned were made by S. H. Grimm for the Very Rev. Sir Richard Kaye, Dean of Lincoln.

In a later communication, Mr. Elton writes:—

"The Summer-house must, I think, refer to an ornamental tower, which Sir Abraham Elton built at the top of the hill (Court Hill). It is shown in an old oil painting of Clevedon Court and grounds in the last century, which we have at home. It is in the form of an 'arc de triomphe,' not very beautiful according to our ideas! I have no doubt that there was a space above the arch where one could sit and admire the view. No vestige remains of it now, save one or two cut stones, and some earthy mounds in the middle of a thicket. As to Walkden Lodge, the name must be Walton Castle, since there is no other place in the neighbourhood with any similar appellation."

With regard to the curious lines mentioned by Banks, Mr. W. Jerdone Braikenridge is so good as to inform me that they are held by antiquarians to be traces of Roman circumvallation. "They are hardly," he says, "discernible now, but I have more than one interesting drawing of them, made about the year 1787. The camp spoken of is Cadbury Camp, occupied by the Romans, but considered to have been originally British.

[18] **Ophrys apifera.**—It is a singular fact that at page 180 of the *Picturesque Guide* already quoted, occurs the following passage, where, speaking of S[t] Vincent's Rock:—

"Sir Joseph Banks was the first who discovered here a species of Ophrys, often met with on Durdham-downs." This information was perhaps obtained from some Bristol acquaintance of Banks.

[19] **M[r] Catcot.**—This, I conclude, was the Rev. Alexander Catcott, Vicar of the Temple Church in Bristol, the author of *A Treatise on the Deluge*, who bequeathed his Cabinet of Fossils to the Corporation of Bristol. He died in June, 1779.

[20] **M[r] Innis.**—John Innys, of Redland Court, was one of the sons of Andrew Innys, of Bristol, gent., and must have been born about the year 1695, he being 83 when he died in 1778. I have collected the following information about John Innys and others of his family, which I think worth preserving in connection with Sir Joseph Banks' *Journal*.[1] The Jeremy Innys I am about to mention was a brother of John.

In the vestry of the parish church of Westbury-on-Trym is a large oak chest with the following inscription:—

"This Chest and Cushions, with the Communion Rails, the Gift of Jeremy Innys, of Redland Court, Esq., 1759."

There is also a lofty oak surplice press with the following inscription:—

"The Gift of John Innys, of Redland Court, Esq., Churchwarden, 1764."

John Cossins, who built Redland Court about the year 1730, and who married Martha, the sister of John Innys, died April 19th, 1759, and, according to Mr. Beaven,[2] Jeremy Innys died November 22nd, 1764. It should be observed that Jeremy Innys, "of Redland Court, Esq.," presented the chest the year John Cossins died, and John Innys, "of Redland Court, Esq.," presented the press the year Jeremy Innys died.

[1] See *Bristol Times and Mirror*, November 7th, 1899.

[2] See *T. and M.*, August 31st, 1899.

According to Mr. William George, John Innys was living at Redland Court as early as 1754, during the lifetime of John Cossins. The Poll Book for 1739, in the Bristol Museum Library, which belonged to him, bears the inscription on the fly-leaf—

"John Innys,
1756,
Redland Court,
Glouer."

by which it would seem as if at this period he was permanently settled at Redland Court. Mr. George informs me that in John Cossins' trust deed it is said that Mrs. Cossins bequeathed her estate to her brother, John Innys, by which he concluded that John succeeded to Redland Court, on the death of Mrs. Cossins in 1762. Under the circumstances it is difficult to understand the inscription on the chest, where Jeremy Innys is styled "of Redland Court, Esq.," as if he had succeeded to the estate on the death of John Cossins, in 1759. Jeremy Innys was living in 1762, when John is said to have succeeded to the estate.

With regard to the previous life of John Innys, from 1721 to 1725 he was in partnership with his brother William, who was a London bookseller and publisher. Such being the case, it is natural to suppose that he would live in or near London, his connection with which city in addition being shown by his name appearing in the lists of the Stationers' Company. In 1749 he was apparently living at Chelsea, between which date and 1754 he perhaps moved to Bristol, as in the latter year he is said to have been living at Redland Court.

I can obtain no confirmation of the statement made in the *Bristol Times and Mirror* of January 16th, 1886, that John Innys at one time used Cotham Tower as a snuff mill, and that he had a tobacco manufactory on the site of the Woolhall, in Thomas Street. In connection with this matter, I will quote the following passage from Latimer's *Annals of Bristol in the 18th Century*, page 303:—

"In 1754 William Hulme, a Scotch snuff maker, in Mary-le-port Street, leased a windmill at Cotham, and transferred it into a snuff manufactory. When he became bankrupt, three years later, the place was advertised for sale, 'having eleven mills erected for that purpose.' I am informed that 'eleven mills' should be 'eleven mulls,' a mull being a kind of large funnel-shaped mortar in which a steel pestle revolves by the aid of an arm and cog-wheels."

If John Innys was at any time a tobacco manufacturer he must

have taken, I presume, to the trade after he had come to reside at Bristol. Cotham Tower was conveniently situated with regard to Redland Court, and must have been for sale about the year 1757 when John was settled at Redland. It is remarkable that a man who had been connected with books all his life should have taken to botany in such a practical form, unless some circumstance should have led him to do so, and that he should have selected officinal plants, to which class tobacco belongs: but I will now mention a collection he formed of a different nature.

At page 46 of the *Delineations of the County of Gloucester*, it is stated that John Innys, who was brother of Mr. Innys, a bookseller, "made a celebrated, and perhaps matchless, collection of maps and views in nearly 100 volumes." This collection was acquired for the library at Holkham, the seat of the Earl of Leicester, as may be seen by referring to Gough's *British Topography*, vol. 1, 1780, page 109, where, in connection with the subject of maps, he writes:—

"The late Mr. John Innys, of Redland Court, near Bristol, younger brother to William Innys, the bookseller, and some time in his business, had collected, in a number of volumes, all he could meet with for the whole world, but without specifying the maker or engraver, and had compiled an exact index referring to every place in each. This collection is now in the library at Holkham."

The librarian at Holkham has been so kind as to inform me that this collection of maps and plans is called "A System of Cosmography," and is most interesting and valuable. It consists of 113 folio volumes, and is prefaced by a written index, in two volumes, compiled by John Innys, to which is appended a preface, in the form of a letter by John Innys to a friend, dated Chelsea, June 5, 1749. At the conclusion of the letter he writes:—

"You have, sir, a short account of the work, or, rather, a plan of what is designed, for though it has been the amusement of my leisure hours for above thirty years, yet it is not so complete as I could wish; I mean as to materials I have already by me, for new ones offer themselves daily."

As John Innys was 83 in 1778, and the above letter is dated 1749, he must have commenced this collection about the year 1719, when he would have been in his 24th or 25th year.

In a letter-book belonging to the collections of George Vertue in the British Museum, consisting of notes concerning antiquities and historical extracts, 1743–1746, is a copy of this letter in Vertue's handwriting. It is dated London, June 4, 1744, and differs from

that at Holkham in some comparatively unimportant matters. Strange to say, in the concluding paragraph, Innys, at this prior date, speaks of the collection having taken him over 30 years to make. According to this letter, he must have commenced the collection before the year 1714, when he would have been about 19 years of age!

At the time the collection was probably acquired—after the death of John Innys in 1778—Holkham was the seat of Thomas William Coke, born in 1754, and created Viscount Coke and Earl of Leicester in 1837.

I may here mention that I have a copy of Brander's *Fossilia Hantoniensia*, 1766, which belonged to John Innys. On the fly-leaf is the inscription :—

"John Innys
1767
Redland Court
Glouc."

curiously the year in which Banks visited Redland Court; and on the inside of the cover his circular book-plate engraved with his monogram, the same as in the Poll Book before mentioned.

With regard to the position of William and John Innys as booksellers and publishers, on referring to Nichols' *Literary Anecdotes of the 18th Century* it will be found that in 1712 William Innys subscribed £5 5*s.* to the fund raised on behalf of William Bowyer, the printer, on the occasion of the fire which destroyed his house and goods.

In 1720 the Prospectus of Jebb's *Aristides* announces that volumes will be delivered by the author to subscribers at Mr. Innys', in St. Paul's Churchyard.

In 1721 John was in partnership with his brother William, their names appearing thus—William and John Innys, in St. Paul's Churchyard. In 1725 John was still in partnership with his brother, during or after which year the connection appears to have ceased.

In 1735 William Innys was in partnership with R. Manby.

Mr. E. M. Borrajo informs me that the Directories in the Guildhall Library, in London, which, of course, are not complete, give :—

1736–1740. Innys and Manby, booksellers, corner of Ludgate Street.

The name does not occur in the 1744 or 1749 issues.

1752–1755. Innys and Richardson, Paternoster Row.

The name does not occur after 1755.

The names of both John and William Innys occur in livery lists, as of the Stationers' Company, as under:—

1710–1713. William Innys.

1722. William Innys, John Innys.

1776. John Innys, Redland's Court, near Bristol.

"William Inneys, bookseller, son of Andrew Inneys, of the city of Bristol, gentleman," served the office of Master of the Stationers' Company in 1747 and 1748.

On the left of the window in the vestry at the south-west corner of Redland Chapel is a monument with the following inscription: "To the memory of John Innys, Esq., of Redland Court, brother to Mrs. Cossins, who died 27th October, 1778, aged 83."

I am much indebted to Mr. William George, of Bristol, and Mr. E. M. Borrajo, of the Guildhall Library, London, for the information and references they have given me, in the compilation of this note.

P.S.—A statement in the Preface may lead its Readers to suppose that the British Museum contains none of the Banks Correspondence, which was dispersed at Sotheby's. I therefore may as well mention that, in 1887, I bought of an Autograph Dealer, for the sum of £10 10*s.* (ten guineas), an immense mass of these letters, about one thousand out of which, on botanical subjects, I have since given to the British Museum. I still retain the most interesting and valuable portion, including over one hundred letters of Dryander, who was Librarian to Banks, other most interesting letters, as well as minutes on the British Museum, in the handwriting of Banks, of which Institution he was a Trustee. These minutes, a portion of which are dated May 13, 1801, are most interesting and valuable, and consist of thirty-six folio pages in the handwriting of Banks. They formed part of the Collection dispersed at Sotheby's, and I fancy part of my purchase above mentioned, if not since acquired. These facts I mention to show at how trifling a cost the Nation might have done honour to Banks, as well as for the purpose of correcting any mistaken conclusion that may be caused by the Preface.

The above sum no doubt included an adequate or ample profit on the purchases the Dealer made at the Sale.

Lot. 6 consisted of a "Journal of an Excursion to Wales, etc., began Aug. 13, 1767," 159 pp. 4to. It is throughout in the handwriting of Banks, and of the greatest interest; yet, though illustrated with original sketches and diagrams, realised only the sum of 14*s.* This Journal I also purchased of the Collector, into whose hands the present Journal passed, and for a similar sum.

S. G. P.

Nature in the Nature Poets.

READ BEFORE THE BRISTOL NATURALISTS' SOCIETY,
BY THE REV. A. C. MACPHERSON, M.A.
December 2nd, 1897.

THE poet and the scientist have at least one thing in common: they have the same great subject on which their work is to be spent. This visible and audible world, with the unseen mental phenomena connected with it, these are the foundation of their power and the object of their love. True, the great Greek philosopher, who busied himself with transcendental speculations, and the first great English philosopher, who based all scientific knowledge, not on reasonings based on nothing, like the tortoise that carried the world, but on the consentient voices of observation and experiment—both of these, it is marvellous to relate, despised and neglected poetry. As the late Professor Brewer says: "Strange that the two most poetical philosophers should have treated poetry so indignantly" (J. S. Brewer, *Novum Organon*). And yet the poet and the philosopher have in common so large a reality as the love of the great world of Nature. This world is, in its physical aspect, even as it

was said in the beginning, very good; and both the poet and the natural philosopher have a mission towards this great good thing. The poet's mission is to make the good beautiful, whether in inanimate nature or in man; and the business of the scientist, in both these same departments, is to make the good intelligible to man and useful for his well-being. I am going to treat this, if you will allow me, as a truth assented to by all. Doubtless, I shall say more in this paper about the one interpreter of the universe than the other. But I shall assume that they are friends together. The soul of man is the common beautiful roof-tree of them both.

When Tennyson speaks of

> "The fairy tales of Science,"

or of that crowning race he dreamed of, who

> "Eye to eye and face to face
> Shall look on knowledge; in whose hands
> Is Nature like an open book,"

we feel, not that we are carrying the war into an enemy's country, but that we are only removing a misunderstanding between essential friends, who only need just so much as that to embrace one another and clasp hands for evermore. It is the business of science to present us, after long and arduous search, with completed wholes, with a rainbow full-orbed, such as one sees from the summit of a hill; and as for poetry, what the imagination loves is a completed and rounded whole. I know nothing, for example, more poetical, more captivating to the imagination, than the way in which some great geologist will picture for us, out of the fragments at his command, an entrancing picture of a world like, and yet unlike, ours, with other seas and other hills, with other flowers and trees, with other living creatures on the herb or

in the sea; a world that knew not man, yet which seems now to live before us as though it were the possession of to-day.

The treaty of peace, then, having been signed, or, if you prefer the image, the bonds of wedlock having been entered into, one of the parties in either of these engagements will rest a while, to let the other speak. And in this both will rejoice. If Poetry shall feel as though she were in some way taking up a challenge-glove thrown down, this will be more in the form than in the essence and spirit of her story. She moves through a land she loves, wherein are others who also love. The cherubim know most, and perhaps the seraphim love most, and there is room for both in the intellectual heavens.

It is very pleasant to think that two apparently opposing personalities are moving together through that fairy land, an invisible link binding them together. They are moving hand in hand, like partners in some stately measure, each with its own characteristic step, and yet in rhythmical accord. Perchance one day the poet shall strike even yet wider reconcilements, and find that what once seemed hard and metallic and unlovely is really clothed in glory and delight; and the man of positive knowledge shall learn that the laws he is tracing out are after all most true poetic harmonies, and that the skies above his daily path are multitudinous with song.

What is it then that the poets have to say about nature? Now, in answering this question, we have inevitable need to limit ourselves. We cannot call into council the whole starry field of nature-poetry from Bion and Moschus to Wordsworth, or from the idylls of Theocritus to the idylls of Tennyson. Let us think mainly of English poetry as it has come to us, fresh and strong, as a reaction from the

school of Dryden and of Pope. And we will not do this without a parting salutation in which is mingled no small measure of regret.

Gladly would we tread the fields of the old English spring with Chaucer:

> "Whan that Aprile with his schowres swote
> The drought of March hath perced to the rote
> And bathed every veine in swich licour,
> Of which vertue engendred is the flour;
> Whan Zephirus eke with his sote brethe,
> Enspirèd hath in every holt and hethe
> The tender croppes, and the younge sonne
> Hath in the Ram his halfe cours yronne,
> And smale foules maken melodie,
> That slepen alle night with open eye,
> So priketh hem nature in hir corages."

But we must not linger. It is but a parting glance of the eye that we can give to Shakespeare, rapidly but devoutly thanking him for such poetic gems as this:

> "Yet marked I where the bolt of Cupid fell;
> It fell upon a little western flower
> At first milk-white, now purpled with love's wound,
> And maidens call it 'Love-in-idleness.'"

We can but devote a rapid heart-beat to Milton, with his

> "Silver cloud [that]
> Turns back her silver lining on the night,"

and all the other exquisite passages in the *Comus*, the *Allegro* and *Penseroso*, and in *Paradise Lost.*

Neither must what is called the artificial or formal school, or shall we say the school which sums itself up in the words

> "The proper study of mankind is man,"

be passed entirely over as unworthy of notice, even in regard of nature. Dryden and Pope had their own stately way of admiring (unless indeed words mean nothing) and of noting

in polished yet not wholly unfeeling periods the beauties of the natural world.

I may be forgiven for quoting the well-known passage in Dryden's "Indian Emperor":

> "All things are hushed, as Nature's self lay dead;
> The mountains seem to nod their drowsy head,
> The little birds in dreams their songs repeat,
> And sleeping flowers beneath the night-dew sweat;
> E'en lust and envy sleep, yet love denies
> Rest to my soul and slumber to my eyes."

But better than this are the lines on the swallow ("Hind and the Panther"):

> "This merry chorister hath well possessed
> Her summer seat and feathered well her nest,
> Till frowning skies began to change their cheer,
> And time turned up the wrong side of the year;
> The shedding trees began the ground to strew
> With yellow leaves, and bitter blast to blow:
> . . . When prudence warned her to remove betimes,
> And seek a better heaven and warmer climes."

So much then for Dryden. He held for a long time an unequalled position in the literary world, and it was more than a century before his influence, joined with that of his most distinguished follower, disappeared from the form, and substance too, of English poetry. He fulfilled the words he puts into the mouth of his own Sebastian:

> "A setting sun
> Should leave a track of glory in the skies."

But the sun set not on hills and rivers, woods and plains, on fern and flower, but on man and cities, on action and passion, controversy and war.

Turn for a moment to Pope. His influence was even greater than Dryden's. I hardly like to say that he was founded on Dryden, as nearly a century's poetry was founded

on Pope. Rather let us say that they were the great Brethren who "rode through the ringing lists, lords of the mellay," while successive generations looked on with manifold applause. At any rate, Pope is usually looked upon as the great example of the classical, formal, or artificial type of poetry in England. But his notices of external nature, as they most certainly are to be found, so they must not be dismissed with anything like contempt. Nature was not his leading theme, not the moving mainspring of his work, but his was the master hand that when it touched was able to adorn.

I will quote just one or two passages, which I think show that in this glorious field the great poet of society and of satire was not insensible to the beautiful and the true.

Take just one from the "Temple of Fame," which has been justly praised:

> "So Zembla's rocks—the beauteous work of frost—
> Rise white in air, and glitter o'er the coast;
> Pale suns, unfelt, at distance roll away,
> And on the impassive ice the lightnings play;
> Eternal snows the growing mass supply,
> Till the bright mountains prop the incumbent sky:
> As Atlas fixed, the hoary pile appears,
> The gathered winter of a thousand years."

I will only name the second passage, as occurring in the "Messiah," where nature is united to man in the enjoyment of millennial happiness: a beautiful passage, which may probably have suggested a magnificent portion of the sixth book of Cowper's *Task*, unless indeed both poets found the source of their inspiration in a fountain more divine.

A third passage, which seems an echo of Milton's *Penseroso*, and in which the outlook on nature is depicted as mightily influenced by the condition of the mind, is to be found in the Epistle of Eloisa to Abelard:

"The darksome pines that o'er yon rocks reclined,
Wave high, and murmur to the hollow wind;
The wandering streams that shine between the hills,
The grots that echo to the tinkling rills,
The dying gales that pant upon the trees,
The lakes that quiver to the curling breeze;
No more these scenes my meditation aid,
Or lull to rest the melancholy maid.
But o'er the twilight groves and dusky caves,
Long sounding aisles, and intermingled graves,
Black melancholy sits, and round her throws
A death-like silence, and a dread repose:
Her gloomy presence saddens all the scene,
Shades every flower, and darkens every green,
Deepens the murmur of the falling floods,
And breathes a browner horror o'er the woods."

It is not uninteresting to compare with this subjective piece of nature-painting the utterance of a more modern poet. In Thomas Hood we have the well-known passage from a minor poem:

"I remember, I remember
The house where I was born,
The little window where the sun
Came peeping in at morn;
I remember, I remember
The fir trees dark and high;
I used to think their slender tops
Were right against the sky:
It was a childish ignorance,
But now 'tis little joy
To know I'm farther off from heaven
Than when I was a boy."

Here then we part from Pope and the more artificial school of poetry, with its comparatively small contributions to the poetry of external nature. I think I have said enough—even without mentioning that the bard of Twickenham was instrumental in abolishing the Dutch system of landscape gardening, and introducing a more natural style—

enough to show that some love for this beautiful world is to be found even in the great satirist of society, that Pope was not like the nature-despiser, the fortune-hunting husband of the unhappy Miss Kilmansegg, of whom it is said:

> "To tell, indeed, the true extent
> Of his rural bias, so far it went
> As to covet estates in ring fences:
> And for rural lore he had learned in town
> That the country was green, turned up with brown,
> And garnished with trees that a man might cut down,
> Instead of his own expenses."

To Pope, at any rate, we owe the line:

> "And look thro' nature up to nature's God."

In the year 1726 the first part of Thomson's *Seasons*—"Winter"—was published. It has been well observed: "So true and beautiful are the descriptions in the poem, and so entirely do they harmonise with those fresh feelings and glowing impulses which all would wish to cherish, that a love of nature seems to be synonymous with a love of Thomson."

We may indeed, if we will, call Thomson the father of the modern natural school of English poetry—the school of poets who loved nature for her own dear sake, who loved, not because they wrote, but who wrote because they loved. And not only wrote, but looked upward as they did so. Witness the "Hymn on the Seasons":

> "These as they change, Almighty Father, these
> Are but the varied God. The rolling year
> Is full of Thee. Forth in the pleasing Spring
> Thy beauty walks, Thy tenderness and love.
> Wide flush the fields; the softening air is balm.
> . . . Then comes Thy glory in the Summer months,
> With light and heat refulgent. Then Thy sun
> Shoots full perfection through the swelling year;

. . . Thy bounty shines in Autumn unconfined,
And spreads a common feast for all that lives.
In Winter awful Thou! with clouds and storms
Around Thee thrown, tempest o'er tempest rolled,
Majestic darkness! on the whirlwind's wing
Riding sublime, Thou bidd'st the world adore."

To Bruce ("Lochleven") we owe the exquisite line:

"The secret primrose path of rural life."

And in real, avowed love of nature, we have Dyer in "Grongar Hill" (1726):

"Be full, ye courts; be great who will;
Search for peace with all your skill;
Open wide the lofty door,
Seek her on the marble floor:
In vain you search, she is not there;
In vain you search the domes of care!
Grass and flowers Quiet treads,
On the meads and mountain heads,
Along with pleasure close allied,
Ever by each other's side;
And often, by the murmuring rill,
Hears the thrush, when all is still,
Within the groves of Grongar Hill."

Shall we call this rather more than a humble companion of Milton's *Allegro* and *Penseroso*, by which it was not improbably inspired?

As one studies these ages of song, one is struck by the fact that many poets, with that sensitive nature which belongs to most of their order, have linked the various aspects of nature closely with their own circumstances or feelings. Milton, in his blindness:

"Thus with the year
Seasons return, but not to me returns
Day, or the sweet approach of even or morn,
Or sight of vernal bloom or summer's rose,
Or flocks or herds, or human face divine;

But cloud instead and ever-during dark
Surrounds me; from the cheerful ways of men
Cut off, and for the book of knowledge fair
Presented with a universal blank
Of nature's works to me expunged and rased,
And wisdom at one entrance quite shut out."

Poor Michael Bruce, cut off by consumption at the age of twenty-one, plaintively refers to the contrast between the advent of spring and his own exhausted life, and echoes Milton:

"Thus spring returns, but not to me returns
The vernal joy life's better years have known;
Dim in my breast life's dying taper burns,
And all the joys of life with health are flown."

Or Henry Vaughan (1614–1695), anxious for the renown both of his own verse and of his native river, links them both in these lines:

"When I am laid to rest hard by thy streams,
And my sun sets where first it sprang in beams,
I'll leave behind me such a large kind light
As shall redeem thee from oblivious night,
And in these vows which—living yet—I pay,
Shed such a precious and enduring ray,
As shall from age to age thy fair name lead,
Till rivers leave to run, and men to read."

These lines, but little known, seem to form a companionship with Denham's well-known apostrophe to the Thames, in "Cooper's Hill":

"Thames, the most loved of all the ocean's sons
By his old sire, to his embraces runs,
Hasting to pay his tribute to the sea,
Like mortal life to meet eternity.
* * * *
"O could I flow like thee, and make thy stream
My great example, as it is my theme!
Though deep, yet clear; though gentle, yet not dull;
Strong without rage, without o'erflowing full."

We are tempted to leap over a century, and quote the wonderful stanzas of *In Memoriam*:

"My love has talked with rocks and trees;
He finds on misty mountain ground
His own vast shadow glory-crowned;
He sees himself in all he sees."

And his friend thus also beholds him:

"Thy voice is on the rolling air;
I hear thee where the waters run;
Thou standest in the rising sun,
And in the setting thou art fair."

But we must not linger in this truly fascinating field.

In close proximity to Thomson we might mention also Robert Blair, who has the honour of adapting from a still earlier poet, and passing on to a later poet, with whom the glory of it always rests, one immortal line.

Norris of Bemerton, in "The Parting," had said:

"How fading are the joys we dote upon;
Like apparitions seen and gone;
But those who soonest take their flight,
Are the most exquisite and strong,
Like angels' visits, short and bright;
Mortality's too weak to bear them long."

Blair (in "The Grave," 1743) has it thus:

"The good he scorned
Stalked off reluctant, like an ill-used ghost,
Not to return; or, if it did, in visits,
Like those of angels, short and far between."

And thus Campbell (*Pleasures of Hope*) completes it:

"What though my winged hours of bliss have been,
Like angel visits, few and far between?"

Time would fail me to tell of Goldsmith, whom one cannot help loving, but who is too well known to need mention here. He has a charm of his own.

I confess also to a liking for Beattie and his "Minstrel." His "Hermit" also is very beautiful. I venture to quote the concluding lines:

"And darkness and doubt are now flying away,
No longer I roam in conjecture forlorn;
So breaks on the traveller, faint and astray,
The bright and the balmy effulgence of morn.
See truth, love, and mercy in triumph descending,
And nature all glowing in Eden's first bloom,
On the pale cheek of death smiles and roses are blending,
And beauty immortal awakes from the tomb."

We may well ask ourselves whether the young poet of the "Minstrel" may not have suggested somewhat to the young poet of the *Prelude* or to the "Wanderer" of the *Excursion*.

But with these words it is time to ring in the concluding act of my little presentation. There is nothing now to wait for. We are ready for the outburst of the full glory of our nature poets. The curtain falls for a moment only, and rises on William Cowper and William Wordsworth.

Now we must not, in speaking of nature poetry, expect the bard to take us in order round the circle of the sciences. There is no regular zodiac of song. And yet, while the poet's eye glances from heaven to earth, from earth to heaven, it will rest in its own time and way on most of the various fields that the man of science calls his own.

We will not, for example, expect from Wordsworth or Cowper geographical or geological principles, the distribution of land and water, or the classification and dissection of plants and flowers. In fact they sometimes speak, although I believe their hearts were both sound on the importance and the glory of true knowledge, as if science were opposed to poetic feeling. One speaks in reproach of

"A fingering slave,
One that would peep and botanize
Upon his mother's grave";

while the other considers knowledge as

" . . . a rude unprofitable mass,
The mere materials with which wisdom builds."
(*Task* bk. vi.)

