NATURAL HISTORY TRANSACTIONS

OF

NORTHUMBERLAND, DURHAM,

AND

NEWCASTLE-ON-TYNE,

BEING PAPERS READ AT THE

MEETINGS OF THE NATURAL HISTORY SOCIETY

OF

NORTHUMBERLAND, DURHAM, AND NEWCASTLE-UPON-TYNE,

AND THE

TYNESIDE NATURALISTS' FIELD CLUB, 1877-79.

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THE Committee of the two Societies beg to state that the Authors alone are responsible for the facts and opinions entertained in their respective papers.

RICHARD HOWSE, EDITOR.

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CORRIGENDA.

Page 173, line 7, *for* Weightman, *read* Wightman.
,, ,, ,, 17, ,, ,, ,, ,,
,, ,, ,, 27, ,, ,, ,, ,,
,, 174, ,, 15, ,, stratum, ,, district.
,, 256, ,, 26, ,, *supra*, ,, *infra*.
,, 257, ,, 22, ,, *supra*, ,, *infra*.
,, 263, ,, 23, ,, *supra*, ,, *infra*.
,, 285, ,, 13, column 2, ,, Valley-Terraces, ,, Valley.—Terraces.
,, 285, ,, 14, ,, 2, ,, Valley and Escarpment-system, *read* Valley-and-Escarpment System.
,, 293, ,, 4, footnote 2, *for* these, high lying, formations, *read* these (high lying) formations.
,, 313, ,, 23, *for* is seen, *read* however, is also seen.
,, 315, ,, 2, ,, turn, ,, twin.
,, 326, ,, 12, ,, it, ,, them.
,, 331, ,, 3, ,, this region, ,, this Northumbrian region.
,, 331, ,, 2, footnote, *read* "set on an hill."
,, 354, ,, 17, *insert a comma after* seen.
,, 365, ,, 36, *for* Class, ,, Club.

NATURAL HISTORY TRANSACTIONS

OF

NORTHUMBERLAND, DURHAM, AND NEWCASTLE-UPON-TYNE.

ADDRESS TO THE MEMBERS OF THE TYNESIDE NATURALISTS' FIELD CLUB,

READ BY THE PRESIDENT, GEORGE HARE PHILIPSON, ESQ., M.A., M.D., F.R.C.P., AT THE THIRTY-FIRST ANNIVERSARY MEETING, HELD IN THE MUSEUM OF THE NATURAL HISTORY SOCIETY, NEWCASTLE-UPON-TYNE, ON THURSDAY, APRIL 19TH, 1877.

LADIES AND GENTLEMEN,—For the distinction which you were pleased to endow me with, at the last Anniversary, I am prompted to offer to you an expression of my appreciation for your consideration, and in acknowledgment of your remembrance, to assure you of my determination and my aim to perform the duties and expectations of the position. By the sagacity and forethought with which the rules of the TYNESIDE NATURALISTS' FIELD CLUB have been framed, it is indicated that the President, at the termination of his year of office, shall give an address or written summary, recounting its proceedings at the Field and other Meetings, and referring to such other subjects and events in Natural History as he may deem conducive to the welfare of the Club and the furtherance of its objects. Of the many pleasures of the office of President, assuredly this is not the least, for in referring to the proceedings and events of the past, the beauties and the interest of the localities visited, the enjoyable occurrences of the Social Meeting and of friendships formed, and the delight or admiration at the acquirement

of some new fact or thought is rendered still more pleasing, as, by the very revival of the reminiscence, its value is enhanced.

The First Field Meeting of the Season was held at Gosforth Lake, on Thursday, the 11th of May. The party, numbering about sixty members, and including several ladies, proceeded by train to Killingworth Station, where they arrived soon after one o'clock, P.M., and by the kind permission of Thomas Eustace Smith, Esq., M.P., entered Gosforth Park by the east lodge at the Four Lanes End, and walked through the Fir woods to the south side of the lake, an artificial sheet of water, rush-fringed, above fifty acres in extent. The lake was made partly by the subsidence of the ground caused by the workings of Killingworth Colliery, and partly by embanking. It is frequently visited by wild Swan. At the time of our visit there was only one Swan, two others having departed a few days previously. Coots, wild Duck, and other aquatic birds, breed near its margin, but, owing to the lateness of the season, their nidification was not far advanced. Accompanied by Mr. Bocock, the resident Steward, who pointed out all the objects of interest, the party next proceeded to Gosforth House, a handsome mansion built in the year 1757, from designs by Pain, and added to by the late Rev. Ralph Brandling, about the year 1820. The gardens, vineries, fernery, and forcing houses, were also visited. The fernery was examined with much interest. After an enjoyable walk along the beautiful main avenue to the fine gateway at the west entrance of the park, the party traversed the home grounds and returned by the north side of the lake to the lodge by which entrance to the park had been gained earlier in the day.

It was not anticipated that many plants in bloom would be met with, yet the naturalists, in admiring Nature in all its phases, felt that perhaps at no season of the year is the country more attractive than in spring.

> Gentle spring! in sunshine clad,
> Well dost thou thy power display!
> For winter maketh the light heart sad,
> And thou, thou makest the sad heart gay.

He sees thee, and calls to his gloomy train,
The sleet, and the snow, and the wind, and the rain,
And they shrink away, and they flee in fear,
When thy merry step draws near.

The woods were gaily decked with the primrose, the violet, the anemone, and the ranunculus. The yellow catkins of the various species of willow added to the charm, and the more observant explorer viewed with delight the small, but exquisitely beautiful, bright scarlet stigmas of the common hazel. The great feature, however, was the show of primroses and violets. At places the hedgerows were completely covered with their bloom, which, lit up with a clear spring sky, made a picture so alluring, that even the reticent could not refrain from extolling the beauties of our wild flowers. Several of the geologists left the park earlier than the majority of the party, with the object of examining the Gosforth Colliery pit heap, and were fortunate in obtaining some Coal-Measure fossils.

An excellent tea was provided by Mrs. Rutter, of the Brandling Villa Inn, near Gosforth Station, from whence the party returned to Newcastle shortly after seven o'clock. A most enjoyable afternoon was spent, to which Mr. Smith's kindness in permitting free access to the whole of his park, grounds, and gardens very materially conduced, and which was duly acknowledged by the members in a hearty vote of thanks. Eleven new members, three of whom were ladies, were elected.

The Second Field Meeting was held at the Farne Islands, on Whit Monday, the 5th of June. In consequence of the death of my dear and much revered father, I was unable to be present. I am indebted to our estimable Junior Secretary, Mr. Edwin Dodds, for the following particulars relating to this excursion.

Notwithstanding the early hour of starting, and the threatening aspect of the sky, nearly fifty members assembled and left the Central Railway Station, Newcastle, by the north mail, at 6.8 o'clock A.M. Alighting at Chathill Station, a pleasant walk of about four and a half miles brought the party to North Sunderland, where breakfast was obtained at the White Swan Inn, the

accommodation being scarcely equal to the strain brought upon it. After breakfast the party proceeded to the harbour, but the fresh breeze and the sight of the white crested waves made many waver and finally determine to walk along the coast to Bamborough Castle, instead of running the risk of suffering from the sea trip. About thirty, including several ladies, in no way daunted, embarked in the boats, and after a voyage, though unattended with danger, yet certainly too rough to be pleasant, the Staples Island was reached, and the breeding places of its various feathered inhabitants were inspected. The Pinnacles were seen to the greatest advantage, around their bases waves were surging, in their cracks and fissures elegant Kittiwakes were resting, and crowded on their summits were Guillemots, with their variously coloured eggs. Nests of the Lesser Black-backed Gull were abundant on the flat rocks and among the herbage. Several Puffins were taken from their nests in the Rabbit burrows, and two nests of the Rock Pipit were also found. From the Staples Island the boats crossed to the Brownsman, where several nests of the Eider Duck and Arctic Tern were seen. The breeze beginning to freshen and the state of the tide not being favourable, it was decided, after some discussion, to return to North Sunderland without attempting to land on any of the other islands, and, after a very quick run before the wind, this was accomplished, with no worse disaster than the loss of hats by several.

In the interval the worthy hostess of the White Swan Inn, Mrs. Robson, had prepared a hay loft as a temporary dining room, where a substantial meal was very heartily enjoyed. The Rev. R. F. Wheeler, M.A., Vicar of Cullercoats, Vice-President, kindly acted as chairman. After dinner Mr. Wheldon, of London, gave a very interesting account of the erection of the Longstone Lighthouse, in the year 1829, in which work he had been engaged. After a hearty vote of thanks to the Rev. Charles Thorp, M.A., for his kindness in allowing the members to visit the islands, and the election of thirteen new members the meeting was concluded, and the members walked or were conveyed to Chathill Station, where, through the kindness of the officials

of the North Eastern Railway Company, the eight o'clock P.M. train was stopped to receive them.

The following birds and plants were observed on the islands.

BIRDS.

Charadrius hiaticula, Ring Dotterel.
Hæmatopus ostralegus, Oyster Catcher.
Larus marinus, one specimen.
L. fuscus, Lesser Black-backed Gull.
L. argentatus, Herring Gull, very scarce.
L. tridactylus, Kittiwake.
Sterna Cantiaca, Sandwich Tern.
S. hirundo, Common Tern.
S. paradisea, Arctic Tern.
Uria Troile, Guillemot.

PLANTS.

Silene maritima, very abundant.
Potentilla reptans.
Armeria maritima.
Honckeneja peploides.
Cochlearia officinalis.
Leontodon Taraxacum, Linn.
Sedum acre.

On the Links between North Sunderland and Bamborough, *Cynoglossum officinale* and *Hyoscyamus niger* were observed in great abundance.

Various historians have graphically described the Farne Islands, and none more so than Pennant, who in his Tour in Scotland, Vol. I., p. 46, has given the following account of the Farne Islands, which, for terseness and clearness of description cannot well be excelled. "Opposite to Bamborough lie the Farne Islands, which form two groups of little isles and rocks to the number of seventeen, but at low water the points of others appear above the surface. The nearest isle to the shore is that called the House Island, which lies exactly one mile sixty-eight chains from the coast; the most distant is about seven or eight miles. The House Island, the sequestered spot where St. Cuthbert

passed the two last years of his life. Here was afterwards established a Priory of Benedictines for six or eight months, subordinate to Durham." On the Farne St. Cuthbert built himself a cell and a small oratory. In Leland's Itinerary, *V.* 6, *Fol.* 67, the Farne Islands are quaintly described thus. "There ly certen Isles adjoining to Farne Isleland bigger then Farne it self. But in them is no Habitation. Certen bigge foules, caullid S. Cuthbertes Byrdes, brede in them, and Puffins, Birdes less then Dukkes, having grey Fethers like Dukkes, but withoute paintid Fethers, and a Ring about the Nek, be found breding ther in the cliffy Rokkes."

The THIRD FIELD MEETING was held at Staward Peel, on Thursday, the 13th of July. There were about one hundred and twenty ladies and gentlemen, comprising fully one hundred members, one sixth part of the Club, present.

The party left Newcastle by the 11.30 A.M. train, arriving at Hexham at 12.27, where a detention of forty-five minutes occurred before they were able to proceed by the Hexham and Allendale Railway to Staward Station, where they arrived at 1.47. The time at Hexham, however, was very agreeably spent. Some visited the Abbey Church, while others strolled quietly in the enclosures of the market gardens, which are common. Necessarily the Club numbers amongst its members a proportion who do not profess to be versed in scientific lore, but who very gladly avail themselves of the excursions, and find much interest and diversion in viewing the ecclesiastical and other ancient structures in the localities visited.

To join advantage to amusement, to gather profit with pleasure,
Is the wise man's necessary aim, when he lieth in the shade of recreation.

Hexham is a town of great antiquity. It was the metropolis of a famous Shire of that name. The Abbey Church, the pride of Hexham, is a relic which preserves the memory of a dignified past. Here, in the reign of Egfrid, King of Northumbria (674), it was erected into an Episcopal See by St. Wilfred, Archbishop of York, and afterwards confirmed by Theodora, Archbishop of Canterbury. Seven Bishops had their seat here until the Danes

came, in the ninth century, and burnt and slew after their manner. Then followed two hundred years of ruin and neglect, ere, early in the twelfth century, the present church was built. Not long did it flourish, for before the next century closed the unruly Scots burnt down the nave and plundered the priory, and by and by the finishing stroke was given by the first Defender of the Faith, who, to defeat the prior's opposition, ordered him to be hanged. The nave was never restored, consequently there remain only the choir and transepts, crowned by the tower. The style is early English, and is especially remarkable for the absence of the elaborate ornament usual in pointed architecture. Here the effect of graceful form is strengthened by simplicity. Admirable is the view of the lofty arches in the clerestory. Admirable, also, the view of the choir, with its quaintly carved shrine of stone.

At Staward Station the party were met by Mr. J. W. Hetherington, Assistant to Mr. Thomas J. Bewick, Mining Engineer, Haydon Bridge, under whose kind direction a pathway, through field and wood, was taken to the Peel, where some time was spent in plant and butterfly hunting. The opportunity and locality being favourable for rest and for refreshment, groups were formed on the green-sward, and soon the appearance was that of a large pic-nic.

At the Peel William Henry Charlton, Esq., of Hesleyside, and Francis Charlton, Esq., County Engineer, joined the party, and gave them the benefit of their local knowledge, topographical and botanical, and descanted on the beauties of the woodland scenery. Mr. Hetherington, also, who had thoughtfully provided himself with the ordnance map, explained the geological features, and pointed out the position of the faults, the Great Stublic Dyke, etc. The fault, or Stublic Dyke, which intersects the Coal-Field for many a mile, and by which the base line of the Coal-Measures in Northumberland is prolonged in a narrow band up the valley of the Tyne to the extremity of the County of Northumberland into Cumberland.

The old Castle or Peel of Staward, or Staworth, as it is also called, stands out towards the River Allen on a rounded rocky

promontory, with a steep wooded bank on the opposite side, and a high heathery moor in the back ground. The wooded bank rises for fully one hundred feet, with much abruptness. The approach is narrow, on an elevated way, chiefly formed by Nature, rocky steeps lying on each side clothed with wood, beneath which is viewed a pretty picturesque plain, washed by the murmuring streams of the Allen. From the rocky promontory was obtained a most extended view of the surrounding country. Staward Castle, or as it was anciently called, Staward-le-Peel, of which little now remains but a rugged gateway which was defended by a drawbridge and porteullis. Some ruined walls exist to the westward. The outworks are a deep foss, with a vallum of stone and earth. This castle has a remarkable situation, being seated on a peninsula formed by the conflux of the River Allen and the Harsondale Burn. The Peel belonged to the Eremite Friars, of Hexham, under the grant of Edward, Duke of York. The view northwards was the most extended, taking in the village of Thorngrafton, surmounted by the cliffs above Sewing Shiels, which formed the horizon. Upon descending into the river valley, by a rugged pathway, which, owing to the projections of large masses of rock, was not unattended with peril, but which was safely accomplished, a sulphur spring was reached. This spring is dedicated to St. Mary, and is called the Holy Well. It is situated in the sinus of a sloping freestone rock, where are lodged large pellets of sulphur, the aperture and sides being tinged with a silvery hue. The water has a nauseous fetid taste and odour. Being so near the Allen the floods often encroach upon it, and force it to change its situation in the rock, bursting out again in some other site. The practice of consecrating springs is very ancient. Sometimes they were consecrated as a living memorial of extraordinary mercies received from Heaven. This occurred in the patriarchal age. Sometimes, as a testimony of important foedera, of compacts or covenants entered into among men; and, at other times, for their healing virtue. Within a little distance of the Holy Well a very fine cascade, called Cypress Linn, and under it a large and deep basin, were viewed.

Up to this time the party had remained together. In consequence, however, of having received permission from Henry Bacon Grey, Esq., of Styford, for the members to be free to ramble, according to their inclination, one portion selected to wander up the river bed, while the others preferred the open country. The former again and again encountered difficulty from the huge rocks which intercepted their path, and which obliged them to diverge into the steep and densely wooded banks. However, they were not discontented with their toil, for the scenery was of the most enchanting and interesting description. The views were picturesque and romantic, the winding stream forming many beautiful bays and peninsulas, bounded by rocks and hanging woods, which afforded a multitude of little solemn and secluded retreats, through which the waters murmured. Those who selected the open country wended their way through a grove of trees, where the naturalists proper betook themselves to Nature's own nooks, those shady and sequestered spots where valued plants vainly try to hide themselves. The Oak Fern, *Polypodium Dryopteris*, was in great perfection. The woods were reluctantly left, and the fields were recrossed and again a halt was made, when W. H. Charlton, Esq., much to the satisfaction of all, again expatiated on the topography of the situation. On the north, as the most striking feature, he pointed out the "Whin Sill," an intrusive bed of igneous rock, which in some places reaches a height varying from eight hundred to a thousand feet above the sea level, forming a decided ridge from west to east. Along the top of this ridge the Roman Wall is carried, following the irregularities of the ridge with pertinacious adherence. The Nine Nicks of Thirlwell, Wall Town Crags, Cock Mount, and Sewing Shiels, were also denoted. With the regret of this contingent, the Messieurs Charlton then took their leave, and entered their carriage, which was in waiting. The high road was then taken, the botanists, by the way, making additions to their collections. As tested, either by the number of species or individuals, the boreal element of the Flora is considerably smaller than in Weardale, and still more so than in Teesdale. The principal

interest of the district, from a botanical point of view, arising from the extent and perseverance with which agricultural and horticultural cultivation has been carried on, at, for Britain, an unprecedently high altitude. Cool and refreshing breezes were experienced as the hills were passed, resuscitating in their influence, so that, notwithstanding the ardent heat of the earlier part of the day, Allendale Town was reached, without any one being much fatigued. The Golden Lion Inn was repaired to without delay, where a sumptuous dinner, temptingly prepared by Mrs. Burn, was found, to which ample justice was done. Hearty votes of thanks were afterwards accorded to Henry Bacon Grey, Esq., for his kind consideration in allowing the members to ramble over his estate, and to Mr. Hetherington for his courtesy and kindness in guiding the party. Six new members were elected. After dinner several members visited the Smelting Mills of W. B. Beaumont, Esq., M.P., where they were received with every attention; others inspected the Church, and then proceeded to the Catton Road Station to join the return train at 6.55, where several of those who had rambled up the river bed and its banks had only shortly before reached. After a short detention at Hexham, Newcastle was safely reached at 8.45, the pleasure and the enjoyment of the trip being the parting theme in bidding farewell.

The Fourth Field Meeting was held at Stanhope, Weardale, on Monday, August the 7th (bank holiday). The party, more than fifty in number, including several ladies, left Newcastle by the 10.5 A.M. train, and arrived at Stanhope shortly after noon. At the railway station they were met by the Rev. John Wagstaffe, M.A., of Stanhope, who courteously acted as guide throughout the excursion, and most kindly gave them the benefit of his local and botanical knowledge. The majority of the party walked, for a short distance, by the side of the railway, and then through the fields of the glebe, which were fragrant from the recently mowed grass, and gradually ascending reached the Limestone Quarries of Parson's Byers, an altitude of eight or nine hundred feet above the sea level, from which a very extensive and

picturesque view of the vale of the Wear was obtained, that to the east, including Frosterley, being much remarked upon. At this quarry the limestone is twelve fathoms deep, and two thousand five hundred tons are sent away each week, principally to the Ironstone furnaces at Middlesbrough. After ascending the hill side the beautiful ravine of Jack's Crags was reached. Each one of the party, either alone, or with the kindly aid of friends, safely made the ascent of the gorge, which at places was perilous and difficult. One of the first to reach the top was Mr. John Hancock, who had carefully examined for traces of the feathered inhabitants, but unfortunately without any success. In descending from Thimbleby Hill (nearly twelve hundred feet), after passing Newlandside Hall, the ancient seat of the Wards, the quarries of Newlandside were inspected, where blasting by means of dynamite was being proceeded with, and which operation was viewed from a safe distance with much interest. Here some lead ore was shown which appeared to be rich in metal. The hill side was then gradually descended, through fields where hay making was in process. The hedgerows were studded with the Woodruff, *Asperula odorata*, in bloom, its sweet aroma being very grateful. In the bed of the Wear a remarkable bed of Basalt first described by Sir W. C. Trevelyan was pointed out. After crossing the Wear by the picturesque stone bridge Stanhope Hall was visited. This is a large ancient building situated on an eminence, and guarded with a curtain wall, to which you ascend in front by a flight of many steps. It is one of the possessions of the Earl of Carlisle, but more anciently was the family house of the Featherstonhaughs, the last male of whom fell in the field in the Civil wars, soon after which the estate was sold. After a short distance Stanhope Castle, the residence of Henry Pease, Esq., was reached, when the members were permitted to inspect the beautiful garden, vineries, and grounds.

A small number of the party, upon arriving at Stanhope, proceeded to explore Stanhope Burn and the site of the Heathery Burn Cave, among whom was our esteemed Secretary, Mr. Richard Howse, who has kindly communicated the following account of their visit.

Stanhope Burn is a rather deep ravine, running northwards from the main valley of the Wear. Formerly both banks were well covered with trees and brushwood, but of late much of the eastern side of the burn has been extensively quarried for limestone, as the Great Limestone is well exposed and advantageously situated for that purpose. The increased demand for limestone in recent years for iron-smelting purposes, and the exhaustion or diminution of the supply from the same bed at Frosterly and Bollihope has driven iron manufacturers, and others requiring limestone, further up the valley, to the great disfigurement of portions of Stanhope Burn and neighbourhood. Near the western extremity of the village the Great Limestone is quarried on the Fell Side to nearly the full thickness of the bed, which is more than seventy feet in perpendicular section. The visitors on this occasion, after searching in vain for fossils on the fresh-fractured and recently-quarried surfaces, examined the top of the section, and were much gratified by being able to observe that the uppermost part of this bed of limestone was covered with a thick deposit of Boulder-clay ten or twelve feet in thickness. Wherever this clay had been removed the upper surface of the limestone was most distinctly polished and rubbed down and scratched, the general direction of the scratches and markings being in the direction of the valley and the slope of the ground, scratches in cross direction downwards and onwards being on many parts of the surface distinctly visible. The elevation of this Boulder-clay is not much less than one thousand feet above the present sea-level. Another special point of interest in these quarries is the well-exposed section of some mineral veins which have been cut through in the process of quarrying, and as the limestone is much deteriorated and metamorphosed by the passage of the veins, large masses of vein-stuff as it is called, are left standing boldly forward, and allow the geologist and others a favourable opportunity of examining the structure of mineral veins and their contents in broad day light. Interesting specimens of galena, calc-spar, fluor-spar, and quartz were soon collected. Much further up the burn the next object of interest was the exposed portion of the large fissure, the lower part of

which formed the once well-known Heathery Burn Cave, the abode at least for a time of human beings with foreheads villainously low, who used instruments of bone and weapons of bronze, who have left behind nothing but these scanty memorials buried in sand beneath inches thick of stalagmite to puzzle us and excite our curiosity and ingenuity to explain who they were and how long ago they lived. The cave itself, which was at the lowest part of this fissure near the burn side no longer exists, having being removed in 1861–2 by the quarrymen engaged in working the limestone. A very interesting and faithful account of the excavation of this cave and its contents is to be found in the "Geologist" for 1862, by the late Mr. John Elliott of Stanhope, who was not only much interested in the geology and antiquities of the place, but was well acquainted also with the local Flora. Like many other caves in Weardale and Mountain-limestone districts, this appears to have been excavated in the fissured limestone solely by the agency of running water carrying at times, no doubt, considerable quantities of sand and gravel with it, which would aid its excavating power. In this case the water has been derived from the drainage of the lofty steep side of the burn, and from water diverted from a small tributary burn not far distant. Snail shells, bones of Foxes and other animals, were frequently found by the workmen partially embedded in or wholly covered up in calc-sinter on the sides of the fissure, and stalactites of considerable size, and still in process of formation, were met with plentifully. Our time passed rapidly away, and having taken a glance at the Smelting Mills, we began to retrace our steps down the bed of the burn for the special purpose of examining the Four-fathom Limestone, the main object of our visit, in the hope of finding some specimens of *Saccamina Carteri*, a small fossil supposed to be a Foraminifer, and also asserted to be a characteristic fossil of the Four-fathom Limestone of Northumberland. In search of this fossil though we spent some hours, though we sought long and diligently, and though the limestone was well exposed and as much weathered as could be desired, we were not successful. On a former visit to Stanhope we were more fortunate, as we found some unmistakeable specimens in

the Great Limestone of Bollihope and in the Four-fathom Limestone of Middlehope. From the searches we have made for this fossil in the Four-fathom Limestone we are inclined to the opinion that it is not peculiar to one bed of limestone, either in Durham or Northumberland, and that further and more careful search will show that it has as extensive a range, bathymetrically, in the northern counties of England as it has in the west of Scotland. *Cystopteris fragilis* and *Asplenium trichomanes* were formerly very abundant and of luxuriant growth in this burn, but we regretted to observe that the ruthless fern mania had left not a trace of the former and only a few inaccessible plants of the latter. The beautiful giant Campanula, and several of the St. John's Worts were in full flower and abundance. On former visits to Stanhope we have frequently observed *Polygonum viviparum* flowering freely on the left bank of the Wear, brought down by floods probably from its native Alpine heights.