Nay, he seems to go farther. The man with knowledge, but without wisdom,

"Whatever he discuss—
Whether the space between the stars and us,
Whether he measure earth, compute the sea,
Weigh sunbeams, carve a fly, or split a flea—
The solemn trifler, with his boasted skill,
Toils much, and is a solemn trifler still."
(*Charity.*)

And again (*Task*, bk. iii.):

"Some drill and bore
The solid earth, and from the strata there
Extract a register, by which we learn
That He who made it, and revealed its date
To Moses, was mistaken in its age.
. . . And thus they speed
The little wick of life's poor shallow lamp
In playing tricks with nature, giving laws
To distant worlds and trifling in their own. . . .
Defend me therefore, common sense, say I,
From reveries so airy, from the toil
Of dropping buckets into empty wells,
And growing old in drawing nothing up."

Yet with all this Cowper does not intend to decry the pursuits of science. In his "Tirocinium" he exhorts the parent to teach his son the wonders of the heavens rather than spend too much time on the history, not always edifying, of heathen gods and goddesses. Thus he makes the *amende honorable*, or rather, shows us what he really intended by his earlier utterance.

But looking at the general aspect of the world—the same world, be it noted well—in its poetic view, how both these men show forth their love, their joy, their rapture! Cowper expresses it both in the light and graceful lyric of which he is a master, and also in the statelier epic measure. Examples of the former are "Catharina" and "The Rose." And in the *Task* we have the following (bk. iv.):

> "The country wins me still.
> I never framed a wish, or formed a plan,
> That flattered me with hopes of earthly bliss,
> But there I laid the scene. There early strayed
> My fancy, ere yet liberty of choice
> Had found me, or the hope of being free.
> My very dreams were rural; rural too
> The firstborn efforts of my youthful muse."

And again (bk. i.):

> "God made the country, and man made the town.
> What wonder, then, that health and virtue—gifts
> That can alone make sweet the bitter draught
> That life holds out to all—should most abound,
> And least be threatened, in the fields and groves?"

Turn now to the other, seemingly of a calmer mood, only we must remember that it is the calmness of passion strongly reined, a smouldering enthusiasm that enthrals his being. Let me select from a great variety of communings with nature two poems especially, in each of which the natural feature which suggests the moral correlative in the mind of man is a river. As an instance of the happy marriage between thought and nature—Bacon's *commercium mentis et rerum*, though not in Bacon's sense—an instance of highest insight in the interpretation of nature—the same philosopher's *man the minister and interpreter of nature*—look at the concluding sonnets of the series on the river Duddon. The river rolls before his eyes into the sea, and

the poet's deep moral insight at once translates the peaceful sweep of the stream into the language of the soul:

> "And may thy poet, cloud-born stream! be free—
> The sweets of earth contentedly resigned,
> And each tumultuous working left behind
> At seemly distance—to advance like thee,
> Prepared, in peace of heart, in calm of mind
> And soul, to mingle with eternity."

Then follows the noble concluding sonnet, than which that fascinating poetic form has rarely, if ever, in my judgment, reached a higher level.

The second instance is in the well-known lines on revisiting the Wye, above Tintern Abbey. In exquisite blank verse, with great variety of pause and melodious intonation, he first welcomes and describes the landscape thus seen once more when

> "Five years have pass'd; five summers, with the length
> Of five long winters! and again I hear
> These waters, rolling from their mountain springs
> With a soft inland murmur."

And after passing through the chief points of the well-loved sight, he comes in his true characteristic refrain to the touch of human interest; he beholds the wreaths of smoke

> "Sent up, in silence from among the trees!
> With some uncertain notice, as might seem
> Of vagrant dwellers in the houseless woods,
> Or of some hermit's cave, where by his fire
> The hermit sits alone."

He then recalls how such sights and sounds have been with him in memory during absence from them. He has owed them "sweet sensations, feelings of unremembered pleasure, and

> That blessed mood
> In which the burden of the mystery
> Of all this unintelligible world

Is lightened; that serene and blessed mood
In which the affections gently lead us on";

and we are enabled to

"See into the life of things."

And if this be too much to say, at the very least the scene has been a pleasure of memory, a rest for the spirit in the fever of life.

He turns now to the present, but mainly to contrast it with the past. He feels that something has gone from him, a feeling which is more strongly expressed in the "Immortality" Ode. He still ardently loves nature, but the feeling is softened since the days of youth, when

"The sounding cataract
Haunted me like a passion: the tall rock,
The mountain, and the deep and gloomy wood,—
Their colours and their forms were then to me
An appetite; a feeling and a love
That had no need of a remoter charm
By thought supplied, or any interest
Unborrowed from the eye."

He has heard more of the "still sad music of humanity," and is conscious of a presence in nature

"That impels
All thinking things, all objects of all thought,
And rolls through all things."

He concludes with an exquisite passage, full of that tender home affection, that love and friendship in holy union, which is so prominent both in Cowper and Wordsworth. If he were without that vision, he has still the presence of his "dearest friend," his sister, to whom, in the same language, he had addressed one of his earliest poems, and whom he now meets on the banks of the sylvan Wye. He sees in her the same simple love of nature that once was his, and he

looks to a time when she also shall experience the deeper and more humanized affection.

> "When these wild ecstasies shall be matured
> Into a sober pleasure; when thy mind
> Shall be a mansion for all lovely forms,
> Thy memory be as a dwelling place
> For all sweet sounds and harmonies."

I venture to say that the *commercium mentis et rerum*, the poetic communing with the beautiful sights and sounds of earth, can go no farther than in the lines of this exquisite poem.

Follow these two nature poets now only once more. Let them end for us in the empyrean, like Dante, in each part of the Divine Comedy, among the stars. Take two passages from Wordsworth; one, well known, from that beautiful fourth book of the ***Excursion***, "Despondency Corrected":

> "Chaldean shepherds, ranging trackless fields,
> Beneath the concave of unclouded skies
> Spread like a sea, in boundless solitude,
> Looked on the polar star, as on a guide
> And guardian of their course, that never closed
> His steadfast eye. The planetary Five
> With a submissive reverence they beheld:
> Watched, from the centre of their sleeping flocks,
> Those radiant Mercuries, that seemed to move
> Carrying through ether, in perpetual round,
> Decrees and resolutions of the gods;
> And by their aspects, signifying works
> Of dim futurity, to man revealed."

And one, not perhaps so well known, from the fourth book of the ***Prelude***, "Summer Vacation":

> "Nor less do I remember to have felt
> Distinctly manifested at this time
> A human-heartedness about my love
> For objects hitherto the absolute wealth
> Of my own private being and no more;
> Which I had loved, even as a blessed spirit

Or angel, if he were to dwell on earth,
Might love in individual happiness.
But now there opened on me other thoughts
Of change, congratulation or regret,
A pensive feeling! It spread far and wide;
The trees, the mountains shared it, and the brooks,
The stars of heaven, now seen in their own haunts,
White Sirius, glittering o'er the southern crags,
Orion with his belt, and those fair Seven,
Acquaintances of every little child,
And Jupiter, my own beloved star."

And add the loving touch, redolent both of heaven and home, when we read of the maid who

"Dwelt beside the untrodden ways,
Beside the springs of Dove,
A maid whom there were none to praise,
And very few to love;

"A violet by a mossy stone,
Half-hidden from the eye,
Fair as a star, when only one
Is shining in the sky."

We turn once more to Cowper, the laureate of winter, when the stars are bright. In the "Winter Morning Walk," he unites the thought of the glories of creation with high spiritual truths, showing how these two act and react upon each other. Speaking of the truly Christian soul, he says:

"Much conversant with heaven, she often holds
With those fair ministers of light to man,
That fill the skies nightly with silent pomp,
Sweet conference. . . .
Tell me, ye shining hosts,
That navigate a sea that knows no storms,
Beneath a vault unsullied with a cloud,
If from your elevation, whence ye view
Distinctly scenes invisible to man,
And systems, of whose birth no tidings yet
Have reached this nether world, ye spy a race

Favoured as ours—transgressors from the womb,
And hasting to a grave, yet doomed to rise,
And to possess a brighter heaven than yours?
As one who, long detained on foreign shores,
Pants to return, and when he sees afar
His country's weather-bleached and battered rocks,
. . . So I with animated hopes behold,
And many an aching wish, your beamy fires,
That show like beacons in the blue abyss,
Ordained to guide the embodied spirit home
From toilsome life to never-ending rest.
Love kindles as I gaze, I feel desires
That give assurance of their own success,
And that, infused with heaven, must thither tend."

Such are the feelings of the Christian when he beholds the most glorious works of the Creator. Nor can he rightly hear their message until he is at peace with God. Then, and only then,

"A voice is heard that mortal ears hear not
Till Thou hast touched them; 'tis the voice of song,
A loud hosanna sent from all Thy works;
Which he that hears it with a shout repeats,
And adds his rapture to the general praise."

With this example of the nature poet's loftiest strain we conclude. As we read these things, or write them, we are conscious that, as we grow older, things are not with us as vividly or as delightfully as they were. As Wordsworth laments, in his immortal "Ode on Immortality," while at the same time he recognises a delightful compensation:

"There hath passed away a glory from the earth.
. . . The clouds that gather round the setting sun
Do take a sober colouring from an eye
That hath kept watch o'er man's mortality;
Another race hath been, and other palms are won.
Thanks to the human heart by which we live,
Thanks to its tenderness, its joys, its fears,
To me the meanest flower that blows can give
Thoughts that do often lie too deep for tears."

The Circulation of Nitrogen in Nature.

AN ACCOUNT OF SOME INDISPENSABLE MICROBES.

By F. W. STODDART.

THE purpose of my remarks to-night is to introduce to your notice some of those Liliputian labourers popularly known as "germs," but which in the present instance have none of the vicious propensities generally associated with that name.

The progress of the science of bacteriology up to the present time may be roughly divided into three stages. The first stage, which may fitly be called the reign of terror, includes the discovery of the active agents of certain diseases. The specific organisms of anthrax, typhoid, cholera, leprosy, glanders, tuberculosis, tetanus, and diphtheria—some of the greatest scourges of the human race—all made their bows within a very few years, and indeed followed one another in such quick succession that one fairly wondered how a single individual managed to survive the insidious onslaught of so many well-armed foes.

But as time went on, and we were not all wiped out—as indeed we were permitted to assume the attitude known to the adherents of a much older, and therefore, I presume, a much more respectable science, as "sparring for wind"—we became conscious that the fight was not entirely one-sided; that not

only was the germ not altogether as black as he was painted, but that he possessed a vast number of sisters, cousins, and aunts, who, so far from being inimical to our well-being, were working for our good, and were even indispensable to our continued existence. To this second stage succeeded the present era of investigation into the mode of action of these minute workers, a line of research which bids fair to lead to the achievement of the acme of polemical skill—the turning the enemy's weapons against himself.

Our business to-night, however, is with the friendly microbes, labouring day and night for the good of all the higher forms of life, and more particularly with those which, amongst other functions, so manipulate nitrogen and nitrogenous compounds as to render them available for the maintenance of our life and health.

But here I must ask your forbearance whilst I briefly review such of the chemical relations of nitrogen as are essential to the understanding of our subject proper.

Nitrogen, as you are aware, is a gas constituting by far the larger portion—almost exactly four-fifths—of the atmosphere. We are therefore dealing with a substance existing in immense quantities in nature; for instance, this room contains 8,424 cubic feet or 626 lb. weight of this gas. I have used the name nitrogen because it is that commonly employed; but the great French chemist Lavoisier, who was the first investigator to show that it was a simple body, called it originally "azote," meaning inconsistent with life. We now know that if there is one element more intimately connected with the manifestation of vital force than the others, that element is nitrogen.

Now it has long been known that, besides being a constituent of air, nitrogen occurs in combination in many substances both mineral and organic.

If an electric spark be passed through a vessel containing air, red fumes are produced which readily dissolve in water with formation of nitrous and nitric acids. This latter is identical with that obtained from saltpetre or nitre by heating it with sulphuric acid. Hence the name nitrogen, or nitre generator. Nitre then is the salt produced by neutralizing nitric acid with the alkali potash, and is strictly potassium nitrate; but if we employ the name generically we can understand by it any neutral salt formed by acting upon nitric acid with a base such as lime or magnesia, and we have lime nitre or calcium nitrate, magnesium nitre, silver nitre, and so on.

Now if we withdraw a portion of the oxygen from a nitre, which can easily be done by heating either alone or with a substance which will abstract oxygen, we form a second series of salts known as nitrites, of which potassium nitrite is the type, and of which we can produce a complete series corresponding to the nitrates.

If, however, we carry this reduction so far as to remove all the oxygen, we liberate the nitrogen as the elementary gas.

But if we at one and the same time strongly reduce, and present a sufficiency of hydrogen, we can combine the nitrogen with the hydrogen and form ammonia.

Further, ammonia can be produced by the direct union of nitrogen and hydrogen under the influence of the silent discharge; the ammonia can be directly oxidized by platinum black into nitrous acid, and the latter further oxidized into nitric acid by permanganate of potash, and so we can complete the inverse series of changes. In this way we can ring the changes on these substances, and, given one of them, can produce all the others, but only by processes which are not in force to any appreciable extent in nature.

These substances—ammonia, nitrous and nitric acids—are readily identified by the tests I now propose to show you.

Lastly, nitrogen exists as a constituent of an immense variety of compounds with carbon, hydrogen and other elements, forming what are known as organic bodies. These are produced by animals and plants from food materials, and for the present only interest us as one of the forms in which nitrogen may occur, and from which it is liberated generally without much difficulty in the shape either of the element or as ammonia by such a process as burning. In fact, as we shall see, there is a constant and very large addition to the atmospheric nitrogen resulting from the destruction of nitrogenous organic matters. On the other hand, the laboratory operations just referred to, as means by which elementary nitrogen can be brought into combination, are represented in a very slight degree only in nature. It would appear therefore that there is a continuous degradation of nitrogen to the elementary condition—a very serious matter if the nitrogen so degraded is finally removed from the sphere of action of organized beings. Are there then any other agencies at work to restore the balance, and enable this apparently useless gas to return within the arena of physiological activity?

Let us start then with the atmospheric nitrogen: does it ever enter into combination, and assume other forms than the elementary?

Now throughout the earlier part of this century this question was fiercely debated, but in spite of some experimental evidence to the contrary it was ultimately concluded that there were no grounds for supposing that either plants or animals could assimilate gaseous nitrogen, except perhaps so far as it was combined with oxygen under the influence of atmospheric electricity.

So deeply rooted was this view that we find it persist even in the most advanced text-books of the present time.

A very different complexion, however, was put on the matter by some experiments carried out by Professors Hellriegel and Willfarth at the experimental station at Dahme. Very contradictory results had been obtained in a series of experiments on the nutrition of plants belonging to the natural order Leguminosæ and recourse was had to cultivation in sterile soil. It was found that growth was normal for some days, but that unless a proper supply of available nitrogen (in the shape of nitrate) was kept up, the plants did not as a rule arrive at maturity. In exceptional cases, however, the plants developed normally, and on examination were then found to have attached to the rootlets a number of small nodules, which were observed to contain bacterium-like bodies to which the name of rhizobes has been given. Such plants when analyzed contained much more nitrogen than could be accounted for by the materials supplied in the soil. On repeating the experiments with a number of leguminous plants, some of which were dosed with an extract of these nodules, it was found that those plants only came to maturity which had been so treated, and which in consequence developed tubercles on the roots. Hence it was concluded that leguminous plants at least can, under the influence of the organisms which give rise to nodule formation, absorb and assimilate the free nitrogen of the air.

These experiments have been repeated and confirmed by numerous investigators, including Sir John Lawes and Sir Henry Gilbert at the Rothamstead experimental farm.

Microscopic examination of the tubercles shows that they consist of tissue resembling and continuous with that of the root itself, but that the cells are permeated by a branched mycelium which at a later stage gives rise by budding to

innumerable bacterium-like bodies, or rhizobes, which form the means by which new plants are infected.

These organisms can be cultivated by the usual bacteriological methods, and the cultures so obtained act just as well as the tubercles themselves in producing tubercles on new plants.

Some confusion has, however, been created by various other investigators, who have produced evidence to show that the nitrogen may be fixed by the plants independently of the tubercles, and even by soil containing organic matter independently of plants altogether.

The question may, however, be said to have been rescued from the chaotic condition into which it threatened to relapse by the admirable investigations of Schlœsing and Laurent at the Pasteur Institute.

It will be noted that the class of evidence already referred to does not establish the whole truth; it proves that the plants plus the tubercles have acquired an excess of nitrogen over that furnished in the soil, and it proves also that this close relationship is necessary for the assimilation of this nitrogen, but it does not prove that the nitrogen is derived from the air. This direct proof can only be obtained obviously from a careful measurement of the nitrogen supplied in the gaseous state to the plant during its growth, a matter of great difficulty, considering the length of time—some three months—over which an experiment must extend.

If, however, these two sets of measurements can be carried out simultaneously—that is, if on the one hand the plant is proved to have assimilated a quantity of nitrogen over and above that contained in the soil, the seed, the water, and manurial matters, and on the other hand the air in which the plant is immersed has lost a certain quantity of nitrogen which, within the limits of experiment, is the same as that

gained by the plant—the conclusion is unavoidable that the latter has increased its nitrogen contents at the expense of the air.

This enormously difficult problem was solved by the investigators I have mentioned in the most admirably complete manner by means of the apparatus of which I exhibit photographs.

The plants were grown in an artificial atmosphere, in which the proportions of nitrogen, oxygen, and carbon dioxide were maintained within normal limits by the frequent withdrawal and analysis of small samples. The quantity of nitrogen in the soil, the seed, the water, and the air on the one hand, and in the full-grown plant and the residual atmosphere on the other, were determined with scrupulous exactness, check experiments showing a loss or gain of only 2–3 c.c. nitrogen. The leguminous plants in every case showed an abundant crop of tubercles.

The results of the earlier experiments pointed to the following conclusions :—

(1) A large fixation of nitrogen by the leguminous plants.

(2) A small but distinct fixation in some other cases.

It was noticed that in the latter cases there was a growth of lowly vegetable forms on the surface of the soil; a further series of experiments therefore was undertaken, in which this growth was prevented. The subjoined table of results shows that no fixation of nitrogen takes place with other than leguminous plants, but that these do remove a very appreciable quantity from the air. It was therefore concluded that the higher plants of themselves do not fix atmospheric nitrogen, that some lower forms do, and that in the case of the leguminosæ a very extensive assimilation takes place under the influence of the rhizobes.

In the light of these and similar investigations, I think

we may safely conclude that the rhizobes do possess the power of fixing atmospheric nitrogen, possibly when unattached, probably when associated with certain cryptogams, certainly when attached to the rootlets of leguminous plants. Further, in this interesting instance of symbiosis, the plant meets the rhizobe half-way, and constructs a special expansion of root-tissue, richly supplied with starch, etc., in organic connection with its own system, into which at a certain stage the nitrogenous compounds manufactured are absorbed. It is found too that there are as many species of rhizobes as of leguminous plants, or at least that the latter succeed best when inoculated with rhizobes derived from the same species.

I have already pointed out that the rhizobes are readily cultivated apart from the plant, and this is now done on the commercial scale, cultures being sold expressly for the purpose of enriching the soil, under the exceptionally ill-selected name of nitragin. I exhibit three specimens of nitragin.

Our next step is to inquire what becomes of the nitrogen thus withdrawn from the air, and bound up in plant tissues.

The life of a plant is terminated in one of two ways—by a natural death or by ingestion by animals.

In the former case disintegration is a comparatively slow process, at any rate as compared with the corresponding change in animal tissues. You are, of course, well aware that it is quite easy by a comparatively imperfect process of desiccation to preserve most plant tissues in a fairly natural condition.

Before the plant dies, if it has run its proper course, much of the accumulated nitrogen is stored up in the seed; that portion, however, which remains in the stem, leaves, and roots is largely evolved as the element during the slow decay. In

all forms of putrefaction this is the case to some extent, but pre-eminently so with vegetable matter. Thus, marsh gas—that is, the gas evolved from the decaying vegetable matter in bogs and stagnant pools—contains much nitrogen. An analysis by Bunsen of such gas from a pond in the botanical garden at Marburg showed that it contains 51·5 per cent. nitrogen. Firedamp also—the gas evolved from coal—contains a large proportion of free nitrogen. On the other hand it is important to note that comparatively little ammonia is formed.

But a large proportion of vegetable growths are destined to become the food of animals, and this is especially the case with numbers of the leguminosæ, which are extensively cultivated for this very purpose. In this case the condition of affairs is profoundly modified by the conversion of the nitrogenous matters from the vegetable to the animal type. Further, we know not only that animal tissues as a whole are richer than vegetable in nitrogen, but that animals are constantly, as a necessary part of their vital functions, throwing off effete matter of a highly nitrogenous character. Indeed, animals may be looked upon from this point of view as concentrators of nitrogen.

Now when an animal body dies, or the waste material from a living animal is cast off, we know that under ordinary conditions it rapidly enters into decomposition; that is, it becomes the prey of numerous micro-organisms which proceed to pull to pieces the complicated structures which the living animal had been busied throughout its life in building up. And in doing so they serve a most useful purpose, for, as has often been pointed out, if it were not for their untiring activity, not only would the corpses of the innumerable generations of countless centuries still encumber the earth, but an immense store of indispensable

material would be locked up, and be denied to us. Indeed, the world, deprived of these useful Liliputians, would by this time be peopled by the dead rather than by the living.

But in the execution of this benignly destructive work it is of the greatest importance to us to note that the nitrogen is very largely converted into ammonia. Thus the following table shows the relative proportions of nitrogen as ammonia and as organic matter contained in water in which vegetable and animal tissues respectively were decaying:

	Vegetable.	Animal.	
Ammoniacal nitrogen . . .	·0085	3·387	Parts per
Organic „ . . .	1·287	·200	100,000.

Probably a great number of organisms are concerned in this process, but I will show photographs of two or three which are almost ubiquitous, as well as cultures on gelatine medium.

We now have our nitrogen in the shape of ammonia, a substance which in itself is useless either to animals or plants, but which, diffused in the superficial soil, falls beneath the influence of two species of bacillus which present features of exceptional interest. These are the nitrifying bacteria. It had been known for centuries that when animal refuse mixed with an alkali was allowed to remain for a length of time with free access of air at a moderate temperature, a nitrate of the alkali was formed. In this way indeed saltpetre was always manufactured up to the time of the discovery of the natural deposits in Chili. It was supposed that the oxidation of the nitrogen of the animal matter was a purely chemical process. It was, I think, Pasteur who first suggested that a true fermentation was involved; but in 1877 two French chemists proved this to be the case in the following manner: A glass tube was filled with a mixture of calcined sand and fragments of

limestone, and sewage was slowly filtered through it. Now sewage contains about five grains of ammonia and one grain of organic nitrogen in each gallon, but no trace of nitre. At first the sewage passed through the filter unaltered, but gradually the ammonia began to diminish, whilst calcium nitrate made its appearance in the filtrate, until at length the latter contained no ammonia, but a quantity of nitrate almost corresponding to the nitrogen in the original sewage. Now the conditions of the experiment altogether were very suggestive of the establishment of a fermentation; but the truth of this supposition was confirmed by the crucial test of applying a reagent that would inhibit all biological action without disturbing the chemical conditions. The vapour of chloroform was allowed to pass through the filter. All nitrification immediately stopped, and could only be renewed by the original slow process of filtration. Much work has since been done in connection with this phenomenon, but progress has been very slow, owing to the very peculiar habits of the organisms. In particular, they abhor organic matter, and it is impossible, therefore, to cultivate them upon any of the ordinary media. It has been found, however, that they can be grown fairly easily upon a medium the basis of which is gelatinous silica, or a jelly prepared from certain seaweeds from which all soluble organic matter has been removed by putrefaction.

In this way it has been shown that two distinct organisms are concerned, one converting ammonia into nitrous acid, the other completing the oxidation into nitric acid.

These organisms are both short bacilli, frequently occurring in pairs attached to the particles of soil over which the ammoniacal water is passing. They flourish between the temperatures of 10° and 30° C., are sensitive to bright light, and require a constant supply of oxygen and a base,

generally lime or magnesia, with which the nitrous and nitric acids can combine. At the same time, the alkalinity must be feeble, a bicarbonate of an alkali or alkaline earth being the best form of base. They differ from most known species, not only in their complete independence of organic food, but also in their peculiar invisibility, water in which they are quite abundant being perfectly bright, and even brilliant.

They differ from one another in several important particulars. The nitrous organism is a rather stout, oval bacillus, developing rapidly in water containing an ammonium salt, such as the phosphate of soda and ammonia.

The nitric organism is a narrow, small bacillus, often peg-top shaped; it is very intolerant of ammonia, and does not, therefore, come into play if much ammonia is present, but remains latent until most of the ammonia has been converted into nitrite. In ordinary soil, however, the conditions are generally such as to allow of both fermentations proceeding, so that the nitrite is oxidized almost as soon as formed.

I exhibit here the older form of experiment showing the fermentations proceeding in flasks, also a filter representing a section of soil, and similar to that just referred to.

In this way our nitrogen is rendered available for plant food generally, for it is as nitrate that nitrogen is taken up by plants from the soil. The necessary bacteria are universally present in the superficial soil, abundantly to a depth of about eighteen inches, more sparingly to a depth of about eight feet. In the light of these researches it is possible to understand what guides the farmer in his choice of a nitrogenous manure. If he wishes to get an immediate effect he chooses a nitrate; if he requires the action to extend over a slightly longer period he applies an ammoniacal

manure which has to pass through the stage of nitrification before it becomes available, and in this he is assisted by a curious difference in the behaviour of soils towards the two classes, viz., that whereas nitrates are very rapidly washed away, and may be lost if carried beyond the range of action of the roots, ammonia on the contrary is retained by the soil, and not removed bodily by water, but only gradually becomes available under the influence of the nitrifying ferments. If nitrogenous organic substances are applied, of course a still longer preparation in the shape of putrefaction is required before the contained nitrogen can become assimilable.

But the microbic action does not end here. Nitrates, if unabsorbed by plants, sink with the drainage water into the subsoil and rapidly disappear. For if we bore into cultivated and manured land, and take samples of the water percolating into the boring at different depths, we shall find that the nitrates so abundant at and near the surface speedily diminish, until at a depth of upwards of 100 feet they have practically disappeared.

Now this change is chiefly, if not entirely, brought about by organisms similar in many respects to those effecting nitrification, but which have not an oxidizing, but a reducing power. This was supposed at one time to be due to a single species, *B. denitrificans*; but the reducing power has been shown to be common to a great number of species, an interesting instance being afforded by the cholera spirillum.

In this way an inverse series of changes results, and finally the nitrogen is liberated as the free element in the gaseous condition, ultimately reaching the atmosphere dissolved in the water of deep springs, the gas evolved from which, as in the case of our Hotwell, consists very largely

of nitrogen. Thus we regain the point at which our survey of the circulation of nitrogen commenced.

Now a subject like the present naturally teems with interesting suggestions. I have chosen three matters arising out of it which are perhaps of exceptional interest, but which appeal to different sections of our Society.

One of the most important problems of the day is the question of sewage disposal. In all the earlier attempts in this direction the utilization of the manurial matters contained in sewage was considered to be of as much importance as the removal of offensive substances. It was not long, however, before it became apparent to practical men that the recovery of the valuable constituents undoubtedly contained in sewage was impracticable owing to their extreme state of dilution, and that if sewage could be so far purified that it could be turned into natural watercourses without offence to the public weal, we ought to rest satisfied with the good riddance of bad rubbish. To this end every imaginable kind of substance has been recommended, and generally patented, for the removal of the solid matter. I am not putting it too strongly when I say that the treatment of sewage by chemical precipitation is on its last legs, and has proved to be nothing better than a gigantic and costly failure. The establishment of sewage farms may be described as a blind groping in the right direction, for it implies an attempt to dispose of the organic matter of sewage by natural agencies. The impossibility, however, of setting aside a sufficient area of suitable land for the purpose has proved in most cases an insuperable obstacle to this device, and it is only lately, and as a direct result of the observations referred to earlier in this paper, that a move has been made in what is undoubtedly the right direction, that is, to provide a place where the purifying

microbes shall be so developed as to deal with the sewage in a much more rapid and complete manner than is possible under natural conditions. It is not part of my scheme to pursue this subject further, but it is interesting to note that one of the latest developments is a return to the oldest form of sewage receptacle, the cesspit, in which a very remarkable amount of purification is effected by micro-organisms.

I think perhaps too little attention has been paid by sanitary engineers to the total difference in conditions prevailing in the first and second stages of purification. In the first stage it is required to break down organic matter by means of micro-organisms which revel in it. The purification is carried to completion by the nitrifying organisms, which require a minimum of organic matter and an abundance of air.

The second point I wish to draw attention to is the effect of this purified sewage upon health. This question is constantly brought before us in connection with drinking-water in this way: A water yields to chemical analysis no evidence of the presence of organic matter or even of ammonia, but contains nitrates and the mineral constituents of sewage; it is evidently mixed with sewage that has undergone the changes of which I have been speaking during its passage through two or three yards of subsoil. Is it to be regarded as wholesome water?

In the early days, when the dangerous properties of sewage-polluted water were attributed to some indefinite organic matter, it was argued that when nitrification was complete all dangerous matter must be burnt up, and the water devoid of its original injurious pollution.

More cautious observers at that time, whilst admitting that a completely nitrified sewage might be innocent, pointed out that a slight change in meteorological conditions

might render the nitrification imperfect, and a well-water that showed nitrates to-day might contain organic matter to-morrow merely in consequence of a heavy rainfall, and that this constituted a real danger. Modern bacteriological research has shown that even this was far too favourable a view to take of such water. Nitrification is essentially an oxidation it is true, but that is not synonymous with the destructive process implied in the expression "burnt up." It is a biological oxidation exerted upon the dead and comparatively innocent organic matters; it does not in any way affect the specific germs of disease which may be present in the original sewage. Precisely similar phenomena are observed in all fermentative processes, such for instance as brewing. Whilst the yeast is in full activity breaking up the dead organic matters of the wort, other micro-organisms which may have accompanied it merely bide their time, and when the conditions become favourable spring into activity, and unless suitable precautions are taken the beer may become acid, or ropy, or putrid, or even become entirely converted into vinegar.

In precisely the same way the typhoid or cholera organisms are indifferent to the action of the nitrifying microbes, and quietly await their entry into their favourable habitat—the digestive system of man. Whilst sewage was being completely nitrified in the filter before you, a culture of cholera germs was passed through, and the filtrate contained numerous vigorous spirilla for many hours. Of course, after a certain amount of percolation the water will become freed from bacteria; but by that time, as I have shown, the nitrates also will have ceased to exist. It must be admitted, therefore, that drinking nitrified sewage either neat or diluted with pure water is a dangerous as well as nasty practice.

Lastly, there are some theoretical considerations arising out of the chemical changes brought about by the nitrifying organisms which are very interesting.

Until the discovery of the nitrifying bacilli it was almost universally accepted that those plants only which contained chlorophyll could acquire the carbon necessary for their tissues from carbon dioxide. And this seemed consistent with both theory and observation.

Chemical reactions are classed as exothermal or endothermal according as the combining bodies contain locked up in themselves more or less than sufficient energy for the process of combination. In the former case there is an excess of potential energy, the surplus generally taking the shape of sensible heat, hence exothermal. Endothermal reactions cannot take place unless the necessary supplementary energy is supplied from an outside source. The combustion of carbon is an exothermal reaction which we daily employ in order to avail ourselves of the surplus energy, with which we cook our food and warm our fingers. But to convert the carbon dioxide into any less oxidized substance requires a supply of energy from some outside source, which, in the case of the chlorophyll-containing plants, is the light of the sun. Hence plants devoid of chlorophyll were supposed to derive their carbon from organic matters only; and, generally speaking, observation tended to support this view.

When it became clear, however, that the nitrifying bacilli, devoid of chlorophyll, working only in the dark, yet obtained their carbon from carbon dioxide only, and were even prejudicially affected by the presence of organic matter, it became necessary to look about for some new source of energy. This is found in the oxidation of the nitrogen, in which reaction a large surplus of energy is liberated, much

more indeed than is required for the fixation of the necessary carbon. It was found by Winogradsky that the nitrifying bacilli oxidized thirty-five parts of nitrogen whilst they assimilated one part of carbon, so providing by one function the energy necessary for the performance of the other.

It is curious to notice that whilst we burn carbon in our systems to provide us with the energy necessary amongst other things to avail ourselves of the all-important nitrogen in our food, the nitrifying bacilli burn nitrogen in order to acquire the power of annexing the equally necessary carbon.

Reports of Meetings.

GENERAL.

DURING the year 1898 the usual number of general meetings were held, at seven of which papers were read, while the eighth was the exhibition evening.

On January 27th the President, Mr. S. H. Swayne, read a paper for his brother, Mr. R. A. Swayne, entitled, "Some Observations on the Protective Habits of Birds."

On March 3rd Mr. Stoddart read a very comprehensive paper, entitled, "The Circulation of Nitrogen in Nature," illustrated by experiments and lantern slides.

On April 14th Mr. C. Bucknall read a paper on "Sedges and Grasses," illustrated by lantern slides.

On May 5th Professor Lloyd Morgan showed a large number of beautiful lantern slides of scenery, and commented upon the geological features of interest illustrated by them.

On October 6th Mr. D. T. Price read a paper on "Some Features of Interest in the Ornithology of the Neighbourhood."

On November 3rd Mr. George Brebner read a paper on "Vegetable Parasites," illustrated by coloured lantern slides.

On December 18th Dr. Gubbin read a paper on "Men and Animals of the Stone Age," illustrated by lantern slides.

The exhibition evening was held on February 10th. Mr. C. Bartlett, Mr. Charbonnier, Mr. Brebner, Mr. Griffiths,

Mrs. Roden, Mr. Rudge, Dr. Norton, Dr. Gubbin and Dr. Fisher showed specimens.

THEODORE FISHER.

BOTANICAL SECTION.

THE Saturday excursions continued to be fairly well attended. Early in the spring the interesting hybrid violet *V. permixta* Jord. was found in several new localities in Somersetshire, and also at Almondsbury. A rarer hybrid between *V. odorata* and *V. hirta*, having white flowers and long stolons, scentless and hairy. *V. sepincola* Jord. was discovered between Mells and Great Elm. In May, Mr. D. Fry reported the occurrence of *Falcatula ornithopodioides* on Syston Common, a welcome extension of the range of this rare trefoil. Later, two of us employed some days among the hills near Dursley and Wotton-under-Edge, where the botany has a distinctive character. *Elymus europæus*, *Verbascum nigrum*, *Hieracium murorum* and *Hypericum dubium* are among the best plants. *Pyrola minor* was found in the beechwoods, but not *P. media*, for which we made careful search near Woodmancote, whence a single specimen in the Stephens Herbarium is said to have come. Dr. Stephens' specimen, however, has been so much damaged by insects (nothing but leaves remain) that it is now hardly possible to say if it were correctly named or not. Some evidence corroborative of the existence of *P. media* in the Bristol district is much wanted. The area of *Stachys alpina* is ascertained to be about two square miles. Mrs. Gregory reports that the tuft of *Scirpus holoschœnus* on our coast produced at least fifty flowering stems this season; and that *Antennaria dioica*, formerly recorded by Dr. St. Brody from Brean Down, is actually growing on Worle Hill.

Seven or eight flowering plants of the autumnal squill were seen this autumn upon St. Vincent's Rocks.

J. WALTER WHITE, F.L.S.

ENTOMOLOGICAL SECTION.

SIX meetings were held during the year; no papers were read and no excursions were taken during the summer. Some knowledge of the work of the Section may be gained from the following.

On February 8th, Mr. Griffiths exhibited a box of foreign lepidoptera, including some fine Papilios. Mr. Charbonnier exhibited the following:—Coloured drawings of *A. lubricipeda* vars. *Eboracii* and *radiata*; photographs of parasites of the hedgehog, tick of a tortoise, and a dipteron parasite on an Indian bat; also a number of parasitic diptera and hymenoptera with their hosts.

The Hon. Sec. illustrated by preserved specimens in all stages the life histories of twenty-seven species of British lepidoptera, also the specimen of *Prodenia littoralis* bred from a larva found by him at Brockley Combe in 1897. This is the only recorded instance of this species occurring wild in Britain, a specimen recorded in 1891 having being bred from an imported tomato.

On March 8th, Mr. Griffiths exhibited some fine silk-producing moths, a specimen of *Gastrophora heuricaria* from Queensland; and on behalf of Dr. Fisher a *Mantis* from British Guiana.

On April 12th, Mr. Barton exhibited amongst others a specimen of *Cicindela regalis* from Senegal, having a large species of tick attached to the underside of the thorax.

Mr. Charbonnier exhibited some photographs of portions of insects and of ova of lepidoptera.

The Hon. Sec. showed some parasites bred from lepidoptera and for Mr. Watkins, of Painswick; amongst others, a specimen of *Sirex gigas* with its parasite *Rhyssa persuasoria*, also the rare singing fly *Sericomyia borealis*.

On November 8th, the meeting was held at Mr. Barton's.

Mr. Griffiths exhibited some lepidoptera bred from pupæ sent from Australia, including a new and undescribed species of the family Lithosidæ from near Brisbane. Mr. Charbonnier showed some parasitic hymenoptera and diptera.

The Section sustained a severe loss in November through the death of their esteemed President, Mr. Stephen Barton, F.E.S., who was one of the founders of the Bristol Naturalists' Society, and who had been President of this Section since its formation in 1864. Meetings were frequently held at his house, where his immense collections, especially of coleoptera, were a never-failing source of instruction to the members. To fill the position thus left vacant, Mr. G. C. Griffiths, F.Z.S., F.E.S., was elected.

CHAS. BARTLETT, *Hon. Sec.*

GEOLOGICAL SECTION.

THE number of members of the Section is practically constant. During the year two meetings were held, and two sectional excursions took place. At the first meeting, on March 23rd, Mr. B. A. Baker gave an account of the celestine deposits of the Bristol district, illustrating his paper by a valuable collection of specimens. This meeting was followed up by an excursion to the celestine-bearing rocks on May 21st, by the kind invitation of Professor Lloyd

Morgan, the shafts and cuttings of the new railway near Chipping Sodbury being visited also on the same occasion.

On June 4th the Section was invited by the late Mr. J. M. McCurrich to join a geological excursion to Denny Island, which was found to consist of carboniferous limestone dipping at a high angle towards the south. The exact horizon of this Denny limestone, as compared with that of the Avon Gorge, could not, however, be ascertained.

There was a fair attendance of members at University College on November 10th to hear Mr. Bolton read a paper upon "Museum Geology," in which he suggested various means of popularising the study of geology. The paper, which was fully illustrated by specimens and lantern slides, led to an interesting discussion.

The financial condition of the Section is sound. The Section continues to subscribe to the British Palæontographical Society, whose publications are placed in the library, Berkeley Square. The *Geological Magazine*, bought by the Section, is also placed there month by month.

H. PENTECOST, *Hon. Sec.*

ORNITHOLOGICAL SECTION.

THE meetings of this Section have been, during 1898, almost entirely devoted to the compilation of a local list of species. This list is now in an advanced state of efficiency, though it has been found a much more lengthy proceeding than was at first imagined. It was felt, however, that any hurry which might at all impair the thoroughness of the list must be avoided.

Two meetings have been devoted to other subjects.

On March 31st, Dr. J. A. Norton exhibited a great number

of eggs, and thereby started an interesting discussion on the causes of their variation in colouring and texture.

On October 27th, Mr. S. H. Reynolds read a paper on "Fossil Birds" and discussion followed on the points raised therein.

An attempt is being made to discover some means by which this Section may work in conjunction with the Curator in carrying out an improvement of the collection of birds in the Bristol Museum.

The Section now consists of thirteen members, and its finances are in a flourishing condition.

D. T. PRICE, *Hon. Sec.*

PHYSICAL AND CHEMICAL SECTION.

FOUR meetings of the Section have been held in the course of the year and the following papers read:—

February 8th. "On Professor J. J. Thomson's Recent Experiments suggesting the possible Subdivision of the Chemical Atom," by Professor A. P. Chattock; "On an Experiment exhibiting the Wave Trace of an Alternating Current," by Mr. W. M. Thornton, B.Sc.

March 10th. "On Further Experiments upon the Influence of a Silent Discharge of Electricity on Gases," by Mr. W. A. Shenstone, F.R.S.

March 29th. Mr. F. W. Stoddart read a paper on the following subject:—(*a*) The Assimilation of Atmospheric Nitrogen; (*b*) Nitrification. History of Investigations and special Methods employed.

December 6th. "On Further Researches upon the Composition of American Petroleum," by Dr. S. Young, F.R.S.

LLEWELYN N. TYACK, *Hon. Sec.*

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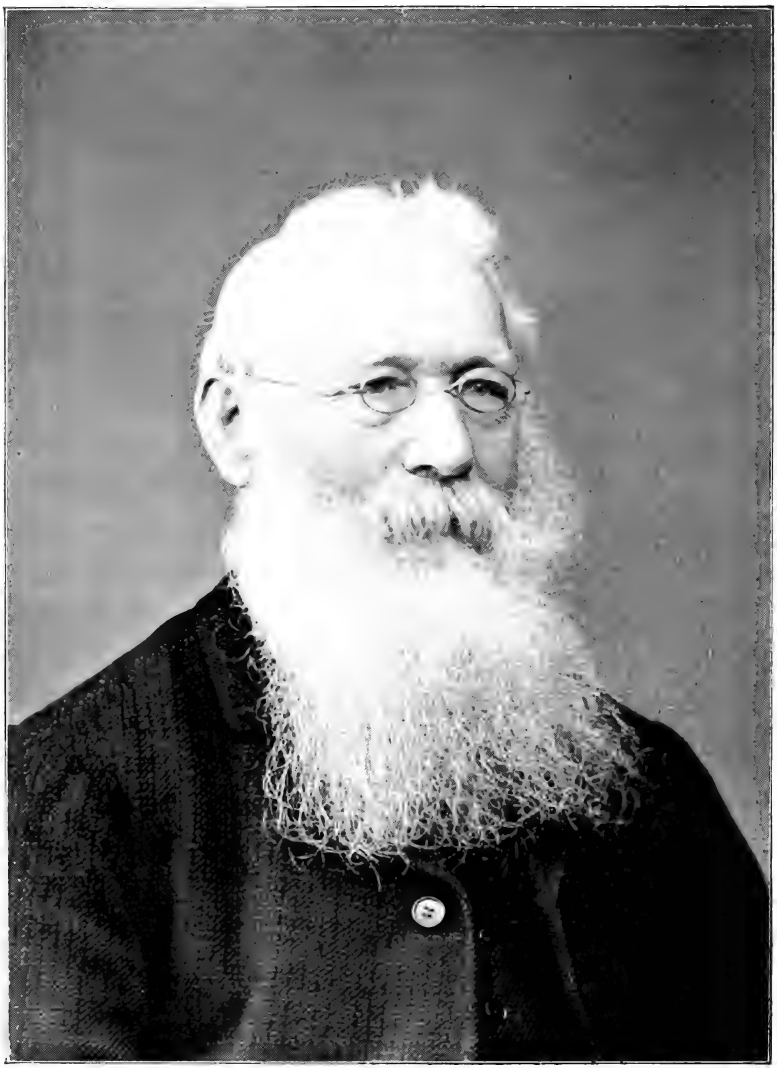


Adolph Leipziger

Adolph Leipner.

FREDERICK ADOLPH LEIPNER was born August 13th, 1827, at Breitman, in Saxony. His father was a schoolmaster, and in his father's school he received his early education. In his fifteenth year he proceeded to the Lehrer Seminar in Dresden, remaining there for nearly four years. From his childhood he had taken great interest in natural science, and was an enthusiastic collector of minerals, plants and shells. It is not surprising, therefore, to learn that whilst at Dresden he took charge of the museum belonging to the college.

In 1848 he came to England as tutor in a family, and afterwards taught the grandson of Lord Justice Knight Bruce. From that time onwards England was his home; and in 1854 he settled in Clifton as a teacher of German and Natural Science. He soon became a member of the Microscopical Society, and for many years was seldom absent from its meetings, taking an active share in its work.

In 1864 Mr. Leipner succeeded to the Lecturership in Botany and Vegetable Physiology at the Bristol Medical School, and, when University College was founded in 1876, he was appointed Lecturer in Botany and in German. His connection with the College only ceased with his death in 1894. The estimation in which his services were held is shown by the facts that in 1886 his status was raised to that of Professor of Botany, and that after his death a glass-house

was erected in the Botanical Gardens of the College to his memory by subscription among his many friends and pupils. Both to colleagues and students he endeared himself by his unfailing courtesy, his transparent integrity and honesty of purpose, his ready sympathy and his capacity for taking pains, not only in his own work, but also in furthering that of others.

The minutes of the first meeting of the Bristol Naturalists' Society on May 8th, 1862, bear Mr. Leipner's name as Hon. Sec. of the Provisional Committee which framed the constitution of the Society. The members of the Provisional Committee were Steven Barton, John Beddoe, M.D., W. S. Fedden, Henry E. Fripp, M.D., C. T. Hudson, M.A., and W. W. Stoddart. And at this first meeting of the Society Mr. William Sanders was elected President, the Rev. Canon Guthrie and Dr. Alfred Day, Vice-Presidents, Mr. W. W. Stoddart, Treasurer, W. Lant Carpenter, Reporting Secretary, and Herr Adolph Leipner, Secretary. At the following meeting, on June 5th, we find Mr. Leipner's name entered as that of an exhibitor. And from that time onwards till 1893, a period of thirty-one years, the energy and enthusiasm of its Hon. Sec. did much—how much those who were privileged to be intimately associated with him know best—to infuse life into its work. The Society's appreciation of his long and valuable services took practical form in a testimonial. At more than twenty meetings did Mr. Leipner read papers or exhibit objects of interest. He was seldom absent from the summer excursions, in the planning and conduct of which he was indefatigable. And on these occasions his geniality and tact, together with his knowledge of the district generally, and of its botany in particular, contributed in no small measure to their success. Some years before his death he was urged to allow himself to be nominated for the presiden-

tial chair, but it was not till 1893 that he at last consented to occupy that position ; and he held it scarcely a year. He died early in 1894. Many mourned him, for he was one whom all could trust, and one who gained the affection of those who knew him well. His kindly smile, ready help, and unfailing sympathy were missed in Clifton, and especially at the University College, but nowhere was their absence more keenly felt than at the meetings of the Bristol Naturalists' Society.

List of Papers contributed to our Proceedings by Professor Leipner.

1865. Remarks on a Lemur presented to the Museum.
1865. Fructification of Rhodosperm Algæ.
1865. Asexual Reproduction in some Diptera.
1866. On Pollen.
1867. On Ferns.
1868. Classification of the Mammalia.
1868. Mammalian Skulls from Burmah.
1868. Mammalia of Newfoundland.
1868. Mosses of the Bristol District.
1868. Proteus anguinus.
1868. Some Species of Seals.
1871. Amongst the Forest Giants of Australia.
1872. The Host Worm (larva of *Sciara militaris*).
1874. Characeæ.
1875. Land and Fresh Water Mollusca of the District.
1875. Mosses and their Allies.
1880. Prolification of *Cyclamen persicum*.
1881. A Naturalist's Ramble in Guernsey.

The Birds of the Bristol District.

TWENTY-FIVE years ago a list of the Birds of the Bristol District was made by Mr. E. Wheeler, and published in the Proceedings of the Society. Since then it has become possible to add a good many species to the list, and so an Ornithological Section was formed with the object of making it complete up to the present date. The new list differs from the old in many points, but we are anxious that Mr. Wheeler's work should receive due acknowledgment.

In preparing such a list we should wish, in the first place, to give an account of those species which are to be found in the country immediately surrounding the city; for it is that country with which we feel more competent to deal. There are, however, many rarer species which have occurred at no great distance from the city; and we thought that these should properly be included in the list. For this reason we have gone rather further afield, and have included species whose occurrence has been recorded within the district of which the following are roughly the boundaries:—on the north, a line drawn eastwards from Aust Cliff to the boundary of the county of Gloucester, near Badminton; on the east, a line drawn from Badminton to Wells so as to include Bath; on the south, the River Axe; on the west, that part of the coast-line of the Bristol Channel which stretches from the mouth of the Axe to Aust Cliff.

The district nowhere extends more than 15 miles from the

city, yet it contains country of much variety; for it includes mud-banks on the Severn coast; flat land intersected by wide water ditches and large hedges; broken country of hill and dale, well-wooded and watered; and, finally, high ground of the Mendips and Cotswolds. It is no doubt due to the varied features of the country that as many as 197 species of birds have been found within so small an area.

We believe that we have only included species of which the occurrence is well authenticated; but it is quite likely that, owing to the small number of members in the section, we may have omitted some species which have undoubtedly occurred. Where special records seemed necessary we have appended the initials of the member on whose authority they are quoted. The following are the members whose initials will be found so appended:—Mr. H. J. Charbonnier, Dr. J. A. Norton, Mr. H. C. Playne, Mr. D. T. Price.

The nomenclature is that adopted by Mr. Howard Saunders in his *Manual of British Birds*, 2nd edition.

Mistle-Thrush.—*Turdus viscivorus.* Resident, common.

Song-Thrush.—*T. musicus.* Resident, very common.

Redwing.—*T. iliacus.* Winter visitor. Occurs regularly in abundance.

Fieldfare.—*T. pilaris.* Winter visitor. Occurs regularly, and sometimes stays with us until the end of May.

Blackbird.—*T. merula.* Resident. Very common.

Ring-Ouzel.—*T. torquatus.* Occasionally seen on passage in the spring. Nested at Almondsbury, 1899, and the young birds were drowned in the nest (J. A. N.).

Wheatear.—*Saxicola œnanthe.* Summer resident. Nests in a few localities such as Dundry and Brean Down. Used to nest on Durdham Down, but is now only seen there on migration at the end of March. Sometimes

remains in the neighbourhood during winter (*Zoologist*, 1899, D. T. P.).

Whinchat.—*Pratincola rubetra.* Summer resident. Common, and generally distributed.

Stonechat.—*P. rubicola.* Resident. Breeds in suitable localities.

Redstart.—*Ruticilla phœnicurus.* Summer resident. Common. A male bird was caught within the city boundary on February 4th 1878 (J. A. N.).

Black Redstart.—*R. titys.* Winter visitor. Rare. Was observed at Sea Mills during the winter of 1893-94, and obtained there on January 8th 1895 (H. J. C.).

Robin.—*Erithacus rubecula.* Resident. Very common.

Nightingale.—*Daulias luscinia.* Summer resident. Nests in most parts of the district, and on Durdham Down.

Whitethroat.—*Sylvia cinerea.* Summer resident. Common.

Lesser Whitethroat.—*S. curruca.* Summer resident. Fairly common.

Blackcap.—*S. atricapilla.* Summer resident. Common. Has been obtained during the winter (H. J. C.).

Garden-Warbler.—*S. hortensis.* Summer resident. Not so common as *S. atricapilla.*

Golden-Crested Wren.—*Regulus cristatus.* Resident. Fairly numerous; more abundant in winter.

Chiffchaff.—*Phylloscopus rufus.* Summer resident. Common.

Willow-Wren.—*P. trochilus.* Summer resident. Very common.

Wood-Wren.—*P. sibilatrix.* Summer resident. Local. Common in the Leigh Woods.

Reed-Warbler.—*Acrocephalus streperus.* Summer resi-

dent. Nests sparingly in a few localities such as Nailsea and Saltford.

Marsh-Warbler.—*A. palustris.* Summer resident, arriving late in May. Has nested in four localities in the neighbourhood during the last six years (H. C. P., D. T. P.).

Sedge-Warbler.—*A. phragmitis.* Summer resident. Common in suitable localities.

Grasshopper-Warbler. — *Locustella nævia.* Summer resident. Nests every year, but is not common.

Hedge-Sparrow.—*Accentor modularis.* Resident. Common.

Dipper.— *Cinclus aquaticus.* Not often found near the city. A pair was seen at Compton Dando, April 1898 (D. T. P.), also at Frenchay, during the summer, 1898 (J. A. N.).

Long-tailed Titmouse. — *Acredula caudata.* Resident. Common.

Great Titmouse. — *Parus major.* Resident. Common. The most abundant of the Titmice.

Coal-Titmouse.—*P. ater.* Resident. Common.

Blue Titmouse. —*P. cæruleus.* Resident. Common.

Marsh-Titmouse. — *P. palustris.* Resident. Common. The least abundant of the Titmice.

Nuthatch.—*Sitta cæsia.* Resident. Common.

Wren.—*Troglodytes parvulus.* Resident. Very common.

Tree-Creeper.—*Certhia familiaris.* Resident. Common.

Pied Wagtail.—*Motacilla lugubris.* Resident. Very common.

Grey Wagtail.—*M. melanope.* Fairly numerous in winter. Remains to breed occasionally, *e.g.*, Coombe Dingle, 1894 (D. T. P.), Hambrook, 1893 (H. J. C.).

Yellow Wagtail.—*M. raii.* Summer resident. Common.