A very comfortable dinner was in readiness at the Phœnix Inn, Stanhope, which was much enjoyed. After dinner the thanks of the meeting were heartily given to the Rev. John Wagstaffe for his affability and kindness. Eleven new members were elected. On the way to the railway station the party visited the Rectory garden and grounds, where they were most courteously and kindly received by the Rector, the Rev. Canon Clayton, M.A., and Mrs. Clayton, the latter since deceased. As they passed under the shade of the magnificent avenue of Lime trees, sweet in their bloom and musical, from the humming of the bees, great enjoyment was evinced by many. The situation of the Rectory was much admired, and the extensive view of the dale, east and west, was regarded with delight. In the garden the collection of British plants, collected and planted by the late Rev. William Darnell, M.A., for many years Rector, was examined with much interest.

The Church of St. Thomas the Apostle occupies an elevated situation on the north side of the town, and has nave, aisles, chancel, and organ chamber, with a low square bell tower. The living is a Rectory in the gift of the Bishop of Ripon, and at the present time is held by the Rev. Charles Clayton, M.A.,

Canon of Ripon, of Gonville and Caius College, Cambridge, where he was for many years Senior Fellow and Tutor. The Rectorship of Stanhope has been held by many eminent divines. Among those who have held this living may be named Bishop Butler, author of the "Analogy," Bishop Murton, Bishop Philpotts, and Bishop Barrington, who endowed many schools in the district.

The trade of the town of Stanhope, as well as of the entire parish, is to a great extent dependent on the iron and lead mines, and the numerous limestone quarries in the neighbourhood.

Concerning the family of Stanhope, Earl of Chesterfield, Collin in the Peerage, quoting Camden, observes them to be denominated from a place of their own name (without doubt) the town of Stanhope, near a forest so called, in Darlington Wapentake, in the Bishoprick of Durham, of which they might be owners, for it is certain their residence was in those parts before they came into Nottinghamshire, as is fully attested by Glover's Somerset Herald.

The party left Stanhope at 5.5 P.M., and, after a short detention at Bishop Auckland, reached Newcastle at 7.45, well satisfied with their visit to Weardale.

The FIFTH FIELD MEETING, as has been customary for the September Meeting, for some years, was arranged to extend over two days, and in consequence of the prolongation of the time, was fixed for a more distant locality, Leyburn, Wensleydale, Yorkshire, and was held on Thursday and Friday, the 14th and 15th of September. The members, numbering twenty-three, and five ladies, proceeded by the 8.30 A.M. train from Newcastle, and by the kindness of the directors of the North Eastern Railway Company, were accommodated with a "through carriage," so that they were relieved from the trouble of a change at Northallerton. After a pleasant journey, the Leyburn branch from Northallerton being new to many, Leyburn was safely reached at 11.40, and the party, without delay, proceeded to the Bolton Arms Hotel, which was to be their head quarters during the excursion. After giving the necessary instructions

for the providing of the sleeping accommodation required, and after partaking of luncheon, the party proceeded to walk, as arranged, to Middleham. In passing through Leyburn it was found that the town consisted of an oblong square, and appeared to have been almost entirely rebuilt within no distant period. In the way they crossed the River Ure, and had very fine prospects of Wensleydale and Coverdale. Penhill was a conspicuous feature to the south-west, and Great and Little Whernside appeared high on the south. On the roadside, on an open space of sward, they were much delighted to find the Meadow Saffron, *Colchicum autumnale*, in bloom, and in beautiful luxuriance. The Common Colchicum or Meadow Saffron consists of little more than a deep bulbous root, and a delicate lilac flower. The following beautiful lines were vividly represented.

> Of the stored and uncounted riches lying hid in all creatures of God,
> There be flowers making glad the desert, and roots fattening the soil,
> Not long to charm away disease hath the Crocus yielded up its bulb,
> Nor the Willow lent its bark, nor the Nightshade its vanquished poison.

Upon reaching the town of Middleham, the remains of the once formidable castle were approached, where the party were received by the venerable custodian, who discoursed in homely language upon its history, the picturesqueness of the situation, and the beauty of the surrounding scenery. Middleham Castle was the residence of the celebrated Earl of Warwick, the king-maker. This castle, says Leland, is the fairest castel in Richmountshire, next Bolton. The castle was built about the year 1190 by Robert Fitz Ranulph, and afterwards became the property of the Earl of Warwick, and here he confined Edward IV., who contrived to effect his escape, and soon after defeated his powerful enemy at the battle of Barnet. The castle becoming forfeited to the Crown, Edward gave it to his brother Richard, the Duke of Gloucester, who made it his favourite residence, and in this place was born his only son Edward, afterwards Prince of Wales, who died at the early age of twelve years. At what time the castle ceased to be inhabited is not known. Tradition says it was reduced to ruins by Oliver Cromwell.

After reflecting upon these records of the past, and viewing

the remains of the castle, which are now a huge mass of ruin, the party proceeded, passing East Witton, with its modern church, and came to Jerveaux Abbey, a Cistercian foundation (1156), beautiful in ruin, whose name Ger-, Jer-, Yer-, or Ur-vaulx, Veaux, or Vaux, is derived from the River Ure flowing beneath its walls. Here Wensleydale ends, the hills subside into easy slopes, the valley opens into a wide area, and on one side loses itself in the vale of York. The River Ure, with its continuation the Ouse, is the most considerable river in Yorkshire. Another point of interest is, that the name of Yorkshire is derived from the Ure. The Saxons at first called what is now Yorkshire Deira, the County of Deer. Afterwards, they gave it the name of Eurewicscire, and the city of York, Eurewic, evidently pointing to the root of the Eure or Ure. Through the kindness of the noble owner of Jerveaux Abbey, the Earl of Aylesbury, the party were permitted free access to the grounds, and were thus enabled to form an idea of the grandeur and the magnitude of the structure when it had been in habitation. Gerveaux Abbey, says Leland, Akarius Fitz Bardolph, in the time of King Stephen, gave to Peter De Quin Crano, a monk, and to other monks of Savigny, certain lands at Fors and Worton, in Wensleydale, being part of his possession, where, in 1145, they began to lay foundations of a monastery of their order, Cistertians. What little remained of this structure had become overgrown with rough weeds and briars, and scarcely any trace of it, as a building, was seen, except some few arches nearly level with the ground, when, in 1805, the late Earl of Aylesbury visited this place, and among the great variety of improvements projected upon his estate, was much pleased with an experiment that had been made by his steward, in digging down to the bottom of one of the arches, which proved to be the door of the Abbey church, and led to a beautiful tessellated pavement and several tombs. His lordship caused the whole of the ruins to be explored and cleared out, which was done in the years 1806 and 1807, at a very considerable expense, as the base of the building was buried several feet deep below the surface, when the Abbey church and choir, two

hundred and seventy feet in length, with transept, high altar, and several tombs, the chapter house, forty-eight feet in length, by thirty-five feet in width, with marble pillars, formerly supporting the roof, were discovered; also the Abbot's house, kitchen, refectory, cloisters, and dormitory. Reluctantly withdrawing from this venerated situation the party returned to Leyburn, which they reached in time for dinner at 6.30, having walked fully thirteen miles. At a meeting held afterwards four new members were elected, and the route for the succeeding day was decided upon, namely, to drive up the dale, westward, as far as Aysgarth, a distance of ten miles.

On the morning of Friday several of the party were early astir, and being favoured with clear and beautiful weather, greatly enjoyed a walk to Leyburn Shawl or Schall, a delightful promenade, situated to the west of the town, of almost a mile in length, richly wooded, and commanding a very extended prospect. About midway there is an opening into the wood through which, it is said, Mary, Queen of Scots, passed when she attempted to escape from Bolton Castle. By this pass they rambled through the wood, and were well repaid for their exertion, as they obtained charming views. After an hour's enjoyment they returned to Leyburn, and found their friends assembled for breakfast. After partaking of which, it being market day, the arrangement of the market, which is held in the open square, was observed with interest.

At nine o'clock, A.M., having been accommodated with three open carriages, the party left Leyburn, and drove up the north side of the dale to Scarth Nick View, from which a most extended prospect was obtained, the heather-covered hills adding much to the beauty of the scene. From thence to Bolton Castle, passing on the way the hamlet of Castle Bolton. The remains of Bolton Castle are very considerable, and the walls are of great strength. The view of the surrounding scenery was very beautiful. Bolton Castle, with its fine towers, is one of the most complete, in respect of walls, at least, of the Yorkshire castles, and dates from the latter part of the fourteenth century, having been rebuilt by Richard Lord Scrope (Richard le Scrope),

Chancellor of England, whose family mostly resided at it, until the title became extinct in the days of Charles I. It stood for the king, and it was taken in 1645. This was one of the many prisons of the beautiful but unfortunate Mary, Queen of Scots, 1568. On approaching this noble pile, from the east, were noticed, with much interest, on each side of the road, the ancient cottages, Castle Bolton, which crouch, as it were, under the shelter of the castle.

At Aysgarth the party left the carriages and proceeded on foot to the waterfall, which was in great beauty. Aysgarth, the Celtic word for water and promontory, for which Aysg-arth well describes this remarkable situation. The rapids begin and soon become the powerful cataracts on which Turner bestowed some touches of his magic pencil. The River Ure, like other northern streams, especially near their source, varies greatly in respect of the quantity of water which it discharges. In floods it is a great, a mighty river, bursting with a prodigious effect through magnificent rocks, but in drought only a few gentle rills, the tears of the Naiads, run over the edges of the limestone. Near the bridge, a structure of A.D. 1536, the Sea Pink, *Armeria maritima*, was observed in beautiful bloom. Aysgarth church, which stands in a prominent position above the falls, was also visited. The manner in which the renovation of this ancient structure has been completed was much admired. This church may be regarded as the mother church for all the upper part of Wensleydale, including Askrigg and Hawes. Below this point the parishes are of smaller extent and of more frequent occurrence, indicating more ancient and important settlements than most of those in the higher part of the dales.

In returning, the south side of the dale was taken, passing in view the elegant and modern mansion of Bolton Hall, the seat of Lord Bolton, where the river was recrossed by the Wensley bridge, and the village of Wensley was arrived at. This beautiful village is like Aysgarth, a large parish, including the whole of the north side of the dale from Bolton to Leyburn. It may be regarded as having been a place of importance in early times, since it gave its name to the dale. After visiting the ancient

church the road was again taken, and no further halt was made until Leyburn was reached at four o'clock. After enjoying dinner the party proceeded to the railway station and left Leyburn at six, and after a short detention at Northallerton reached Newcastle at 10.15, delighted with the excursion, and to be remembered with satisfaction whether for the beauty and the variety of the scenery, the exhilarating effect of the pure air, the interest of the archæological features, or the pleasant friendships formed.

In accordance with the rules of the Club five Field Meetings have usually been held. However, the Committee decided to hold a sixth, and, as the Club had not visited Marsden for several years, this favourite marine locality was selected, and Friday, the 6th of October, was fixed upon.

The route taken was from the Cleadon Lane Station, visiting by the way the picturesque grounds of the Rev. George Cooper Abbs, Vice President, from thence to Whitburn, and along the coast to the Lizard's Lighthouse, at Lizard Point, and Marsden Grotto. The party were under the guidance of their venerable fellow-member, the Rev. G. C. Abbs, who, in making reference to the years he had known Marsden, reverently reminded all of the ravages of time, how the rocks, shattered by a thousand storms, had parted, from age to age, leaving vast fragments that stand in every variety of grotesque form and combination, pillars, and tombs, and towers. He also directed their steps to some singularly wild and picturesque spots, and secluded and hence little known caverns. The majority of those who were present ascended the lighthouse, and were much gratified with the inspection of the apparatus and electrical machinery for the revolution of the light.

Although the weather for several days had been extremely unsettled, and the morning was anything but propitious, fully forty members and several ladies were present at tea, ample provision and every comfort having been provided by Mr. Hawkes, the enterprising proprietor of the grotto. Mr. George Lyall, of South Shields, exhibited a photograph of a grave, with skeleton, found in the burial ground of the Romans, at the Lawe, South

Shields. After electing five new members, and passing a hearty vote of thanks to the Rev. G. C. Abbs for his kindness in acting as guide, and to Mr. Mallett, the superintendent of the light-house, the party regretfully dispersed to wend their way, in the bright moonlight, to Cleadon Lane or to Tyne Dock, to catch their return train.

Four Evening Meetings, in conjunction with the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, have been held in the Museum of the Natural History Society. All the meetings were well attended, and after the conclusion of the business of each meeting tea and coffee, kindly prepared under the direction of Mr. Joseph Wright, the obliging keeper of the Museum, was partaken of by the members and their friends.

The First Evening Meeting took place on November 23rd, 1876, when three new members were elected.

The Right Honourable the Earl of Ravensworth communicated a short memoir "*On the Capercailzie* (*Tetrao Urogallus*, Linn.)," and the attempt made to rear broods of this species at Eslington, Northumberland, from 1872 to the year 1876.

Mr. John Hancock read a paper "*On the Occurrence of the Passenger Pigeon, Columba* (*Octopistes*) *migratoria*," Linn., in Yorkshire.

Dr. Embleton read a paper "*On the Coloration of Eggs*," and exhibited a series of typical specimens of eggs.

Mr. Thomas Atthey communicated a paper "*On Anthracosaurus Russelli*," Hux., and showed several geological specimens in illustration.

Mr. T. P. Barkas exhibited two scales of *Ceratodus Forsteri*, Krefft, from Queensland.

Mr. Thomas Thompson exhibited a case of Partridges, a rare variety of plumage, shot at Elihaugh, Northumberland, in September, 1876; also two Dotterel, mature plumage, shot on the Newcastle-upon-Tyne Town Moor, in 1876.

This variety of Partridge has occurred in Northumberland

during the past few years, and is fully described by Mr. John Hancock in Vol. VI. of the Natural History Transactions of Northumberland and Durham.

A hearty vote of thanks, on the motion of Joseph Blacklock, Esq., was accorded to the authors of the communications, and to those who had favoured the meeting with speeches.

The SECOND EVENING MEETING was held on January 23rd, 1877, when five new members were elected.

The Rev. R. E. Hooppell, LL.D., F.R.A.S., Rector of Byers Green, read an elaborate and exhaustive paper "*On the Discovery and Exploration of Roman Remains at the Lawe, South Shields, in the Years* 1875 *and* 1876." The paper was illustrated with beautiful photographs, and many of the relics found were also shown. A map of the excavation, kindly favoured by Mr. Robert Blair, of South Shields, was handed round. All elicited the admiration of the members. On the motion of John Clayton, Esq., seconded by the Rev. J. C. Bruce, LL.D., a hearty vote of thanks was carried by acclamation to the author of the paper.

Mr. Hugh Miller, F.G.S., of H.M. Geological Survey of England and Wales, read a paper (Part I.), "*On the Escarpments of West Northumberland.*" The paper was illustrated by diagrams. A hearty vote of thanks was accorded by acclamation to Mr. Miller, on the motion of the Rev. J. C. Bruce, LL.D.

The THIRD EVENING MEETING was held on February 26th, 1877, when eleven new members were elected.

Mr. Hugh Miller, F.G.S., of H.M. Geological Survey of England and Wales, read Part II. "*On the Escarpments of West Northumberland.*" As on the former occasion, the paper was illustrated by diagrams.

The Rev. G. Rome Hall, F.S.A., Vicar of Birtley, North Tyne, exhibited and remarked upon a piece of Timber recently encrusted with Carbonate of Lime.

Mr. R. Y. Green noticed the "*Occurrence of Testacella haliotoidea,*" Drap., "*a Mollusc new to the District, at Gateshead.*"

The Rev. G. Rome Hall, F.S.A., exhibited some teeth and fossil remains, found upon excavating a Roman village, at Gunnerton, North Tyne. The excavation is being conducted by Mr. Hall, in accordance with an instruction from His Grace the Duke of Northumberland.

The thanks of the meeting, on the motion of Mr. Richard Howse, were heartily accorded to the readers of the papers.

The Fourth Evening Meeting took place on March 26th, 1877, when nine new members were elected.

Mr. C. M. Adamson communicated papers, entitled, "*A Naturalist's view of the Extension of the Close Time of the Sea Birds' Preservation Act in Northumberland,*" and "*Observations on the Knot, Tringa Canutus,*" Linn.

A lengthy discussion followed, and on the motion of the Rev. J. M. Hicks, the thanks of the meeting were voted to Mr. C. M. Adamson.

The papers by the Right Honourable the Earl of Ravensworth, Mr. Hancock, and Mr. Atthey have already been published in the Transactions; the others will appear in due course.

The retrospect of the proceedings of the Club during the past year would not be complete unless its publications are referred to. A Part of the Transactions has been issued with commendable punctuality. It contains contributions from several of our most distinguished naturalists. It will bear favourable comparison with those issued in former years. The Part completes Volume V. In addition, a Part of the Illustrated Catalogue of Remarkable Trees of Northumberland and Durham, selected and executed under the personal supervision of the late George Clayton Atkinson, Esq., has been issued. In making mention of the name of Mr. Atkinson, it is with extreme regret that we have to deplore his decease, which occurred on April 14th, 1877, at the age of 69. Mr. Atkinson was an original member of the Natural History Society founded in 1830; and of the Tyneside Naturalists' Field Club, of which he was President in the year 1871, and ever took a lively personal interest in its proceedings and in its

prosperity. He was an ardent botanist, and an enthusiastic meteorologist. He contributed several important and valuable papers on the science of meteorology. He was of very kindly disposition and considerate feeling, and always evinced great pleasure and interest in imparting his information to others. Nothing afforded him more satisfaction than when he was engaged in inciting his friends, more especially his young friends, to pursue and engage in the study of the natural sciences. His memory will be warmly revered and cherished.

Mr. Atkinson contributed the following papers.

To the Transactions of the Natural History Society.

Vol. I., p. 132:
Sketches of the Life and Works of the late Thomas Bewick.

Vol. II., p. 215:
Notice of the Island of St. Kilda, on the north-west coast of Scotland.

To the Tyneside Naturalists' Field Club.

Vol. V., p. 29 and p. 209:
Meteorological Notes at Wylam-on-Tyne.

Vol. V., p. 36:
Rainfall in the Vale of the Tyne for sixteen years, from 1845 to 1860.

Vol. VI., p. 46:
Rainfall at West Denton and Wylam for fourteen years, from 1849 to 1862.

Vol. VI., p. 240:
Meteorological Report for 1863.

To the Natural History Transactions of Northumberland and Durham.

Vol. I., p. 114:
Meteorological Report for 1864.

Vol. I., p. 173:
Meteorological Report for 1865.

Vol V., p. 63 and p. 154:
Two Instalments of a Catalogue of the more Remarkable Trees of Northumberland and Durham, with Plates, Parts I., II., and III.

Another much esteemed member has also been removed by death during the past week, Henry Blackiston Fell, of Biddick

Hall, near South Shields, who died at his residence on April 14, 1877, at the age of seventy-six years. Mr. Fell was elected a member of the Club in the year 1860, and was a frequent attender at the Field and Evening Meetings. Mr. Fell was an ardent naturalist, a great admirer of Nature's beauties, and happy in anecdote. Although Mr. Fell had not communicated any papers, yet he was more than once a Vice President, and was ever zealous in aiding the advancement of the Club.

Part III. of the Illustrated Catalogue of Remarkable Trees contains six photographs, and of these one would appear particularly to call for special remark, namely, that depicting dead trees at Washington. The viewing of this is sad to contemplate, and brings with it a feeling of distress and commiseration. For, if plants and trees languish and die from vitiation of the atmosphere, so must animals, and most assuredly the highest of all living beings, man.

The tree that is scathed seldom blossoms anew!

The beauty of field and of fell are murdered with poison fumes. Even down the course of our own River Tyne vegetation has become blasted, and the green branches of trees have become converted into gaunt black spectre arms mournfully waving over the grave of the grass and the hedgerow blossom. If it can be shown that such sins against the spirit of loveliness are costly, that the death of shrub and of flower, the spoliation of beck and of dene, cost money, then the words of the despised prophet of æstheticism will be listened to with attention, and a little more light will be shed upon the marvellous correlation which links man and his works with Nature and hers. As a prelude to this, let us hope that the appointment of the Royal Commission respecting noxious fumes from works and factories may prove the first step. This Commission has been appointed to inquire into the working and the management of works and manufactories from which sulphurous acid, sulphuretted hydrogen, and ammoniacal or other vapours and gases are given off. The Commissioners are to ascertain the effect produced by these emanations on animal and vegetable life, and are to report on the means to be adopted for the prevention of injury in such cases. The

inquiry is large and momentous. On the one hand we have a host of manufacturing and trading industries, while on the other hand we have the comfort and the health of thousands of individuals, and the question of preserving the crops and the trees from destruction.