Tree-Pipit.—*Anthus trivialis.* Summer resident. Common.

Meadow-Pipit.—*A. pratensis.* Resident. Common in winter.

Rock-Pipit.—*A. obscurus.* Resident. Breeds in the Avon gorge, and on the Channel coast.

Great Grey Shrike.—*Lanius excubitor.* Winter visitor. Rare. Occurred at Clevedon and Abbots' Leigh, 1888 (H. J. C.), and at Dyrham Park, January 1891 (*Field*).

Red-backed Shrike. — *L. collurio.* Summer resident. Fairly common. Nests on Durdham Down.

Woodchat.—*L. pomeranus.* Has occurred twice, in 1852 and 1892 (*Zoologist*).

Waxwing.—*Ampelis garrulus.* Winter visitor. Has occurred several times, but of late years its visits have been rare.

Spotted Flycatcher.—*Muscicapa grisola.* Summer resident. Common.

Pied Flycatcher.—*M. atricapilla.* Summer resident. Rare. Nested within half a mile of the city boundary in 1899 (J. A. N.).

Swallow.—*Hirundo rustica.* Summer resident. Common.

Martin.—*Chelidon urbica.* Summer resident. Common.

Sand-Martin.—*Cotile riparia.* Summer resident. Common. Nests in the city.

Greenfinch.—*Ligurinus chloris.* Resident. Very common.

Hawfinch.—*Coccothraustes vulgaris.* Resident. Has increased in number during the last few years, and is now common in winter. Nests in the immediate neighbourhood of the city.

Goldfinch.—*Carduelis elegans.* Resident. Gradually decreasing in number. Still nests within a small radius, but very sparingly.

Siskin.—*C. spinus.* Winter visitor. Appears with fair regularity.

House-Sparrow.—*Passer domesticus.* Resident. Very common.

Tree-Sparrow.—*P. montanus.* Resident. Small colonies are to be found in many localities.

Chaffinch.—*Fringilla cœlebs.* Resident. Very common.

Brambling.—*F. montifringilla.* Winter visitor. Occurs regularly in fair numbers.

Linnet.—*Linota cannabina.* Resident. Very common.

Lesser Redpoll.—*L. rufescens.* Resident. Fairly common, and seems to have increased in number lately. Nests on Durdham Down.

Twite.—*L. flavirostris.* Occurs regularly on flight, but in very small numbers.

Bullfinch.—*Pyrrhula europæa.* Resident. Common.

Crossbill.—*Loxia curvirostra.* Winter visitor. Occurs irregularly.

Two-barred Crossbill.—*L. bifasciata.* Occurred at Keynsham, February 1895 (*Zoologist*).

Corn-Bunting.—*Emberiza miliaria.* Resident. Fairly common. More abundant in the Cotswolds.

Yellow Bunting.—*E. citrinella.* Resident. Very common.

Cirl Bunting.—*E. cirlus.* Resident. Not common.

Reed-Bunting.—*E. schœniclus.* Resident. Fairly common in the lower ground.

Snow-Bunting.—*Plectrophenax nivalis.* Winter visitor. Occurs fairly regularly.

Starling.—*Sturnus vulgaris.* Resident. Very common.

Rose-coloured Starling.—*Pastor roseus.* Occurred at Clevedon, September 1895 (*Field*).

Chough.—*Pyrrhocorax graculus.* A bird of this species flew along the edge of the cliff on Durdham Down on

July 13th 1900. It had probably wandered from the coast of Wales (H. C. P.).

Jay.—*Garrulus glandarius.* Resident. Common.

Magpie.—*Pica rustica.* Resident. Common.

Jackdaw.—*Corvus monedula.* Resident. Very common.

Raven.—*C. corax.* Used to nest at Dyrham Park, Glos. Nested at Brean Down, 1897 (D. T. P.).

Carrion-Crow.—*C. corone.* Resident. Breeds regularly.

Hooded Crow.—*C. cornix.* Reported in the winter, 1883, by Mr. A. C. Pass. Also occurred at Puxton in the winter, 1897 (J. A. N.).

Rook.—*C. frugilegus.* Resident. Very common.

Sky-Lark.—*Alauda arvensis.* Resident. Common.

Wood-Lark.—*A. arboreus.* Regularly found in the district, but has become rarer during the last few years. There seems to be no record of its nesting.

Shore-Lark.—*Otocorys alpestris.* Occurred at Ashton, 1866 (J. A. N.), and at Avonmouth, October 1894 (H. J. C.).

Swift.—*Cypselus apus.* Summer resident. Very common.

Nightjar.—*Caprimulgus europæus.* Summer resident. Fairly common.

Wryneck.—*Iijnx torquilla.* Summer resident. Fairly common.

Green Woodpecker.—*Gecinus viridis.* Resident. Common.

Great Spotted Woodpecker.—*Dendrocopus major.* Resident. A few pairs nest every year in the immediate neighbourhood of the city.

Lesser Spotted Woodpecker.—*D. minor.* Resident. Fairly common.

Kingfisher.—*Alcedo ispida.* Resident. Not common near the city.

Bee-eater.—*Merops apiaster.* Four birds, out of a small flock, were shot at Stapleton by Mr. Harding in May 1866.

Hoopoe.—*Upupa epops.* Occurred in the spring of the years, 1870, 1892, 1895 (H. J. C.); also at the New Passage, 1888 (J. A. N.).

Cuckoo.—*Cuculus canorus* Summer resident. Common.

Barn-Owl.—*Strix flammea.* Resident. Fairly common.

Long-eared Owl,—*Asio otus.* Reported occasionally; at Ashton Park, 1895, and at Frampton Cotterell, 1897. Probably resident.

Short-eared Owl.—*A. accipitrinus.* Occurs occasionally in autumn; at Ashton, 1891 (H. J. C.).

Tawny Owl.—*Syrnium aluco.* Resident. Fairly common.

Hawk-Owl.—*Surnia funerea.* Occurred at Yatton, August 1847 (*Manual of British Birds*, Howard Saunders).

Montagu's Harrier.—*Circus cineraceus.* A specimen was caught in a trap on Brean Down in June 1864 (*Zoologist*); another occurred at Tickenham, 1891 (J. A. N.).

Sparrow-Hawk.—*Accipiter nisus.* Resident. Fairly common.

Kite.—*Milvus ictinus.* Occurred at Chewton, and at Wraxall, August 1888 (J. A. N.).

Peregrine Falcon. — *Falco peregrinus.* Occurs fairly often. Nested on Brean Down in 1869.

Hobby.—*F. subbuteo.* Occurred at Chewton in 1885, and at Wrington on November 6th 1896 (J. A. N.).

Merlin.—*F. œsalon.* Taken nearly every autumn by bird-catchers. These are often immature birds.

Kestrel.—*F. tinnunculus.* Resident. Common.

Cormorant.—*Phalacrocorax carbo.* In 1896 a bird of this species was observed sitting on the tower of St. Mary, Redcliffe, and was photographed (J. A. N.).

Shag.—*P. graculus.* Once seen at Shirehampton some years ago (J. A. N.).

Gannet.—*Sula bassana.* A party of four or five was seen on Denny Isle on September 3rd 1893 (J. A. N.).

Common Heron.—*Ardea cinerea.* Resident. Fairly common.

Little Bittern.—*Ardetta minuta.* Was obtained at Weston-super-Mare in October 1865, by Rev. Murray A. Matthew.

Bittern.—*Botaurus stellaris.* Occurs nearly every winter. At Hambrook, July 1891; Portishead, December 29th 1891; Clevedon, 1892; Novers, 1892; Ashley Down, January 1900 (H. J. C., J. A. N.).

Grey Lag-Goose.—*Anser cinereus.* Occurs on the Severn coast in winter.

White-fronted Goose.—*A. albifrons.* Occurs on the Severn coast in winter. This is the most abundant of the four species of geese which visit the district.

Bean-Goose.—*A. segetum.* Occurs on the Severn coast in winter.

Brent Goose.—*Bernicla brenta.* Occurs on the Severn coast in winter.

Bewick's Swan.—*Cygnus bewicki.* Occurred at Clevedon, 1879.

Common Sheld-Duck.—*Tadorna cornuta.* Resident. Breeds in fair numbers near the Severn coast.

Mallard.—*Anas boscas.* Resident. Nests in suitable localities.

Shoveller.—*Spatula clypeata.* A few pairs breed on the moors of North Somerset.

Pintail.—*Dafila acuta.* Occurs on the Severn coast (J. A. N.).

Teal.—*Nettion crecca.* Occurs commonly on the Severn coast in winter.

Wigeon.—*Mareca penelope.* Common on the Severn coast in winter.

Pochard.—*Fuligula ferina.* Occurs yearly on Barrow reservoir.

Tufted Duck.—*F. cristata.* Has occurred on Barrow reservoir.

Scaup-Duck.—*F. marila.* Has occurred on the Severn coast (J. A. N.)

Golden-Eye.—*Clangula glaucion.* Has occurred on the Severn coast, and at Barrow reservoir (J. A. N.).

Eider Duck.—*Somateria mollissima.* Occurred on Barrow reservoir, October 30th 1889 (J. A. N.).

Common Scoter.—*Œdemia nigra.* Occurs every winter on the Severn coast.

Velvet-Scoter.—*O. fusca.* Has occurred occasionally on the Severn coast.

Goosander.—*Mergus merganser.* Occurred at Wraxall, 1870 (J. A. N.), and at Bitton, January 1891 (H. J. C.).

Smew.—*M. albellus.* Occurred at Clevedon, January 1892 (H. J. C.).

Ring-Dove.—*Columba palumbus.* Resident. Common.

Stock-Dove.—*C. œnas.* Resident. Not uncommon.

Turtle-Dove. – *Turtur communis.* Summer resident. Fairly common.

Pallas's Sand-Grouse.—*Syrrhaptes paradoxus.* Several were obtained in 1863.

Black Grouse.—*Tetrao tetrix.* Is shot every year on the Mendips.

Red Grouse.—*Lagopus scoticus.* Has occurred on the Mendips (J. A. N.).

Pheasant.—*Phasianus colchicus.* Resident. Very common.

Partridge.—*Perdix cinerea.* Resident. Common.

Red-legged Partridge.—*Caccabis rufa.* Uncommon. A specimen was caught in the streets of Bristol in June 1888, and three were shot at Frenchay in August 1888 (H. J. C.). It also occurred at Portishead, 1897 (D. T. P).

Quail.—*Coturnix communis.* Occurred at Knowle in October 1885, and on Bedminster Down in June 1900. Has nested at Cheddar.

Land-Rail.—*Crex pratensis.* Summer resident. Common. Has been found occasionally in mid-winter.

Spotted Crake.—*Porzana maruetta.* Used to be common at Weston-super-Mare, and still is often shot there. Nests near Glastonbury.

Baillon's Crake.—*P. bailloni.* Occurred at Weston-super-Mare in October 1865 (*British Birds*, Yarrell).

Water-Rail.—*Rallus aquaticus.* Resident. Not uncommon in suitable localities. More abundant in winter.

Moor-hen.—*Gallinula chloropus.* Resident. Common.

Coot.—*Fulica atra.* Resident. Not uncommon in certain localities.

Stone-Curlew.—*Œdicnemus scolopax.* Has occurred at Avonmouth and on the Mendips. Nests on the Wiltshire downs.

Dotterel.—*Eudromias morinellus.* Occurred on Steepholm in May 1869 (Rev. Murray A. Matthew). Used to breed on the Mendips (Montagu).

Ringed Plover.—*Ægialitis hiaticola.* Resident. Common on the Severn coast.

Golden Plover.—*Charadrius pluvialis.* A frequent visitor in spring and autumn.

Grey Plover.—*Squatarola helvetica.* Occurred at Avonmouth, October 1889; Weston-super-Mare, September 1892; New Passage, November 1892 (H. J. C.).

Lapwing.—*Vanellus vulgaris.* Resident. Very common.

Turnstone.—*Strepsilas interpres.* Occurs frequently on the Severn coast in winter (J. A. N.).

Oyster-catcher.—*Hæmatopus ostralegus.* Resident. Common on the Severn coast. Nests on Denny Isle.

Grey Phalarope.—*Phalaropus fulicarius.* Several were obtained at Avonmouth in 1896; also occurred at Barrow reservoir in 1886.

Woodcock.—*Scolopax rusticula.* Winter visitor. Fairly common.

Common Snipe.—*Gallinago cœlestis.* Fairly common in winter.

Jack Snipe.—*G. gallinula.* Winter visitor. Fairly abundant in some years.

Dunlin.—*Tringa alpina.* Common on the Severn coast throughout the year. Often seen on the banks of the Avon.

Curlew-Sandpiper.—*T. subarquata.* Two were obtained at Weston-super-Mare in the autumn of 1893 (H. J. C.).

Purple Sandpiper.—*T. striata.* Occurred at Lawrence Weston in November 1888, at New Passage in January and October 1892 (J. A. N., H. J. C.).

Knot.—*T. canutus.* Occurs frequently in small numbers at Weston-super-Mare (H. J. C.).

Sanderling.—*Calidris arenaria.* Occurs frequently on the Severn coast. Three specimens were obtained at Oldbury-on-Severn, October 1st 1900 (H. J. C.).

Ruff.—*Machetes pugnax.* Occurred at Weston-super-Mare in 1864. Also at Wrington, September 1889 (J. A. N.).

Common Sandpiper.—*Totanus hypoleucus.* Appears in fair numbers every spring on migration, and is occasionally seen during the summer; but there seems to be no certain evidence of its nesting.

Green Sandpiper.—*T. ochropus.* Occurred at Clevedon, September 1887 (H. J. C.).

Common Redshank.—*T. calidris.* Fairly common on the Severn coast, except in the breeding season.

Bar-tailed Godwit. — *Limosa lapponica.* Occasionally occurs in winter on the Severn coast.

Curlew.—*Numenius arquata.* Common on the Severn coast throughout the year.

Whimbrel.—*N. phœopus.* An autumn visitor to the Severn coast.

Black Tern.—*Hydrochelidon nigra.* Occurred at Avonmouth in September 1896 (H. J. C.).

Roseate Tern.—*Sterna dougalli.* Occurred at Clevedon in April 1897 (H. J. C.).

Common Tern.—*S. fluviatilis.* An uncommon visitor. Three specimens occurred at Litton in September 1896.

Arctic Tern.—*S. macrura.* An occasional visitor. In Yarrell's *British Birds* is an account of the appearance in the city of great numbers of this and the preceding species, in May 1842.

Sooty Tern.— *S. fuliginosa.* Occurred at Bath in October 1885 (Lloyd's *Natural History*).

Sabine's Gull.—*Xema sabinii.* Occurred at Weston-super-Mare in the years 1863, 1865, 1867 (*Zoologist*); also an immature bird was obtained at Tickenham on September 24th 1896 (H. J. C.).

Little Gull.—*Larus minutus.* Occurred at Clevedon in October 1889 (J. A. N.).

Black-headed Gull.—*L. ridibundus.* Very common about the coast, especially in winter. At low tide considerable numbers come close to the city to obtain food from the river.

Common Gull.—*L. canus.* Frequently to be seen about the Severn coast, and up the river Avon.

Herring-Gull.—*L. argenatus.* Common. Nests on Steep-holm.

Lesser Black-backed Gull.—*L. fuscus.* Seen about the coast in small numbers.

Great Black-backed Gull.—*L. marinus.* Fairly common about the Severn coast.

Glaucous Gull.—*L. glaucus.* Occurred in the winter of 1840 (*British Birds*, Yarrell), and has been obtained at Weston-super-Mare by Rev. Murray A. Matthew.

Kittiwake Gull.—*Rissa tridactyla.* Fairly common, except in the breeding season.

Pomatorhine Skua.—*Stercorarius pomatorhinus.* Six were obtained in November 1879. Also occurred at Clevedon, and at Chew Magna, in October 1880 (H. J. C.).

Buffon's Skua.—*S. parasiticus.* Occurred at Clevedon in October 1891 (J. A. N.).

Razorbill.—*Alca torda.* Common in the Channel during the summer.

Common Guillemot.—*Uria troile.* Common in the Channel during the summer.

Puffin.—*Fratercula arctica.* Seen in the Channel during the summer. A young bird was caught alive at Cheddar in October 1888 (J. A. N.).

Great Northern Diver.—*Colymbus glacialis.* Two were shot some years ago in the floating harbour.

Great Crested Grebe.—*Podicipes cristatus.* Occurred at Barrow reservoir in April 1897 (H. J. C.).

Slavonian Grebe.—*P. auritus.* Occurred at Barrow reservoir in 1890 (H. J. C.).

Little Grebe.—*P. fluviatilis.* Resident. Common. Breeds regularly.

Storm Petrel.—*Procellaria pelagica.* A living specimen was picked up by Mr. C. S. Wheeler in Post Office Lane, Small Street, in November 1876.

Fork-tailed Petrel.—*Oceanodroma leucorrhoa.* A specimen was found dead in the Avon in 1886 (J. A. N.).

Manx Shearwater.—*Puffinus anglorum.* Has occurred at Clevedon (H. J. C.), and at Ashton (J. A. N.). On a stormy day in June 1897, several were seen over the water off Avonmouth (H. C. P.).

Fulmar.—*Fulmarus glacialis.* Occurred at Weston-super-Mare in 1869 (Rev. Murray A. Matthew), at Avonmouth in August 1878 (J. A. N.).

A Rhætic Section at Redland.

By W. H. WICKES.

IN the *Quarterly Journal of the Geological Society* for 1891 p. 545, the late Edward Wilson remarks:—"Although the Rhætic rocks have a wide horizontal distribution in the neighbourhood of Bristol, it is but seldom that they are exposed at the surface. In the absence of natural inland sections, and of quarries on the horizon of a thin series of rocks which yield no minerals of commercial value, we have generally to trust to new railway cuttings or other artificial excavations for affording us opportunities for their examination. . . . A redescription of the Pylle Hill section, therefore, appears desirable while it is in a fresh state. In a very short time the new cutting, which, like the old one, is sloped at so high an angle as to be almost inaccessible, will become obscured by rainwash and vegetation, and thus be no longer available for detailed examination."

The foregoing quotation so accurately represents the state of the Rhætic rocks in this neighbourhood that it is worth reproduction. All the sections previously described in this district are now built upon, grown over, or otherwise inaccessible. A detailed description of a new local section may therefore be of interest. Some fields near Redland Green have been lately laid out for building purposes under

the name of "New Clifton," and a low hill, on which Coldharbour Farm stands, has been cut through for the main road, exposing Lower Lias, Rhætic, and Upper Trias beds. Owing to small anticlinals, which give a somewhat wavy appearance to the section, the dip is not very easy to determine, but it may be reckoned at some 2° or 3° N. 60° E. The cutting is about 5 to 7 feet in depth; but being on a slope, by measuring at various points the section shown opposite has been obtained.

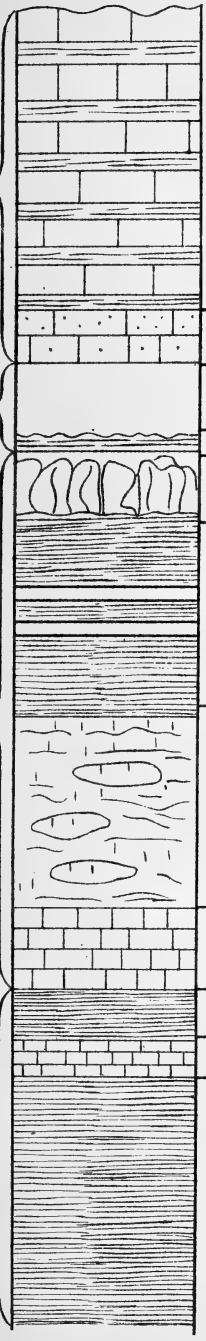
The Black Shales probably continue downwards for another 4 feet or 5 feet; but although the Tea-green and Red Marls crop out a short distance away, the junction is not exposed.

Of the sections previously recorded, that of Pylle Hill[1] so nearly resembles the above that the marginal letters used by Edward Wilson have been added for purposes of comparison. Owing to the thinning out of some beds, also to changes in composition of others, this co-relation is in a few cases only approximate. Pylle Hill shows 17 feet of Rhætics. This section (allowing for 5 feet unexposed) gives only about 14 feet, the principal loss occurring in bed "**M**," which measures 4 feet 11 inches in E. Wilson's section.

Many of the beds are of the usual character, and require no special comment, but bed "**K**" is very fossiliferous, being in some horizons full of the pretty little water plant known as *Naiadites acuminatus*. This plant has been found at other local sections by Stoddart, Tawney, Wilson, etc., but it is doubtful if any better specimens have ever been unearthed than those from this bed, where it occurs in profusion. The excellence of preservation in many instances is remarkable, considering the friable nature of the rock.

[1] E. Wilson, *Q.J.G.S.*, 1891, p. 545.

REDLAND (NEW CLIFTON) SECTION. Scale $\frac{1}{24}$.



			ft.	in.
Lower Lias		Six beds of hard limestone with clay partings *Ammonites planorbis, A. johnstoni, Nautilus striatus, Pleuromya* sp., *Ostrea liassica, Lima gigantea, Pecten pollux, Cardinia listeri, Extracrinus* sp., *Cidaris edwardsi, Rhynchonella calcicosta.*	3	0
	Q	Rubbly limestone *Ostrea intusstriata.*	0	7
White Lias	P	White shaly limestone, with occasional hard conchoidal masses *Monotis deccussata, Modiola minima,* Insect fragments.	0	9
	O	Clay parting	0	1½
	N	Compact conchoidal limestone with "landscape" marking (Cotham marble) *Modiola minima* and small gasteropods (undetermined).	0	8
Upper Rhaetic	M	Laminated blue and brown clay (weathering greenish grey), with two white calcareous bands and some dark-brown septaria Vertebræ of *Plesiosaurus*, small Ostracoda (*Darwinula?*).	2	0
	L K	Cream-coloured shaly limestone, with blue core and greenish-grey septaria Fish teeth and scales (*Saurichthys, Pholidophorus, Gyrolepis, Acrodus, Lepidotus, Legnonotus*), Insects (? dragon-flies or beetles), *Estheria minuta, Darwinula, Pecten valoniensis, Cardium rhaeticum, Plicatula intusstriata, Anatina suessi, Discina* sp., *Naiadites acuminatus.* Sun cracks, ripple marks, and beach layers.	2	2
	I	Dark bluish-green crystalline limestone	0	8
	H	Dark-brown and black clay	0	5
	G	Dark crystalline limestone *Acrodus minimus, Gyrolepis alberti,* etc	0	4
Lower Rhaetic	F	Black shales and clay *Avicula contorta, Pecten valoniensis, Schizodus* (2 species). *Cardium rhaeticum, Lima precursor, Myophoria emmrichi.*	3	0

In the same bed occur two or three layers of crushed shells (principally *Cardium rhæticum*), amongst which are some fragments of beetle wings, mostly small and difficult to determine. One form, however, is in very fair condition, and has caused some discussion among the entomologists, some considering it a larval form of a Lampyrid beetle, while others think it is a pupa case of one of the Libellulidæ.

There does not appear to be any definite "bone bed," as at Aust Cliff, but teeth and scales of fish are scattered through the section. At some horizons they are more plentiful than at others, but bones are scarce, and when found, are usually very small.

The bed "**N**" of Cotham Marble is the best development the writer has seen of this curious rock, many hundreds of blocks having been unearthed. The thickness is unusual (varying from 4 inches to 11 inches)—about double the average measurement. Many of the larger blocks have double "landscapes." Some of these have been polished with very satisfactory results, the rest have been used for road making!

There is not room in this paper to enter into the question of the origin of this remarkable rock, but the writer would like to mention that after seeing many hundreds of blocks, both *in situ* and loose, he has been unable to find any evidence in favour of the "dendritic" theory, while there is equally little to support the "pressure" theory advanced by some writers. Altogether, the paper written by Mr. Beeby Thompson (*Q.J.G.S.*, August, 1894) appears to more nearly fit the facts than any of the other solutions offered.

Near this section the writer was fortunate in finding a small deposit of the rare mineral known as "Baryto-Celestine." This mineral was first noticed by a former member of the Bristol Naturalists' Society, Dr. Norman Collie, who contributed a paper on the subject to the Society's

Proceedings (1879, p. 292). Since that time it seems to have escaped notice. It has been found in the Trias, near Clifton Down station, and in the Rhætic on Cotham Hill. It is usually in a decomposed state, but in these beds some good unweathered crystals occur. This mineral is a local rarity, as Bristol appears to be the only British locality, the other places noted being Hanover-Bex (Switzerland), and Lake Erie.

As another member, Mr. James Parsons, is preparing some notes on this mineral, it is needless to allude to its composition, but the following physical differences from Celestine may be mentioned:—more opaque, crystals smaller, and always radiate, angles obscure, lustre duller, more brittle, weathers rapidly to a soft powder, does not occur in geodes, but in veins and fissures, and generally has more of the appearance of Barytes than of Celestine, although the latter is the "predominant partner."

The beds in this section have been deposited in a shallow sea or estuary in the immediate proximity of land, whether mainland or islands is not quite clear. The presence of insects, land plants, also ripple marks, sun cracks, and beach remanie constitute the evidence. There is little doubt that we are here on the fringe of the great Rhætic Sea, the great mass of the deposit occurring in the Rhætian Alps of Lombardy, the Tyrol, etc., where some 3,000 feet to 4,000 feet have been noted. Considering this great thickness of beds, and the characteristic fauna therein, the question arises as to the advisability of still naming these as "transition" or "passage beds," and whether they are not entitled to be considered as a distinct "formation."

NOTE.—Professor Sollas writes with reference to these "Naiadites" plants:—"Thank you for the fresh material to hand, which has proved very useful. I asked my daughter to undertake

their further investigation. This she has done, and, after a vast deal of labour, not yet quite finished. She has made out all the important points of the structure. The sporangia belong to the 'Naiadites,' which is proved by them to have been a member of the Lycopodiaceæ. The sporangia contain tetraspores beautifully preserved. They may occasionally be found occupying their proper position in the axil of a leaf. The structure of the stem of 'Naiadites' is equally that of a Lycopodiaceous plant.

"My daughter read a paper on the subject before the British Association, and is now busily engaged in completing a memoir for the Geological Society."

Additional Observations on the Rhætic Beds at Redland.

By JAMES PARSONS, B.Sc., F.G.S.

FOR comparison with the typical section at New Clifton, described by Mr. W. H. Wickes, the following notes on two sections in the immediate neighbourhood may be of interest, as throwing some light on the physical conditions under which the beds were deposited.