Vegetation is desolated and human comfort is seriously interfered with by the fumes of works and factories. The great manufacturing industries have done much to pollute the streams and the rivers which once gave beauty to the landscape and promoted the health of the people. But air is invaded as well as water, and breathing as well as drinking becomes a peril. That vegegation perishes, and that human enjoyment is seriously curtailed, in consequence of the discharge of what may be termed artificial gases, cannot be denied. But while the destruction of vegetable life is patent to the observer, the effect on animal life is not so obvious and direct. A depressing odour, occasioning nausea, headache, lassitude, and other symptoms, may not be immediately identified with disease, but it is certain that no one will remain in a disagreeable or vitiated atmosphere who can possibly escape it.

Serious damage of a pecuniary kind is thus inflicted on the owners of house property. If safety and comfort are only to be sought in flight, we shall have a wider gulf than ever between the rich and the poor, the former removing to localities which are free from trade nuisances, while the latter will be massed together in large town populations subject to those annoyances and dangers from which the wealthy are able to escape.

Commercial, sanitary, and social questions are thus connected with this topic: How the interests of the manufacturer may be rendered consonant with the well being of the community at large! Among the facts which show how real and yet how subtle is the mischief which arises from what we may call imperfectly regulated works may be mentioned the following. By experiment it has been shown that sulphurous acid, even if greatly diluted, does much injury to vegetation. Professor Stockhardt considered that the proportion of this acid in the air ought not to exceed one part in two hundred and fifty thousand.

Professor Frezteg found that air with one part of sulphurous acid in fifty-five thousand destroyed the green leaves of wheat, oats, and peas, when moist, the effect being visible in a few hours. Muriatic acid is the special pest of the alkali districts, but the operation of the Alkali Act occasions a continually increasing development of sulphuretted hydrogen from the tank waste. The amended Alkali Act, which came into operation in the year 1875, dealt more strictly than before with the muriatic acid, and required the suppression of all other noxious gases given forth by alkali works, so far as "the best practicable means" could compass the end. In due course we shall be told of the real extent of the evil. It is to be trusted, also, that some way may be discovered for preventing the growing pollution of the atmosphere, while still leaving to the manufacturer ample scope for the realisation of profit.

Another question which calls for comment, which more particularly concerns naturalists, and more particularly ornithologists, is the providing, by the Legislature, a close time for the protection of indigenous animals. It is with a feeling of great satisfaction that allusion is made to the passing by Parliament of the Wild Fowl Preservation Act, in the Session of 1876. The bill was carried in the House of Commons by a majority of three hundred and twenty-four, the voting having been three hundred and thirty-seven for and thirteen against. Petitions in favour of the bill were presented to the House of Commons by Matthew White Ridley, Esq., M.P., for North Northumberland. The petitions were signed by the magistrates, numerous landowners and residents in the county of Northumberland. The Committee of the British Association appointed for the purpose of inquiring into the possibility of establishing a close time for the protection of indigenous animals, reported at the Annual Meeting of the Association at Glasgow. The indirect cause of the decrease of wild fowl, Wheatears, Goldfinches, Linnets, etc., are the diminution of their breeding haunts by reclamations and the various other improvements and curtailments induced by modern civilization. Fishes, such as Cod, Herrings, and the like, have Dog-fish, Cormorants, Porpoises, and other enemies

innumerable, but, owing to their fertility, they have hitherto successfully contended with them. When however man steps in and the balance is destroyed, when the fish are cut off before their otherwise allotted time, then their numbers dwindle, and it becomes necessary to consider whether some limitation should not be set also to our sea fisheries. Moreover, it is to be hoped, that in spite of the subordinate position held by science in our aquaria, they may yet conduce to give us a definite knowledge of the habits and the spawning times of fishes, and when this has been accurately acquired, if not before, it may be further anticipated that increased intelligence, and a wise political economy, may impose a close time for the scaly inhabitants of the sea, as effectually at least, as it already more or less has done for the feathered denizens of the air. These reflections point to the paramount importance of preserving and of providing extensive nurseries. In our midst, happily, we have the good fortune to have the Leazes Park, the Town Moor, and the beautiful grounds of Sir William Armstrong, C.B., in Jesmond Dene. Let us hope, that before long the almoners of the former will be incited to extend this well arranged retreat, and with an enlarged Leazes Park, and the formation of other recreation grounds, on the outskirts of the Moor, the secluded breeding places will be so extensive that at no distant period our townsmen will not only gain delight and instruction in watching our feathered inhabitants, but also that their health may be vivified thereby.

Respecting the preservation of sea birds, by order of H.M. Chief Secretary of State, from the Home Office, dated November 27th, 1876, the time has been extended, during which the killing, wounding, or taking of sea birds is prohibited by Act of Parliament, making such prohibition, within the limits of the County of Northumberland, extend from the first of April to the first of September every year, instead of the first of August, as prescribed in the Act. There is some doubt as to the effect for good of this extension of the close time. For the preservation of the late broods is of minor importance, in comparison with the harm which is done by the taking of the eggs in the early part of the season, and the wanton destruction of the young birds

throughout the whole of the close season. The more vigilant watching of the breeding places during the hatching period is what is wanted. Some further regulations therefore would seem to be required to be applied to the bird catchers. The difficulties in the way however are considerable.

Concerning the advances that have been made in natural science, during the past year, the following may be specially referred to.

The views which Dr. Dohrn, of Leipzig, has recently put forth, as to the details of the steps by which the vertebrate stock arose out of an ancestry not very much unlike the existing Annelids, are of much interest. He first draws attention to the correspondences between vertebrate and insect embryos, which have been too little regarded in consequence of our designating the nervous side in the one as dorsal, and in the other as ventral. Yet the facts, that in both, the nervous system is developed on the convex side of the embryo and acquires a strong convex plexure anteriorly, and that the body cavity is finally closed upon the side of the body opposite to the nervous system point to a common origin at a comparatively high level. The surface of the animal which is called ventral is determined by the presence of the mouth on that surface, and if any vertebrates had a mouth opening between the brain and the spinal cord on the dorsal surface that dorsal surface would necessarily become ventral. Since, moreover, the ancestors of the vertebrata must have had a nervous ring surrounding their gullet, it would appear more reasonable to suppose that the mouth opening had been changed in the course of development than that the situation of the nervous centres had been altered. We are thus led to look for traces of an old mouth opening on that surface of the early vertebrates which correspond to our dorsal surface, and to seek reasons for regarding our present mouth as a comparatively modern development. Dohrn believes that the old mouth passed through the nervous centres between the crura cerebelli, or, more accurately, in the fossa rhomboidea, or fourth ventricle, which is remarkable for being of greater proportionate

size early in development, and afterwards undergoing retrogression. At an early stage we only need to conceive a slit to be made in the nerve tube at the bottom of the fossa rhomboidea, in order to furnish a suitable passage into the alimentary canal. His first reason for regarding the vertebrate mouth as a modern structure is that it arises so extraordinarily late in development. The embryonic body is almost completely framed, all the great systems are established, the circulation is in active operation, while as yet there is no mouth. Again, the mouth does not arise in the position in which it permanently remains in the great majority. It undergoes considerable shifting forwards. Only in the Selachians and Ganoids does it retain its primitive situation. Moreover, the study of development is steadily tending to establish the idea that the mouth of vertebrates is homodynamous with the gill-clefts. It is limited, like them, by a pair of arches, lies just in front of the first pair of gill clefts, arises simultaneously with them in the embryo, and opens into the alimentary canal. A glance at the ventral surface of a Ray shows the likeness of the mouth to a pair of coalesced gill-clefts. Consequently, it becomes probable that the present mouth opening once existed functionally as a gill-cleft, that at a certain period in the ascending development both the old and the new mouths supplied nourishment, that the latter gained the predominance, and that finally the old mouth became aborted.

The next problem attacked is the origin of the gill-clefts. A very elaborate account is given of the supposed process by which the external gills and segmental organs of Annelids were metamorphosed into the gills and the gill-clefts of vertebrates and the skeletal elements connected with them. The great difficulty which Dohrn confesses in this matter is the connection of the inner extremities of the segmental organs with the wall of the alimentary canal. But if this be granted, it is comparatively easy to understand how the shortening and the widening of the segmental organs might give rise to gill-cavities such as those of the Selachians.

It follows, from the view of the origin of vertebrates thus expounded, that Amphioxus loses much of its interest, for there is

no place for Amphioxus among Annelids, nor among the primordial vertebrates, as it lacks almost all that they possess. Yet nothing can be gained by excluding Amphioxus from the vertebrates, for it is so connected with the Cyclostome fishes that it cannot be placed at any great distance from them, while on the other hand it is so related to Ascidians that the latter must be included among the vertebrata. Dohrn then proceeds with a long argument to show that the Cyclostome fishes are degenerate from a higher type of fishes, and that Amphioxus is a result of still further degeneration. He shows how their mode of life necessitates many of the modifications they have undergone, and that the diversities of the details of structure in Cyclostomes are inconsistent with their being viewed as representing stages in upward development. Finally, the larva of Ascidians is represented as a degenerate fish, a degenerate Cyclostome possibly, which carries to the extreme all the departures of the latter from the fish type. The most important element in this degeneration results from the fact that Ascidians, instead of being attached to fishes or to any objects from which they can derive nutriment, are fixed to stones, plants, or to such parts of animals (cephalothorax of Crabs, tubes of tubicolous annelids) as do not afford them nourishment. Consequently, they have lost the old mouth in the organ of attachment, homologous with that of all vertebrates and have developed a new one, homologous with the nasal passage of Myxine. Thus we can explain the astonishing fact, that the mouth opening of the Ascidian larva has a communication with the fore wall of the so-called cerebral visicle. The most patent objection to Dohrn's view about Amphioxus is that it fails to account for the development of a many-segmented respiratory apparatus as a degeneration for a higher animal with a small number of gill arches. It would appear far more reasonable to suppose Amphioxus to be a degeneration from a much lower elevation than the Cyclostome type, namely, from some stage where the respiratory apparatus retained the multiserial character derived from its Annelid forefathers. The keynote of this reasoning is to be found in the principle of transformation of functions. It is stated thus: "The transformation of an organ

happens through a succession of functions being discharged by one and the same organ. Each function is a resultant of several components, of which one constitutes the chief or primary function, while the others are lower or secondary functions. Diminution of the importance of the chief function, with increase of the importance of a secondary function, alters the entire resultant function, the secondary gradually rises to the chief function, the resultant function becomes different, and the consequence of the whole process is the transformation of the organ." This principle is considered to be a complete answer to the difficulty so strongly insisted on by Mivart, the incompetency of natural selection to account for the incipient stages of subsequently useful structures. Dohrn's statement of his principle would seem not to be very different from Darwin's, though a little more definitely stated. Darwin says, "The same organ having performed simultaneously very different functions, and then having been in part or in whole specialised for one function, and two distinct organs having performed at the same time the same function, the one having been perfected whilst aided by the other, must often have largely facilitated transition."

At a meeting of the Cambridge Philosophical Society, held on October 30th, 1876, an account was given by Mr. Bettany of some of the conclusions arrived at by Professor W. K. Parker and himself on the morphology of the skull. The detailed comparison, for the first time, of the whole of the developmental histories of skulls which had been hitherto investigated, including some very recent researches, had led to some important modifications of view. The questions dealt with referred to the cranial elements which appear the earliest. It was sought to discover what parts are axial and what parts appendicular. Whether, indeed, the axis of the body ceases at the middle of the base of the skull, and the latter has to annex properly appendicular structures in order to become complete. There was much difficulty in determining these points, because in many of the higher forms the earlier stages of development were passed through with great rapidity, and because in other cases the adaptation of the adult form to its special conditions of life more or

less affected the course of development and disguised the real relationships. It was argued, that the development of no one type afforded an absolute guide to principles; only when the whole of the facts become known could adequate generalisations be arrived at. Professors Huxley and Parker had some years ago been led to view the trabeculæ cranii, the primary elements underlying the base of the fore part of the brain, as non-axial, but as comparable to the visceral arches or mandibular hyoidean and branchial series. Some of their main reasons appeared to be that the trabeculæ in several types arose distinct from the axial parts at the hinder part of the skull, that in the early flexure of the fore part of the brain, about the end of the notochord or dorsal axis, the trabeculæ became correspondingly down-bent so as to be more or less parallel with the visceral arches, and that a very constant distribution of a branch of the great trigeminal nerve seemed to be analogous to the distribution of nerves in the facial arches. But many considerations now induced Professor Parker and Mr. Bettany to abandon that view, and rather to regard the trabeculæ as proper axial elements. Some of these were, that the trabeculæ arise in tissue immediately underlying the cerebral cavity just as the vertebræ arise in tissue beneath the spinal canal, that the temporary mesocephalic flexure does not make the tissue other than axial, while the proper axial position is early resumed, that every relation of the trabeculæ proper is to the nervous centres, and that cartilaginous growths continuous with them bound the cranium laterally, just like the formation of the lateral occipital or vertebral regions. Further, it was sought to show, that reckoning the trabeculæ as axial elements, they probably possessed their own appendicular parts in the pre-nasal and ante-orbital region. It was contended, that in the face of these facts it was in the highest degree undesirable to consider the fore part of the skull as a mere modification of facial appendicular parts, and that there were strong reasons for a recurrence to the earlier, more natural, and simpler conception, that the most important part of the skeleton had its own proper axis, and did not borrow it from without.

Much light was doubtless shed upon the higher forms by researches into the lower, but it was sometimes forgotten that the converse was also true, and that much light respecting the significance or potentiality of the lower forms was shed upon them by observations of higher types. In spite of all that has been recently said on the subject, the segmental or vertebral theory of the skull is one of the most assured of morphological views. It is impossible to make even a cursory examination of the mammalian skull without being convinced, with Goethe, that it was a continuation of the vertebral series, and that in its anterior or trabecular part it was like the rest of the skeleton, planned in conformity with the principle of transverse segmentation. The divergence of the trabeculæ, caused apparently by the presence of the structure from which the pituitary body is formed, led to the view of their appertaining to the visceral arch or appendicular elements, but their horizontal position and relation to the cranial cavity pointed to their axial character. At any rate, there cannot be a doubt that the osseous centres formed for them or in connection with them, the basi-sphenoid, the basi pre-sphenoidal, and the basi-ethmoidal, are axial elements. The trabeculæ, possibly, may be both axial and appendicular elements forming the bases of the axial segments, and being continued forwards and downwards in the median plane as a visceral structure constituting the septum narium.

The event of greatest practical importance in Botany, during the year 1876, has been the publication of De Bary's observations on the life history of the potato fungus (*Peronspora infestans*). The ground on which it can be claimed as part of England's share of progress is that the observations were undertaken at the request of the Royal Agricultural Society, funds for the purpose were furnished by the Society, and the report appears in its Journal. As the habits of this uncontrolable pest are better known, it may fairly be hoped that the proper means for lessening its ravages will be put into practice, and that potato disease will not again be the terrible scourge it has been.

Mr. G. Bentham's paper, communicated to the Linnæan Society,

on a new classification, and on the Terminology of the Monocotyledonous plants stands out as a brilliant exception to the other work of the past year. There has been a large amount of determining new plants and arranging collections, but with this exception, nothing to make the year remarkable. What the influence of this new classification may have on the evolution theory it is too soon to see. Mr. Bentham proposes an entirely new arrangement of the orders of *Endogens*, which he believes to be more in accordance with their generic affinities and the essential points of their structure than any at present in use. He proposes to classify *Endogens* under four series, namely,—

I. *Epigynæ*, flowers with a double, usually petaloid perianth, ovary usually inferior, syncarpous.

II. *Coronarieæ*, flowers with a double, usually petaloid perianth, ovary superior, almost always syncarpous.

III. *Nudifloræ*, flowers usually achlamydeous, or with a dry perianth, ovary mostly apocarpous.

IV. *Glumales*, Perianth replaced by membranous scales, (pales or lodicules) ovary always uniovular.

Lindley, in his "Vegetable kingdom," proposed the separation of a distinct class, *Dictyogens*, for certain genera with reticulate venation, a division generally rejected. Fries (1835) taking the perianth established four primary divisions, partially corresponding to those here adopted. Brongniart (1843) relied on the nature of the albumen for a re-arrangement of the *Dicotyledons* and *Monocotyledons*. From this, however, serious exceptions detract. Other characters have been considered important by different botanists, but none strictly followed out in detail. The classification of Mr. Bentham is recommended as combining practical convenience along with supposed natural affinities.

In Physiological Botany, Professor Burdon Sanderson, M.D., has made some important observations on the electricity of leaves, and the localization of the electricity of certain portions of them. He found that, as in the muscles of animals, an electrical current exists in the leaf of the *Dionæa muscipula*, the Venus' Flytrap, in its unexcited state, and that, during excitation, the current is reduced in intensity or undergoes a negative variation.

The results of an investigation of a similar nature have just been published by Mr. Yule, of Magdalen College, Oxford, who has demonstrated the existence of like conditions in the fruit of *Momordica elaterium*, a plant of the Cucumber family. The fruit in question is gourd like, about two inches in length, and when ripe separates from its peduncle, leaving a small hole through which the seeds are expelled with such violence as sometimes to be shot off to a distance of fifteen feet, the fruit at the same time undergoing a marked diminution in size. Mr. Yule found that in most cases the breach of the fruit, or the end farthest from the peduncle, was positive to the centre, so that the direction of the current is precisely opposite to that of a muscle, and that a very considerable negative variation took place at the moment of dehiscence.

The safe return of H.M. ship "Challenger," after an absence of three years and a half, is a subject of general congratulation. This exploring vessel weighed anchor from Spithead on December 21st, 1872, and returned to Portsmouth on May 24th, 1876. The object of the expedition was to determine, as far as possible, the physical and the biological conditions of the great ocean basins, the Atlantic, the Southern Sea, and the Pacific. This important marine scientific investigation has reached a successful termination. She has steadily traversed a track of sixty-nine thousand miles, and has established three hundred and sixty-two observing stations. Some hundreds of specimens have been obtained, including many interesting specimens of Natural History, a collection of unexampled interest, testifying to the research and energy of the staff. Perhaps the most important are comprised in a paper read before the Linnean Society, entitled, "*Observations on new, living Crinoids and on Echinodermata*," groups to which the eminent director, Sir Wyville Thompson, as is well known, had previously paid much attention.

The peculiarity of the expedition was, that in the case of the "Challenger" the cruise became secondary, and the scientific object primary, that she was in fact fitted up with the view of

obtaining certain scientific data which were requisite for the further progress of natural knowledge. In her case the duty of geographical exploration was subordinate, and the duty of scientific investigation paramount.

In addition to this important recognition, by Government, of Natural Science, it is only due also to make mention of the Government aid to scientific research. The legislature of the land has at last seen it to be its duty to act upon the recommendation of His Grace the Duke of Devonshire's Commission, and to make a substantial contribution towards the endowment of pure scientific research. A sum of five thousand pounds per annum is now devoted to this object, and is to be administered by the Royal Society. One sum of one thousand pounds is to be appropriated mainly to the providing of instruments and other assistance necessary to scientific inquiries, while the other sum of four thousand is to be applied to the aid of scientific investigators, not only by providing instruments and assistance, but by making personal allowances or grants of money to the investigators for their services.

In bringing this valedictory address to a conclusion, a short reference to the present position of the Club would appear to be the most fitting. At the last Anniversary, the Club was constituted of six hundred and thirteen members, of whom fifty-three have been withdrawn, either in consequence of resignation or of death. During the year eighty-five new members have been elected, so that the Club, at the present time, is composed of six hundred and forty-five members, an increase of thirty-two in comparison with the previous year. This is very pleasing, and is an evidence of the stability and of the increasing appreciation of the privileges of its membership. The financial position is equally satisfactory. For such, we are indebted to our much esteemed Treasurer.

The meetings, Field and Evening, during the year, may be regarded as to have been successful. To the Committee, but more especially to the Honorary Secretaries, for the admirable arrangements that were made for our edification and comfort,

our acknowledgments are most justly due, and are hereby gratefully tendered. The excursions were interesting, and were not unproductive as to their results. The goodly number of members present at the Evening Meetings, those pleasant reunions, is cause for general gratulation. While the papers which were read, the remarks made, and the information given, together with the specimens and objects exhibited, were quite in keeping with the objects contemplated.

It is pleasant to note all plants, from the rush to the spreading cedar,
To watch the workings of instinct, that grosser reason of brutes,
To trace the consummate skill, that hath modelled the anatomy of insects,
To read the antique history of the earth, stamped upon those medals in the rocks.
It is an admirable lore, to learn the cause in the change,
To study the chemistry of Nature, her grand, but simple secrets,
To search out all her wonders, to track the resources of her skill,
To note her kind compensation, her unobtrusive excellence.
In all, it is wise happiness to see the well-ordained laws of Jehovah,
The harmony that filleth all his mind, the justice that tempereth his bounty,
The wonderful all prevalent analogy that testifieth one Creator,
The broad arrow of the Great King, carved on all the stores of his arsenal.

The following gentlemen were elected members of the Tyneside Naturalists' Field Club during the year 1876–7 :—

At the Anniversary Meeting, April 11th, 1876 :—Joseph Coxon, J. G. Benson, Newcastle; Arthur Brown, Thos. Richardson, Gateshead; T. H. Hedworth, Dunston; William James Johnson, Allendale; D. C. Glen, J. Barclay Murdoch, Glasgow.

At the First Field Meeting, May 11 :—J. Brown, Matthew B. Gardner, W. H. S. Thompson, Newcastle; Benj. Barkus, W. T. Kay, Miss J. L. Mawson, Mr. J. Walton Robinson, Jun., Gateshead; Miss M. Ormston, Low Fell; W. H. White, Killingworth; J. H. Penny, South Shields; Miss Bainbridge, Cullercoats.

At the Second Field Meeting, June 5th :—Thos. Pumphrey, David Gemmell, C. S. Hunting, James Fletcher, F. W. Rich, J. Edmonson Joel, Jas. Garland, E. H. Richardson, Newcastle; Mrs. Mary Charlton, Henry Charlton, Thomas Bowden, Gateshead; Thomas Young, North Shields; George Egdell, Morpeth.

At the Third Field Meeting, July 13th :—John T. Alcock, T. J. Armstrong, Newcastle; Colin Smart, Frederick Clark, Harry Clark, Sunderland; R. C. Nelson, Roker.

At the Fourth Field Meeting, August 7th :—T. H. Bainbridge, Market Street, Benj. Plummer, Jun., Westmorland Road, Newcastle; William Glover, Low Fell, G. H. Herbert, Oxford Terrace, W. H. Ryott, Saltwell Grove, Gateshead; Robert Cameron, The Green, J. W. Fletcher, Argyle Square, T. G. Hutton, South Moor, W. H. Shevill, Norfolk Street, Sunderland; W. J. Atkinson, Morpeth; Chas. F. White, Windsor Road, Ealing, W.

At the Fifth Field Meeting, September 14th and 15th :—Miss Cooke, John Cutter, Andrew Balfour, Newcastle; George Douglas, Gateshead.

At the Sixth Field Meeting, October 6th :—Rev. Thomas Douzer, Newcastle; J. G. Angus, Rev. J. Maber, Gateshead; James Rennoldson, Cullercoats.

At the First Evening Meeting, November 23rd:—Henry Hutchinson, Elswick Ordnance Works; Eustace M. Swanwick, West Hartlepool; H. E. Draper, London.

At the Second Evening, January 23rd, 1877:—Geo. C. Davis, Newcastle; Thos. Lambert, Whickham; J. F. Armstrong, M.D., South Shields; Walter Scott, Sunderland; Hugh Miller, F.G.S., Wark-on-Tyne.

At the Third Evening Meeting, February 26th:—Thomas Heath, James Dellow, W. S. Young, J. Blake, W. C. Arnison, William Neill, Thomas Bailes, Newcastle; James Joicey, Alfred C. Coning, Henry N. Ground, Gateshead; J. H. Beckingham, Tynemouth.

At the Fourth Evening Meeting, March 26th:—Dinsdale Oubridge, John Page, Edwin O. Reid, Mark Wm. Pybus, John Storey, William Maughan, Newcastle; Thomas Sewell, David Hetherington, Bulman Village; Joseph Crisp, South Shields.

The Field Meetings for 1877 were arranged to be held as follows:—

May 21st	Middleton-one-Row.
June 25th.....	Castle Eden and Black Halls.
*July 19th	Naworth and Lanercost.
August 6th	Bishop Auckland and Neighbourhood.
September 14th .	Druridge and Newbiggin-by-the Sea.
October 5th	Marsden.

* A Special Meeting to the Cheviot in July, if twelve or more members wish to join such an Excursion.

THE TREASURER IN ACCOUNT WITH THE TYNESIDE NATURALISTS' FIELD CLUB.

Dr.	£	s.	d.
1877.			
To Balance brought forward	24	11	1
April 19.			
,, Subscriptions.....	164	10	0
,, Sale of Transactions.....	11	14	8
,, Natural History Society for Parts 2 and 3, Vol. V.	25	17	0
	£226	12	9

Cr.	£	s.	d.
1877.			
April 19. By Commission	7	14	9
,, Printing Transactions	75	3	0
,, Plates.....	30	14	3
,, Printing Circulars and issuing same	28	13	9
,, Postage, etc.	17	7	7
,, Balance	66	19	5
	£226	12	9

1877, April 19.—Examined and found correct,

T. P. BARKAS, Auditor.

THE following gentlemen were elected officers of the Club for the year 1877–8 :—

PRESIDENT.

Rev. R. E. Hooppell, M.A., LL.D.

VICE-PRESIDENTS.

John Philipson, Esq.
D. O. Drewett, Esq.
E. C. Robson, Esq.
William Maling, Esq.

Ralph Carr Ellison, Esq.
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T. Sopwith, Esq., F.R.S.
Rev. Canon Tristram, F.R.S.
George Wailes, Esq.
Rev. G. C. Abbes, M.A.
Rev. A. M. Norman, M.A.
Rev. J. C. Bruce, LL.D.
Rev. A. Bethune, M.A.
E. J. J. Browell, Esq.
Rev. R. F. Wheeler, M.A.
Prof. G. S. Brady, M.D.
H. B. Brady, Esq., F.R.S.
Rev. J. E. Leefe, M.A.
Rev. G. R. Hall, M.A., F.S.A.
G. H. Philipson, Esq., M.D.

TREASURER.

Robert Y. Green.

SECRETARIES.

Richard Howse. | Thomas Thompson. | Edwin Dodds.

COMMITTEE.

Thomas Atthey.
William Dinning.
John Hancock.
John Glover.
T. W. Backhouse.
James Clephan.
W. M. Wake.
T. T. Clarke.
John T. Thompson.
Emanuel Young.
Joseph Blacklock.
Rev. J. M. Hick.

AUDITORS.

J. S. Foster. | T. P. Barkas.

II.—*A Paper on Eggs.* By D. Embleton, M.D.

I. Preamble.—Eggs have always been invested with special interest: in ancient times they were regarded as objects of worship, and they are still looked upon as symbols of the resurrection of the body and of eternity. To the Biologist they present subjects for the study of the early phases of the evolution and development of the animal frame. They furnish a delicious and eminently nutritive form of food alike for young and old, the healthy and the invalid, when taken in moderation. They have afforded to the Architect and the Decorative Artist models of strength and beauty of outline. And it may be added they have become of very great and increasing importance as articles of commerce.

The form, and also the colouring of eggs, are always pleasing to the eye, and our interest in these beautiful objects would probably be increased in proportion to our more intimate acquaintance with them. And although an investigation into the causes of their form and colour may seem to many to be a matter so trivial as to be almost unworthy of notice, yet the lover of nature and of her truths will not despise such inquiry, inasmuch as it involves a manifold reference to the sciences of Human and Comparative anatomy, and touches at more than one interesting point the chemistry of the bile and the blood.

The word Egg is of Teutonic origin. In Icelandic it is Egg; in Anglo-Saxon, Aeg or Æg; in German, Ei or Ey; in Dutch, Ei; in Flemish, Ei; and in Danish, Äg, and Swedish, Ägg or Ägg, pronounced as Egg in English.

In very early English (see Richardson's Dictionary) the word is written, by Robert of Brunne, Ay; as,

> "An ay bi it selue for fiue schillynges was bouht,
> A pere for penyes tuelue, or thei had it nouht."

In Pier's Plouhman it is Egge; in plural, Eyren and Eiren.

By Wiclif, it is written Eg; as,

> "Or if he axe an eg, whether he schal areche him a scorpioun."

In Chaucer, Ey; as,

> "Hire bord was served most with white and black,
> Milk and broun bred, in which she fond no lack,
> Seinde bacon, and sometime an ey or twey."

In Gower, Eie; as,

"And polished was eke so clene
That no signe of the sculle was sene,
But as it were a grips eie."

In the Bible of 1551 it is Egge.

After that time the word assumed its present form in writing and in print. But we know that in Yorkshire and some other southern counties, like some other words beginning with a vowel, it is pronounced with an aspirate; whilst other words, which are normally aspirated, have the aspirate omitted, as "Wat will you ave for breakfast? Am and Heggs?"

In Greek egg is ὠόν which, with the digamma (F) interposed between the vowels, and the Latin termination substituted, becomes ovum. This in Italian is uovo; in Portuguese, ovo; in Spanish, huevo; in Catalan, ou; in Provençal, ov, uov, ueu; in the district of Bourg, eu; in that of Berry, œu; in Picardy, ue, ui; in the Walloon district, oû.

In French of the thirteenth century it was uef, oef (pl. oes), as "comme l'ecaille d'un uef," and "Les jors que un ne mangera char, un jor un quartier di fromage et l'autre jor quatre oes." (Du Cange fr. Chartul. Campin. fol. 273, col. 2.)

In the fourteenth century, euf, œuf (plur. eufs); in the fifteenth, œuf (pl. oes); after which time it assumed entirely its present orthography. (Littré Diction. de la lang. Française.)

Oeuf, ὠόν, is said to be derived from ὄιον, seul, parceque dans les oiseaux chaque femelle n'en pond ordinairement qu'un par jour. (Dict. des Sc. Med. 1819, tom 37.)

In the Celtic languages, egg, in Gaelic, is ubh; in Irish, ugh; in Welsh, wy (pl. wyan); in Cornish, uy, oy (pl. oyow); in Bas Breton, vi, ui (pl. viou), and uieu; and in Manx, ooh. (See Dictionaries of those languages.)

The relations to each other of most or all of these names for egg will best appear in a quotation from "Lectures on the Science of Language by F. Max Müller, M.A., 7th edit., 1873, Vol. II, p. 315, in which this great master in Philology states, that "The English sound of *i*, which in English expresses an *eye*, oculus, is used in German in the sense of *egg*, ovum; and it

would not be unreasonable to take both words as expressive of roundness, applied in the one case to an *egg*, in the other to an *eye*. The English *eye*, however, must be traced back to the Anglo-Saxon *eáge*, Gothic *augô*, German *auge*, words akin to Sanskrit akshi, the Latin *oculus*, the Greek ὄσσε; whereas the German *Ei*, which in Old High German forms its plural *eigir*, is identical with the English *egg*, the Latin *ovum*, the Greek ὠόν, and possibly connected with *avis*, bird."

The figurative Mundane Egg, in process of incubation, or being protected by the Serpent, which was itself also anciently an object of worship, has been found represented on an ancient coin of Tyre with the inscription "Turiorum." It is figured in "Ceramic Art of Remote Ages," Plate 47, fig. 8 (Maurice after Gronovius, Vol. I.), by my late friend Mr. J. B. Waring. A copy of the figure of this Phœnician coin representing the Serpent and Mundane Egg, etc., is here given. Woodcut No. 1.

No. 1.

Mr. Waring thereon remarks: "In the Tyrian coins, Nos. 7 and 8, the earliest of which is stated to be posterior to the time of Alexander the Great, we see, beside the Serpent and Mundane Egg, and the Serpent and Ambrosial Stone, the Murex shell from which the Tyrian purple dye was obtained, and the Palm, an emblem common to the Phœnicians and Jews. Mr. Gliddon, in a very valuable note to Chapter V. in Squiers' 'Serpent Worship,' points out that this symbol of the Serpent and Mundane Egg was not usual among the Egyptians, and he considers that

it was peculiarly Phœnician: in each of these cases the Serpent, no doubt, represents the creative and protecting power of the primal Deity."

In Littré (Diction. de la lang. Française) we find the following: "L'oeuf primitif, ou oeuf d'Orphéo, est la symbole de certains philosophes anciens pour désigner le principe intérieur de la fecondité."

With regard to Egg-worship, the following passage from De Gubernatis' Zoological Mythology may be of interest. He says, "Part of the worship which was offered to the cock and to the hen was also rendered to the egg: the Latin proverb, *Gallus in sterquilinio suo plurimum potest*" shows the great value of the egg. The pearl which the fowl searches for in the dunghill is nought else but its own egg; and the egg of the hen in the sky is the sun itself. During the night the celestial hen is black, but it becomes white in the morning; and being white on account of the snow, it is the hen of winter. The white hen is propitious, on account of the golden chickens hatched by it.

"In the Monferrato it is believed that the eggs of a white hen laid on Ascension Day, in a new nest, are a good remedy for pains in the stomach, head, and ears, and that when taken into a cornfield they prevent the blight, or black evil, from entering among the crops, or when taken into a vineyard they save it from hail.

"The eggs which are eaten at Easter, and concerning which, accompanied sometimes by songs and proverbs, so many popular customs, mythologically in accordance, are current in the various countries of Europe, celebrate the resurrection of the celestial egg, a symbol of abundance, the sun of spring.

"The hen of the fable and the fairy tales, which lays golden eggs, is the mythical hen, the earth or the sky, which gives birth every day to the sun. The golden egg is the beginning of life in Orphic and Hindoo cosmogony; by the golden egg the world begins to move, and movement is the principle of good. The golden egg brings forth the luminous, laborious, and beneficent day. Hence it is an excellent augury to begin with the egg

which represents the principle of good, whence the (equivocal) Latin proverb, "*Ab ovo ad malum*," which signified, "from good to evil," but which properly meant "from the egg to the apple," the Latins being accustomed to begin their dinners with hard-boiled eggs and to end them with apples, a custom which is still preserved among numerous Italian families.

"But to begin *ab ovo* also means to begin at the beginning. Horace (Ars Poetica) says that he does not begin from the twin eggs the description of the Trojan war; "*nec gemino bellum Trojanum orditur ab ovo*," alluding to the egg of Leda, to which the Greek proverb "Come out of the egg" (*ex óou exélthen*) also alludes, said of a very handsome man, and referring to fair Helen and her two luminous brothers, the Dioskuroi. (*Zoological Mythology, or the Legends of Animals*, by Angelo de Gubernatis. Vol. II., p. 291, 1872.)

Sir J. G. Wilkinson, in Vol. III. of "Manners and Customs of the Ancient Egyptians," 1837, informs us at page 20, "that the purposes to which the eggs" of the Ostrich "were applied are unknown; but we may infer, from a religious prejudice in their favour among the Christians of Egypt, that some superstition was connected with them, and that they were suspended in the temples of the ancient Egyptians, as they still are in the churches of the Copts." In a note he adds, "They, the Copts, consider them the emblems of watchfulness. Sometimes they use them with a different view; the rope of their lamps is passed through the egg, in order to prevent the rats coming down and drinking the oil, as we were assured by the monks of Dayr Antonios."

The Paschal, Paschall, Pask, or Paste eggs distributed at Easter, appear to have been originally dyed red, and were commonly given and received as symbols of death and resurrection. In the present day they are gaily variegated in colours, silvered, gilded, and so forth, and are commonly in the North of England the mere playthings of children of both sexes.

It is from the study of the ovum that we have been made

acquainted with the astonishing phases presented by the growth and development both of plants and animals,

"A mighty maze but not without a plan."

This study has opened out new vistas in the vast domains of Anatomy and Physiology, through which we can see our way to a clearer understanding of the conditions of health and also of the departures from it called disease, and we are thus better enabled to cope with these latter in the endeavour to save life and relieve suffering.

The human body, not to mention the bodies of mammals and birds, derived as they are from an egg, *omne vivum ex ovo*, preserves in its trunk its primitive form, which is repeated in many of its parts. Thus the outlines of the head, of the face, of the eyes, of the ears, of the tongue, of the hand, of the foot, and of many other organs, internal as well as external, are more or less ovoid or egg-shaped.

The forms of many full grown plants, of leaves, and of fruits are similar; indeed, the ovoid form is capable of an almost infinite variety of modification.

From a dietetic point of view it may be inquired, which are the best eggs? Some persons choose the large ones which are broad at one end and taper sharply to the other; some prefer the small roundish eggs of the pullet; others, the long oval ones. A hungry man will take the biggest because it contains most food. Freshness, whatever be their form and size, is their best quality, and this, in towns, we have generally to take on credit from the dealer. The proof of the egg, however, like that of the pudding, is commonly in the eating, though now and then it is discovered unhappily in the smelling.

The eggs of all varieties of the Common Fowl are most esteemed. Those of the Partridge, Pheasant, Turkey, Guinea Fowl, and Pea Fowl, are excellent; but, on account of their comparative rarity and high price, they are little used. Those of Ducks, and especially of Geese, are seldom eaten at breakfast, whilst, on the other hand, the eggs of Plovers and Guillemots,

though they have a greener white (albumen) than those of Ducks, and thus excite the prejudice of those who have had no experience of them, are in the greatest request among epicures, and in the London market bring a high price.

The eggs indeed of almost all birds are edible and wholesome.

The bird-nesting schoolboy was often no bad judge of the edible quality and savour of birds' eggs in general; for, in his hungry quests by hill and dale, by wood and field, he was obliged to suck them raw, delighting most in the sweet savour of the white egg of the cushat which could often be seen by him through the thin nest as he eagerly peered through the branches of the pine tree.

Now, however, the new laws for the protection of sea and land birds have almost put an end to his wanderings and his oological experiences, and have unfortunately interfered not a little with the prosecution of the study of the subjects of this paper.

It is interesting to read what was said in old times about eggs as articles of diet. Aristotle,* and after him Pliny,† relates that "the large sharp eggs are males; those which are round, and circular at the sharp end, are females." Horace‡ gives, through Catius, the following directions for choosing eggs for the table:

> "Longa quibus facies ovis erit, illa memento
> Ut succi melioris, et ut magis alba rotundis
> Ponere; namque marem cohibent callosa vitellum."

And Columella is of the same opinion as Horace.

I do not know whether, now-a-days, long eggs are considered whiter than round ones, or whether the former always contain males and the latter females. It is probable, however, that the largest eggs, as a rule, are males, the cock being a larger bird than the hen; but it has been observed that in the Order *Rapaces*, in which the female is larger than the male, the largest eggs produce females.§

* Book VI., Chap. III. † Lib. X., Cap. LIII. ‡ Book II., Satire IV.

§ My nephew, Mr. H. C. Embleton, informs me that "if you hold the round end of an egg to a lighted candle in a dark room you will observe the air-cavity to be sometimes exactly at the end and sometimes on one side of the end. Those eggs that have the air-cavity at the end are female, and those with the air-cavity on the side are male eggs. I gathered this information from the Journal of Horticulture about two years ago. We always act on this information in selecting our eggs for setting, and seldom find it to fail."

Again, after the lapse of more than a thousand years, we find in the Latin medical poem, "Regimen sanitatis Salernitanum,"* written in the twelfth century, the following lines relative to eggs as articles of diet:

"Ova recentia, vina rubentia, pinguia jura
Cum similâ purâ, naturæ sunt valitura."

Also

"Si sumas ovum molle sit atque novum."

And

"Singula post ova pocula sume nova."

The old English translation of the above-mentioned poem, called "The Englishman's Doctor," 1607, gives the following free versions of these lines:

"Egges newly laid are nutritiue to eat,
And rosted reare are easie to digest."

"The priest's rule is (a Priest's rule shold be true),
Those Egges are best, are long and white and new,
Remember eating new laid Egges and soft,
For every Egge you eat you drink as oft."

"If Egges you eat they must be new and soft."

Andrewe Boorde, "of Physycke Doctour," in his Compendyous Dyetary of Helth,† 1542–47, also gives us the following information:

"¶ The xiij Chapitre treateth of whyt
meat, as of egges, butter, chese,
mylke, crayme &c.

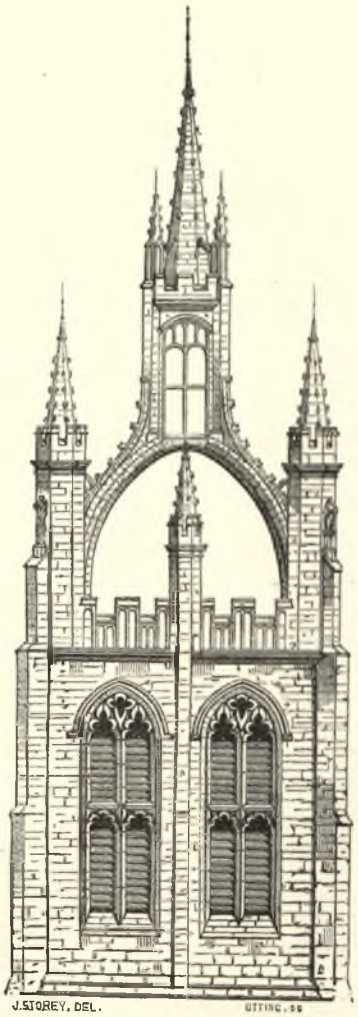
In England there is no egges used to be eaten but hen-egges; wherfore I wyl fyrste wryte and pertract of hen-egges. The yolkes of hen-egges be cordyalles, for it is temporatly hote. The whyte of an egge is viscus and colde and starke of digestyon, and

"I have always found the air-cavity at the large end of the egg, never at the small end, and have generally observed that the head of the chicken in hatching is near the large end, but whether the air-cavity has anything to do with that I do not know."

If we apply the tongue first to one end and then to the other, we distinguish the position of the air-cavity by the sensation of warmth.

* *Regimen Sanitatis Salernitanum*, a poem on the Preservation of Health, in rhyming Latin verse, addressed by the School of Salerno to Robert of Normandy, son of William the Conqueror, with an ancient translation; and an Introduction and Notes, by Sir Alexander Croke, D.C.L., and F.A S., Oxford. D. A. Talboys, 1830.

† Compendyous Regyment of a Dyetary of Helth, made in Mountpyllier, compyled by Andrewe Boord, of Physycke Doctour. Published by Early English Text Soc., edited by F. J Furnivall, M.A., 1870, p. 264.



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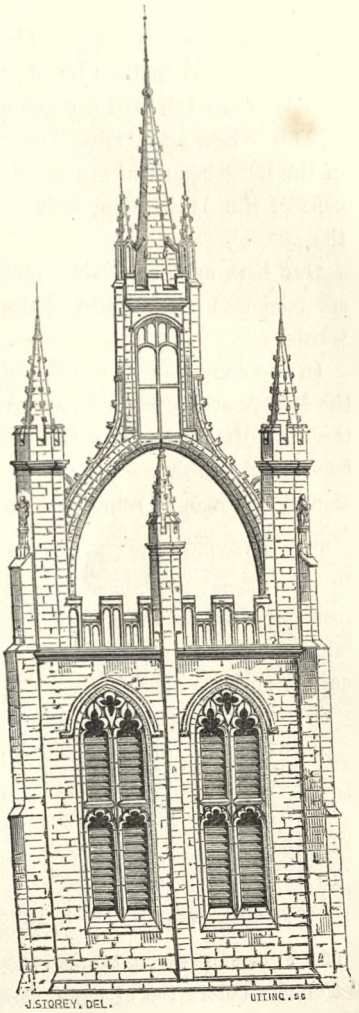
doth not ingender good blode; wherfore, whosoever that wyl eate an egge, let the egge be newe, and roste hym reare, and eate hym; or else poche hym, for poched egges be best at nyghte, and newe reare rosted egges be good in the mornynge, so be it they be tyred with a lytell salte and suger; than they be nutrytyue. In Turkey and other hyghe chrystyan landes anexed to it, they use to seth two or three busshels of egges togither harde, and to pull of the shels, and sowse them, and kepe them to eate at all tymes; but hard egges be slowe and slacke of dygestyon, and doth nutryfie the body grosly. Rosted egges be better than sodden; fryed egges be naughte; Duck-egges and Geese-egges I do not prayse; but fesaunt-egges and partriges-egges, physycke syngularly doth prayse."



No. 2.

The form of the egg, combining as it does the qualities of strength and beauty, has been adopted by architects and decorators in many of their works. The Gothic window has often an egg-shaped arch, and the beautiful lantern of our mother church of St. Nicholas, woodcut No. 2, stands on intersecting arches which, when viewed from any of the cardinal points, and

at a certain distance, are seen to enclose the perfect shape of the sharp end of a hen's egg. The accompanying illustration of the spire of St. Nicholas' Church, taken from the West, is from the pencil of our talented townsman, Mr. John Storey.

The "Egg and Arrow" or "Egg and Tongue" device is one of the most beautiful ornaments in classic cornices, and as in the case of the Anthemion, it is a form which does not readily tire the eye.

Our best modern drains, instead of being as formerly square, are modelled on the form of the egg with the sharp end downwards.

In the copper-plate writing at the heads of school copy-books, the letters are nearly all formed more or less after the pattern of the egg, the letter *O* being the primary type, as our late old friend and fellow member, Mr. John Storey, showed me a good many years ago, in some specimens of his admirable calligraphy.

The importance of eggs as articles of commerce is best shown by the official records of the numbers that have of late years been imported into the United Kingdom, and also of their money value. Of the vast number produced in these islands no estimate is perhaps attainable.

There were imported as follows:

In 1872....	531,526,800	eggs, valued at	£1,762,803.
In 1873....	660,033,240	,, ,,	£2,367,741.
In 1874....	680,645,080	,, ,,	£2,431,113.
In 1875....	741,411,960	,, ,,	£2,561,433.
In 1876....	752,980,880	,, ,,	£2,610,231.

—(*Economist, Jan.* 10, 1874, 1876, and 1877.)

II. Introduction.—My attention was first called to the subject of the coloration of eggs, some years ago, and more particularly in 1863, when at the meeting of the British Association for the Advancement of Science held in Newcastle the late Dr. John Davy read, in the Physiological Section, a short paper entitled, "Some observations on the Eggs of Birds."