The first section to be described is exposed about 200 yards north of the cutting where Mr. Wickes' measurements were taken. The Black Shales are there shown resting uncomformably on a platform of Carboniferous Limestone, evidently the result of marine denudation. From the thickness of Black Shales accumulated on this platform it must have been submerged early in Rhætic times, but in the Triassic Period may have existed either as an island, or more probably as the end of a small peninsula—a continuation of the Limestone ridge extending from the main plateau of the Downs, along Coldharbour Lane, as far as St. Alban's Church, where Lias rests directly on the Carboniferous. The absence of any cutting to the immediate north of Cold Harbour prevents us from saying whether the Triassic land was directly continuous from New Clifton to Westbury or not, though on the north side of the Henleaze district the Black Shales rest

directly on Carboniferous. The limestone floor at New Clifton slopes at first gently in an easterly direction parallel to the overlying Black Shales, and then suddenly at an angle of about 10° in an easterly direction, and disappears beneath the later deposits. It should be clearly understood that I refer to the slope of the platform, not to the dip of its beds, which is 35° S. 80° E. The rock is a dark coarse oolite, with shaly bands, and is, apparently, of the Upper Limestone Series. The Rhætic Beds dip at 10°–12° in a direction a few degrees N. of E. Their succession is as follows:—

The beds are lettered to correspond with that in Mr. Wickes' paper.

		ft.	*in.*
N.	Cotham stone, having at its base a band containing *Monotis decussata*	0	5
M.	Laminated, bluish-green clay, with many variable, cream-coloured arenaceous bands	2	0
K.L.	*Naiadites* beds	2	0
I.	(Absent)	0	0
H.	Black shaly clay	0	8
G.	Black shaly limestone, crowded with *Pecten valoniensis*, *Schizodus*, *Modiola*, etc., especially in bands. Abundant fish remains	0	4–6
F.	(iv.) Black shaly clay	3	6
	Narrow ferruginous band	(variable)	
	(iii.) Nodular inconstant limestone and clay	0	8
	Narrow ferruginous band	(variable)	
	(ii.) Greenish-black clay	1	0
	(i.) Well-bedded, black pyritous shale	1	4
	Narrow red ferruginous band	(variable)	

Some of the bands in bed *M* superficially resemble compact limestone, but are more correctly described as calcareous sandstone. An analysis of one of the bands yielded the percentages:—

Fine sand	59·5
Carbonate of lime	40·5

On treating a piece with acid the sand grains remained coherent.

The limestone in bed *F* (iii.) occurs in lenticular masses, having a greater axis of about 1 foot 6 inches. Between the masses occurs a siliceous clay. In the limestone *Avicula contorta* was found.

Though there are no signs here of erosion or shore deposit at the base of the Naiadites beds, Mr. Wickes has found a shore deposit in bed (i.), indicating that, owing to silting up, combined perhaps with slight elevation, shallow water conditions prevailed after the deposition of the Black Shales, those possibly forming muddy flats on which Naiadites could flourish. Mr. Rendle Short, B.Sc., has noted ripple marks in the Naidites beds, and they also occur in the bands in the overlying clay, though this is not conclusive proof of very shallow water conditions.

The second section was exposed beneath the roadway immediately on the east side of the Bishop's Palace at Redland Green in laying a sewer. The measurements were made with a plumb line under disadvantageous conditions, and may not be accurate to an inch or so.

		ft.	*in.*
N.	Cotham stone	0	4
L.	Clay	2	6
K.	Naiadites beds	2	7
(*G.H.I.*?)	Hard, dark limestone, crowded with crushed shells (*Pecten valoniensis*, etc.), and abundant fish remains	2	10
F.	Black pyritous shales (base not seen) .	5	0

The thick, dark limestone contains numerous cream-coloured argillaceous nodules, with no fossils; the smaller nodules are pressed out in the bedding-planes, while the shelly laminæ curve round the larger.

The thickening of the beds, especially of the limestone,

indicates deeper sea conditions than prevailed farther north at Cold Harbour.

Since Mr. Wickes' paper was read, I have been able, by a little digging, to expose the junction of the Black Shales with the Tea-green Marls.

Below the Black Shales the section is as follows :—

		ft.	*in.*
(iv.)	Red ferruginous band	0	1
(iii.)	Brown clay	0	8
(ii.)	Sandstone interbedded with green marl .	0	4
(i.)	Tea-green marls (a continuous section, not exposed)	about 9 ft.	

The most interesting point in this section is the change which occurs in the Black Shales towards their base, the typical black laminæ occurring curiously interbedded with pale-green marl the latter predominating as their base is reached. It would be difficult to explain this by any conditions of sedimentation, and may, I think, be better accounted for by oxidation of the carbonaceous matter through the agency of iron pyrites. In bed *F* (i.), in the section first described, pyrites occur abundantly, partially oxidized to limonite, forming brown partings precisely similar to these pale-green ones, and indicating clearly the same process at work, only not carried so far. A further confirmation of the supposition is given a few yards from the spot where these shales are found, where only the first foot of Black Shales can be properly called black, the remainder being greenish-brown with black streaks. The two divisions are well marked, and I noticed a similar sharp division between the *pyritous* shales *F* (i.) and the overlying shaly clay *F* (ii.) in the first-described section.

I would suggest that the chemical changes involved are—

(1) The oxidation of pyrites by air and percolating water.

(2) The oxidation of the carbonaceous matter by the

sulphate formed, reducing this again to iron sulphide, possibly in the form of marcasite, known to occur in the Green Marls.

I am aware that this suggestion implies, *a fortiori*, that the whole of the Green Marls were produced by the decomposition of carbonaceous mud through the agency of pyrites, but in the present uncertain state of knowledge as to their conditions of deposition, this may not be deemed impossible. If they are so produced, the curious shales I have described lose no interest as true passage beds, and show that the Rhætic Beds graduate as insensibly into the underlying Trias as into the overlying Lias.[1]

If the brown clay (iii.) is the result of decomposition—and I have seen just such a clay produced by weathering of pyritous Black Shales—the sandstone (ii.) would be the actual base of the Black Shales. It occurs in narrow bands, at most half an inch in thickness, with clay partings, and is a light-coloured, fine-grained sandstone, somewhat micaceous, smooth on one surface; the other surface is irregular, and shows larger, well-rounded grains of clear and white quartz, and of dark chert, with some glauconite.

In the clay adherent to this surface occur distinct, though scanty and ill-preserved, fish remains, but these would not in any way justify the denotation of this sandstone as a "Bone-Bed."

[1] A distinction might be drawn between beds that are physically transitional, and those that are transitional in respect of their organic remains. The Rhætic fauna is at least as distinctive as that of many greater formations.

EMBOROUGH.

THE SOMERSET FULLERS EARTH AND OCHRE COMPANY Ld

Plan of Workings & Test Holes.

Scale 2 Chains to 1 inch.

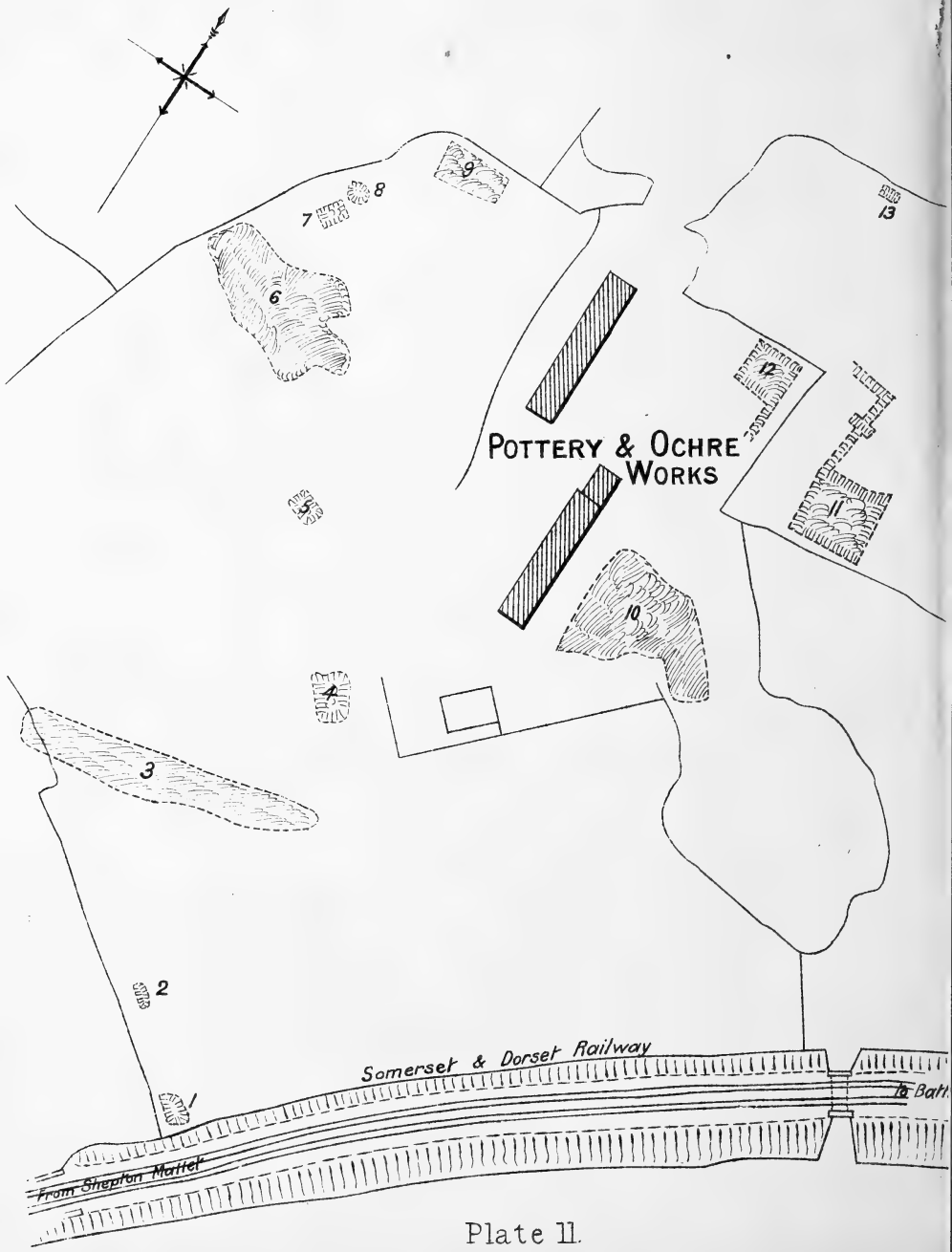


Plate 11.

Triassic Deposits at Emborough.

By C. LLOYD MORGAN, F.R.S., F.G.S., and
S. H. REYNOLDS, M.A., F.G.S.

I. Introductory.

DURING a visit paid in the summer of 1900 by the Geological Field Class of University College, Bristol, to the Somerset Fuller's Earth and Ochre Works at Emborough, so many points of interest were disclosed that it seemed to us desirable that a record of them should be preserved.

In our examination of the beds we have been greatly helped by Mr. Barton, the manager of the works, to whom our warm thanks are tendered. We are also greatly indebted to Mr. F. J. Bird, of Norton House, Midsummer Norton, for having provided us with a plan of the workings.

The works occupy some fields lying south of the Wells

and Radstock road, about a quarter of a mile south-west of Old Down Inn at Emborough.

II. Detailed Description of the Exposures.

(*a*) *Those to the west of the works.*

The Triassic beds rest with complete discordance on a very uneven surface of Carboniferous limestone, which is exposed in three of the thirteen excavations now open. It is seen (1) in the extreme south-west corner of the field near the railway, dipping at 33° E. 35° N. In the surface soil above the limestone occur lumps of weathered limestone concerning which Mr. Barton said enquiries had been made with regard to the extraction of zinc. Mr. J. Parsons B.Sc., F.G.S., has however kindly examined some of this material for us and has found no trace of zinc in it. Another small excavation (2) north-west of the first shows the limestone dipping at 40° N.E.

The Carboniferous limestone is, however, much better exposed in the comparatively large quarry (3) a little farther north-west, where it is worked for road metal. The limestone includes several partings of shale, some of which are very fossiliferous, and have yielded a number of large specimens of *Producta gigantea*, together with *Producta semireticulata* and *Orthis resupinata*. Large masses of *Lithostrotion irregulare* were also found. The limestone contains several pockets of valuable ochre and of iron-stained sand. The dip in the south-west corner of the quarry is 68° N.E., while in the northern part it is not quite so high. The Carboniferous limestone is also exposed in the north-east part of the large quarry in the Dolomitic conglomerate (6) to be referred to subsequently.

The remaining excavations are all in beds of Triassic age.

The first of these (4) lies some fifteen yards north of the

limestone quarry, and indicates well the extremely irregular character of the surface of the limestone, as although some fifteen feet of Triassic beds are now exposed, and Mr. Barton says that the excavation had at one time been carried down six feet further, the Carboniferous limestone was not reached. The beds exposed here consist at the base of some twelve feet of sandy limestone, or calcareous sandstone (bed *b*) much iron-stained, containing barytes and calcite in larger or smaller portions, together with numerous little angular pieces of limestone. Above are several feet of red marl (bed *c*) passing imperceptibly into surface soil. Blocks now lying on the surface of the ground, obtained from the lower beds here exposed, show much barytes in radiating masses, and calcite in well-formed crystals.

A trial shaft (5) a little further to the north-west shows a very irregular series. At the base on the north side of the pit, red ochreous marl (bed *c*) has been excavated, while above it is a band containing a great deal of barytes. On the west side there is a band of red clay. The upper part of the excavation shown included blocks of Carboniferous limestone and pockets of white clay resembling china clay. It also shows masses of peroxide of iron, which Mr. Barton believed to contain a considerable proportion of manganese. In the specimens analyzed by Mr. Parsons, however, manganese is not present.

Proceeding farther north, one comes to a quarry (6) with Dolomitic conglomerate, one of the largest excavations in the locality. The Carboniferous limestone forms an irregular floor to the quarry, and is seen in the north-east corner dipping at 46° E.S.E. Mr. Barton says it has been exposed by quarrying operations at other points in the quarry, but is now covered up. Most of the rock exposed in the quarry is typical coarse Dolomitic conglomerate (bed *a*)—blocks of hard

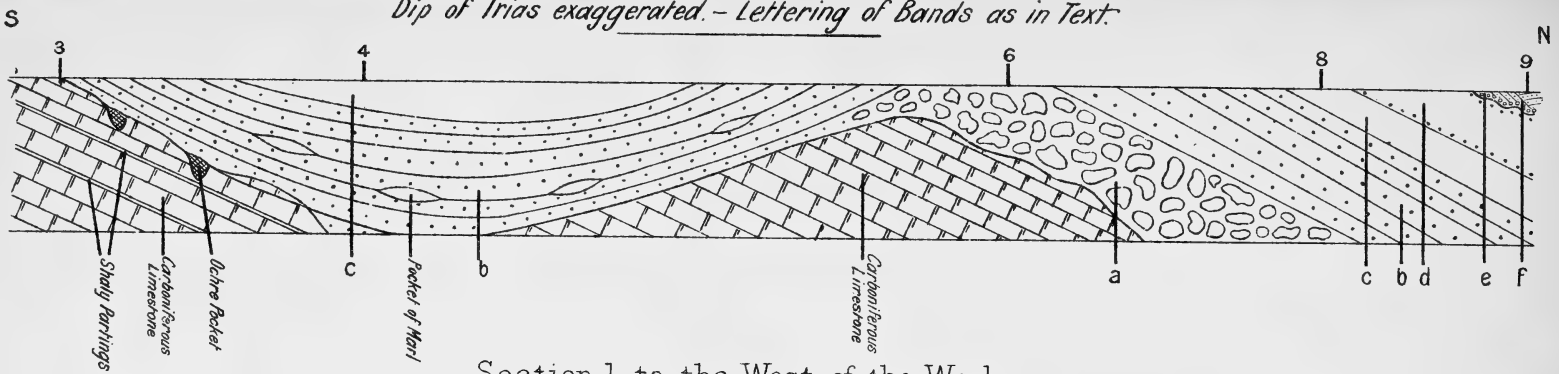
Carboniferous limestone, many of very large size, imbedded in iron-stained clay or firmly united in hard red limestone breccia. Large pockets of both red and yellow ochre and geodes lined by fine quartz and calcite crystals occur. Mr. Barton believed that a good deal of manganese occurred round the edges of the ochre pockets; but Mr. Parsons, to whom we submitted specimens, found that it was not present.

North of this quarry two trial shafts (7 and 8) have been opened in red calcareous sandstone (bed *b*) containing small fragments of limestone and much barytes and calcite in larger or smaller pieces. The more southerly (7) of these two shafts shows about eight feet of this rock. The more northerly (8) shows several feet of red crumbly marl (bed *c*) resting on the red calcareous sandstone, which here contains irregular bands of red and greenish clay. These beds dip north at a very low angle. Some very large blocks were removed from this shaft. One of these, which, according to Mr. Barton, originally weighed about six tons, consists of Carboniferous limestone breccia, with barytes, quartz and calcite filling up the space between the fragments. Another, the weight of which was about the same, is an enormous geode, now broken into six pieces. The wall of the geode is formed of red sandy limestone; this is lined by a layer of impure quartz, and then comes a layer of big calcite crystals projecting into the cavity.

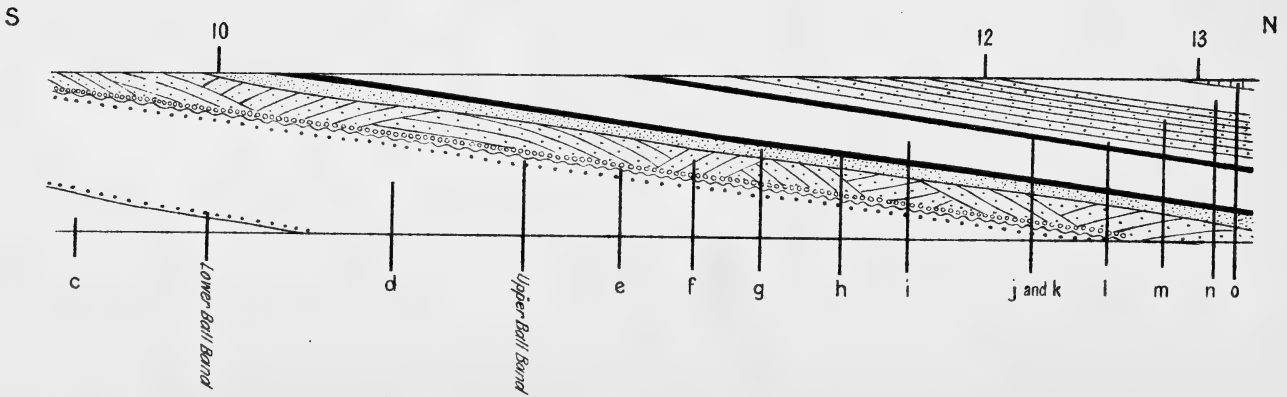
The red marls seen in the previous excavation can also be detected in the next (9), now partially occupied by a little pond, lying in the north-west corner of the field. Resting on them are about six feet of yellowish clay (bed *d*) which is used as fuller's earth, and is the equivalent of the Tea-green marls of other localities. Along the bottom and also near the top of this clay occur bands of curious sub-spherical lumps of

SECTIONS THROUGH THE TRIASSIC DEPOSITS AT EMBOROUGH.

Horizontal Scale 20 yards = 1 inch. Vertical Scale 16 feet = 1 inch.
Dip of Trias exaggerated. – Lettering of Bands as in Text.



Section I to the West of the Works.



Section II to the East of the Works

Plate III.

calcareous matter. Mr. Barton terms them the "Ball Bands." The "Balls" may be as much as six inches in diameter, and are very hard. When broken, they are seen not to be concretions aggregated round a centre; but their mode of origin is by no means clear. Immediately above the lower "Ball Band" there occurs a peculiar bed about nine inches thick, which Mr. Barton calls the "rough bed." It consists of little irregular highly calcareous lumps, about one-sixth of an inch in diameter, embedded in marl. The top of the clay (fuller's earth) band shows an eroded surface, and on it rests an irregular band of false-bedded sandstone (bed *f*), with a thin basal layer of conglomerate (bed *e*) containing fish scales. This is the most northerly exposure seen to the west of the works.

(*b*) *Those to the east of the works.*

To the east of the works there occurs also a very interesting series of exposures. The most southerly of these (10) shows at the top:—

		ft.	*in.*	
Bed *f*.	False bedded sandstone	1	6	seen.
„ *e*.	Conglomerate with pebbles of quartz and chert and numerous fish teeth . .	0	5	and under.
„ *d*.	Yellowish clay (fuller's earth) with "ball bands" at top and bottom .	10	0	
„ *c*.	Red marls . . . . about	1	0	seen.
		12–13		feet.

The yellowish clay (fuller's earth) is several feet thicker than it is to the west of the sheds.

In the field to the north-east of the sheds there is a very interesting exposure (12) of the Black Shale series. The section shows at the top:—

		ft.	in.	
Bed *m*.	Hard grey sandstone, weathering soft and yellow, and containing *Cardium concinnum*, *Schizodus ewaldi*, *Avicula contorta*, *Pleuromya* sp., and scales of *Gyrolepis*	2	6	seen.
,, *l*.	Grey and pale shale	0	8	
,, *k*.	Band of fibrous carbonate of lime ("Beef")	0	½–1	
,, *j*.	Upper Bone Bed with *Acrodus minimus*, *Saurichthys acuminatus*, *Hybodus raricostatus* (spine), *Gyrolepis alberti* (scales), *Plesiosaurus costatus* (vertebral centrum and proximal end of femur)	0	2	and under.
,, *i*.	Black shale, used as fuller's earth .	3	6	
		6–7 feet.		

Mr. Barton says that below the Black Shale in this little excavation (12), the following beds were penetrated:—

		ft.	in.
Bed *h*.	Lower Bone Bed	0	6
,, *g*.	Sand . . . . . about	0	9
,, *f*.	Hard false-bedded sandstone . . .	2	0
,, *e*.	Conglomerate	0	3

The section just described with the Beef and Upper Bone Beds occurs on the west side of the little quarry (12). On the south side the Beef and Upper Bone Beds are not traceable, but are replaced by a band of sandstone.

In another excavation (11) east of the last, the sandstone (bed *m*) is seen forming the floor of the quarry, and above it are three feet of pale clay. At the present time nothing can be seen below the sandstone (bed *m*) owing to the lower part of the pit being full of water. Mr. Barton says that below it several feet of clay were penetrated, material which is now used for pot and brick making. The Beef and Upper Bone Beds are apparently not developed at this spot.

The lower and chief Bone Bed is not seen in any of the excavations which are at present open, but it was met in running a trench north from excavation No. 11. Many excellent blocks lie about on the bank by the trench. The bone bed here is a very interesting development and crowded with fossils. We have obtained from it *Acrodus minimus* (teeth very common), *Saurichthys acuminatus* (teeth very common), *Hybodus raricostatus* (teeth), *Sargodon tomicus* (teeth), *Sphærodus minimus* (teeth), *Gyrolepis alberti* (scales), *Plesiosaurus costatus* (vertebral centrum). We however found no trace of *Ceratodus*.

A small excavation (13) north of the last and close up against the hedge, shows about four feet of compact, mottled clay (bed *n*), and in the overlying surface soil are blocks of White Lias. The White Lias occurs *in situ* in the next field, a short distance beyond the hedge.

III. Table showing the Beds.

The whole Triassic series penetrated in these various excavations is as follows:—

			Max. Thickness. ft.	in.
Upper Rhætic, 7 ft. 11 in.	*o.*	White Lias.		
	n.	Compact pale or mottled clay . . .	3	0
	m.	Hard grey sandstone, with *Avicula contorta*, etc.	4	0
	l.	Grey and pale shale	0	8
	k.	"Beef" band	0	1
	j.	Upper Bone Bed.	0	2
Lower Rhætic, 7 ft. 2 in.	*i.*	Black shale	3	6
	h.	Lower Bone Bed	0	6
	g.	Sand	0	9
	f.	False-bedded sandstone	2	0
	e.	Conglomerate, with scales and teeth .	0	5

			ft.	in.
Keuper, about 31 ft.	*d.*	Yellowish clay used as fuller's earth (= Tea-green marls), with "Ball Bands" at top and bottom . . .	10	0
	c.	Red marl . . . . . about	3	0
	b.	Calcareous sandstone . . ,,	18	0
	a.	Dolomitic conglomerate . . ,,	12	0
		Total ,,	58	1

IV. Concluding Remarks.

This little irregular series of Triassic beds shows a number of points of interest. In the first place, the Rhætic series is very thin, only some 15 feet 1 inch being seen. At Aust the Rhætics are 34 feet thick, and at Penarth 42 feet. This small development, taken in conjunction with the irregular and patchy occurrence of the Keuper beds, may not improbably be due to the fact that the area in which they occur was at the time of their deposition in close proximity to the land surface of the Mendip Isle, which was not wholly submerged beneath the waters of the Mesozoic Sea until later Triassic times.

The occurrence of two well-marked Bone Beds and of a third layer (band *e*), which from the fact that it contains fish scales and teeth might be regarded as a Bone Bed, is noteworthy, as is the absence of the Cotham marble band.

As regards the Keuper series, its most marked feature is its pockety character, and great variability within a small area.

Another interesting feature is the variety of materials of economic value which the deposits yield. These include:—

a. Fuller's earth, both pale (9, 10) and dark (12).

b. Clay for brick and pottery making (5, 11, 13).

c. Red and yellow ochre (3, 5, 6).

d. Road metal (1, 3).

An analysis of the fuller's earth, from the Tea-green Marls

(band *d*) made by Mr. J. T. Norman for the proprietors, gave the following result:—

Insoluble silica	6·30
Soluble silica	44·00
Iron oxide	2·85
Alumina	32·75
Lime	4·50
Magnesia	1·10
SO_2, HCl, P_2O_3, alkalies and water	8·50
	100·00

Reports of Meetings.

GENERAL.

IN the thirty-sixth annual session—that for the year 1899—the usual number of general meetings was held, at seven of which papers were read, while the eighth was an exhibition meeting.

On January 26th Mr. L. N. Tyack read a paper upon "Evidences of Stellar Evolution." The paper was illustrated by lantern slides.

On February 16th the annual exhibition meeting was held. Objects were shown by Messrs. Brebner, Griffiths, Perry and Reynolds, and by Dr. Nicholson.

The subject for the March meeting, held on March 7th, was "The Races of Southern India," by Mr. S. H. Reynolds. The lecture was illustrated by a number of lantern slides.

On April 6th the subject of the meeting was "The Song of Birds," by Messrs. A. L. Fleming and H. C. Playne.

On May 4th Prof. C. Lloyd Morgan gave an address on "Some Features of Geological Interest in the Neighbourhood of Bristol." The address was illustrated by lantern slides.

On October 5th Mr. L. N. Tyack gave a lantern lecture on "Astronomical Photography."