In the printed abstract of that paper, the only conclusions warranted by Dr. Davy's researches that had reference to the

present subject, are thus given: "As to the colour and markings of eggs, that these are very various, that the colouring matter is of an organic kind, very similar to that of leaves and flowers, and in part depends on molecular arrangements."

In the short discussion that followed the reading of the paper, I expressed myself as not satisfied with Dr. Davy's explanation, and offered the opinion "that the coloration of eggs of birds occurred during their passage down the oviduct to the exterior, and was due to the effusion of blood in varying quantities from the capillary vessels of the mucous membrane of the oviduct; and that the blood so effused was acted upon, as by a mordant, by the plastic matter thrown out for the formation of the shell, and that its colour thus became fixed, that in fact the process of the coloration of eggs is a species of natural fresco-painting."

Since the above date this subject has seldom been referred to by me. Only lately, indeed, and as a pastime at spare moments, in the intervals of professional duties, have I been able to put into its present form what has since been observed. And it will be seen that I hold the same opinion as before with respect to the markings on eggs being caused by effused blood; but I was at that time unaware of the fact that the blood, after effusion, underwent any chemical change, nor had it occurred to me what might possibly be the cause of their uniform ground colour.

In books on Ornithology, or on Oology, we find little else than conjectures as to the origin or cause of the markings in question.

Dr. Erasmus Darwin,* in his Zoonomia, referred to by several authors, ascribes the origin of the colours of eggs to the colours of the objects among which the mother bird chiefly lives acting upon the shell through the medium of the nervous system.

His concluding words are these, "and finally, that colours may thus be given to the egg-shell by the imagination of the female parent."

Knapp† states, "That in the eggs of one hue the colouring matter resides in the calcareous part, but when there are markings, these are rather extraneous to it than mixed with it. The

* Zoonomia, Sect. 39, p. 511. 2nd Edit. London, 1794.

† Journal of a Naturalist, p. 23.

elegant blue that distinguishes the eggs of the Fire-tail (*Sylvia Phoenicurus*, Latham), and of the Hedge Sparrow, though corroded away, is not destroyed, with muriatic acid.

"The blue calcareous coating of the Thrush's egg is consumed, but the dark spots, like the markings on the eggs of the Yellow Hammer, House Sparrow, Magpie, etc., still preserve their stations on the film, though loosened and rendered mucilaginous by this rough process."

Mr. W. C. Hewitson* says, "That the colouring of bird's eggs is an animal matter, and dependent on the health of the bird, there can be little doubt. The day previous to their being produced and after the shell has become hard, they are, in those birds that I have examined, pure white; a large proportion of the colour also is easily rubbed off, for some time after they have been laid. Thus we find in their eggs the same want of colour, which is also occasionally observable in the feathers of white varieties of birds. Fear, or anything that might affect the animal functions, exerts its influence upon the colour also. The eggs of birds I have captured on their nests, during the time they were laying, and kept in close confinement, have thus been deprived of much of their colour."

Professor Flourens,† in his Lectures, has the following passage, which I met with December 7, 1870, "La coloration bizarre, variée à l'infini des coques des ovipares, parait tenir ou à des echappées sanguines hors des vaisseaux de l'oviducte, et à la combinaison de sels metalliques, on plutôt être le resultat d'une secretion particulière."

Professor Owen‡ tells us that "The colour of the egg shell depends on pigmental matter secreted by particular follicles of the villous membrane of the 'uterus;' and either incorporated uniformly with the outermost layer of the shell, as in the Thrush, or deposited in cells more or less dispersed or aggregated in patches."

* Coloured Illustrations of the Eggs of Brit. Birds. 3rd Edit., Lond., 1846, Vol. I., Introd., p. VII.

† Cours sur la Génération l'Ovologie, etc., publ. par Deschamps Paris, 1836.

‡ Anatomy of Vertebrates, Vol. II., p. 254.

Professor Allen Thomson* says that "in those instances in which the shell of eggs is coloured the pigment substance of various hues is generally deposited in cells, which are strewed uniformly or in patches over the external surface of the calcareous shell. In some other instances however the colour seems to be merely a uniform tint of the outermost layer of calcareous matter."

These items of information are all that I have been able to gather from books; in the works of Temminck, Mudie, Yarrell, Bewick, Macgillivray, Jones, Newman, Morris, and Audubon, the cause of the coloration of eggs is not mentioned, and Professor Flourens, as has been seen, prefers the theory of a peculiar secretion to that of emissions of blood, as that which would best account for the coloration.

In the works of those who have treated of eggs or their colours, we find no description whatever of glands in the lining membrane of the oviduct that might be supposed capable of secreting pigmentary matter, and it has not been demonstrated that the colouring matter either of the ground colour or the spots is contained in special cells.

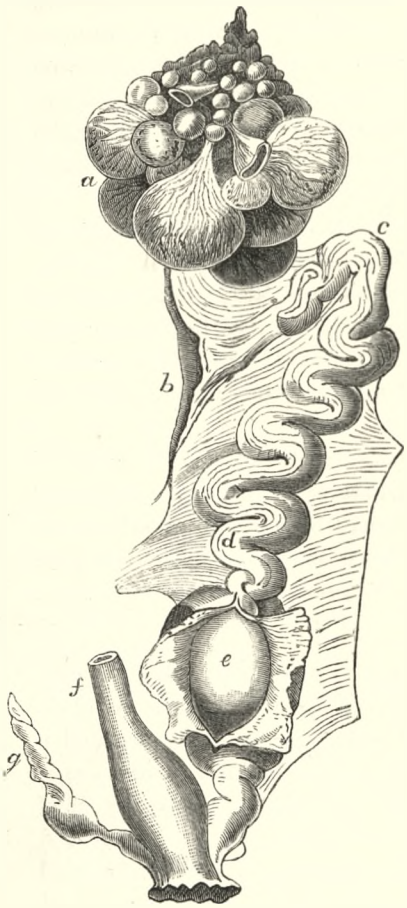
III.—Anatomy and Physiology.—Before discussing the subjects of the form and coloration of eggs, it will be useful to notice briefly the anatomy and physiology of the reproductive organs of the female bird, and the gradual building up of the egg.

It is generally known that in birds the generative organs of the left side only, as a rule, come to maturity of structure and function, those of the right side remaining comparatively small and inactive.†

Of the accompanying Woodcuts, No. 3 is taken from Dr. Thomson's Article "Ovum," in Todd's Cyclopœdia of Anatomy and Physiology, and No. 4 from Traité élémentaire D'Anatomie comparée par C. G. Carus, Paris, 1835. In both the ovarium, with ova in various stages of development, is seen at the top, *a*, and one of the points of the fringe of the funnel, *b*, at the top of

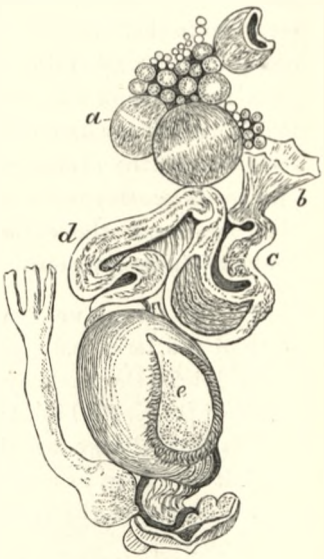
* Cyclopœdia of Anat. and Physiol., Vol. V., Supplement, p. 63.

† In some of the Raptorial birds they present an equal development. Carpenter's General and Comparative Principles of Physiology, 3rd Ed., p. 514.



No. 3.

the oviduct is seen attached to the ovarium: the oviduct is below, *c*, *d*, and is convoluted down to almost the lower part where the tube has been opened to show an egg, *e*, on its way to the exterior. The uppermost part of this tube is that which secretes the albumen, further on is the narrow isth-



No. 4.

mus, and below that the widest part, the uterus.

The undeveloped right oviduct, *g*, and the intestine, *f*, are also indicated, No. 3, as entering into the cloaca, into which, moreover, the ureters or ducts from the kidneys empty themselves.

The ova are developed in the bag of the ovarium, and are periodically discharged thence into the oviduct, the open, upper end of which is funnel-shaped, fringed, and muscular, adapted to grasp the ovarium, and to press out, receive, and transmit the

ova. Below this opening the oviduct is a tortuous but not long canal, which ends at the cloaca and the vent. The oviduct is formed of three layers; an outer serous, or peritoneal; a middle or muscular, in two strata, the external of which has the fibres running longitudinally, the internal circularly; and an internal lining or mucous membrane, of great delicacy, and which varies considerably both in structure and function in the three great divisions of its extent.

An ovum discharged into the open end of this canal is simply the yolk, enclosed in a pellucid membrane of extreme fineness, its other coverings being gradually laid on in succession as it passes on to the lower part of the oviduct.

The best account I have seen of this passage of the ovum, in the case of the Common Fowl, is that by Professor Allen Thomson, in his highly interesting article "*Ovum*," already referred to, from which I quote the following paragraphs.

"The passage of the yolk through the first two-thirds of the length of the oviduct, in which part the albumen is deposited, is very rapid, scarcely occupying more than three hours, according to Coste, before it arrives at the narrow or constricted part of a more limited extent (isthmus) in which the membrane of the shell is formed.

"About three hours more suffice for this process, and the ovum then enters the dilated portion, which has been called uterus, in which the substance of the shell is deposited and gradually consolidated on its surface.

"The egg does not descend in a straight, but in a spiral, direction, corresponding with that of the ridges of glands with which the mucous membrane of the upper part of the oviduct is beset, and the various layers of albumen are deposited spirally one over the other. It has been ascertained by experimental observation that the membrane of the shell is formed in the narrow part of the oviduct, which intervenes between the albuminiferous part and the uterine dilatation. It consists, no doubt, in the fibrillation of consolidated albumen or some analogous substance, which must take place with great rapidity, but we are not yet sufficiently acquainted with the nature of this

process, for the phenomena of the solidification and fibrillar organization have not been minutely examined, nor has any difference yet been ascertained between the substance secreted in the isthmus, which undergoes the fibrillation without calcification, and that of the uterine dilatation, which seems to have no such tendency, remaining amorphous or cellular, and having very soon a deposit of calcareous matter formed in it.

"By the time the egg arrives in the uterus it has acquired its peculiar oval form, the small end pointing downwards in the oviduct. The cause of this form, which is already apparent in the white previous to the formation of the shell, is somewhat obscure, on account of the complexity of the mechanical conditions influencing the egg in its passage. It may probably depend on the circumstance that the soft mass dilates the oviduct more gradually as it insinuates itself between its coats, in being propelled onwards, whilst the part of the duct through which it has passed contracts more abruptly and firmly in consequence of the stimulus of distension to which it has been subjected. But the variety of forms which occurs in the eggs of different birds and other animals must not be forgotten, as indicating that the peculiarity of a lesser or greater end is not essential, and may depend on very slight or transient circumstances. Perhaps the greater density of the albumen secreted over the end which advances first in the oviduct may also have some effect in giving this part the smaller volume. It certainly seems remarkable that the ends of the egg should be moulded into so smooth and rounded a surface as that of the membrane and shell by a tubular organ.

"The egg remains a much longer time (from twelve to eighteen or more hours) in the uterine dilatation of the oviduct during the formation of the shell. The mucous membrane of this part differs in structure considerably from the rest. It presents over its whole extent large villus-like processes or short folds of a flattened form containing small follicular glands from which the substance of the shell is secreted. As soon as the egg enters this part of the passage a thickish white fluid is poured out from the membrane which speedily coagulates on the surface of the membrane lining the shell, and very soon we can perceive

with the microscope small heaps or united groups of particles somewhat of a crystalline appearance, but in reality calcified blastema, studded over the whole surface. These are the calcareous particles of the shell which are deposited in a delicate matrix of animal tissue of a large cellular structure. The deposit goes on rapidly increasing: at first the shell is soft, it remains friable for a considerable time, and subsequently it gradually acquires its peculiar dry hardness.

"The egg remains in the uterine dilatation till it is about to be laid. The expulsion of it from this cavity, through the narrow part of the tube leading to the cloaca, requires very strong muscular contraction for its accomplishment; and although the egg always descends in the oviduct, and usually lies in the uterus, with its narrow end downwards, both Purkinje and Von Baer state that they have sometimes seen its position inverted towards the end of the time of its residence there, in consequence of the force of the muscular contractions of the wall of the oviduct."

Dr. Thomson also states that "during the passage of the egg and the formation of the albumen, membrane, and shell, a greatly increased determination of blood is observed in the vessels of the several parts of the oviduct," and that "the advancing motion of the egg of the fowl is caused by the peristaltic action of the muscular coat of the oviduct, which may easily be seen in any laying fowl opened immediately after death."

On opening a female bird killed during the laying season, it is remarkable how large a space in the abdomen is occupied by the ovarium and oviduct, especially if an egg be on its passage, and how large, vascular, and red these organs are as compared with the intestine.

They have been in full functional activity, their sensibility and other vital properties intensified by the influences of the male bird.

The ovum, entering the upper end of the oviduct, acts on the latter as an additional stimulus, the consequence of which is, that the lining membrane pours out a succession of secretions of albumen, and the muscular tunic stimulated through the nerves of the visceral system, and by the actual presence or contact of the

ovum, to contraction, pushes the ovum gradually onwards obliquely along the "rifling" of the lining membrane.

By the time the ovum arrives at the narrow part of the tube it is much increased in bulk by the addition of the albumen, and will act as a proportionally greater stimulus to the walls of the oviduct, and will demand and receive greater muscular force to enable it to overcome the resistance of this commencement of the narrower part.

Arrived in the isthmus the ovum stimulates the lining membrane there to the performance of its function, which is the exuding in successive quantities of a fluid resembling fibrin, or some peculiar modification of albumen, for it solidifies, or sets, by fibrillation, in much the same way as does the plastic fluid which is given out by an inflamed serous membrane in the higher animals. The membrane thus formed is that on which the shell is to be laid (*membrana putaminis*); it consists of fibrils which are closely felted as it were together, united every here and there and arranged in two principal layers, each divisible into other minor ones, superimposed upon each other, and forming together a strong and tough covering for the ovum. The ovum now has had bestowed upon it a more distinctive shape, becomes rougher, and has an increased size and consistence. It has, in short, taken to a great extent its future form. Wind eggs, or those prematurely laid, having generally more or less approximation to the normal egg shape, and being white, not coloured.

From the isthmus the membrane-covered egg is driven into the more open and fleshy part of the oviduct, the tissues of which, being in consequence greatly excited, prepare to execute their functions; the lining membrane pours forth an abundant flow of a thickish muddy white fluid, holding in solution, in a hundred parts, ninety-seven of carbonate of lime, one part of phosphate of lime and magnesia, and two parts of animal matter, with traces of sulphur and iron.

This liquid plaster is thrown out over the whole egg, and gradually as the egg is thrust downwards layer after layer is exuded and sets, just as was the case with the albumen and the shell membrane. In the fluid thus effused a very delicate cellular

tissue is formed in which the calcareous matters are entangled, and crystallize in minute round balls. The first layer of the shell thus deposited is always either white or of the colour of the albumen.

The layers which come after are either white or of some special ground colour as cream-coloured, blue, green, or of some secondary tint; and in many eggs that are spotted one or more of these layers may be spotted, in others the surface layer alone is spotted and always with some tint of red.

The exact nature of the fluids thrown out by the isthmus and the shell-forming part of the oviduct has not as yet been made out, any more than the peculiarities of these parts of the lining membrane which produce them, as Dr. Thomson in his paper has remarked.

The egg being completed by the addition of the shell, its size and form are at length fixed, it is more or less roughened on the surface, and has to be propelled down the lower part of the oviduct. The muscular tunic is here thicker and stronger than elsewhere, and the lining membrane, with its intense vascularity, is not only stretched to the utmost over the egg, but is ground, as it were, between the hard and rough shell on its inner surface, and the powerful muscular contracting agents operating on its outer surface. The egg reaches at length the *sphincter* of the oviduct, through which it must be forced into the common receptacle, the *cloaca*, and afterwards propelled through the *sphincter ani* out into the exterior. All these movements require considerable muscular exertion.

During the short but variable time that the egg remains in the cloaca it receives a varnish of mucus from the walls of that cavity which aids in its final expulsion and in the protection of its surface.

This coating is easily rubbed off by the finger wetted with water, and the muddy fluid thus obtained is found when examined under the microscope to contain cells of epithelium from the mucous membrane of the cloaca, and numerous minute globular or oval bodies, singly or in little strings, which are particles of urate of ammonia, traces of the urine of the bird which happened

at the time to have been left in the cloaca. The whole of this light coating will be quite removed during the boiling of the egg.

The external coloured spots can also be easily removed by scraping or even rubbing the surface.

Dr. Thomson says that the small end of the egg is the first to see the light. I have also seen the same position of the egg in the oviduct, and have observed an egg, dropped by a hen through necessity, on a stone floor, indented at the small end, just as it had fallen from the bird. Purkinje and Von Baer are quoted by Dr. Thomson as having seen an egg reversed in its passage, and we can conceive of this taking place if we examine the parts sometime after the death of the bird, for they then become so flaccid that you can easily cause the egg to revolve in the duct. Immediately after death however, and no doubt therefore during life, the egg is almost always closely embraced by the contracted walls of the oviduct. Nevertheless, it is possible, that by some irregular disordered action of the muscular wall of the oviduct, an egg may occasionally be turned quite round in that tube.

There is reason, however, to believe, that in wild birds at least, the large end is that which is most commonly laid first.

I have seen the large end lying lowest in the oviduct on two occasions, in a Rook and in a Peewit, and the small end lowest in one case, in a Peewit. These as single instances cannot make a rule and cannot prove anything. More satisfactory evidence of the reasonableness of the above belief will be given further on, and it may here suffice to say that analogy is in favour of the large end being the first to come into the world, if it contains the head end of the chick, which appears really to be the case; for in Mammalia generally, and notably in the human race, the rule is that the head first presents itself and is born, after which the rest of the ovum passes with comparative facility.

It is natural to infer, on considering the condition and the functions of the parts, that birds in the act of parturition, in common with the higher animals, must suffer a certain amount of inconvenience and of pain, particularly during the passage of the shell-coated egg down the uterine portion of the oviduct, and

especially whilst it is being expelled through the sphincters, and that the amount of such pain and inconvenience will greatly vary among the various tribes of the feathered race.

No one who has examined with attention and compared the parts concerned in their quiescent, unimpregnated, and in their active breeding conditions, can view without surprise and admiration the vast change that they have undergone in passing from one to the other state; and no one can wonder that pain should be the consequence of such extreme distension of the oviduct as takes place in birds, particularly in those which lay eggs large in proportion to their bodies. It would be a marvel if in such cases during parturition no blood were shed.

IV. With regard to the form of eggs, we know that it varies greatly, from the rounded, more or or less globular shape of those of some of the Falconidæ and Strigidæ, some of the Willow Wrens and of the Ostrich and Cassowary, to the extremely pyriform condition of those of the Waders and Guillemots, and the long oval, spindle form of those of Cormorants, Gannets, and Grebes; the eggs of the Common Fowl, and many others, usually exhibiting a beautiful intermediate ovoid. See Plates I.–IV.

No doubt can exist that all the forms of eggs are produced by the varied actions of the longitudinal and circular muscular layers in the wall of the oviduct. These layers, like their analogues in the wall of the intestine, are, to a certain extent, and under certain circumstances, mutually antagonistic, whilst under other conditions they aid each other. They can restrain or expedite the passage of the egg, their normally combined and regulated efforts resulting in its final, orderly passage; just as those of the muscular layers of the intestine result in the transit of the fæces which, in many animals, are rounded or ovoid.

The form of the egg must be impressed upon it before it reaches the isthmus, or at least on its arrival at that part of the oviduct.

In the case of a rounded egg the propelling and the restraining forces must be nearly balanced, but there ought to be a preponderance on the side of the former; for if they were equal, the egg would, in all probability, become stationary

and never be laid, and it would be quite globular, which an egg never is naturally.

In the case of a pyriform egg, if, as Dr. Thomson says, the small end passes first, this peculiar form may be produced by the restraining *vis à fronte* acting not merely on the central point of that end of the egg going first, but also more or less on the parts surrounding that centre; the pressure diminishing gradually as far back as the widest part of the egg, these parts would thus be compressed and tapered back, giving to that end more or less the form of a cone gradually enlarging backwards, and bulging out the hinder part; at the same time, the propelling *vis à tergo* acting strongly and abruptly against the base or hinder part of the cone, would enlarge and somewhat flatten that part, giving it a blunt rotundity. In this form an egg is well adapted for being gradually insinuated into the closed oviduct before it, the apex of the cone acting as a circular wedge, and opening out by degrees the folds and windings of the tube as the egg is being driven on.

If the large end be the first to pass, the restraining force must be represented by a firm, abrupt, ring-like contraction of the walls of the oviduct in front of the downward end of the egg which, being forcibly urged from behind against that contraction, would become more or less flattened in front and bulged out laterally; the rest of the egg being pressed upon by a graduated force increasing backwards, would assume a conical form in that direction.

In each case the regular contraction of the circular fibres of the oviduct will preserve the transverse rotundity, and the form thus produced will be stamped upon the egg by the superposition of the shell membrane in the isthmus.

In the former of these cases the conical anterior end of the egg is driven on like a wedge by pressure exerted on the broad posterior end; in the latter, the broad end is driven forward by the *vis à tergo* acting upon the greater part of the surface of the egg behind: in the former, there is an advantage in form, in the latter, a superiority of power.

By the application of these muscular forces in variously modified ways and degrees the varieties of the form of eggs are produced.

In different genera and species, and in different individuals almost innumerable varieties of form occur, the same bird indeed will, even in the same nest, lay eggs differing greatly in form.

The size, also, as well as the form of eggs, is similarly varied. Indeed, I have the authority of Mr. John Hancock for saying that there are never two eggs exactly alike in these respects.

The largest eggs known are those of the Dinornis of New Zealand, and the Epiornis of Madagascar, both extinct birds. The egg of the Dinornis measures eight inches and a half in length, and that of the Epiornis thirteen inches. They are both unspotted, and of beautiful oval form.

The smallest, of the size of a small pea, are those of some Humming Birds.

These then are established facts, and we can see how in all probability different forms arise, but why they should so differ is another question. Why, for instance, should a Guillemot lay a pyriform egg that will not readily roll off the narrow bare ledge of smooth rock on which it is laid, whilst a Plover drops an egg of similar form into a concave and safe nest out of which it cannot roll, and which is placed on the surface of a ploughed field or on a moor?

An answer to this question I shall not here attempt though, perhaps, it might be less difficult to find than a reply to the very old question, "Which was first, the egg or the hen?"

V. With regard to the coloration of eggs. Eggs vary even more in their ground colour and markings than in their form, those of the same species, and even of the same individuals, often differing singularly from each other. Those from the same nest even are found at times to differ so considerably, both as to ground colour and markings, that any one, ignorant of the occurrence of such difference, examining them for the first time apart from the nest, would hardly believe them to have been laid by the same bird. For instance, very pale or even perfectly white eggs frequently occur, as may be seen in Mr. John Hancock's instructive collection, which have been laid in the nests of birds that produce, normally, highly coloured eggs.