On November 2nd Mr. S. H. Reynolds gave a lantern lecture entitled "A Journey down the South-west Coast of India."

On December 7th the Rev. H. H. Winwood read a paper on "The Gravels of the Avon and their Contents."

S. H. REYNOLDS, Hon. Sec.

BOTANICAL SECTION.

LOCAL field-botanists have been well repaid for their efforts during the year 1899. Several flowering plants new to the district, and some additional localities for rare species, have been discovered. Among the latter a small patch of *Cerastium arvense*, found by Miss Roper near Portbury; *Carex axillaris* and *Scirpus Tabernæmontani*, both on Ken Moor; and *Carex Hornschuchiana* on Clapton Moor, as well as in Max Bog, are the most remarkable. Three new and well-marked Rubi have been added to our list; and a bladder-wort (*U. intermedia*) not previously found in the county of Somerset has been identified from foliage-specimens taken from a peaty ditch near Weston-in-Gordano in 1894. *Scilla autumnalis*, on St. Vincent's Rocks, flowered more freely than is usual.

JAS. W. WHITE, Hon. Sec.

ENTOMOLOGICAL SECTION.

FIVE meetings have been held during 1899, but no excursions. The following details give some particulars of papers and exhibits brought before the section.

January 9th. Mr. Griffiths read a letter from Mr. Reid, giving an account of collecting in Rannock, Forres, N. Argyle,

Perth, Shetlands, Pitcaple and other parts of Scotland. The life histories of *Sesia scoliæformis*, *Emmelesia albulata*, and *Pachnobia alpina* being described. Mr. Watkins, of Painswick, sent a photograph of the lining of the stomach of a cuckoo, showing two smooth patches of hairs of the larvæ of the moth *Arctia caja*, arranged in a circle through the motion of the contents of the stomach.

March 14*th*. Mr. Watkins sent for exhibition the following photographs:—Head of the larva of the horse bot-fly, *Gastrophilus equi*; spinnerets of the garden spider, *Epeira diadema*; legs and suckers of *Dytiscus marginalis*.

Mr. Griffiths exhibited three named varieties of *Vanessa cardui*, viz.:—*V. cardui*, from Queensland; *V. caryæ*, from Vancouver; and *V. Kershawii*, from Queensland; also a collection of Lepidoptera taken along the route of the Canadian and Pacific Railway during the visit of the British Association in 1897.

April 11*th*. Mr. Griffiths exhibited a large number of Lepidoptera, including the genera, *Danais*, *Papilio* (including *P. antenor*), *Satyrus*, *Morpho*, *Brassolis*, *Caligo*, *Dynastor* (including the rare *D. Napoleon*), *Parnassius*, etc., also a drawer illustrating mimicry amongst the Lepidoptera.

November 14*th*. A paper was read from Mr. Watkins on "Lepidoptera in the Painswick District, 1899," which recorded specimens of *Lycæna arion*. Mr. Charbonnier exhibited ova of *Acherontia atropos*, and a collection of butterflies from Uganda. Mr. Griffiths showed a large number of Lepidoptera, principally *Heliconiidæ*.

December 13*th*. Mr. Charbonnier exhibited photographs from Mr. Watkins of specimens of *Ixodes reduvius*, a tick found on many species of animals, the figures representing different stages of development. Mr. Charbonnier explained the peculiar method of fertilization and oviposition followed

by this species, and compared it with that of the tarantula (*Mygale*), a dried specimen of which was shown.

Mr. Charbonnier also exhibited collections of Hymenoptera and Diptera, and recorded fifty-five species of Diptera, thirty-five Aculeate Hymenoptera, and four Chrysidæ, as occurring in his garden, some uncommon species being represented.

CHARLES BARTLETT, Hon. Sec.

GEOLOGICAL SECTION.

DURING the year three meetings were held. On February 9th the Rev. G. H. Whidborne read a paper on "Palæozoic Corals," referring more particularly to those Devonian corals which he has himself studied for some time past. Numerous specimens illustrated the paper.

On March 24th Mr. S. H. Reynolds gave an account of the geology of the Canadian-Pacific Railway route, and there was an exhibit of rock specimens and geological photographs obtained in the Rocky Mountain region.

On October 19th an exhibition meeting was held at University College. Prof. Lloyd Morgan showed bones and other finds from the cave-earth deposit at Uphill; Mr. Reynolds exhibited lantern slides illustrative of the volcanic region of Auvergne; and amongst other exhibitors were Miss MacIver, Messrs. Baker, Perry, Jecks, Marshall and Richardson. The attendance was meagre.

The Section has a balance in hand, and continues to buy the Palæontographical Society's publications and the *Geological Magazine*. These are presented to the parent society. The number of members is twenty-four.

H. PENTECOST, Hon. Sec.

PHYSICAL AND CHEMICAL SECTION.

THE Physical and Chemical Section did not meet during the year. Two meetings were arranged, but had, from unavoidable causes, to be abandoned.

L. N. TYACK, Hon. Sec.

ORNITHOLOGICAL SECTION.

OWING to lack of material and some misunderstandings with regard to dates, only one general meeting of the Section was held.

On this occasion Dr. Rudge exhibited many specimens of tracheæ of the Anatidæ, and introduced a discussion on the part played by the various organs connected with them in the economy of each species.

At other meetings progress was made with the preparation of the Local List of Birds.

The membership of the Section is small, and very few members regularly attend the meetings.

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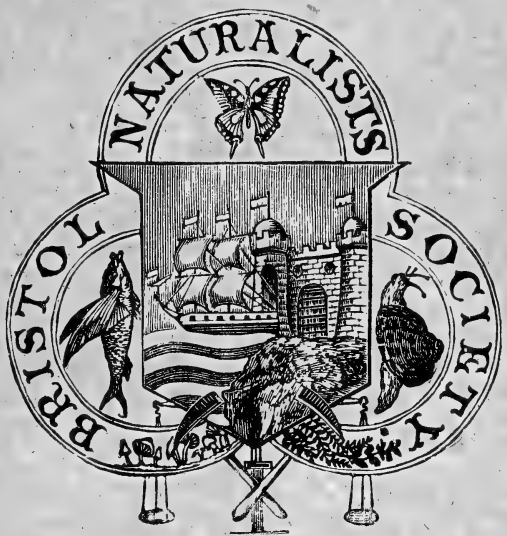

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Bristol Field-botany in 1901.

By JAMES W. WHITE, F.L.S.

TWENTY years have gone by since the local "Flora of the Bristol Coal-fields" began to appear in these Transactions. The publication was completed in annual instalments spread over a lengthened period; the later portions naturally containing more information than the earlier ones. However imperfect this work may have been, it was in the main accurate, and has probably proved serviceable to many botanical students.

During these intervening years much field-work has been done in the district, a consideralbe number of additional species and varieties have been discovered, some obscurities in old records have been made clear, misconceptions in nomenclature have been corrected, and great general progress made in tracing the distribution of flowering plants around our city.

Although a good deal of this recently acquired knowledge has been made known in supplementary additions to the book, in the Reports of the Society's Botanical Section, and in "Notes on Bristol Plants," Published in the *Journal of Botany*, it is thought advisable to give the members a more

detailed and connected account of what has been accomplished, especially as the issue of a second edition of the *Flora* may unavoidably be deferred for a considerable time.

RANUNCULACEÆ.

Thalictrum. There is scarcely any doubt that the several forms of *T. minus* L. found in Cheddar Gorge abundantly, and very sparingly at Clifton, and to which at various times the names of *montanum*, *flexuosum*, *Kochii* and *saxatilis* have been given, are really one segregate, for which *T. collinum* Wallr. is the oldest and most fitting name. Individual specimens often differ much in appearance, but these variations probably depend on situation and the influence of surrounding conditions. Two plants only are known to exist at Clifton. I saw them in 1884, 1897, and again in May, 1901. They were not flowering on the last two occasions. The common Meadow-Rue of the district is *T. sphærocarpum* Lej., but a second variety with narrow fruit (*T. riparium* Jord.) is now known to grow on the peat-moor at Burtle and Edington.

Ranunculus. The study of our Water Crowfoots (Batrachia) —so plentiful in ditches draining the lowlands adjacent to the Severn Sea—has been carried much farther, but it is still difficult to determine some plants of this group with certainty. To me the most troublesome problem is to find characters by which to separate *floribundus* from *heterophyllus*. At present I meet with plants that can be referred to either with equal hesitation. However, as a general rule, these aquatics, if in good condition, can readily be assigned to their respective places. *R. tricophyllus* is frequent and well marked, and the same may be said of *R. Drouetii*, though it is not so common. Good examples of the latter can always be found in ditches between Shirehampton and Avonmouth. A form of *heterophyllus* with floating leaves coriaceous in texture, hairy beneath, and divided deeply into straight-sided wedge-shaped seg-

ments that are often themselves stalked, and sometimes merge gradually into capillary divisions like those of submerged leaves, is my idea of *R. radians* Rev. derived from a French description. This form is frequent on Ken Moor, and below Nailsea.

I have gathered *triphyllus* Hiern. and *submersus* Hiern. near the Channel, towards Portishead ; the latter grows also on Ken Moor and near Avonmouth. *R. Baudotii* is abundant in brackish water, and unmistakable. *R. peltatus* (the type with large sweet scented flowers on long peduncles) shows a curious preference for high ground. I have it from a pond on Mendip, near the " Castle of Comfort," and from two pools at the elevation of 600–650 feet south of Barrow Hill, S. *R. circinatus* is locally plentiful. It is a most satisfactory species with no variations.

Two interesting plants of this order (*Ranunculus hirsutus* and *Myosurus minimus*) have not been seen in the district of late years. It is very desirable that they be rediscovered.

PAPAVERACEÆ.

Papaver Argemone has been gathered in several places in both counties since the publication of the *Flora*. No confirmation, however, of the occurrence of *P. hybridum* in our area can be obtained. It seems to grow only on the west of the Parrett in the vicinity of Bridgwater, Kilve, etc. It is a misfortune that Rev. J. C. Collins, who reported this plant (and *P. somniferum* also) from Burnham, left no specimens, and in their absence some records of this botanist that have never been confirmed must be regarded with great doubt. In July, 1899, *P. somniferum* appeared abundantly in a cultivated field above Wotton-under-Edge, G. *P. Lecoqii* proves to be less rare than was at one time expected. It is always frequent on cultivated ground about Stockwood and Whitchurch, and has been seen on Lansdown, at Uphill, etc.

FUMARIACEÆ.

The little patch of *Corydalis claviculata* first recorded in 1835 from the edge of a thicket on St. Stephen's Hill, has from some unknown cause gradually diminished until it seems to have disappeared. A new locality for the plant is much wanted. Two new species of *Fumaria* have been observed: *F. pallidiflora* near Axbridge, and *F. densiflora* at Wells; both in small quantity.

CRUCIFERÆ.

Cardamine impatiens L. The following additional localities are known: Border of a wood near Tortworth; on the pennant at Crew's Hole, 1885; valley in Leigh Wood, 1899, 1900; debris at the base of rocks near Cheddar in two spots, 1884-98.

Lepidium Smithii Hook. A few plants were found at Uphill by Mr. Harold Thompson, in 1888, and two on a wall near Portishead Church, 1889, by Mr. J. F. Hopkins.

Draba muralis grows abundantly in East Somerset at Mells, Chelwood, Stone Easton, and Horrington. Alien plants of this order that have been found in the district are *Sisymbrium pannonicum*, Jacq., *Erysimum repandum* L., *E. perfoliatum* Crantz., and *Bunias orientalis* L.

CISTACÆ.

Helianthemum polifolium Mill. As recorded in the *Journal of Botany*, October, 1888, this extremely rare plant was found, growing plentifully on Purn Hill, Bleadon, by Mr. David Fry. Its occurrence there, about two miles S.E. of Brean Down marks an important extension of the previously ascertained range of this species in N. Somerset.

VIOLACEÆ.

That our knowledge of local violets has advanced so far during the last few years is mainly due to the initiative of Mrs. Gregory, who has very critically studied the plants of the neighbourhood of Weston-super-Mare. She was the first to recognize the *odorata* × *hirta* hybrids (*V. permixta* Jord.) in the Worlebury Wood, and to point to the presence of *V. calcarea* Bab. on the limestone hills of N. Somerset. The latter fact is especially interesting because the plant can no longer be found at the original station near Cambridge. The characters of this variety are well marked and permanent in cultivation, separating it distinctly from small states of *V. hirta*. Mrs. Gregory also detected the *rosea* form of this species, and the form *villosa* of *V. Riviniana*. The latter, however, is a very slight variation, and becomes glabrous in cultivation. A very beautiful violet is the form *lactiflora* of *V. hirta*, which grows in plenty on high ground between Brockley and Goblin Combes and on Cadbury Camp. Its flowers are large and almost pure white. The *permixta* hybrid first mentioned is well distributed in the districts on limestone. In some of the plants the *odorata* element preponderates, while others are nearer *hirta*.

CARYOPHYLLACEÆ.

Dianthus Armeria occurs rarely and as a rule in very small quantity. A few plants have been found near Congresbury, at Clevedon, Bourton and Brockley. Quite recently Mr. A. E. B. Gregory came upon a large colony of this pink at Cadbury Camp. *D. prolifer* grew sparingly at "Holly Gess," near Kingswood, 1883 to 1888, but then disappeared. *D. deltoides* was discovered (1886) by Mr. D. Fry, in a pasture between Keynsham and Brislington, whence no doubt the specimen in Herb. Jenyns (1867) was obtained, and probably

also Dr. Thwaites' record for N. Somerset in Topographical Botany. *D. cæsius* is not quite confined to Cheddar Cliffs. I have seen it on rocks two miles from the Gorge, and Mr. Read tells me that a small patch exists in Brockley Combe, where I hardly think it can be native.

Sagina ciliata proves to be well distributed. I have seen it on the Downs between Pembroke Road and Sea Walls, on Brandon Hill, Rodway Hill, Siston Common, near Keynsham, on Mendip above Ebbor, and on Brean Down in plenty. *S. maritima* was abundant by the Avon at Lamplighters in 1894 and subsequently.

Arenaria tenuifolia is undoubtedly a Bristol plant. Besides Penpole Point, where it grows in quantity, this plant has several localities on and about the local railways for which it shows a peculiar liking. *A. leptocladus* Guss. may not be a distinct species as is sometimes contended, but its slender habit and flexible capsules enable one to easily separate it from *A. sphærocarpa*, than which it is often more abundant.

Cerastium arvense. New to the district. Discovered in 1894 by Mrs. Gregory on a hillside above Loxton, and near Portbury in 1900, by Miss Ida Roper. *C. pumilum* is now known to be frequent on limestone hills at Clevedon, Worle, Cheddar and elsewhere. *C. quaternellum* (*Moenchia*) has been found abundantly in Dr. Stephen's old locality near Keynsham, but cannot be rediscovered at Brandon Hill.

Lepigonum rubrum exists on Brandon Hill, Troopers' Hill, and by the side of the high road at Bitton. Plants answering to *L. salinum* Fries, and to *L. neglectum* Kindb. have been gathered on the sea-banks and shore of the Channel at Avonmouth, Clevedon and Burnham.

Scleranthus annuus. Plentiful in a rough pasture on pennant, N.W. of Keynsham. In the Bristol district this is one of the rarest of the Caryophyllaceæ. Alien plants of this order that occur in the district are *Saponaria Vaccaria* L., *Silene noctiflora* L., and *S. dichotoma* Ehrh.

HYPERICACEÆ.

Hypericum elodes was unknown to us until reported by Mr. Withers in 1892 from a boggy spot near Mangotsfield. It is remarkable that this species had not been recorded previously for any locality in the county of Gloucester.

LINACEÆ.

Linum angustifolium grows on the coast between Portishead and Clevedon, and by the roadside near Publow.

LEGUMINOSÆ.

Melilotus arvensis and *M. indica* are neither of them native British plants, but of late they have occurred about Bristol in fair quantity. The former has been seen at Clevedon, Saltford, Filton, and by the railways at Avonmouth, Portishead, and St. Philip's Marsh. The latter grew in a cultivated field at Newton St. Loe, 1893–1900, and also more recently on waste ground at Portishead and St. Philip's Marsh.

Trigonella purpurascens (*Falcatula*). The two old records for Lamplighters and St. Vincent's Rocks have both been confirmed; and, in addition the plant is found on Brandon Hill and Siston Common.

Vicia gracilis Lois. At the time when our Leguminosæ were published, the only record which connected this vetch with the Bristol district was the mention by Babington (*Suppl. Fl. Bathon.* 1839, p. 74): "*Ervum gracile.* On Barrow Hill," and this did not seem sufficient ground for its being included. However, in 1886, Mr. David Fry rediscovered this rare species at Barrow Hill, near Twerton; and not long afterwards it was found by him also at Ursleigh Hill, and by Mr. Burr, near Midford. *V. bithynica* is still to be found about Stockwood, and on the hillsides near Pensford (*Fl.* p. 70). Some interest attaches to these localities on account of *Lathyrus*

hirsutus having been thence erroneously recorded in the third edition of Withering's *British Plants*, published 1796, on the authority of Swayne, who mistook *V. bithynica* for *L. hirsutus*, a species which has only been found in Essex and Surrey. This error, repeated by Babington (*Suppl. Fl. Bathon.* 1839), on the authority of T. B. Flower, who is stated to have rediscovered *L. hirsutus* in 1838 at both the localities near Pensford referred to by Swayne, has been widely disseminated, not only in local Floras, but also in works of more general importance, as Bentham's *Handbook of the British Flora*, where *L. hirsutus* is cited as a Somerset plant. We have only one locality for *V. bithynica* in Gloucestershire, viz., by the roadside between Winterbourne and Patchway, where it was noticed by Mr. Bucknall.

Lathyrus Aphaca is permanent on hedgebanks near Uphill, and *L. palustris* on the peat-moor near Edington, at the southern limit of the district.

Aliens sometimes met with are *Medicago falcata*, *Coronilla varia*, *Vicia lutea*, *V. hybrida*, and *Lathyrus tuberosus*.

ROSACEÆ.

Prunus domestica. This rather unsatisfactory species appears to be a little "wilder" than is sometimes judged. A large number of trees of various sizes grow along the Channel shore on a low cliff between Woodhill Bay and the Black Nore, and more of them form a loose hedge at the Nore. There are likewise plum-trees in the ancient hedges on lias above Corston. If these be all cultivated plums that have escaped, it is hardly credible that they should be always of the same variety, or that different varieties should have everywhere run down exactly to the *P. domestica* of the books. We may at any rate conclude that the trees of our district, growing in several places with as much semblance of being truly wild as the vegetation with which they are associated, may quite correctly

be named *P. domestica*, and I doubt if anything nearer than segregate is to be met with elsewhere.

Rubus. A good deal of interest attaches to the Bristol brambles. The number of recognized forms has greatly increased. Some of them are widely distributed, others are locally plentiful, and a few occur very sparingly. One plant from the vicinity of Wotton-under-Edge has been described and named as a new species (*R. Bucknalli*), and this has since been found in Herefordshire. Perhaps no family of plants is more clearly influenced by the geological nature of soil. But it may be sufficient for the purpose of this paper to give merely a complete list of the local species arranged in natural order according to the latest view. *R. idæus* L., *R. fissus* Lindl., *R. sulcatus* Vest., *R. plicatus* W. & N., *R. nitidus* W. & N., *R. opacus* Focke, *R. affinis* W. & N., *R. imbricatus* Hort., *R. carpinifolius* W. & N., *R. Lindleianus* Lees, *R. erythrinus* Genev., *R. rhamnifolius* W. & N., *R. dumnoniensis* Bab., *R. pulcherrimus* Neum., *R. villicaulis* Koehl., *R. rhombifolius* Weihe, *R. thyrsoideus* Wimm., *R. argentatus* P. J. M., *R. rusticanus* Merc., *R. pubescens* Weihe, *R. macrophyllus* W. & N., *R. micans* Gren. and Godr., *R. pyramidalis* Kalt., *R. leucostachys* Schl., *R. mucronatus* Blox., *R. anglosaxonicus* Gelert, *R. raduloides* Rogers, *R. Borreri* Bell Salt., *R. Drejeri* G. Jensen, *R. Leyanus* Rogers, *R. echinatus* Lindl., *R. rudis* W. & N., *R. Babingtonii* Bell Salt., *R. fuscus* W. & N., *R. pallidus* W. & N., *R. scaber* W. & N., *R. hystrix* W. & N., *R. infecundus* Rogers, *R. adornatus* P. J. M., *R. Koehleri* W. & N., *R. dasyphyllus* Rogers, *R. viridis* Kalt., *R. Kaltenbachii* Metsch., *R. diversifolius* Lindl., *R. tuberculatus* Bab., *R. corylifolius* Sm., *R. Bucknalli* J. W. White, *R. cæsius* L., *R. saxatilis* L. We have also the following hybrids: *rhamnifolius* × *Lindleianus*, *leucostachys* × *rusticanus*, *rudis* × *Lindleianus*, *corylifolius* × *rusticanus*, *cæsius* × *rusticanus*, *cæsius* × *corylifolius*.

Rosa. It appears that the sea has receded in Kewstoke

Bay, and that the old coastline of sand-hills has been enclosed for many years. In this way *R. spinosissima* became screened from observation, but a good deal of it is still there, along a line of—say—400 yards. Mrs. Gregory finds this rose near the Town Quarry, and in one or two other spots at that side of the wood at Weston-super-Mare, thus confirming Dr. Stephen's old record. Respecting the var. *Briggsii* of *R. micrantha*, from St. Thomas' Head, there is an interesting note by M. François Crépin in *Journal of Botany*, 1897, p. 216, from which it appears certain that, although Mr. Briggs himself repeatedly named the Somerset plant *R. Briggsii*, the rose is really *R. sepium* Thuill (*inodora* Fr.). The var. *Briggsii* appears to be of extreme rarity. It is characterized by its pedicels, receptacles and backs of the sepals being completely eglandular. Plymouth remains the only British station for the true plant. Additional varieties of *R. canina* that have been noted in the district are *frondosa, decipiens, cæsia, andegavensis, dumetorum* and *vinacea.*

ONAGRACEÆ.

Epilobium Lamyi F. Schultz was first recognized in the district by Mr. D. Fry, at Corston and Hanham, in 1890. It was afterwards found on colliery waste near Kingswood, and at Fox Wood Quarries. Specimens from all these localities agree well with those gathered by Wirtgen. The area of *E. lanceolatum*, one of the rarest British species, has been lately extended into Somersetshire by its discovery at Brislington, Keynsham, Abbotsleigh, and Hallatrow; but the plant does not appear to be known anywhere else in the county. Nearly all the species of this genus hybridize very freely, with the result as regards Bristol that we have become acquainted with several crosses: *hirsutum* × *montanum*, *obscurum* × *montanum*, *Lamyi* × *montanum*, *Lamyi* × *lanceolatum*, and *tetragonum* × *obscurum*. It has been dogmatically asserted

that Epilobium hybrids do not and "cannot" produce fertile seeds. The negation however has been plentifully disproved. As in Viola and Rumex, so in Epilobium, although only a very small proportion of the seeds from hybrids is good, yet seedlings are often found, and have been raised in the second generation.

UMBELLIFERÆ.

Eryngium campestre still exists at Weston-super-Mare, on a hillside above the town, but latterly has not flowered. This is certainly not the spot where the plant was discovered in 1843 by the late Mr. G. S. Gibson (*Phytol.* i. 757). That has no doubt been built over.

Cicuta virosa. The late Mr. T. B. Flower showed me several specimens of Cicuta gathered on Burtle Moor, July, 1859, and told me further that he had a memo. of having seen the plant in a canal near Highbridge at a later date, when he did not gather any. In July, 1888, Mr. Harold Thompson also found some in a peat-ditch near Shapwick Station.

Oenanthe pimpinelloides L. has been observed in two or three adjoining meadows between Keynsham and Compton Dando. This is much nearer Bristol than the previously recorded stations. *Oe. fluviatilis* Coleman is an addition to the *Flora.* It is abundant in the canal between Midford and Combe Hay. I fear that *Oe. silaifolia* Bieb. must be struck out of the list. The Yatton specimen proves to be only *Silaus*, while some doubt attaches to the Gloucestershire records, which have not been confirmed.

Leycesteria formosa, a Himalayan species, grows in the middle of a large wood at Shutshelve, near Axbridge, where it has been an object of interest to gamekeepers and others for many years. Its origin is unknown; but when I record that a fair-sized cactus was, in June last, discovered flourishing in the cleft of a rock on Callow Hill, Mendip, one should cease to feel surprise at the occurrence in the district of alien plants

from far off lands. With regard to the cactus, the only probable explanation of its presence is that it was intentionally planted.

RUBIACEÆ.

Galium erectum Huds. Good botanists, to whom I referred specimens, are agreed that a plant gathered on Breakheart Hill, near Dursley, is this species, new to the local list, and we agree also that there is much difficulty in separating it specifically from *G. Mollugo*.

VALERIANACEÆ.

Valeriana Mikanii Syme, which in the *Flora* was not noted as a distinct form, has been identified at Bath, Portishead, Cheddar, Mells, Wotton-under-Edge, and Dursley.

Valerianella Auricula DC. as I ventured to anticipate it would be, was rediscovered by Mr. David Fry, in arable fields between Keynsham and Stockwood. *V. carinata* Lois, a rarity seldom met with in the western counties, is an important addition to the list. Discovered by Rev. W. O. Wait in 1887 (*Fl. Somerset*, p. 180), it is reported to grow plentifully on one part of Hampton Down, Bath : and to have the appearance of a native.

COMPOSITÆ.

Filago minima Fr. The old records for Hanham, G., and Brean Down, S., by Stephens and St. Brody respectively, have been confirmed, and I have gathered the plant on pennant between Keynsham and Brislington.

Gnaphalium sylvaticum grows not only on Downhead Common, N. of Cranmore Tower, but also near Clevedon (*S. T. Dunn*), in a wood near Weston-in-Gordano, and in Lord's Wood, Houndstreet (*Rev. W. S. Browne*).

Antennaria dioica. St. Brody's record of this plant is correct. It occurs in very small quantity, and is difficult to find, but Mrs. Gregory has seen it twice on Brean Down, and she discovered some also on Worle Hill, Weston-super-Mare, whence I had from her a specimen.

Carduus arvensis Curt. var. B. *setosus* (*Suppl. Notes*, 1886). This distinct-looking variety which has been known many years on the right bank of the Avon, below Bath, is now determined to be *Cirsium arvense* Scop. var. *obtusilobum*, f. *subincanum* G. Beck, *Fl.* N.Ö. p. 1239, Koch, *Syn.* ed. iii. p. 1553 (*Journ. Bot.* 1901, p. 91). We have gathered on dust-heaps on the other side of the river a form with leaves glabrous beneath, which is the f. *subviride* G. Beck.