As examples, may be cited the eggs of *Lanius rufus*, *Anthus pratensis*, and *arboreus*, of the House Sparrow, of *Sylvia trochilus*, Linn., common Guillemot, and many others. Eggs with shells, prematurely laid, are, as Mr. Hewitson says, commonly white.

Many eggs are naturally of a spotless white, as those of the *Strigidæ*, and some others of the Order *Rapaces*, some *Sylviadæ*, *Paridæ*, and *Fringillidæ*, most of the *Picidæ*, and *Columbidæ*, most Geese, the tame Swan, many Ducks, the Grebes and Cormorants, many Petrels, the Ostrich, and the ordinary barn door fowl.*

Others are cream coloured or yellowish, as those of many *Palmipedes*.

Some are altogether and uniformly more or less blue such as those of some *Turdidæ* and *Sylviadæ*, Starlings, Herons, and the Ibis.

Others similarly green, as those of some *Ardeidæ*, and *Anatidæ*, and of the Emu.

Some have a uniform ground colour of some shade of red as those of some *Muscicapidæ*, the *Sylvia Cetti*, the Bittern, *Tetraonidæ*, and game fowl, etc.

The colour of others is a red brown, more or less dark, as in some *Tetraonidæ*, or dark olive brown, as in case of the Nightingale; those of the *Prinia Stewardi* are of a light mahogany red, with a fine polish on them. Those of the *Rhyncætus rufescens* are ash coloured and nearly black, punctated all over, and polished like glass.

There are also many of various intermediate tints.

With the exception of the uniformly white, yellow, blue, green, and red eggs, all others are freckled, streaked, spotted, blotched, or otherwise marked partially or all over, generally most at the large end, with some shade of red, from the palest pink, to a red brown so dark as to appear almost or altogether black.

Again, if we examine the different layers of which the shell consists, we find that they also differ frequently from each other.

* I have been informed that some Common Hens lay eggs covered with small red spots. My brother states that he has seen such, at Aamdal, in Phelemarken, Norway, brought to table for breakfast, and the eggs of Cochin fowls are often similarly spotted. Mr. John Hancock has shown me four specimens of the eggs of barn door fowls and of the Cochin variety which are more or less spotted with red but less so than eggs of the Turkey.

Thus, in the egg of the Emu, the innermost layer of the shell is white, the next pale green and more crystalline, further out the colour deepens, whilst on the external surface there is an irregularly reticulated coating of a very dark, varnish-like, opaque, deep olive green, the ridges having a fine polish.

In the eggs of the Peewit and Guillemot the innermost layer is white, the middle part, in many, very pale green, and the layers external to this are white, yellow, blue, or green, spotted more or less with dark red or brown, and the surface is the same.

In those of the Thrush a thin white layer lies next the *membrana putaminis*, and the delicate greenish blue, characteristic of this egg, succeeds. The same white internal layer exists in the egg of the Blackbird. In both of these cases the spotting, when it occurs, is confined to the external surface. In Mr. J. Hancock's "Catalogue of the Birds of Northumberland and Durham," published in the Nat. Hist. Trans. of North. and Durh., Vol. VI., 1874, we find it stated, that "the eggs of the true Falcons can be readily distinguished from those of the ignoble. Those of the former are of a pale yellow colour when held up to the light and looked at from the interior of the shell. Those of the Eagles, Buzzards, Hawks, etc., when examined in the same manner, are of a pale green hue."

In the case of the Greater Black-backed Gull, the innermost layer is of a dull white, those external to it are of a purer white, crystalline and granular in texture, and mottled here and there with dusky spots like those of the exterior.

In many spotted or blotched eggs the spots or blotches are not confined to the surface but exist in several of the subjacent layers; and those near the surface show through the outermost coating, more or less imperfectly, as in eggs of the *Scolopacidæ*, the innermost layer being, as already stated, more or less pure white, or of the colour of the albumen.

Examples of all the above named, and of many other varieties, are easily to be met with in any good collection of eggs. Those which have here been noticed may not all be found in a small collection, but they are to be seen in the collections to which I have had access, namely, to that of the Natural History Society

of Northumberland, Durham, and Newcastle-upon-Tyne, and especially to the classical series of Mr. John Hancock, who has thus very kindly rendered me much service in the preparation of this paper.

The colours of eggs fade gradually by exposure to light; hence the necessity of keeping them in the dark, except when they are required for examination.

The question now arises, How are the ground colours and the markings on them produced?

Before offering a reply it will be necessary to refer to some recognised physiological and other observations bearing on the question.

The colours of the shells of eggs are not found to be different from those which are produced by the blood of mammals and birds, when it has been effused among the living tissues of these creatures, in consequence of a blow having contused the skin and subjacent parts, and ruptured their blood vessels. Such blood, during its gradual disappearance by absorption, gives rise to all the gradations of colour in the solar spectrum. Even in the interior of the human body, in the brain itself, similar changes and shades of colour may be observed after death around an old hæmorrhagic clot that has for months, or even years, been undergoing a gradual process of absorption.

Again, the same colours are produced, in life, during pathological states of the human mucous membranes. Thus, during severe inflammation of the lungs, uterus, kidneys, urethra, and other organs, blood is at times extravasated, and tinges or deeply dyes the mucus or other secretion of the part, and as the quantity of blood that escapes from the capillary network varies much, so the colour of the secretion varies, from the faintest tint of pink, to a red so deep, that it appears almost black.

If the inflammation be intense the colour of the secretion will be very dark red, if less acute, the colour will be paler. In a still less degree there may be, in the case of a serous membrane, a fibrinous plastic effusion fibrillating and forming a false membrane, containing a certain proportion of blood globules, or none at all. In lower degrees still of inflammation the mucus given

out is of a more or less green colour, or blue, or yellow, and, it may be, more or less dotted or streaked with blood; and these last named colours, as the inflammation clears off, are replaced by the normal white of the ordinary secretion.

The lining membrane of the oviduct of the bird presents the same conditions, and gives out the same secretions, with additions of the lime, etc., as the mucous membrane of the higher animals. The whole oviduct during the laying season is in a very sensitive and excited physiological condition, one bordering on, if not actually and for a time identical with, an inflammatory or pathological state, as are the corresponding parts of the human subject under similar circumstances; and the products, which might be expected to be similar, are, with the exception of the shell of the egg, very much alike. The boundaries between physiological and pathological processes are, in some cases, very difficult of definition.

The lining membrane of the oviduct, supplied as it is with abundance of blood, is then of itself quite equal to the furnishing of all the colours borne by eggs, and it seems unnecessary to have recourse, for the explanation of the presence of these colours, to the hypothesis of special pigment glands in the oviduct, which glands no one, so far as I know, has ever described.

In two instances in which I was enabled to examine, during the laying season, the oviduct of the Rook, at the time when an egg had arrived at the lower part of the "uterus," I have seen intense vascularity of the mucous membrane, distinct ecchymoses in it, and small effusions of blood lying against the already spotted egg, on which the shell had been previously consolidated and finished.

There can be no doubt as to the above state of the oviduct, and if the tube could have been examined a little earlier, the real connection of the escapes of blood with the spotting of the shell as it was "setting" might very probably have been observed.

In the case of birds that normally lay white eggs, it may be presumed that the oviduct undergoes the lowest degree of excitement incidental to that organ during the breeding season, or that its lining membrane and vessels have a strength not existing in

other birds; consequently the albumen and the shell are of a more or less pure white, not blue, or green, or red, and still less is there any blood thrown out, either in the "uterus" or at either sphincter; and therefore under such conditions, it is extremely probable that little or no severe pain is experienced by the maternal bird.

Then, as Mr. Hewitson, above quoted, points out, "fear, or anything that might affect the animal functions, exerts its influence upon the colour also. The eggs of birds I have captured on their nests, during the time they were laying, and kept in close confinement, have thus been deprived of much of their colour."

Such eggs have been formed, or finished, and laid, under very unfavourable circumstances, have been hurried through their stages of formation and laid prematurely.

We know also that some wicked boys have been known at times to have chased hens till they have laid white, shell-less, or wind eggs.

In human parturition, it is well known that on the occurrence of terror, fear, grief, or other violent emotion, or of certain diseases, abortions (of "white eggs," as they may be termed) may take place, and that easily and with little delay or pain or hæmorrhage, whereas, when all the necessary steps of the normal process are allowed to be naturally carried out, the act is slow, intermittent, severe, painful, and not without effusion of blood.

When eggs have shells of a uniform blue ground colour, congestion, though to only a small extent, is believed to have been present in the "uterus," and to have followed immediately after the deposition of the first layer of the shell.

In other cases in which the albumen or the shell is green, a greater degree of excitement must have prevailed in the uppermost part of the oviduct, or in the "uterus," than in the previous case, a state bordering on, or partaking of, the inflammatory. Take, for example, a number of the eggs of Plovers or Guillemots; in these the albumen is commonly green, the membrane of the shell white, which indeed it always appears to be, and the first layer of the shell itself is the same; but the succeeding

layers, as in different other birds, will be found white, or blue, or green, or pink, indicating different degrees of excitement or of inflammatory action in the different parts of the lining membrane of the "uterus."

When any of the layers of the shell are red, and it is chiefly the exterior ones which are so, it is inferred that the lining membrane was as highly inflamed, at the part that produced the red plaster, as it is possible for it to be, short of disorganisation, and the admitting of a speedy return to its normal state; the colouring matter of the blood, meanwhile, varying in quantity according to the degree of excited action present, having escaped from the vessels and become thoroughly incorporated with the calcareous mucus.

Setting aside the lime, this red fluid has very much the appearance of the red, rust-coloured mucus, expectorated from the human lungs in cases of inflammation of these organs.

In any of the above cases of coloured eggs there may be, in addition, actual rupture of blood vessels from over distension and abrasion, and consequently freckling, spotting, or blotching of one or more layers of the shell will of necessity occur.

In the eggs of the game fowl, Partridge, and Pheasant, this red colour alone pervades the shell. In those of the Grouse, Guinea Fowl, and Turkey, we find in addition numerous blotches, spots, or freckles, of a much darker red than that of the ground, scattered profusely all over the surface.

In order to heighten the probability that the red spottings on the different layers of the shell are owing to escapes of blood, it must be observed that it is only after the first layer of the calcareous coating has become consolidated on the exterior of the shell membrane, that the large rough egg, grating upon the delicate lining membrane, will have any tendency to irritate and abrade its minute but turgid vessels. It is then only that we begin first to find red spots or blotches on the succeeding layers, any of which may be so marked; and generally the last or most external is that which is most marked, the egg having acquired its maximum size.

If these markings are not due to blood, but to the secretions of

pigment glands, they might be expected to be more regular in position and better defined than they are, and to vary in colour, not being always of some shade of red; and the eggs of any given species or individual ought to be more alike than they are found to be. It is true that on some eggs the spots do present a certain degree of regularity, as in the coloured rings presently to be noticed; but this is capable of explanation without our being obliged to have recourse to the hypothesis of the existence of pigment glands in the lining membrane.

Of the high degree of probability that the markings on eggs are really of blood, I shall, in the sequel, endeavour to adduce additional evidence; but here I would seek, before going further, to answer the query, Which end of the egg first comes to the light? This indeed is seemingly a very small matter, but a correct answer to it may help to elucidate the main question, Are the markings really blood markings?

A discussion, as to which end of the egg is first laid, might possibly incline oologists to range themselves in two opposite and hostile camps; just as the question, which end of the egg they ought to begin to break when going to eat it, divided the Lilliputians into Big-Endians and Little-Endians.

Dr. Allen Thomson says that in the Common Fowl the small end passes first, and from what I have observed with regard to the mode of laying proper to that bird I believe him to be quite right; but he quotes two authorities already named who have seen an egg reversed in its position in the oviduct. There is not wanting, however, as I have said, some good reason to believe that many birds lay their eggs so that the large end comes first; and Aristotle, no mean observer, says, in his "History of Animals," Book VI., cap. ii., 1, "In the egg itself there is a difference, for one end is pointed, the other round. The round end is produced first."

No doubt there is truth on both sides: and Nature, if rightly interpreted, appears to have established the principle, at which, after long and anxious inquiry and debate, the sagacious Lilliputians arrived. They found that the "*end which is most convenient should be first broken;*" and Nature seems to declare that the

end of the egg which is most convenient shall be the first to come into the world.

But it is known that in human parturition the rule is, that the large or head end of the ovum presents itself and passes first, for when this is once extruded no further difficulty remains. This therefore is the most convenient end to be born first. The rule, of course, has its exceptions, the small or foot end at times presenting itself, not to mention various forms of cross birth.

The same rule and exceptions occur in the case of the lower Mammalia.

It is also well known, that on the passage of the mammalian ovum, a copious secretion from the walls of the uterus, etc., occurs, and more or less effusion of blood takes place, which might and would impart most colour to the broad presenting end, and in a lesser degree to the rest of the ovum as it passes out, were the mammalian ovum constituted like that of the bird.

From analogy, therefore, we may believe that *mutatis mutandis* very similar occurrences may take place, as in fact they do, during the laying of an avian ovum.

In civilized human communities births that are abnormal, that is, not according to the generally prevalent law, are, it is believed, more frequent than among uncivilized races who lead simple lives; and therefore it is not improbable that the same difference obtains among highly domesticated fowls, so that we might expect to find more abnormal births of eggs among them than among wild birds.

Granting for the present that the marks on birds' eggs are caused by escapes of blood from the lining membrane of the oviduct, it might fairly be expected that these marks would be more numerous, larger, and more highly coloured, on that end of the egg which is the first to come down, and especially if that were the larger end; for this would offer greater impediment at once, and would require a greater exertion of muscular energy for its propulsion, whilst its extended and roughened surface would be most likely to cause abrasion or rupture of blood vessels. If the small end presented itself first it might also cause abrasion, rupture, and escape of blood, but these would be less than in the

former case, and would cause less coloration, less, at least, in proportion to its inferior size. If the conical end passed first, and after it the body of the egg of gradually increasing size, time would be allowed for gradual dilatation of the oviduct, so that in this case there ought to be less marking even at the blunt end than in the former instance where this end burst through first.

The examination of a good collection of spotted eggs will show to any one,

First: That the large end is that which is the most commonly spotted or otherwise marked, and that such marks are, as a general rule, of a larger size, and of a deeper colour there than elsewhere upon the surface of the egg. Hence it is concluded that, in such cases, the large end was laid first.

Second: That the sharp end, in a comparatively small number of eggs, is that which is most marked, but it is usually not so strongly marked as is the broad end of the eggs in the former instance; in such cases it is presumed that it was the sharp end that first passed.

Third: That in another set of eggs the spotted colouring, faint or strong, is pretty equally distributed over the whole surface, not being more decided at one end than the other; so that it would be difficult from such marks to determine which end had been first extruded.

Fourth: That in rare cases eggs are found which are more strongly marked at both ends than in the intervening space.

I have examined, with Mr. John Hancock, the eggs in his very beautiful and valuable collection, and we found that by far the greatest number of them are most copiously and most strongly marked at the large end. The whole may conveniently be arranged under the following five sections:—

1. Such as are most marked at the large end.
2. Such as are most marked at the small end.
3. Such as are most marked at both ends.
4. Such as are marked more or less all over, or not more at one than at the other end.

5. Such as are unspotted, being of a uniform colour all over, or white.

The whole number of eggs examined was 4376; of these 2440 belonged to the first section, 128 to the second, 7 to the third, 985 to the fourth, and 816 to the fifth.

The eggs in the Museum of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, were also examined, and were found to number 2734 specimens. Of these 1693 belonged to the first section, 109 to the second, 6 to the third, 364 to the fourth, and 562 to the fifth.

Adding together the eggs of the two collections we have a total of 7110 specimens examined. Of these there belong to the first section 4133, to the second 237, to the third 13, to the fourth 1349, and to the fifth 1378.

The proportions of these numbers may perhaps be more readily appreciated if we take a round number, say 1000 eggs; of this number there will be of the first section 581·29, or more than half, of the second 33·33, of the third 1·828, of the fourth 189·73, and of the fifth 193·81.

From these observations and computations it is inferred that it is the large end which would offer the greatest obstacle during the passage of the egg, and which would therefore be likely to be most marked by blood if any were effused, which, in the great majority of cases among wild birds, is the first to descend the oviduct to be laid. Rarely is the small end, which would offer the least resistance, marked as much as the larger one.

The observation of the Stagirite is therefore confirmed, "The round end is produced first."

A great many of the first section of the above eggs are comparatively flat at the large end, and have a blotch of variable size and form, of more or less dark red, or brown almost approaching black, covering the apex, whilst the surface around is much less, or only slightly spotted or blotched. Such eggs seem to have been suddenly and forcibly driven against some strongly contracted part of the oviduct or the closed sphincter, which had as suddenly been burst through, with rupture of blood vessels at the part, and thus a daub of blood had been left deposited

on the apex; as for example, some eggs of *Turdus merula*, *Uria troile*, *Phalarope*, Snipes, and Merlin. See Plate I., figs. 2, 4.

Others, more or less flattened at the large end, present a distinct circular space at the apex, more or less, sometimes entirely, free from marks, and surrounded by a ring, varying in width, of blotches or spots, separate or run together, as if the apex had passed for a short way quietly through the opposing contraction; and that then the *vis à tergo* suddenly forcing a wider part of the egg onward into the opening had caused it to rupture vessels all round, the blood from which had been deposited in the form of a circle of spots or blotches, which become gradually less in size, distinctness, and colour, as they are traced in the direction of the small end. Examples of such a ring exist on eggs of the Sparrow Hawk, the Shrikes, some Sedge Warblers, the Golden-crested Wren, Larks, the Hawfinch, Swallows, *Tetraonidæ*, *Scolopacidæ*, *Charadriidæ*, *Laridæ*, and *Alcidæ*. See Pl. I., figs. 1, 3, 5; and Pl. II., fig. 2.

On some eggs there are two such rings, as on those of some *Laniidæ Fringillidæ* and *Alcidæ*. See Plate III., fig. 2.

On others, as on those of some Guillemots, three such rings may occasionally be found, more or less distinct, one at the large end, another at the middle or near to it, and the third at the small end of the egg. See Plate III., fig. 1.

These rings appear to indicate the occurrence of as many forcible efforts of the muscular wall of the oviduct to overcome obstructions to the passage of the egg, causing as many effusions of blood upon the shell. The spaces between these rings are either clear of marks or much less spotted than the rings.

These coloured rings or zones, often of great beauty, appear to have a certain regularity, as before stated, but if they are carefully examined they are found not to be the same as to number of spots, form, or position on every egg; there is only a general resemblance. They are not so regular as they might have been expected to be had they been the result of the secretion of colour-forming glands, and they are much more easily and naturally accounted for by the hypothesis of their arising from simultaneous effusions of blood all round in the oviduct as the egg was passing through the "uterus."

These spotted rings and their intervening clear spaces may remind the obstetrician of the forcible and painful expulsive efforts, separated by intervals of quiet and ease that always occur during the progress of human parturition.

Occasionally, but rarely, we find at the small end a similar terminal blotch or a zone of coloured spots or blotches more or less regular a little way from the apex, as on eggs of the Osprey and the Honey Buzzard. But never more than one such ring has been found in the collections above cited, at the small end of the egg. See Plate II., figs. 1 and 3.

There are, again, other eggs, the surface of which is as aforesaid dark red all over, and has various irregularly placed blotches of a still darker colour, as in the case of some of the *Rapaces* and *Tetraonidæ*.

Such, it is believed, have required continuous and great efforts at expulsion, though it is quite possible that in these cases there may have been greater excitement and turgescence of the mucous membrane, and perhaps greater delicacy of the blood vessels than in others. The passage of such eggs was probably accompanied with a great deal of pain, which in the laying of white eggs may have been absent.

Eggs, like those of *Emberizæ* and especially of the Guillemots, are at times most curiously streaked with narrow dark lines running in angles and curves, and even circles, in the most irregular manner, and often intricately intersecting each other. Such eggs as these have in all probability not gone continuously on in their downward course, either in a straight or in a spiral direction, but during the escape of blood have been rolled about, nervously or hysterically, as it were, in various directions, up and down, from side to side and round about, by the irregular action of the muscular walls of the oviduct; or it may be that the oviduct has undergone many and various local contractions and relaxations, both itself and the egg moving about irregularly. This peculiar kind of marking occurs almost always at the large end of the egg. In the case of some foreign as well as British birds' eggs, such streaks are intermixed very curiously with spots, as in those of Chaffinches, etc.

There are other peculiarities of the markings of many eggs which deserve notice, and which seem to point out the direction in which the eggs exhibiting them have passed down the lower part of the oviduct. For instance, the spots, which, as already stated, are most numerous and largest at the blunt end, are also largest, darkest, and best defined at that part of their outline which lies nearest to this end; whilst in the opposite direction these spots are prolonged, more irregular, tapering, and fainter in colour, and often seem as if, whilst still wet, they had been rubbed or wiped in the direction from the large to the small end. For example, on some eggs of the Raven, Great Bustard, Crane, certain *Charadriidæ*, *Scolopacidæ*, and *Laridæ:* or there are irregular longitudinal rows of spots which grow smaller and fainter as we trace them from the large to the small end, as on some eggs of the Egyptian Vulture, Common Buzzard, Whimbrel, and other *Scolopacidæ*, *Alcidæ*, and *Laridæ*. Plate IV., fig. 1.

These peculiarities also serve to show that the above eggs must have been laid the large end presenting first, and forcing the passage.

Moreover, though these marks commonly extend in a straight direction from the large to the small end, many examples may be adduced in which they take an oblique direction; and when the egg is held with the small end towards the eye, this obliquity is most commonly from right to left, and from the large to the small end, showing that the egg must have been revolved on its axis from left to right through about a quarter of a circle. Examples of such oblique markings in streaks and blotches are beautifully seen on eggs of *Aquila fulva*, *Milvus regalis*, *Accipiter nisus*, also on those of *Tringæ*, *Totani*, *Charadriidæ*, and *Sternæ*. See Pl. IV., figs. 2, 3.

An obliquity from left to right, has been observed, but much less frequently and distinctly than that from right to left; it may be seen on some eggs of the Gulls and Guillemots, and in Plate I., fig. 1.

In the Common Hen, Rook, and Peewit, the oviduct has along its whole length slightly raised spiral ridges passing downwards from left to right, the eye being directed from the upper to the lower end of the duct; and these, probably, to some extent, guide

the descending egg in a spiral course. Whether the oviduct of the birds previously cited have the same sort of spiral "rifling" I do not know, and it would now be perhaps "illegal" to attempt to ascertain.

It is a curious and instructive fact that the fœtus of the human being, and perhaps also of other Mammalia, likewise performs, during parturition, a similar spiral movement of about a quarter of a circle, and that, as a rule, from left to right, but occasionally also from right to left.

The logical conclusions then seem to be, that there is a considerable similarity between the parturition of the avian and that of the human ovum, in many of the particulars which make up that complicated and wonderful process; that there is also every probability that the ground colours of eggs are owing to albumen and mucus secreted by a mucous membrane in a state more or less decided of congestion or quasi-inflammation; and further, that the markings of various kinds are the result of small escapes of blood from the overcharged vessels of the membrane which have been abraded or ruptured by the rough calcareous coating of the egg as it is rubbed against them by the forcible contractions of the muscular wall of the oviduct.