Crepis biennis, first observed in the district by Rev. R. P. Murray, appears to be spreading at his locality, where I now find it in three fields. Mrs. Gregory has it also at Weston-super-Mare and at Winscombe. *C. nicæensis* was noted too near Axbridge by Mr. Murray. A specimen of *C. fœtida* in the Jenyns herbarium is labelled "Bathampton, July 9, 1867; *C. E. Broome*."

Hieracium. The aspect of this genus has been entirely altered of late years by the critical industry of our leading botanists, who have differentiated and defined many new forms, and in doing so have necessarily subdivided and split up the old groups. For example, the Cheddar "*murorum*" certainly comprised three distinct plants, now known as *H. Schmidtii* Tausch., *H. stenolepis* Lindeb., and *H. Lima* F. J. Hanbury. The hawkweed abundant on limestone about Clifton and Bristol, and formerly named *vulgatum*, is not that type, but is determined to be *H. sciaphilum* Uechtr. The "*H. gothicum*" on Ebbor rocks gathered by Professor Babington in 1851 (*Flora of Somerset*, p. 209), is considered, on examination of fresh specimens, to belong to *H. rigidum* var. *pullatum*. Mr. Bucknall has found the same form on Churchill Batch. In *Journ. Bot.* 1899, p. 418, we referred

to the occurrence of *H. murorum* var. *pellucidum* on oolitic hills above Wotton-under-Edge and Dursley, where type *vulgatum* is also plentiful. And Mr. Hanbury, in his *Monograph of the British Hieracia*, notes the presence of *H. amplexicaule* (not a native) on an old garden wall in Clifton, where it still exists.

Alien Compositæ that have occurred on waste ground, rubbish, etc., are: *Antennaria margaritacea*, *Xanthium spinosum*, *Cacalia hastata*, *Lactuca saligna*, *Artemisia pontica*, *Ambrosia artemisiæfolia*, *Schuria abrotanoides*, *Eucelia mexicana*.

(*Wahlenbergia hederacea* grows on the peat moor near Shapwick Station, but scarcely within the area of Sanders' Map.)

ERICACEÆ.

Pyrola minor was discovered in N. Somerset by Mr. R. Baker in 1883. He and I then traced it about 100 yards in a wood near Abbotsleigh where the underwood had recently been cut. It was not until July 1898, that I saw this plant in Gloucestershire. After a steady hunt about Woodmancote at Dursley, Mr. D. Fry and I found plenty of it on the lower slopes of a wood, occurring here and there for about a mile. We did not find *P. media*.

Vaccinium Oxycoccus L. (*Oxycoccus palustris* Pers., *Schollera Oxycoccus* Roth.). Formerly known on Burtle and Shapwick turf-moors, and stated to have been gathered on Blackdown, Mendip, in August 1860. The Cranberry appeared to be lost to us until June 1896, when Mr. W. F. Miller sent me a specimen gathered by him amongst Sphagnum on the side of Blackdown (*Journ. Bot.*, 1896, p. 319).

GENTIANACEÆ.

Gentiana Amarella L. Mrs. Gregory has found on Brean Down specimens that have been referred by Mr. A. Bennett

to the var. *uliginosa* Willd., and to the sub-species *axillaris* Murbeck.

Menyanthes trifoliata is abundant in a large pond "Wurple Pool," on high ground between Barrow Gourney and Brockley Combe, where it was shown to me by Mr. E. H. Read.

CONVOLVULACEÆ.

Cuscuta europæa occurs at intervals on both banks of the river Avon from Bathford nearly down to Bristol, growing upon a large number of herbaceous species. In 1893 it was reported by Mr. Withers in unusual abundance under Fox's Woods, Brislington, even getting up into the willow trees and hanging in tresses from their branches. In August 1888, I found a large patch of *C. Epithymum* on *Galium verum*, etc., near the lighthouses at Burnham, and at Steart. In 1893 this dodder was pointed out by Mr. Withers on the G.W.R. embankment at Newton St. Loe, abundant on several species of Umbelliferæ and Compositæ. *C. Trifolii* also must take a place in our list. Besides its occurrence at Pill (*Flora*, p. 121, under *C. europæa*), three or four patches were found by the Misses Cundall between Abbotsleigh and Failand, 1897–1898, and I met with it near Charfield, August 1900.

BORAGINACEÆ.

Asperugo procumbens L. is rightly considered by Rev. R. P. Murray (*Flora, Somerset*, p. 233) to be too persistent near Bath to be placed among the excluded species. It was noted in the cornfields there a century ago (*Bot. Guide*, 1805), and a very reliable observer, Mr. Withers, found it plentiful in arable ground near Twerton, in 1892. The same botanist has noticed the plant for several seasons at Fox's Wood Sidings, G.W.R., where it was probably derived from waggon sweepings.

Symphytum tuberosum, a northern species, has been intro-

duced since the publication of the *Flora*. It is well established, in great quantity, on a railway embankment near Montpellier Station, and there are several patches in the damp wood between Stoke Bishop and Sea Mills. *S. asperrimum*, at Brass Knocker Hill and St. Catherine's, by Bath, is a settler of greater age, a specimen in the Jenyns Herbarium being labelled: "June 10, 1853." Other instances of undoubted aliens assuming the habit of native plants when circumstances are favourable are furnished by *Omphalodes verna* Moench, of which there is a large quantity in a steep stony wood by the Avon, near Hanham, where it has been known many years; and by *Pulmonaria officinalis* L., which has escaped into Berwick Wood from an adjacent garden.

SCROPHULARIACEÆ.

Euphrasia. By the aid of Mr. F. Townsend's *Monograph*, and with some kind help from the author himself, the following plants of this genus have been identified in our district: *E. brevipila* Burn. & Grml., *E. borealis* Towns., *E. curta* Fr. var. *glabrescens* Wettst., *E. Kerneri* Wettst., *E. Kerneri* × *Rostkoviana*, *E. Levieri* Wettst., *E. nemorosa* H. Mart., *E. Rostkoviana* Hayne., *E. stricta* Host. These forms are, of course, all included in the old aggregate *E. officinalis* L.

LABIATÆ.

Mentha. Recent field-work has shown that the Mints are at least as well represented in the vicinity of Bristol, as in other parts of Britain. I have seen *M. sylvestris* by the Avon near Hanham, and very abundantly in the Chew valley at intervals along the river's course between Stanton Drew and Chewton Keynsham. *M. Piperita* grows by the Chew at Compton Dando, and has been observed also at Clevedon, Worle Hill, and Woollard. The Clevedon plant was *vulgaris* Sole, a rare and interesting variety, and its loss owing to alterations

in the ground connected with local improvements is to be regretted. *M. viridis*, wherever met with in the W. of England, must, I suppose, be always an escape from cultivation. It has been seen by the roadside between Warmley and Wyck, at Conham, and at South Stoke. *M. rubra*, on the contrary, I am more than ever inclined to regard as a native in our district. I have never seen it in gardens, nor heard of its being cultivated. This handsome mint we have in many places: Nibley, Wotton-under-Edge, Black Mill at Bitton, Conham, Crew's Hole, by the Avon under Leigh Woods, Clevedon, Congresbury, Compton Dando, Litton, and in the green lane between Churchill Batch and Blackdown on Mendip. *M. gentilis* L. In a rough field near Corston, 1889, D. Fry. *M. sativa* L. var. *paludosa* Sole. Plentiful by the river Chew at Compton Dando, agreeing well with descriptions and figures by Sole and others.

Prunella vulgaris L. A white-flowered plant more hairy than usual, with narrow pinnatifid leaves, probably *Brunella alba*, Pall., has been noticed on the Mendips by Mrs. Gregory and myself.

Nepeta Glechoma Benth. Mr. David Fry finds at Corston the well-marked variety B. *parviflora* Benth. It differs from the type by its much smaller flowers, the tube of which only equals, instead of greatly exceeding, the calyx, by its smaller and more acute calyx-teeth and its subglabrous foliage, with more deeply incised teeth.

Lamium purpureum L. var. *decipiens* Sonder occurred in a lane at Hutton and at Tickenham.

Stachys alpina L. was discovered on the wooded hills between North Nibley and Wotton-under-Edge, in June 1897, by Mr. Cedric Bucknall. New to Great Britain. For a detailed description, and figure, refer to *Journ. of Bot.* 1897, p. 380, and 1898, p. 209.

Alien Labiatæ of which I have notes are: *Salvia verticillata*, *S. sylvestris* and *Stachys annua*.

LENTIBULARIACEÆ.

Pinguicula lusitanica and *P. vulgaris* have been long known on the southern peat-moors near Shapwick and Glastonbury, but probably not within our area.

Utricularia intermedia Hayne has been added to our *Flora* and to that of the county of Somerset by the discovery of foliage specimens in a peaty ditch on Clapton Moor (*Journ. of Bot.*, 1901, p. 92).

PLUMBAGINACEÆ.

Statice auriculæfolia Vahl. On Birnbeck Island, Weston-super-Mare, four or five large plants in July 1896.

(*Amaranthus retroflexus* and *A. deflexus* (Eastern food-grains) occur on waste ground and rubbish near the docks and railways.)

CHENOPODIACEÆ.

Chenopodium urbicum has been met with since 1890 at Bath, Corston, and Sneyd Park, and so establishes a claim to be numbered in the list. *C. opulifolium* was first noticed in the district in 1884, and since then has proved constant and plentiful on waste ground and dust-heaps between Bath and Bristol. *C. ficifolium* and *C. murale* too, are now known to be not quite so rare as they were formerly considered.

POLYGONACEÆ.

Rumex palustris Sm. In a former notice (*Journ. Bot.*, 1892, p. 13) Mr. Fry and I drew attention to the occurrence of this rare dock on the Somerset peat-moors, where it grows intermingled with *R. maritimus*, but flowers a month later. In former times it appears, from records of the late Mr. T.

Clark, to have been more abundant. *R. acutus* L. has been specially searched for, and proves to be well distributed in the district. In the experience of some botanists it ripens fruit very sparingly, but local observation with reference to this point bears out Prof. Babington's assertion that the nuts are produced in abundance.

Polygonum maritimum L. In addition to several other good finds for which we are indebted to him, Mr. Harold Thompson showed me, from Berrow sand-hills, a specimen of this very rare plant which has never before been observed in the county of Somerset. Braunton in North Devon is the nearest habitat for the species (*Journ. of Bot.*, 1889, p. 183).

EUPHORBIACEÆ.

Buxus sempervirens L. Abundant in woods about "The Warren," between Alderley and Wotton-under-Edge, where it is known to Sir J. D. Hooker, and is stated in the *Students' Flora* to be certainly indigenous. Further up the valley at Boxwell, outside the district, the box covers many acres and extends half a mile. The reasons for believing this shrub to be truly wild in the West Gloucestershire portion of the Bristol district have been fully stated by C. Bucknall in the *Journal of Botany*, 1901, p. 29.

AMENTIFERÆ.

Salix. The arrangement of Willows in the *Flora* would be revised in a new edition to accord with the results of later study and investigation.

ORCHIDACEÆ.

Orchis ustulata L. I am indebted to Mr. W. F. Miller for a specimen found by him on Wavering Down. The locality on Clavêrton Down has been visited by Mr. D. Fry, who saw

about twenty fine plants of this very beautiful species. Mr. Fry describes to me a plant from Pensford intermediate between *O. maculata* and *O. incarnata*, possessing the leaves of the former and approaching the latter in its hollow stem and flower-characters. This he suspected to be a hybrid, but finding that similar specimens grew on a moor near Tintern where *incarnata* is certainly absent, he thinks the plant in question must be regarded as a variety of *maculata*.

Epipactis. Our records of *E. latifolia* include plants which can well be assigned to *E. media* Bab., and have been so named by various authorities. This especially applies to those growing in woods near Houndstreet, Hallatrow, Clutton and Cheddar. At the same time the characters relied upon for separation of these obscure forms seem to be more or less inconstant, and in Britain at least the best botanists are often unable to form a decided opinion on specimens submitted to them.

AMARYLLIDACEÆ.

Galanthus. I have visited Edford several times, and have found the snowdrop to exist in far greater quantity than had been suspected. On April 2, 1888, the season being very backward, many plants were still in flower on the left bank of the stream, and they covered about an acre on the other bank within the wood. On March 8, 1900, these were all in perfection. I then traced the plant about a mile upstream, and was informed by a gamekeeper that it extended altogether about ten miles in that valley. In fact it does extend as far down as Mells and Great Elm. I have seen it also in profusion in the neighbouring Murdercombe.

LILIACEÆ.

Lilium Martagon. An alien. "During the last four years I have found one or more specimens in the wood at Bishops-

worth ; last year there were four in bloom." *J. F. Hopkins*, June 1888. Wood on Henbury Hill, 1900 ; reported by residents in that vicinity.

Fritillaria Meleagris is happily not extinct, as was feared ; and we have at least two new localities for it. In May 1887, Messrs. D. Fry and R. V. Sherring found in the meadows at Compton Martin twenty-one flowering stems, fourteen white, and seven red. Since that date plants with white and mottled flowers have been discovered on the Tyntesfield estate, five or six miles from Bristol ; and in May 1901, Miss Neale came upon some in a meadow near Chipping Sodbury.

Scilla autumnalis. In a " Note " published 1888 in these *Proceedings*, and in the *Journal of Botany*, January 1889, I was able to announce the rediscovery of this rare bulb on St. Vincent's rocks at a spot to which it had been removed on the commencement of works for the Suspension Bridge that threatened its destruction. It is now very gratifying to state further that the plant still exists sparingly in " the sward on the top of the rocks," just as noted by Swete (*Fl.* p. 78). I saw seven in 1898, and a larger number in 1900.

JUNCACEÆ.

Juncus maritimus Sm. It was not until September 15, 1897, that I found this rush in the district. Then, while botanizing among the sandhills between Brean and Burnham, I came upon a small clump in the outer marsh, and about half a mile further on was a patch of several square yards bearing very fine inflorescence. Its occurrence here is interesting because, although there are old records for several spots on the Somerset coast, none had been seen for many years, and the plant was thought to be probably extinct in the county. *J. compressus* Jacq. We now have this species from Bitton, *D. Fry*, 1886 ; from three meadows on the right bank of the Chew near Bye Mills ; and also from a meadow near the railway embankment in Keynsham Hams.

NAIADACEÆ.

Potamogeton Friesii Rupr. (*P. compressus* Sm., *P. mucronatus* Schrad. *Bab. Man.* ed. vii.). In the canal at Midford near Bath, June 28, 1901; *C. Bucknall.* This pondweed is recorded in *Fl. Somerset*, but was not published in our list. The *gramineus* of *Fl. Bathon.* was doubtless this species.

CYPERACEÆ.

Cyperus longus is, I fear, hopelessly lost from its West of England station in the Walton Valley near Clevedon. Two centuries ago the place seems to have been a fishpond. Later, it became a marsh; and in 1882 drainage had advanced sufficiently for the ground to be dug over and planted with potatoes. Even then the sedge continued to throw up stems on the ditchbanks and among the crop. In 1887 the spot had become still less marshy, a portion had been planted, and the remainder was overrun by cows and pigs. Notwithstanding the adverse human and bestial conditions many plants of Cyperus were in existence, but none seemed likely to flower. In 1893 the conditions remained the same, and at later visits in 1897 and 1900 the ground had been reduced to a mass of black mud by the trampling of animals, "main nasty," indeed, as the tenant said. No sign of Cyperus then.

As if in compensation for the loss of *C. longus*, a surprising discovery of the other British member of this genus (*C. fuscus*) was made last year by Mr. S. I. Coley, in the same valley about a mile from the place where *C. longus* formerly flourished. The circumstances are described fully in *Journ. Bot.*, 1900, p. 446, and 1901, p. 93. Nothing more unexpected could have happened in field-botany than this discovery of the second British Cyperus in North Somerset, a hundred miles or so from the nearest known station for the plant.

Schœnus nigricans had been regarded as a lost Somerset rarity, but was restored to the flora of the county by Mr.

W. F. Miller, who in July 1900, found a large tuft near Winscombe, where I afterwards saw it.

Rhynchospora fusca has been gathered on Burtle Moor as lately as July 1888, by Mr. Harold Thompson.

Eleocharis acicularis Sm. was unknown in this district or in Somersetshire until found by Mr. D. Fry at the edge of the canal at Bath, when the water had been lowered.

Scirpus pauciflorus Lightf. is an addition, now known in three localities : on Blackdown, Mendip ; the peat-moor ; and in damp sand at Berrow Marsh. *S. fluitans* L. also has three stations in the district : the peat-moor, ditches near Weston-in-Gordano, and a bog on Blackdown. *S. cernuus* Vahl. (*S. Savii* S. & M.) was added to our list in September 1900, from the peaty valley near Walton-in-Gordano, where it grows on the banks of several ditches. *S. Holoschœnus* L. The discovery of this great rarity in October 1896, on the shore of the Bristol Channel, by Mrs. Gregory, perhaps the most important addition to the flora of N. Somerset that has been made in our time, aroused much interest among botanists throughout the country. See *Journ. of Bot.*, 1897, p. 124. *S. Tabernæmontani* Gmel. has been seen so far in four moorland ditches near Nyeland and on Kenn Moor. These ditches are periodically cleaned out by the spade, and so this plant, with others, must then disappear for a while until it can re-establish itself from surviving portions of rootstock. *S. Caricis* Retz. was found in 1888 by Mrs. David Fry by a pond among the sandhills near Burnham, growing plentifully. It still occurs in abundance at the old Hampton Rocks station near Bath. These localities differ entirely in soil, aspect, and general climatic conditions, and the distribution of the plant in N. Somerset is certainly very remarkable.

Carex muricata L. var. *pseudo-divulsa* Syme = *C. Leersii* F. Schultz (*C. virens* Koch) is frequent about the wooded hills near Dursley and Wotton-under-Edge, and grows also at the base of a railway embankment under Sneyd Park. *C.*

axillaris Good. A large tuft of this sedge is known to me by the roadside half a mile north of Falfield, and I have found a good quantity on a ditchbank about a mile from Yatton. Mr. Bucknall also observed a little in Berrow Marsh, July 1896. *C. montana* L. was discovered near Charterhouse on Mendip by Rev. E. F. Linton, in July 1889. It extends about 150 yards along a hillside, the pale green foliage rendering it very conspicuous. Not more than a quarter of the plants were in flower in May 1897. *C. Hornschuchiana* Hoppe has been gathered on the moorland below Weston-in-Gordano, and in the peaty meadows near Winscombe. *C. eu-flava genuina* Syme is recorded from Failand, and from a bog under Lansdown, where the type and var. *elatior* Schlec. grow together. Plants from the following localities have been named var. *Œderi* Retz: the peat-moor near Shapwick Station, Walton-in-Gordano, and Weston-in-Gordano. *C. acuta* L. has been repeatedly identified in the district by Mr. David Fry, and the following records are chiefly his: Warleigh Ferry and Claverton Ferry near Bath, bank of Avon near the lock at Keynsham, withy-bed just above Saltford, the river bank at Hanham, and a boggy meadow by the Chew above Compton Dando. Mr. Harold Thompson gathered a sedge in Leigh Wood some years ago that has been determined by Mr. A. Bennett to be *C. depauperata* Good. The place and date were unfortunately not noted. *C. paludosa* Good. var. *subulata* Doell. = *C. spadicea* Roth, is very characteristic and typical in ditches between Cheddar and Nyeland, and in Max Bog.

GRAMINEÆ.

Alopecurus bulbosus occurs in North Somerset in pastures adjacent to the Channel shore between Avonmouth and Portishead. *Calamagrostis Epigeios* also proves to be more widely distributed in both Somerset and Gloucestershire.

Agrostis pumila has been detected on the Mendips near Cheddar. The Polypogons have both disappeared from the district as it was anticipated they must do sooner or later. *Molinia cœrulea.* This species has abounded at intervals during the last few years on both Clifton and Durdham Downs, where it was long since gathered by Dr. H. O. Stephens. It grows also in a swamp near Abbotsleigh. *Glyceria plicata* was not included in the *Flora,* but is now known to be frequent in the Chew valley, on Syston Common, and elsewhere. *G. pedicellata* Towns. which is very possibly a hybrid, with characters, however, much nearer those of *fluitans* than *plicata,* has been gathered at Abbotsleigh, Pensford, Newton Park, and Lawrence Weston. *Hordeum sylvaticum* Huds. (*Elymus europœus* L.) was added to the local flora in 1897 by Mr. C. Bucknall, who detected it on the wooded hills between Dursley and Wotton-under-Edge. It appears to be a dainty grass, growing only in full shade, sparingly, and often under beech trees where no other vegetation exists. Alien grasses that have been met with about Bristol are *Phleum Michelii, Apera Spica-venti, Cynosurus echinatus, Briza minor, Bromus unolioides,* and *Elymus Caput-Medusœ.*

LYCOPODIACEÆ.

Miss Gregory, walking over Blackdown from Burrington to Shipham, August 3, 1896, came upon a large patch of *Lycopodium clavatum.* A beautiful specimen in fruit was gathered.

EQUISETACEÆ.

Lastly, I have to mention the very remarkable occurrence of two horse-tails that have been found growing together in some quantity near Weston-super-Mare : *E. hyemale* L., and *E. variegatum* Schleich. Neither of these species had previously any certain record in the county of Somerset.

The Effects of Lateral Pressure in the Bristol District: an Estimate and a Suggestion.

By PROFESSOR C. LLOYD MORGAN, F.R.S.

THE effects of lateral pressure are threefold: first the arching or troughing of the stratified deposits into domes or basins; secondly, the local dislocation of the strata wherever overthrust or reversed faults occur; and thirdly, the rearrangement of the constituent materials under compression, with a tendency to a thickening of the beds at the summits of the domes and the bottoms of the basins, and a thinning of the beds in the intervening limbs of the anticlines and synclines. When any or all of these effects occur the net result is that the area subjected to lateral pressure has suffered a diminution of horizontal extent. The edges of any given superficies of originally flat-lying deposits are thrust closer together when the strata are thrown into anticlinal and synclinal folds. And the measure of the folding, faulting, and rearrangement of constituents is also a measure of the diminution in horizontal extent of the area in question.

The folding of the Palæozoic rocks in the Bristol district is of a comparatively gentle type as compared with that which results from the acute stress in a typical mountain region. It is true that the Carboniferous strata in some parts of the district have been thrown into a nearly vertical position, and that near Rowberrow, on Mendip, there is some evidence of fan-structure. Still, I am not aware that any estimate has been formed, or that there are sufficient data on which such an estimate could be based, as to the thickening or thinning of the strata under lateral pressure. Without going so far as to admit that this mode of effecting a diminution of horizontal extent in the Bristol area is strictly speaking a negligible quantity, it must be confessed that this cannot be introduced into any calculation based on actual measurement.

The effects of dislocation and faulting can in certain cases be expressed in quantitative terms. But it is not easy fairly to distribute these effects over the whole area. The Clifton fault has caused an overthrust of nearly 1,000 yards, or certainly more than half a mile, measured horizontally. Faults between the Clifton-Clevedon ridge near Clapton-in-Gordano on the one hand, and Portishead on the other, have brought about lateral displacement through two and a half miles as a maximum, while another fault of unknown extent has thrust coal measures over mountain limestone on the foreshore at Portishead. Further north, at Cattybrook, there is evidence of another large fault probably of the reversed type. An extensive fault presumably lies in the space which intervenes between the Middle Hope limestone ridge of Woodspring and that of Worle Hill. And within the Coal-measures of the Radstock district Mr. McMurtrie has described an overlap fault with a maximum displacement of 330 yards in a horizontal direction. These are only some of the faults in our district. Though the average amount of diminution of originally horizontal extent throughout the area does not admit of any reliable quantitative estimate, still it is clear that this

amount is not inconsiderable. If, for example, we assume that the Clifton fault is the only serious dislocation of the strata between Penpole Point and the margin of the coalfield beneath Bath, a distance of about twelve miles, this one fault gives evidence of a diminution of the whole width of 1·4 per cent., or nearly eighty-four feet in the mile.

The diminution due to folding—or the arching and troughing of the strata under lateral pressure—admits of somewhat more accurate determination. Let us take some selected plane for detailed consideration. That which I have chosen for the estimate of the effects of folding in the Bristol district is the plane or the base of the Lower Limestone Shales, or that dividing the Carboniferous system from the Old Red Sandstone. Recorded observations and measurements give us the thickness of the overlying series within the Carboniferous system. The dips are known or ascertainable, and the published maps of William Sanders and the Geological Survey give with sufficent accuracy the boundaries of the constituent series.

Taking these boundaries as reference lines the depth of the selected plane below sea-level, in the synclines, and the height above the sea-level at which this plane would occur in the anticlines, if the strata had not been partially removed by denudation, can be readily calculated. The curved line representing a section of this plane—horizontal and vertical distances being represented on the same scale—may be drawn by interpolation between the points directly calculated. The total length of the curved plane between any assigned limits can thus be measured, and it gives the originally horizontal extent of the plane. The existing horizontal distance between the limits gives the approximation of these limits during compression, and a comparison of the two gives the percentage diminution of horizontal extent due to lateral pressure.

It is unnecessary to give the details of the sections I have thus drawn. In a section between Tortworth Court to the

north and the neighbourhood of Shepton Mallet to the south, a distance of thirty miles, the percentage of reduction due to lateral pressure is in round numbers 2·5 per cent. or 132 feet in the mile. In a section at right angles to this axis drawn through Bristol, and in length twelve miles, the reduction is 3·5 per cent. or 185 feet in the mile.

It may be noted that the Bristol district lies in a region in some degree transitional between the predominantly north and south anticlines and synclines of northern England, with the Pennine axis as a salient physical feature, and the predominantly east and west anticlines of the south, of which the Mendip axis is an expression. The effects of lateral pressure, with a grip from east to west, are more marked in the northern part of the Bristol district; those of pressure exerted from north and south are more marked in the southern part of the district. Hence the somewhat triangular form of the Gloucester and Somerset coalfields regarded as a whole.

Taking all the facts of the district into consideration, and making allowance for the effects of faulting, it appears that a mean reduction of original area by 3 per cent., or in round numbers 160 feet in the mile, may be taken as a reasonable estimate of the quantitative effects of lateral pressure as exerted on the Carboniferous rocks in Pre-mesozoic times in this part of England.

The suggestion I would offer is that similar estimates should be made for other parts of England, so that we may, by correlating the results, reach some conception of the total amount of compression which the rocks of the British Isles have undergone in the successive periods in which they have been subjected to the stress of lateral pressure.

Uphill Bone-caves.

By the late EDWARD WILSON, F.G.S., and
S. H. REYNOLDS, M.A., F.G.S.

THE Uphill Bone-caves are met with in the western extremity of Bleadon Hill, which forms a continuation of the Mendip range.

The occurrence of bone caves in this hill has been known for a very long period. At the village of Hutton, which lies east of Uphill, but on the same ridge of limestone, caves have been known for a much longer period than at Uphill itself. Thus in Phelps' *History of Somersetshire*, published in 1836, it is stated (p. 18) that the Rev. Mr. Calcott, writing in 1759, says that workmen engaged at ochre pits at Hutton in the middle of the previous century, came upon a fissure in the limestone which opened into a cave twenty feet square and four high, containing many bones, including those of elephant, horse and wolf. Thus there is evidence of bone-caves being known in the Uphill neighbourhood as early as the middle of the seventeenth century. It is however with the caves or fissures at Uphill itself that this paper deals. These are situated in a large quarry in the Carboniferous limestone lying just east of the mouth of the Axe and a short distance west of the old parish church of Uphill which in former times was an important

land-mark for sailors. The earliest account of them is that given by John Rutter in his *History of Somersetshire* (p. 79), published in 1829, and a somewhat similar account is given by Phelps in his *History of Somersetshire*, published in 1836. Both these authors reproduce an interesting section, which shows a large lower cave excavated in the limestone and communicating by several irregular vertical pipes or fissures with the surface. This cave, which lies almost immediately beneath the church, was discovered in 1826 by some workmen quarrying stone, who found bones which were recognized by the Rev. Mr. Williams, vicar of Bleadon, as "belonging to a country and climate different from ours." These bones were found at the mouth of one of the vertical pipes or fissures which here expands to form a small chamber, and was closed lower down by blocks of limestone firmly wedged together. The bones were so firmly imbedded in detritus as to be only with difficulty extracted by the aid of the pickaxe. They included hyaena, elephant, rhinoceros, ox, horse, bear, hog, fox, and polecat.

The big lower cave measured forty feet from north to south by eight to twenty feet from east to west, and had a very irregular roof full of hollows, and showing weathered fossils of the Carboniferous limestone projecting from its surface. Fair stalactites occurred, but not such good ones as are often met with. On the floor of the cave was a thin deposit of mud overlying a thick deposit of sand, with numerous bones of sheep, bones of birds—chiefly gulls—a cuttle bone, and human remains in the form of pieces of pottery and a coin of the Emperor Julian. Dr. Buckland considered that the cave had been a foxes' den, and detected their gangway, where at their ingress and egress they had polished the irregular points of rock at the entrance. Dr. Buckland also considered that the bird bones had been brought in by foxes, but Rutter remarks that to judge by their unbroken state they had some other method of introduction. Loam containing birds' bones was also found in some of the vertical pipes.

The Rev. Mr. Williams considered that the cave afforded evidence of three periods of time :—

1. The material in the upper cave or hyaena den included no sand, and was deposited by the Mosaic deluge.

2. The sand which occupied the floor of the lower cave was washed in during a subsequent period when the Glastonbury flats were below sea level.

3. The mud covering the sand was washed in by a subsequent violent irruption of the sea.

Little notice seems to have been taken of the Uphill caves from the period of the publication of Phelps' *History of Somersetshire* in 1836 till the sixties. In the *Geologist*, vol. vii. 1863, p. 331, there is, however, a letter from Mr. C. Pooley, of Weston, dated August 25, 1863. He stated that another cave had recently been opened at Uphill, its entrance being on the south side of the rock at an elevation of about sixty feet from the base. Besides the usual stalagmitic breccia it was partly filled with an unctuous loam which was very rich in animal remains. Mr. Pooley obtained bones of wolf, fox, wild boar and otter, also the antler of a stag, and associated with them remains of man including a thigh bone, and part of the skull of an adult with the teeth in place. Mr. Pooley states that he was informed that several crania had been exhumed, but that in consequence of there being no local museum in which to deposit them they had been removed to Oxford. No trace of extinct animals had been met with.

It is clear that the cave to which Mr. Pooley refers is not one of those described in Rutter's or Phelps' books, for the upper cave described by them was clearly a hyaena den, containing no human remains, while their lower and principal cave lay practically at the base of the cliff, while Mr. Pooley's cave lay sixty feet above the base. Mr. Pooley gives no information as to the size of the cave which he describes, and in all

probability it was a comparatively small fissure and has been destroyed by the subsequent quarrying operations.

The next reference to the Uphill bone caves is in a paper by Mr. E. C. H. Day (*Geol. Mag.* vol. iii. 1866, p. 115), entitled, "On a Raised Beach and other Recent Formations near Weston-super-Mare." This paper, though published in 1866, makes no reference to the new cave described by Mr. Pooley in 1863. The author however says that he writes from memory, and perhaps at the time of his visit Mr. Pooley's cave had not been opened. He gives, however, a very clear account of the original cave described in Rutter's and Phelps' books, and also a good figure which shows the hyaena den as a small though definite cave, rather than simply the mouth of a chimney as in Rutter's figure. He also shows the entrance to the lower cave closed as it was at the time of its discovery by a mass of "head" or rain wash—an earthy deposit full of angular stones, and produced by subaerial denudation. The most interesting section of his paper is however his account of the connection of this cave with the evidence for former changes of level in the district. It will be remembered that while the upper cave was a hyaena den, the lower and far larger cave contained no bones of hyaenas or other animals not now found in Britain. It was not however the blocking of the entrance with "head" that prevented the occupation of the lower cave by hyaenas, but rather the fact that during the hyaena period the cave was under water owing to this part of the coast being depressed below sea level. This depression is shown by the occurrence of well-marked raised-beaches at Kew Stoke and Woodspring, which prove that at the time of their formation the land stood twenty to thirty feet lower than it does at present. The Kew Stoke raised-beach yielded bones and teeth of the horse and other animals whose remains were also found in the upper cave at Uphill, associated with the hyaena bones. The sand and cuttle bone met with in the lower cave were no doubt introduced during this submergence.

Another interesting point connected with the Uphill caves to which Mr. Day, and after him Prof. Boyd Dawkins refers, relates to the existence of the pipe or chimney passing between the upper and lower caves. The upper opening of this passage was at first blocked with masses of limestone wedged together in such a manner as to form the floor of the hyaena den above, and it was resting on this floor that the remains of the extinct animals were found. The blocks were removed by the first explorers of the cave, and it was by way of the chimney that the lower cave was first entered, the outer entry beneath the " head " being discovered subsequently. Had the barrier of blocks given way the remains of the extinct mammals would have fallen into the lower cave and would have been found resting on deposits containing human remains and those of animals of the historic period. Such a simple case of false superposition might not have misled a careful observer, but had the sea at the same time had access to the lower cave the entire contents, ancient and modern, might have been disturbed, washed about, and intermingled in such a way as to completely conceal the true history of the mass. Prof. Boyd Dawkins says that this is probably what has happened at a spot in Kent's Cavern, Torquay, where teeth of *Machairodus* a Pliocene form, were found associated with remains of Pleistocene mammals.

Of the two caves hitherto referred to, the upper one has been destroyed by quarrying operations, while part of the lower one has been closed in by a door, and is now used as a storehouse for blasting material.

In the early part of 1898 other ossiferous fissures were discovered at Uphill, and were examined by the late Mr. Edward Wilson on behalf of the Bristol Museum. Mr. Wilson's lamented death took place while the work was yet in progress. The following account is based on notes left by him.

The rock in which the quarry is opened is a compact grey limestone, generally massively bedded and with scarcely any

clay partings. At the west end of the quarry the beds dip at 20° N. 40° E.; in the middle of the quarry the dip is 18° and at the south end 15°. The limestone is a good deal honeycombed by cavities, and some of these are sufficiently large to merit the name of caves, the largest being the one at the north end of the quarry which was described in the Somersetshire histories, and which is now used as a storehouse of blasting material.

The caves examined by Mr. Wilson are situated about halfway down the chief quarry face, perhaps some fifty feet from the top of the cliff. They lie at three or four different horizons, but there are two principal ones which may be called the upper and lower caves. All these caves are irregular, low-roofed cavities, roughly following the bedding planes, and clearly owing their origin to the action of water. The position of the principal ones was apparently determined by the occurrence of narrow partings of purple and green marl. They extend for varying but sometimes considerable distances into the face of the cliff, and contain irregular deposits of cave earth which vary much in thickness in short distances. At one point the floor showed the following section :—

		ft.	in.
4.	Deep purplish-red soft sandy marl containing blocks of limestone	4	0
3.	Greenish yellow soft sandy marl	1	2
2.	Greenish drab argillaceous sandstone with sparry calcite seams	5	6
1.	Carboniferous limestone floor	—	

The greenish marl (3) whose material may perhaps partially be derived from the original clay parting of the limestone varies considerably in thickness in different parts of the cave, and is frequently brecciated and occasionally tufaceous. It is in this bed that most of the organic remains—bones, teeth, and coprolites have been found. In places, owing to the irregularity of the floor of the cave, the top layer of red marl

rests directly on the limestone. In one place there had formerly been a communication between this chamber and another below, this being subsequently blocked by fragments of limestone wedged together.

A second somewhat larger cavity occurs at a lower level, and contains a mass of rubble or cave-earth of considerable thickness—six to eight feet in places. In this deposit numbers of bones and teeth occurred, generally in a more broken state than in the upper cave. An irregular fissure or chimney passes off from this cavity in a north-north-easterly direction, widening in places by erosion along the bedding planes, and being mainly filled up with cave-earth or rubble. This fissure eventually opens into an irregular cavernous hollow from which other fissures or chimneys passed off, one chimney being in one place nearly circular in outline and six feet in diameter.

Some worked flints and scrapers, and a spear head of a rude character were found in the same rubble as that containing the hyaena and rhinoceros bones, but Mr. Wilson says: "I cannot consider the evidence of their contemporaneity satisfactory. The rubble has certainly undergone some displacement in finding its present position, and it is quite possible that in this process later objects may have been intermingled with the earlier ones."

After Mr. Wilson's death a committee, with Professor Lloyd Morgan as chairman and Mr. Herbert Bolton as secretary, was appointed for the further investigation of the Uphill bone-caves, and in aid of this object a grant was made from the British Association funds. Many more bones were collected and identified, but the cavities in which these bones were found were probably none of them caves of occupation, or the actual dens of the hyaenas. The bones have probably all been washed by water into the positions in which they were found. The actual cave of occupation has not yet been discovered.

ORGANIC REMAINS FROM THE UPHILL BONE CAVES.

Carnivora.

Spotted Hyaena (*H. crocuta*). Bones of hyaenas are far more plentiful than those of any other animal, and indicate the presence of scores of individuals. Some fine mandibular rami were found, including one showing both milk and permanent dentition, but the remains of the crania were very fragmentary. Numerous milk teeth were found, and rootless permanent teeth which had not cut the jaw. Coprolites were met with in some numbers, and numerous fine examples of gnawed bones. It is clear from the occurrence of these teeth of very young individuals that though the cave of occupation has not been found it cannot be very far off.

Cave Bear (*Ursus spelaeus*). The bones of this animal were fairly plentiful, among those found being a perfect femur and a mandibular ramus with teeth in place.

Badger (*Meles taxus*). An extremely fine skull of this animal has comparatively recently been found and is now in the collection of the rector of Uphill. The badger is a native of the county, the last specimen in the Uphill district having been killed about twelve years ago. There can be little or no doubt however that the present skull comes from the same deposit as the cave animals.

Fox (*Canis vulpes*). Several mandibular rami, a number of detached teeth and several other bones were found.

Horse (*Equus caballus*). Next to those of the hyaena, the remains of the horse are the most plentiful of those occurring at Uphill. Many scores of teeth were obtained, and a considerable number of vertebræ and broken limb bones. Several hoof-bones were found.

Woolly Rhinoceros (*R. tichorhinus*). A perfectly preserved humerus and a number of grinding teeth from both upper and lower jaws are the most important remains of this animal met with.

Bison (*Bison priscus*). The remains of this animal are not

very plentiful, but include several teeth and some well preserved metacarpals.

Red (?) Deer (*Cervus ? elaphus*). The remains of deer include several fragments of antlers and a number of teeth.

Mammoth (*Elephas primigenius*). Several fragments of tusks and of broken grinding teeth were met with. One very perfect grinding tooth was also found and is now in the collection of Rev. A. J. Burr, of Uphill. The most interesting find was however two of the minute antepenultimate milk molars, one of them in an exceptionally perfect state. The crowns of these teeth are barely three-quarters of an inch in length.

The skull of a squirrel (*Sciurus vulgaris*) is also among the bones obtained by Mr. Wilson, and its appearance is such as to justify one in supposing that it came from the same deposit as the cave animals.

Bones of the rabbit, sheep, mole, and fowl are also among bones obtained by Mr. Wilson from Uphill, but there is every reason to suppose that they are of later date than the cave earth with the bones of extinct animals. The same remark applies to certain worked flints—scrapers and knives and round stones (pot-boilers) which are also in the series obtained by Mr. Wilson at Uphill. It is noteworthy that bones of the wolf, polecat, otter and wild boar have not been met with among those recently obtained at Uphill, though they are referred to by the earlier observers.

Celestine Deposits of the Bristol District.

By B. A. BAKER.

THE mineral celestine has long attracted the attention of Gloucestershire geologists and has been already referred to in several papers published in the *Proceedings* of the local Natural History Societies.

Mr. Norman Collie (*Proc. Brist. Nat. Soc.* vol. ii. p. 292) deals somewhat fully with it and names many localities where it has been found. Mr. W. W. Stoddart (*Proc. Brist. Nat. Soc.* vol. ii. p. 44) gives a brief description with an analysis. Mr. W. C. Lucy in his paper "On the Minerals of Gloucestershire, with part of the adjacent counties of Somersetshire and Worcestershire" (*Proc. Cotteswold Nat. Field Club*, 1881–2, p. 30) also refers to it. Mr. F. Smith, *Ibid.* vol. x. (1892), p. 71, has a paper on "The Minerals of Gloucestershire: Observations on Celestite."

This paper will deal more particularly with the deposits round Bristol and with the uses of the mineral for commercial purposes.

The name celestine (Latin, *coelestes*, *celestial*) alludes to the

blue colour the mineral sometimes possesses. Analyses show that celestine contains a very high percentage of sulphate of strontium, the amount varying from 83–99 per cent., the average being about 94 per cent.

Celestine is specially well seen in the Bristol District, occurring as thin beds and irregular deposits in the Triassic marls, especially near the boundary between the Red Marls and the Tea Green Marls It is worked for commercial purposes at many places, especially in the Yate and Wickwar district. Starting from the Golden Valley, near Bitton, the exposures have been followed through Wapley, Yate, and Sodbury, near the south end of the Wickwar tunnel, and Cowslip to Ashworthy. The mineral occurs also near Charfield, to the north of the Carboniferous limestone ridge which forms the edge of the Bristol coalfield.

To the south of Bristol it is found on the north side of the Mendips near Winford, and at Regilberry, and on the south side of the Mendips at Easton between Cheddar and Wells.

In all these places the celestine is found in pockets. Often the deposit will run across several fields, but not continuously, as there may be several breaks, and while from one excavation several thousand tons may be obtained, the next may yield only a small quantity. Some of the excavations show two or more beds at different depths, separated by marl and sometimes introduced between the beds of the underlying Palæozoic series. Generally near the surface will be found isolated celestine masses, then may come an irregular bed of the mineral, this may be followed by a deposit of marl and lower again another bed of celestine. The beds are not continuous, but sometimes thin out, or break off suddenly, but commence again further on at the same level. The deposits vary in character. In some the celestine forms a mixture of angular and subangular masses of irregular shape and varying size; in other cases the fragments are rounded. There occur also large geodal masses sometimes weighing several hundred-

weight, and containing beautiful crystals. The crystals vary much in size, some being small, while others associated with them may reach a length of three to three and a half inches.

The minerals found with the celestine vary much in different localities. In the Gloucestershire district selenite (sulphate of lime) is sometimes found closely associated with the celestine in some of the nodules. The celestine from Sicily (Girgenti Valley), like most minerals from that neighbourhood, is associated with sulphur. This celestine contains a very high percentage of sulphate of strontium, often as much as 99 per cent.

When making the deep sea lock at Barry the engineer came across a thin bed of celestine of a deep blue colour and very heavy, while a short distance away when making the tunnel on Barry Island another bed was found, the mineral here being very white and of low specific gravity as compared with the other, this being perhaps due to a large percentage of lime. In the deposits at Wapley and at Winford the celestine is associated with crystals of quartz. A deposit on the north side of Wickwar tunnel rests on the Old Red Sandstone, and the lower portion of the celestine bed contains much silica, the analysis giving 11 per cent. of silica, against about $1\frac{1}{2}$ per cent. usually met with. The celestine frequently contains a large percentage of material derived from the bed on which it is deposited.

At Regilberry a bed containing small celestine crystals mixed with yellow clay passes gradually up into a very pure bed of sulphate of strontium. In the Yate basin very little lime occurs in the celestine, but north of the Mountain Limestone ridge near Wickwar, which perhaps parted two Triassic lakes, the celestine contains much more lime, one analysis giving 4 per cent. The celestine is sometimes stained red or green.

In a pocket to the east of Yate at the back of the *Black Swan Inn* the celestine is worked to a depth of thirty feet, and

even at this depth the ends of the veins have not yet been reached. There are at present about five deposits visible. Some of the associated Coal Measure clays are full of small detached crystals of celestine.

The origin of celestine is a question which to me has never been satisfactorily explained. It seems that it was either deposited from the waters of the Triassic lakes or from mineral springs which must have been fairly active during this period in this locality.

The finding of celestine deposited on hazel nuts and other things in the Bath mineral waters would support the mineral spring theory, but it might be that the water containing carbonic acid passed through a bed of celestine which dissolved the strontia which was again re-deposited.

With one exception I have never seen anything approaching a pipe which one would expect to find if the deposit originated from a mineral spring. In the cutting of the South Wales Relief Railway at Wapley, sections of small beds of celestine were exposed, but there was no sign of a pipe, it being rather as if the celestine had been deposited in pools. The exception referred to is that at Yate, where the beds run downwards, and the bottom has not yet been reached.

Process of Manufacture.

Two methods are employed for the preparation of strontium salts. In the first the sulphate is fused with sodium carbonate, and the resulting mass treated with water. Strontium carbonate which is formed is insoluble, whereas the sodium sulphate is soluble; the former is consequently easily washed and obtained in a state of purity.

The second method which is considered the better of the two, consists in calcining a mixture of powdered celestine and coal. A sulphide of strontium is formed which is dissolved in water and converted into the carbonate by blowing carbon

dioxide into the solution. In this reaction sulphuretted hydrogen is evolved, and being a valuable bye-product is collected in gasometers and burnt to sulphur dioxide which is used for the manufacture of sulphuric acid.

Both the above methods yield strontium carbonate which is the most convenient starting-point for the preparation of the strontium compounds. Dissolved in acids it gives the corresponding salts, and is converted into the oxide by the action of heat. The hydrate obtained by dissolving this oxide in water and recrystallization is used in very large amounts in the beetroot sugar industry.

Molasses, a product of this industry, contains about 50 per cent. of sugar which is so impure that the sugar cannot be obtained from it by recrystallization from water. It is used either for the preparation of rum, spirits of wine, or as food for cattle, but sugar may be extracted from it by means of strontium hydrate, which possesses the power of forming an insoluble compound with it that may be washed, filtered off from soluble matter, and decomposed by a current of carbon dioxide into carbonate of strontium and a sugar sufficiently pure to recrystallize from water.

This industry accounts for nearly the whole of the celestine mined at the present day, the amount used in the manufacture of fireworks and for scientific work being extremely small.

Reports of Meetings.

GENERAL.

IN the thirty-seventh annual session—that for the year 1900—the usual number of general meetings was held, at seven of which papers were read, while the eighth, that on February 8, was an exhibition meeting, at which Drs. Gubbin and Rudge and Messrs. Brebner, Griffiths, Marshall and Reynolds exhibited specimens. The following have been the subjects brought forward at the general meetings :—

Jan. 25. Professor C. Lloyd Morgan, on "A Year's Work" (Presidential Address).

Mar. 1. Dr. F. E. Francis, on "Combustion."

Apr. 5. Mr. H. C. Playne, M.A., on "Summer Holidays in Lapland."

May 3. Mr. S. H. Reynolds showed a number of lantern slides from photographs taken at the London Zoological Gardens.

Oct. 4. Mr. S. H. Reynolds, on "A Short Visit to Burma."

Nov. 1. Professor C. Lloyd Morgan, on "Further Observations on Instinct and Intelligence."

Dec. 6. Mr. W. T. Crank, on "A Prehistoric Burial Place at Harlyn Bay, near Padstow."

S. H. REYNOLDS, Hon. Sec.

BOTANICAL SECTION.

IN the investigation of a local Flora some very essential work has to be done in examining the gatherings of bygone naturalists when their collections are available. But it frequently happens, unfortunately, that unless these herbaria become the property of a society or public institution they are dispersed or destroyed after the owner's death, and much useful information is no doubt lost in that way. For example, the Bristol plants collected about 1840–2 by that distinguished botanist, the late G. H. K. Thwaites, were sold at a Clifton auction some thirty years ago. Should any reader of this notice know where Dr. Thwaites' British plants now are, he would confer a favour by communicating with the writer.

Lately, Bristol botany as been helped by Mr. Harold Thompson, F.L.S., into whose hands has come the herbarium of his great uncle, Mr. Thomas Clark, of Bridgwater, a good botanist, who recorded the flora of the Somerset peat-moors early in the last century. Among his plants are good specimens of some rare and interesting species, difficult to obtain in these days of drought and drainage, e.g. : *Cicuta virosa*, *Sparganium minimum*, *Rhynchospora fusca and Carex filiformis*. *Raphanus maritimus* and *Eryngium campestre*, too, are Somerset rarities, that may never be gathered again in the county. Besides placing these examples in my hands, Mr. Thompson tells me of two good plants in the district, viz. : *Atriplex littoralis* at the mouth of the Brue, and *Carex depauperata* in Leigh Woods.

JAS. W. WHITE, Hon. Sec.

ENTOMOLOGICAL SECTION.

DURING the year 1900 five meetings were held, papers and exhibitions being made as follows :—

March 13. A large number of British Hymenoptera and Diptera were exhibited by Mr. Charbonnier, and Mr. Bartlett

exhibited a specimen of *Sirex juvencus* taken in Cotham Grove, in 1899, also a ♂ *Sirex gigas* with its hymenopterous parasite *Rhyssa persuasoria*, both being taken at Lynton.

April 10. Dr. C. King Rudge was elected a member of the section. Mr. Watkins, of Painswick, sent specimens of the case larvæ of *Coleophora laricella*, with notes thereon, also specimens of the larvæ of *C. discordella*. Mr. Griffiths exhibited a large number of moths, principally of the genera *Syntomis*, *Zygæna*, *Arctia*, and *Ithomia*.

October 16. Mr. Hudd reported that he had been asked and had undertaken to compile a list of Lepidoptera for the *Victoria History of Somerset*. A draft list of the butterflies was read and discussion followed.

November 14. Mr. Watkins, of Painswick, communicated a paper on "The Insect Tenants of a Straw." Dr. Rudge exhibited a bottle of cayenne pepper in which were feeding the larvæ of a coleopterous insect. The pepper had remained so infested in the bottle for two years. Mr. Griffiths exhibited specimens of a *Trombidium* of a brilliant scarlet colour, and about a quarter of an inch across, they were taken from dead wood in West Africa. He also exhibited specimens of *Papilio Ægeus*, with its form *P. Erechthus* bred by him in England from Queensland pupæ, *P. anactus*, *P. Memnon* with its various forms of ♀, *P. Ajax* with its three seasonal forms, *P. glaucus* with its dark and light forms of ♀, and also many *Ornithoptera* and *Syntomidæ*.

December 13. Mr. Griffiths read some notes on, and exhibited specimens of the *Xyloryctinæ*, a sub-family of the *Gelechiadæ*, from Queensland. Mr. Charbonnier made some observations on the *Sarcophagi*, or flesh flies, and produced numerous specimens. Dr. Rudge exhibited living larvæ of *Aeschna cyanea* and specimens of the Hessian fly, *Cecidomyia destructor*, in its different stages; also of its parasite, *Semiotellus nigripes* ♂ which he described.

CHARLES BARTLETT, Hon. Sec.

GEOLOGICAL SECTION.

THE first meeting for the year was held on February 19, when the secretary presented a satisfactory balance sheet. Professor C. Lloyd Morgan gave a lecture on the Geology of the neighbourhood of Lulworth, a district which had been visited by some of the members at Whitsuntide, 1899.

The next meeting was held on October 25, when Professor S. H. Reynolds described on behalf of Professor C. Lloyd Morgan and himself the Triassic deposits of Emborough. At this meeting the president of the section (A. C. Pass, Esq.), who had held the office for some years, resigned, and Professor S. H. Reynolds was unanimously elected to fill the office. The secretary (Rev. H. Pentecost), also tendered his resignation, as he found he could not give sufficient time to the work, and Mr. B. A. Baker was elected in his place.

A vote of thanks was passed to the retiring officers for their past services, and great regret was expressed that they could not continue to fill the posts they had occupied with so much advantage to the section.

The last meeting of the year was held on November 14, when Mr. W. H. Wickes read a very interesting paper entitled "A Rhætic Section at Redland."

It is satisfactory to note that this section still keeps up the number of its members, there being an increase since the last report was issued, and there is every prospect of a further increase for the coming year.

B. A. BAKER, Hon. Sec.

PHYSICAL AND CHEMICAL SECTION.

MEETINGS of the section were held as follows :

May 8. Dr. S. Young, F.R.S. read a paper on "The Relative Efficiency of various forms of Still-head for Fractional

Distillation." This was illustrated by an exhibition of many forms of the apparatus treated of.

May 29. Dr. E: H. Cook read a paper (postponed from an earlier date) on " Some Experiments with the Electrical Brush Discharge."

November 23. The president of the section, Mr. F. Wallis Stoddart, read " Notes on the Estimation of Dissolved Oxygen in Water." The paper was accompanied by a demonstration.

LLEWELYN N. TYACK, Hon. Sec.

ORNITHOLOGICAL SECTION.

ON *October* 18 the Local List of Species for the preparation of which this section was formed, was finally completed.

On *October* 28 several skins of South African birds were sent for the inspection of the section by Mr. Fleming, who had lately returned from Natal.

On *February* 14, 1901, a meeting was held, Professor Lloyd Morgan taking the chair, at which it was decided to dissolve the section, as the Local List had been completed, and matter for ordinary meetings was not to be obtained from those few members still constituting the section. The balance of the section was subsequently handed over to the treasurer of the parent Society on the understanding that it should be applied to the expenses of printing the Proceedings in which the Local List had appeared.

D. T. PRICE, Hon. Sec.

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