VI.—Although the above conclusions may be admitted as probable, it may be very pertinently urged that no actual or distinct proof has been adduced in support of them, and that it is necessary to ascertain what light further research may throw on the subject.

To meet such reasonable objection the spots on eggs, chiefly of the Peewit, have been subjected, by one of my friends, to examination by the microscope, as well as to spectroscopic and chemical analysis, and with the following results.

The microscope has hitherto given no clue to the nature of the spots on the eggs of birds, either when they were examined alone, while dry or wet, or after having been treated in various ways with different re-agents: no blood disks were discovered. It must however be added, that very commonly when blood is congealed on a glass slide, and submitted to a microscope of sufficient power,

it shows no blood disks. They seem for the most part, if not dispersed, to have run together, and lost their individuality.

Eggs now and then are met with which appear to have been smeared more or less with blood of the ordinary colour on the exterior. The daubing seems quite fresh and can be very easily wiped off, as is indeed done by dealers in eggs and by others, when they find such unsightly marks upon them. The first egg of the pullet, or the eggs of hens in the autumn, may be found so marked. No doubt this is blood which comes from the lining membrane of the *sphincter ani* which is abraded at the time of the final and forcible expulsion of the egg from the body of the bird. Such blood lies upon the mucous coating given to the egg during its sojourn in the cloaca, and this coating separates it from the fresh calcareous shell and hinders it from being modified by the latter. Moreover, fresh human blood smeared over a fresh egg does not undergo any alteration. In neither of these cases, however, are the circumstances the same as in the case of the operations going on within the oviduct of the living bird, in which the blood is mingled hot with the nascent and fluid calcareous salts.

"Chemistry shows that the egg spots, indeed, are mainly composed of chlorophyll, and that blood, as such, cannot be said to be present in them; but then this chlorophyll is identical with that which is obtainable in large quantity from the bile of the Ox and the Peewit; and again, this latter is identical with the chlorophyll existing so largely in plants, thus demonstrating that, in regard to this substance, there is a more close alliance between animals and plants than is generally acknowledged.

"Now Berzelius* and others have stated that chlorophyll,

* Berzelius' Chemistry, Vol. V., p. 274, in which he records his last and most careful researches into the nature of bile. "La matière colorante de la bile se metamorphose avec la même facilité que la biline. Cette matière n'est pas celle qui est decrite dans les Elémens de Chimie sous le nom de biliverdine. Celle-ci ne constitue pas un des élémens de la bile fraîche et saine; quand elle se trouve dans la bile fraîche elle est un produit morbide. Nous ne connaitrions pas la matière qui la colore, à cause de la rapidité avec laquelle elle se metamorphose pendant qu 'on l'analyse. Un des produits de metamorphose qu'elle engendre est le chlorophylle. Il faut entièrement réjeter le nom de biliverdine, puisqu'il est prouvé que la matière colorante verte de la bile est identique avec le chlorophylle." Berzelius then proposes to call this metamorphosed colouring agent of the bile cholepyrrhine, orange red bile, because this is its natural healthy colour.

hæmatine, and humine have 'une identité organique,' but he does not appear to have examined the markings on eggs, for he does not even allude to them.

"However, if the chlorophyll composing these spots have an organic identity with hæmatine, though as yet no one has ever converted either of them into the other, it is more than probable that the chlorophyll of the spots has been derived from the blood of the bird, as no other coloured fluid has access to the oviduct; and one may perhaps be justified in concluding that the blood, on its escape from the vessels of the oviduct and being mixed with the mucus holding in solution the calcareous ingredients of the shell, has, at the temperature of the body of the bird, (say 107°.86 Fahr.,) undergone some catalytic action, converting it into chlorophyll, the blood globules at the same time undergoing destruction.

"At page 144, Vol. V., of the 'Chimie Générale de Pelouze and Fremy,' are the following words, taken from some of Berzelius' last works. 'La matière colorante de la bile contient du fer, sa composition se rapproche de celle de l' Hæmatosine.'

"According to other experiments, omitting the iron in the form of metal, and not as oxide, chlorophyll of bile, chlorophyll of grass, and hæmatine of blood have exactly the same composition. And according to Scherer all the iron can be separated from the hæmatine without altering its red colour or its other properties. In autumn this green colouring matter of plants is changed to yellow, red, or dark brown, very like many of the spots on eggs; and when the hæmatine of blood is allowed to putrify in water at a temperature of 90° Fahr. it becomes yellow, then brown, and at last of a greenish black colour, very much resembling the changes by which green leaves or grass are turned by the same means into humus.

"With regard to the employment of the spectroscope, the results are hazy and badly defined with both kinds of chlorophyll, and also with the green colour obtained from egg-spots; but there is a sufficient resemblance as to the situation of the bands in the whole of the three cases: that is to say, in the bands from the chlorophyll of leaves, the chlorophyll of bile, and the green

solution obtained from egg-spots by alcohol and an acid. Thus, all three give a band in the middle part of the red, and a hazy cloud from the beginning of the blue to the violet end of the spectrum; but the depth of tint in these bands is very variable, and in no case have the bands a distinct outline. The spectroscope fails, in this instance, to give any sure indication; but it is worthy of notice that blood, which has been thoroughly deoxidised by the action of phosphuretted hydrogen gas, gives a spectrum like the spectra obtained from the three substances above mentioned. The band in the red is a little nearer to the orange. That is all. The hazy cloud from the blue to the violet being the same."

VII. Considering, therefore, the high degree of probability that has been established under the fourth head of this paper, and the results of the spectroscopic and chemical researches as above given, and which seem decidedly, but perhaps not so strongly as could be desired, to corroborate that probability, it may be concluded, without undue partiality, (1) that the various ground colours which distinguish eggs are owing to different states more or less approaching to, if they be not actually inflammation of the lining membrane of the oviduct, and giving rise to the different coloured albumina seen in the "white" and in the shell. And (2) that the various markings on the ground colour of the shell, whether on the surface or on deeper layers, are the result of irregular escapes of blood from the turgid and ruptured blood vessels of the same membrane, under pressure exerted by the muscular coats of that tube, upon the egg more or less coated with rough shell; the blood being catalysed or altered to chlorophyll, or colouring matter as actually found in the bile both of the Ox and the Peewit.

As before stated, no pigment glands have ever been described as existing in the oviduct. I have looked in vain for them in the oviduct of the Rook and the Peewit, both of which lay highly coloured eggs.

We may conceive it possible that the cells of the delicate cellular tissue which becomes organised in the liquid plaster of the

shell, and in which the calcareous salts are deposited, may have the function of secreting pigmentary matter. But if this were so, ought we not to find something like coloured patterns on the eggs, showing some degree of definition and regularity, and perhaps also pigment granules in the cells of the coloured spots? such appearances, however, do not seem to have been observed, or at least recorded.

VIII. The colours of the plumage of birds, though often so much more brilliant, are even more variable than those of eggs, but there does not appear to be any relationship or correspondence between the colours of the plumage and those of the eggs; nor is there any evidence to prove that Dr. Erasmus Darwin was correct in ascribing the origin of the colours of eggs to the colour of the objects among which the mother bird lives.*

The colours of feathers are not due to mere escapes of blood. They appear rather to be the result of the operation of gland cells at the roots of the feathers, and perhaps in the feathers themselves, upon the matters they receive from the blood circulating in the capillary vessels around them.

The colours of some eggs, as those of the plumage of some female birds, appear to be, in a measure at least, in some cases, the means of their protection; but there are too many examples to the contrary, in both respects, to admit of any rule being thereby established.

There cannot be a doubt that some, as for instance the Bower Birds, admire the nests they build up and ornament with so much skill, assiduity, and even taste; and that others evince great attachment to their eggs, their constant care of which is so conspicuous. On the other hand there are some, as the domestic fowls, that are careless, and will lay almost anywhere, even without any nest. With regard to the number of their eggs, birds generally seem to have only an imperfect notion.

Postscript.—On the 6th of August, 1876, and sometime after

* The first record of the impression on the mind or brain, through the eyes of a mother, influencing the colour of her offspring, is to be found, as is generally known, in the last verses of the thirtieth chapter of the book of Genesis.

this paper was written, Mr. John Hancock kindly lent me the work of F. A. L. Thieneman, M.D., entitled, "*Systematische Darstellung der Fortpflanzung der Vögel Europa's mit Abbildung der Eier.*" *Leipzig*, 4*to*, 1825–38.

In the introduction, p. 1, we find the following passage, which, with others here quoted, I have translated as literally as possible.

"The egg is round in the ovarium, but owing to the pressure it has to undergo in the oviduct, it must there become elongated. That part which first enters that tube, as a rule, becomes the pointed end, for it has to open out the road, and experiences the greatest opposition. The degree of pressure, however, depends upon the condition of the oviduct, and other incidental circumstances which so operate, that no egg has exactly the form of any other, though each species of bird has certain peculiarities which are not entirely lost, though many minute differences occur.

"If an egg passes rapidly down the oviduct it becomes much elongated and has no hard shell on it, as may be seen in the case of hens which, soon after the egg has passed into the oviduct, have been much chased about, the long diameter of the egg is then six to eight times greater than the transverse.

"If the egg goes slowly down the oviduct and becomes perfected and overlaid with a hard shell, it is shorter."

At p. 9.—"The egg when laid is more or less moist, and has often upon it fresh blood spots and streaks which it has derived from the cloaca."

At p. 11.—"The colouring of eggs goes on during the formation of the calcareous shell, and this in two ways. Either the whole shell is mixed throughout with colouring matters, and these are greenish, or yellowish, or brownish; or, through the pressure of the egg on the swollen blood vessels of the oviduct, the pent up blood becomes discharged mechanically, sinks in more or less upon the soft or hardening shell mass, and gives the streaks or spots.

"This conditionates the indefiniteness of the pattern, so that eggs are never produced alike; the state also of the vessels is not always the same, and there is a difference too in the shell.

"In spotted eggs, as a rule, we observe three kinds of spotting, faint, stronger, and full coloured, so that we must conclude that there are three periods of coloration; at the first, are the pale or faint colours, the calcareous matter at their occurrence being softer and permitting of their sinking in; the second find that matter of greater consistence, wherefore they sink less into it; finally, the last are so superficial that they can be washed off.

"The colour of these spots is generally brown, some however pass into yellow, green, red, and violet.

"The unspotted eggs, during the formation of their shell, are covered with a fatty gelatinous humour which keeps the little blood drops from the shell, or gives to the egg a smoothness, or varnish, by means of which the greater part of the pressure on the blood vessels of the oviduct is lessened.

"This humour gives to the shell also greater hardness; hence the shell of the spotless egg is much stronger than that of the spotted. Both the mass of the shell and the spots are the outcome of inflammatory processes caused by the pressure of the passing egg, and these can be seen in any oviduct into which an egg has entered. First, the calcareous matter is thrown out, and this gives rise to the spots through a pressing out of the blood mixed with it, and this is the cause of the colour. In the cloaca there frequently occur blood spots and streaks, both on spotted and unspotted eggs, but these consist of pure blood, and therefore have a pure blood colour.

"The colour of the plumage has no kind of connection with the colour of the eggs; many black, or black and white, or brown and white birds have spotted eggs with a green ground colour, whilst there are others which, though of similar colour, lay white eggs."

In the above work are figured two hundred and ninety-two eggs. Of these eighteen have become so discoloured since publication as to be unreliable as to hue. Of the others, seventy-six are of a uniform ground colour; so that, deducting these ninety-four from the whole number, we find that of the remaining one

hundred and ninety-eight spotted eggs, ninety-nine are most marked at the large end, only six most spotted at the small end, and ninety-three indifferently marked all over, or at least not more at one end than the other.

It is satisfactory to note, in conclusion, that Dr. Thieneman attributes the markings on eggs to escapes of blood from the vessels of the oviduct, and states further that both the shell and the spots are produced by inflammatory processes caused by the pressure of the passing egg. His figures corroborate what has been advanced with regard to the large end being much more commonly and more strongly marked than any other part of the egg.

Read November 23rd, 1876.

The following Plates are printed from Photographs taken by Mr. J. W. Swan from specimens of eggs in the collection of Mr. John Hancock. To both these gentlemen my best thanks are due for their kind assistance.

The eggs are represented somewhat less than the natural size.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Oval Egg of Arctic Tern, *Sterna paradisea*, Brunnich, showing a broad band or zone of dark colour covering the broadest part of the egg, leaving both apices clear, or nearly so. Towards the small end the band sends off projections, which taper to points, and their direction is from left to right.

Fig. 2. Pyriform Egg of Common Snipe, *Gallinago Scolopacinus*, Bp., showing a dark cap covering the apex of the large end, with a few spots around it, which diminish in number and size the further they are from it. The small end is nearly free from spots.

Fig. 3. Oval Egg of Razor Bill, *Alca torda*, Linn., showing an irregular ring or zone of blotches encircling the apex of the large end, which is almost quite white. A few spots are seen towards the middle, but the small end of the egg is white.

Fig. 4. Pyriform Egg of Guillemot, *Uria troile*, Linn., showing a large dark-coloured cap covering the greater part of the large end. The

1

2

3

4

5

1

2

3

1

2

3

circumference of the cap is ragged, and breaks off into irregular fragments, which become smaller and less numerous as they approach the small end, which has few spots.

Fig. 5. Pyriform Egg of Peewit, *Vanellus cristatus*, Meyer and Wolf, showing a partial cap of dark spots at the large end and a narrow dark band across the widest part of the egg. The large end is more spotted and darker than the small end, which has a great deal of shade over it.

PLATE II.

Fig. 1. Almost globular Egg of Honey Buzzard, *Pernis apivorus*, Linn., showing a dark cap on small end, the coloration diminishing towards the large end.

Fig. 2. Pyriform Egg of Sandwich Tern, *Sterna Cantiaca*, Gmelin, showing an irregular ring of dark colour, enclosing the apex of the large end, and situated at nearly the widest part of the egg.

Fig. 3. Bluntly oval Egg of Osprey, *Pandion haliætus*, Linn., the small end of which presents a partial cap of dark colour joined to an imperfect ring, the large end showing only a very few small spots.

PLATE III.

Figs. 1 and 2. Elongated pyriform Eggs of Common Guillemot, *Uria troile*, Linn., both much coloured. No. 1 has a clear apex of the large end enclosed by a broadish band of colour; the small end is strongly marked with spots, forming an incomplete cap, and there is an intermediate band of coloured spots and stripes between the broadest part of the egg and the small end, so that three zones of colour are seen. No. 2 shows the irregularly curved lines of colour and spots noticed in the text; the large end is almost completely capped by them, and they form a zone round the egg between the widest part and the small apex.

PLATE IV.

Fig. 1. Elongated oval Egg of Crane, *Grus cinerea*, Bechstein, exhibiting spots and streaks running longitudinally from one apex to the other.

Fig. 2. Broadly-pyriform Egg of Sandwich Tern, *Sterna Cantiaca*, Gmelin, with broad streaks and blotches extending obliquely from right to left.

Fig. 3. Pyriform Egg of Common Snipe, *Gallinago Scolopacinus*, Bp., showing oblique marking from right to left.

III.—*On a Piece of Timber recently encrusted with Carbonate of Lime from a Coal-Pit near Gunnerton, North Tynedale, with some Remarks on the Rate of Formation of similar Deposits in Ossiferous Caves in Connection with the Antiquity of Man.* By the Rev. G. Rome Hall, F.S.A.

A few weeks since (December, 1876,) Mr. Armstrong, the lessee of the small land-sale colliery at Gunnerton Hill Head, the property of the Rev. C. Bird, Vicar of Chollerton, a member of our Club, brought to my house a piece of Timber which had been used as a cage-girder, or slider for the cage in the shaft of a pit recently disused, another shaft closely adjoining having been sunk by him last year which is being worked at the present time.

In removing the boards from the disused shaft he observed that many of them had become, as he conceived, "petrified," or turned into stone. Thinking that I might take some interest in the phenomenon, he kindly placed a board from the lower part of the shaft, but some distance from the bottom, at my disposal, carrying it himself on his shoulders, a very heavy and burdensome present it must have proved, a distance of one mile and a half.

The district forms a portion of the Carboniferous system, the Mountain Limestone, and is thus described by the late Mr. Geo. Tate, F.G.S., in general terms.* "Northward of the Tyne the Mountain Limestone consists principally of sandstones and shales, with beds of limestones and coal interstratified, and of ironstone nodules and layers among the shales. The general direction of the strata is south-westward, with a rise towards the north-west; but in their range they are interrupted by many faults, which however have the effect of extending the same beds from the Tweed to the Tyne.....A line from the mouth of the Aln to the Tyne, a little east of Corbridge, nearly marks their eastern boundary." The site of both the present and the older pit, whence the timber with encrustation of calcareous spar has been taken, is on the northern slope of the little valley of the Gunnerton Burn,

* "New Flora of Northumberland and Durham." Nat. Hist. Trans., Vol. II., p. 7.

facing the picturesque Barrasford Crags southwards and about a mile distant. These crags form part of the Great Basaltic Whin Sill that can be traced with occasional breaks from Kyloe Crags in the north to Glenwhelt in the south-west of Northumberland. A considerable depth of Boulder-clay is left here above the strata, through which the colliery had been sunk in 1865. In the new pit opened last year, about two hundred yards north-eastward, the depth of the clay is given as forty-four feet, an upper band of limestone occurring at eighty feet from the surface, only six inches thick, while a lower band, two feet and a half thick, is ninety-six feet from the surface.

At the request of my friend, the late Mr. George Tate, F.G.S., after a visit to Birtley in 1867, I obtained from Mr. Armstrong a section of the strata in his pit, which seems to be approximately correct. It is as follows:—

	FEET.
Clay	24
Freestone	22
Plate	14
Freestone	20
*Limestone	4
Freestone	10
Plate	12
Coal	2

The new colliery, closely adjacent to this older one, is, according to Mr. Armstrong, twenty fathoms and a half deep, and in it the limestones are two, instead of one as in the disused pit, though both together do not equal in thickness the single band of the latter by twelve inches.

The plank or board itself is six feet eight inches in length, two inches and a half thick, and five inches in breadth, a portion, one-third, of which is now shown.† The laminated, compact deposit of crystalline carbonate of lime that has been gradually formed in eleven years is from one-eighth to a quarter of an inch in thickness. On this particular board about three-sixteenths has been formed,

* Mr. Armstrong describes it as a coarse band above, blue in the centre, and with shale intermixed. The limestone strata have a thickness of thirty-five to forty feet, at a maximum, near Sewing Shields, but varies greatly in the district.

† It may be seen in the Natural History Museum.

but it appears that a quarter of an inch or rather more was noticed upon the sliders nearer to the bottom of the pit-shaft. Many of these are not yet removed. On the outer side next to the strata the calc-sinter* is thicker than on the inner side which was subject to friction from the cage; and there the lines of drip and shallow vertical grooves are observable, with tiny bosses of drip-stone, the whole surface sparkling in favourable lights. Through the fissures in the superincumbent strata the drops have percolated slowly down the timber cage-supports, and the bi-carbonate of lime† held in solution therein has re-assumed its crystalline form, the excess of free carbonic acid being yielded up to the air through exposure to the air-currents and evaporation. The surface of the timber, wherever it has been bathed by the thin films of the liquid, impregnated by the salt of lime, has become a sheet of sparry deposit having on the under side a beautiful and exact representation of every fibre and knot of the wood.

The inner side of the boards next the shaft shows at once the marks of friction from the frequently-descending "cage," which has prevented the encrustation being formed to the same thickness as on the other side.

It is a point of considerable interest, both in its geological and archæological aspect, to ascertain any facts that may throw light upon the rate at which stalagmite has been and is being formed. I have previously‡ had occasion to refer to one instance that has occurred within the range of our Society's operations, that is, at Boltsburn, in Weardale, where, as the case is given in *Nature*,§ three-quarters of an inch of crystalline stalagmite had formed on boards, which had, in connection with a lead-mine, been placed there just fifteen years previous. But a much stronger instance

* Lat. *calx*, *calcis*, lime, and Ger. *sintern*, to drop. Professor Page, LL.D., F.G.S., in his valuable "Advanced Text-Book of Geology," 5th Edit. (Glossary) p. 451, remarks, "This term is usually applied to compact stalagmitical or stalactitical deposits from calcareous waters. The gradual increment of calc-sinter is usually marked by lines or layers of varying hardness and colour."

† "The Ancient Stone Implements, etc., of Great Britain," by John Evans, F.R.S., F.S.A., Chap. XXII., p. 431.

‡ Presidential Address, Vol. V. (New Series), Part III., 266.

§ December 18th, 1873, p. 122.

of rapid encrustation was given in the same scientific periodical in its issue of a fortnight later, where it is recorded that in Poole's Hole,* near Buxton in Derbyshire, one-eighth of an inch of stalagmite was deposited on the gas-pipes which were used in lighting the caves, six months only after they were placed in position.

It is well known that a strong argument for the antiquity of man has been founded on the phenomena discoverable in Ossiferous Caves as at Kent's Cavern, Brixham, and elsewhere. Mr. Alfred Wallace and other high authorities have referred to the rate of deposition of the stalagmitic flooring of such caves, which cover the remains of extinct animals and man, as a tolerably safe criterion of the extreme antiquity of man on the earth.

This distinguished naturalist, Mr. A. R. Wallace, remarks,† "We have here indications of an immense antiquity from various sources. The upper stalagmitic floor itself marks a vast lapse of time, since it divides the relics of the last two or three thousand years from a deposit full of the bones of extinct mammalia, many of which, like the Reindeer, Mammoth, and Glutton, indicate an arctic climate. It has been remarked that the varying thicknesses of the stalagmitic floor, from sixteen inches to five feet and upwards, closely correspond to the present amount of drip in various parts of the cave, so that the cave itself, with its various fissures and crevices, does not appear to have been materially altered since the stalagmite was deposited. It is true that the drip may once have been greater, but it may also have been less, and we do not know that a more copious drip would necessarily produce a more rapid deposit of stalagmite. But names cut into this stalagmite more than two centuries ago are still legible,‡ showing that, in a spot where the drip is now very copious, and where the stalagmite is twelve feet thick, not more than about

* "Poole's Cavern" is described in Prof. Boyd-Dawkin's "Cave-Hunting," Chap. II., p. 34, und III., p. 126 (1874).

† "*Nature*," October 2nd, 1873, p. 463, speaking of Kent's Cavern, near Torquay, in his review of the fourth Edition of Sir Charles Lyell's "Antiquity of Man."

‡ The following are amongst the names and dates: Robert Hedges, of Ireland,, Feb. 20th, 1688. Peter Lemane. Richard Colby, of London, 1615. See "The Geological Evidences of the Antiquity of Man Reconsidered," by Thomas Karr Callard, F.G.S., p. 14. (Note).

one-eighth of an inch, or say one-hundredth of a foot, has been deposited in that length of time (Brit. Association Report, 1869, p. 196). This gives a foot in twenty thousand years, or five feet in one hundred thousand years; and there is no reason whatever to consider this to be too high an estimate to account for the triple change of organic remains, of climate, and of physical geography. But below this again there is another and much older layer of stalagmite, generally broken up and imbedded in the cave earth. This older stalagmite is very thick, and is much more crystalline than the upper one, so that it was probably formed at a slower rate. Yet below this again, in a solid breccia, very different from the cave earth, undoubted works of art have been found. A fair estimate will therefore give us, say, one hundred thousand years for the upper stalagmite, and about two hundred and fifty thousand for the deeper layer of much greater thickness, and of more crystalline texture. But between these we have a deposit of cave-earth which implies a different set of physical conditions, and an alteration in the geography of the surrounding country. We have no means of measuring the period during which this continued to be formed, but it was probably very great; and there was certainly some great change in physical conditions during the deposit of the lower stalagmite, because the fauna of the county (country?) underwent a striking change in the interval. If we add one hundred and fifty thousand years for this period, we arrive at the sum of half-a-million as representing the years that have probably elapsed since flints of human workmanship were buried in the lower deposits of Kent's Cavern. It may be objected that such an estimate is so loose and untrustworthy as to be altogether valueless; but it may be maintained, on the other hand, that such estimates, if sufficiently multiplied, are of great value, since they help us to form a definite idea of what kind of periods we are dealing with, and furnish us with a series of hypotheses to be corrected or supported by further observation, and will at last enable us to arrive at the antiquity of man within certain probable limits of error. Without laying stress on any portion of the above very rude estimate,

it may, I think, be averred that it is not palpably too high, but is just as likely to be too low."

Now, in considering such a statement as the foregoing, it appears to me that *any equal rate* of the formation of such calc-sinter or stalagmitic covering of the rocky sides and floors of subterranean caves is *against*, rather than favoured by, the facts of scientific observation and inference. In ancient times, when the surface of the ground over the cavities was covered with primæval forest, the "natural laboratory" was there at work in the accumulation of decaying vegetation in the soil, "wherein the rain would find the carbonic acid to act as a solvent upon the calcareous earth." Hence the percolation through the soil of the acidulous liquid and the drip into the caves, the origin of the stalagmite, would be much greater, and produce greater results than could be possible under other and later conditions of surface-ground. Nothing now covers Kent's Hole in Devonshire but a little brushwood, and a row of houses now stands over the stalagmite cave at Brixham. It seems undoubted, too, that the material composing the stalagmite must have been decreasing every year in the superjacent soil, besides the diminution of the solvent every year that the operation was going on. Thus it has been reckoned that the carbonate of lime, which now takes two centuries to cover one-eighth of an inch (a greater deposit having been formed in the Gunnerton Pit in eleven years) might, in days gone by, have performed the work in a very few months. At the rate of deposit of the stalagmite in Poole's Hole, near Buxton, eight hundred years would have sufficed, instead of three hundred and fifty thousand for the formation of the floorings of Kent's Cavern. At the rate of that formed on the boards in the Boltsburn lead mine, four thousand and eighty years would have been the extreme time required for their deposition.

In the case of the piece of timber recently encrusted with carbonate of lime in the Gunnerton Colliery, we may take three-sixteenths as its average thickness. It must be remembered, however, that at, and even at some distance from, the bottom of the shaft, the deposit on the boards, some of which are still *in situ*, is more than a quarter of an inch. Thus three-sixteenths,

or ·1875 of an inch having been accumulated at a low estimate in the eleven years which have elapsed since the board had been placed in position, we arrive at a rate of annual deposition of ·017 of an inch. Then the five feet for the outside thickness of the stalagmitic floor of Kent's Hole or Cavern would have been formed in three thousand five hundred and twenty years at this particular rate; and the lower floor would be represented by eight thousand four hundred and forty-eight years for its maximum thickness of twelve feet. But this goes on the improbable supposition of a uniformity in the rate of formation of the deposit, and would give under twelve thousand years for the entire deposition instead of Mr. Wallace's three hundred and fifty thousand.*

The well-known Jockey Cap stalagmite in the beautiful Ingleborough Cave, Yorkshire, has become, in the able hands of Mr. Farrer, and the late Professor Phillips, a kind of gauge of the rate of such accumulation. Here the annual deposit from 1845 to 1873 was not less than ·2946 of an inch. And that which Prof. Boyd Dawkins has remarked of the great stalagmite of the Ingleborough Cave seems generally true of all similar calcareous deposits. The drip containing the carbonate of lime may be *intermittent*, not continuous. In 1845 Professor Phillips estimated its age at two hundred and fifty-nine years, on the supposition that all or nearly all of the carbonate of lime in each pint was deposited. According to its present rate of growth, however, one hundred years would be amply sufficient, and at the same rate we need not go further back than the time of Edward III. for the date of all the stalagmites and stalactites in that beautiful cavern.

On the need of the avoidance of any such hasty generalizations as those of Mr. Wallace, I may cite some weighty cautions of one who has most thoroughly studied the subject in connection with this last example which I have adduced. "It is evident,† from this instance of rapid accumulation, that the value of a layer

* Reckoning the deposit as a quarter of an inch on the lower boards the times required would be two thousand six hundred and forty, and six thousand three hundred and thirty-six years respectively, or nearly nine thousand years in all.

† Cave-Hunting, Chap. II., p.p. 40 and 41.

of stalagmite in measuring the antiquity of deposits below it, is comparatively little. The layers, for instance, in Kent's Hole, which are generally believed to have demanded a considerable lapse of time, may possibly have been formed *at the rate of a quarter of an inch per annum*, and the human bones which lie buried under the stalagmite in the cave of Bruniquel are not for that reason to be taken to be of a vast antiquity. It may be fairly concluded that the thickness of layers of stalagmite cannot be used as an argument in support of the remote age of the strata below. At the rate of a quarter of an inch per annum, *twenty feet of stalagmite might be formed in a thousand years.*"*

The calc-sinter encrusted board from the Gunnerton Colliery, now before us, may be considered in this aspect, a small connecting link between geology and archæology. It may help us to understand a little better that it is merely the *interpreters* of science and of Scripture respectively who are or who seem to be at variance in some respects in the present imperfect state of our knowledge; not that God's Word and His works can ever really be so. It is well to take wide and unbiassed views of Truth from every point of view. Whilst we acknowledge that the Bible history does not necessarily restrict the age of man on the earth to six thousand years, nor militate against any reasonable estimate of his antiquity drawn from scientific researches, in various fields, bearing upon this most interesting problem; yet at the

* Compare the remark of Mr. Evans to the same effect. "Ancient Stone Implements," Chap. XXII., p. 432.

The late President of the Geological Society says, "The rate of deposit of stalagmitic matter varies so much with different conditions, that its thickness affords no true criterion of the length of time during which it has been accumulated." After the reading of the present paper the Rev. Dr. Bruce exhibited a portion of the well-known Walker *Almanac* stone, which has recorded with exact precision by means of its alternate light and dark layers of stalagmitic deposit the Sundays and holidays, and the working days respectively, of the coal-miners in that pit. It also illustrated the rapidity of the rate of deposition of the carbonate of lime. Another friend, Mr. John Hancock, has sent me two massive bosses, one of which is four inches and a half in height, and the same in diameter, both having been formed in a few years in the workings of a disused colliery on the Newcastle Town Moor. Mr. B. S. Proctor has also favoured me with a portion of a similar deposition from the Lower Fall in Gordale, and some stereoscopic views of the picturesque effect of the great sheet of pendant calc-sinter; an instance of which occurs on a smaller scale in a curious petrified cascade in Warks Burn. See Nat. Hist. Trans., Vol. V., New Series, p. 243.

same time it is very desirable not to be led away by unreliable and unsatisfactory data, or "very rude estimates," such as Mr. Wallace fitly terms his own extravagant assumptions.

The true naturalist will without doubt always feel more deeply interested in the structure and formation of the beautiful sparry deposit, the calc-sinter itself, than in the relative and uncertain measure of the rate of the deposition of the carbonate of lime, from which it is so wonderfully formed, in cave, or rock-crevice, or mine. He will remember, as it has been well said,* that "The circulation of carbonate of lime in nature presents us with a never-ending cycle of change. It is conveyed into the sea to be built up into the tissues of the animal and vegetable inhabitants. It appears in the gorgeous corallines, nullipores, calcareous sea-weeds, sea-shells, and in the armour of crustaceans. In the tissues of the coral-zoophytes it assumes the form of stony groves, of which each tree is a colony of animals, and in the wave-defying reef it reverts to its original state of limestone. Or, again, it is seized upon by tiny masses of structureless protoplasm, and fashioned into chambers of endless variety and of infinite beauty, and accumulated at the bottom of the deeper seas, forming a deposit analogous to our chalk. In the revolution of ages the bottom of the sea becomes dry land, the calcareous *débris* of animal and vegetable life is more or less compacted together by pressure and by the infiltration of acid-laden rain-water, and appears as limestone of various hardness and constitution. Then the destruction begins again, and caves, pot-holes, and ravines are carved out of the solid rock."

* Cave-Hunting, Chap II., p. 71.

IV.—*Bewick Correspondence, with Notes.* Communicated by Sir Walter Trevelyan, Bart.

Thomas Bewick to Sir John Trevelyan, Bart.

Newcastle, 7 Sept., 1807.

Sir,

Your kind letter came to hand last week, by which I am informed of your desire to be furnished with the new Edition of my Books.—In this I am happy to have it in my power to send you the whole, printed so as to match each other compleat, and when you have leisure to examine them, I hope they will meet with your approbation.—Your obliging communications respecting the Water Hen, the Water Ouzel,* and the Hampshire Mouse,† particularly the last two, are I think new, and very curious and shall be attended to, if ever there be occasion for another edition, which I hope there may be, if time should ever bring about a safe and honourable peace.—In your list of names of men taken from Birds, you have furnished me with eight more to mine, and I do not know, not having yours to compare with it, whether or not I can add any new name to yours, except indeed it be that of *Quayle* or Quail, which I think I have got, since I had the pleasure of seeing you.—I can only add, that I have to beg that you will accept my thanks for your kind attention—but indeed Sir, you have so long and so repeatedly done

* The "Water Ouzel." "What I have to say of the Water Ouzel is very short.—When I used to fish in our shallow brooks near Nettlecombe, I have observed that those interesting Birds were accustomed to strike their breasts against the water, with a splash, in order to check their course before alighting on a stone in the brook (their flight being uniformly rapid) which they did, if going up the stream, about a yard from where they would pitch;—if going down, two yards, with greater or less splash according to the current of the water; and so well did they regulate all this, as never to miss their footing, though on the point of a small stone: and though these birds are not web-footed, they are good swimmers."

Extract from a letter from Sir John Trevelyan to his Grandson (now Sir W. C. Trevelyan) dated, Bath, October 26th, 1826.

† "The Hampshire Mouse." The Harvest Mouse, *Mus Messorius*, which was first noticed in Hampshire by Gilbert White, in 1767.

W. C. T.

The list of "names of men taken from Birds," mentioned in this letter, in the handwriting of Sir John Trevelyan, with additions written by T. Bewick, is in my possession.

W. C. T.

me the honour of countenancing my labours, that the ordinary mode of making acknowledgements seems to me too stale and insufficient for such uncommon condescension.

I am,
Sir,
With the greatest respect,
Your obliged and obedt.,
THOMAS BEWICK.

Sir John Trevelyan, Bart.,
Nettlecombe Court,
Near Taunton,
Somersetshire.

THOMAS BEWICK TO THE EDITOR OF THE NEWCASTLE COURANT.
(Published in that paper on 21st October, 1826.)

To the Editor of the Newcastle Courant.

"Allow me to request a place in your paper, for the following letter, from a worthy and highly respected Baronet, whose ardour in the cause of science remains undiminished, notwithstanding his advanced age,* and from whose friendly communications on various points of natural history, especially Ornithology, I am proud and happy to acknowledge myself indebted on many occasions. The fact contained in it, has I believe, never been observed before, and adds a specimen of a very important genus of Birds to our British Fauna."

I am, etc., T. B.

(SIR JOHN TREVELYAN, BART., TO THOMAS BEWICK.)

SIR,

I lately saw a neighbour of mine, the Rev. John Matthew of Kilve, near Bridgewater, whose servant shot a Vulture, in June last, in the above Parish. The Bird was first observed walking on a road, near the House; on being pursued, it flew towards the coast of the Bristol Channel, distant about a mile, where it was found sitting on the Beach, and shot. It measured

* Sir John Trevelyan at this date was in his ninety-first year, having been born on 6th Feby., 1735, he died at Bath, on 18th April, 1828.

W. C. T.

five feet eight inches from tip to tip of the extended wings, and the plumage was in every respect full and perfect; but as represented to me by a friend who has seen it, not exactly similar to either of the portraits of Vultures in your last publication. It had recently gorged itself with a putrid lamb, which may probably have been the cause of its allowing itself to be approached within shot; and on opening the bird for the purpose of stuffing, the smell was excessively offensive. It should be mentioned that another Bird of apparently the same species, was seen near to the place where this was killed, but it evaded pursuit.

The above specimen is now stuffed, in very great perfection, in the collection of the Rev. J. Matthew, Junr., at Kilve.

As this is the first Vulture that I ever heard of being met with in a wild state in this country, I think it due to our old acquaintance, and mutual love of Ornithology, to communicate the fact to you; and you will best know how to make known to the world in any future publication so very extraordinary a circumstance.

I am, Sir,
Your most obedient Servant.
JOHN TREVELYAN.

Nettlecombe, near Taunton,
29th Septm., 1826.
To Mr. Thomas Bewick,
Newcastle-on-Tyne.

EXTRACTS FROM LETTERS OF SIR JOHN TREVELYAN, TO HIS GRANDSON WALTER CALVERLEY TREVELYAN, THE FIRST ENCLOSING COPY OF THE ABOVE LETTER TO THOMAS BEWICK.

Nettlecombe, Septr. 30th, 1826.

Dear Cal:

By the last post, yesterday evening, I sent the above letter to Bewick, which will astonish him.—On the 12th of next month I propose leaving this place for Bath, and on the same morning shall call on the Rev. John Matthew, at Kilve, to see the Vulture in question, as before mentioned in my letter to Bewick.

Nettlecombe, Octr. 3rd, 1826.

Dear Cal:

I could not delay to the time mentioned in my last, the sight of the Vulture at Kilve, so went there yesterday, to see it———when the Rev. John Matthew observing my anxiety in examining the Bird, desired me to take it back with me till Thursday seven nights, the time of my setting out for Bath, when I might leave the Bird again at his house; so it is now standing on the table before me here——. (Sir John then gives a long description of the specimen.) Mr. Bickham Escott intends in a few days to make a drawing in colours of the Vulture, as large as life; and I will get my Gd. Daughter Julia to reduce it and send to you.

Bath, Octr. 26th, 1826.

Dear Cal:

———— I have further to inform you in respect to the Vulture, that it was glutted by having fed on a putrid lamb, when it suffered the man who shot it to come within ten yards of it before he fired and missed, when the Bird flew a mile to the sea side, when he approached again as near as before, and killed it by a single shot in the head. Two days after, Mr. Matthew, who stuffed it, went to the spot where it was shot, and saw another, probably its mate, which was very wild, and flew away out of sight: this contradicts the supposition of a Menagerie. Julia is copying Escott's drawing of it for you, very well done so far; when finished it shall be sent to you.

The following are the true dimensions of the Vulture, as given me by Mr. Matthew: from the point of the beak to the end of the tail, two feet three inches; breadth, with the wings extended, five feet six inches and a half.

THOMAS BEWICK TO SIR JOHN TREVELYAN.

Gateshead, Newcastle, 30 *Octr.*, 1826.

Sir John,

Your very obliging letter of the 29th Ulto. came safe to hand, and the information it communicated respecting the Vulture shot in your neighbourhood, surprised me not a little.—

There can be little doubt of its being the first of the Genus ever known to have visited the British shores. I took the liberty of giving publicity to your letter through the medium of the Newcastle Courant, on Saturday the 21st Inst., and it is very likely it will have attracted the notice of the curious, far and near, before this time. The description you have given to me, as well as some other particulars sent to your Grandson at Wallington, I shall note down to be ready for another edition of the Birds, whenever it may be wanted——as I am well aware, whatever I may have to say will be anticipated in some of the Ornithological publications, long before I can give your description of this *Rara Avis* a place among the British Birds.—How I do grieve to think that it is out of my power, from the distance, to make a drawing and a cut of this Bird; I need not tell you Sir John, that a faithful portrait of anything, either Beast or Bird, is better than the most elaborate and correct description without it.—The two figures of the Vultures in my late publication, were not drawn from nature by me, I can not therefore say how far they may be faithful or otherwise; the drawings of them were furnished long since and before I had decisively made up my mind to draw only from nature, for I can only be satisfied in the consciousness of having done my utmost in aiming at truth, and it would therefore be highly desirable to me to obtain the loan of the specimen, if that were possible.—The Foreign Birds in the Supplement, were mostly done from the preserved figures in the Wycliffe Museum, lately purchased by the Literary and Philosophical Society of Newcastle.

I can not close my letter without warmly thanking you for the pleasure afforded me by yours, which brought back to my mind the vivid remembrance of many favours of a similar kind, through a long course of years, now passed for ever away.

I have the honour to be,
Sir John,
Your most obliged and obedt.
THOMAS BEWICK.

Sir John Trevelyan, Bart.
(Of Nettlecombe),
Bath.

THOMAS BEWICK TO W. CALVERLEY TREVELYAN, ESQ.

Gateshead, 4 Nov., 1826.

Sir,

I have to thank you for your obliging letter of the 1st inst., containing a further description of the Vulture which was shot not far from Nettlecombe, and of which Sir John Trevelyan was so kind as to send me an account.—Since that time I have written to Sir John to thank him, and at the same time expressing my chagrin that from the great distance, I could not have the opportunity of making a drawing of so rare a Bird, for the purpose of cutting it on the wood, for some future edition of the British Birds.

From my long acquaintance with Sir John, and from his equally long attention to me, I feel a debt of gratitude which I shall never be able to repay, and can therefore only give vent to my feelings in ardent good wishes for his health and happiness.

I have earnestly to thank your father for his obliging invitation to Wallington, to spend a few days, but I know not how it is with me, for since my late very severe illness, I have a great aversion to stir from home. I hoped by this time to be able to go on with a numerous set of Vignettes, but in this (as yet) I feel baffled with the cutting of them, my eyes not having recovered their wonted strength; but I live in hope this will return to me, along with complete bodily health, which I feel is coming upon me very fast.

I am, Sir,

Yours truly and respectfully,

THOMAS BEWICK.

THOMAS BEWICK TO SIR JOHN TREVELYAN, BART.

Gateshead, 30 December, 1826.

Sir John,

I did not think of troubling you with answers to your two last obliging letters, until I was enabled to send you an impression from the cut of the Vulture, but I feared lest you might think me inattentive to the obligation I owed you for your kind communication.—I therefore can not think of further delay.—

I received the drawing of the Vulture from Mr. Selby a short time past, and have it now drawn upon the wood, and shall proceed with the cutting of it, as soon as I can—but in this department I can not get so fast forward as *I used to do*.—I shall return the drawing (as desired), to Wallington, as soon as the cut is done.

The Japan Peacock never having been named as a British Bird, by any Ornithologist, I therefore never thought of placing its figure amongst mine:—but should like well to set the example, as soon as I can see the living Bird, on account of its contour, and also a stuffed specimen, to enable me to depict its beautiful plumage—which I do not despair of accomplishing, as you have taken so much pains to spread them.

I think I have in the last Edition, noticed nearly all you say about the nest of the Golden-crowned Wren, but did not know, to a certainty, as to the great number of the young, till now you have satisfied me on this head—and this will be noticed as soon as I can, and the same as to all the particulars relative to the Vulture.—I believe this last has been noticed as having been often met with in the southern parts of Europe, and what Mr. Davis says, is a further corroboration of the fact.

I am, Sir John,
With the greatest respect,
Your most obedt.

THOMAS BEWICK.

Sir John Trevelyan, Bart.,
23, Pulteney Street,
Bath.

THOMAS BEWICK TO W. C. TREVELYAN, ESQ.

Gateshead, 12 *Jan.*, 1827.

Sir,

I yesterday received a few lines from you,* requesting

* The drawing of the Vulture, mentioned in these letters (which is now in my possession) by Sir John Trevelyan's grand-daughter Julia (daughter of the Rev. Walter Trevelyan, and afterwards Mrs. Lowther) is that from which Thomas Bewick made his wood-cut, and from it also Mr. Selby made an etching for the figure in his great work, 'The Illustrations of British Ornithology,' which however he was enabled to complete

to know if I had received the drawing of the Vulture, which had been sent from Nettlecomb, or from Bath, for the purpose of my figuring and describing it, in some future Edition of the British Birds.—Mr. Selby sent the drawing to me a little time ago, and I am now engraving it on the wood—but as I can not now get so quickly on with my work as I used to do, I think it will take me a week longer, before it can be finished as it ought to be—and then I ought to see a good proof taken from it at the press,—which, if it be frosty weather at the time, will be a business of difficulty. But all this I will set aside immediately and do as well as I can without the drawing, if you wish me to do so, or if you can not spare it any longer.—Mr. Selby desired me to send the drawing to Wallington, and this I have kept in mind—I wish to send Sir John and "*Julia Trevelyan delt.*" impressions from the cut, as soon as I could after it was done, and if time will allow me to do so, I will. I shall notice what you say about the very tame partridge—I have long been of opinion that Partridges, as well as some other kinds of wild Birds, might with great pains, taken at first with them, be added to our domestic poultry,—as well as singing birds in our groves.

I think, if I lived at Wallington, I would not despair of bringing up Nightingales so as to breed there.

I am, Sir, with great respect,
Your obliged and obedt.

THOMAS BEWICK.

P.S. You will see, I am at a loss to know whether *Julia Trevelyan* is Mrs. or Miss. She is the only Lady who has thus furnished me with help in any of my publications—I feel greatly obliged to her, and will acknowledge this properly as well as I can.

from the original specimen, at my request kindly lent to him in the following year, by Mr. Matthew.

I may take this opportunity to correct an error which I observe in the text of Selby's Illustrations, from which it has been copied in Gould's Birds of Europe, the English Cyclopædia, and probably in other works: the date of the taking of the Vulture was June, 1826, not October, 1825.

W. C. T.

V.—*Bewick Correspondence.* Communicated by JOHN HANCOCK.*

Newcastle, 9th Jany., 1788.

Dear Brother,

I have your letter of the 1st Novr. last before me. I find it came by Capt. Carr. I am much pleased with the Cuts for "Death's Dance," and wish much to have the book when it is done. I am surprized that you would undertake to do them for 6s. each. You have been spending your time and grinding out your eyes to little purpose indeed. I would not have done them for a farthing less than double that sum. I shewed them to Mr. Edwards a very capital and eminent painter, as well as a very worthy man, now here, painting the scenes in the N'Castle play-house. He approved much of them but was surprized when I told him the price you had for them. He I expect will be your friend, after this when he returns to London. I am glad to find you have begun on your own bottom, and I would earnestly recommend you to establish your character by taking uncommon pains with what work you do. I hope, it will, in the end, turn better out than doing it slightly.—I suppose your next will be an answer to one with 26 impressions per Matthew Williamson. I have wished for your answer to it for some time past. If Mylock's print be the same one which you so obligingly sent to me, I think nothing of it. It is not worth, in my opinion, one of the two Tigers which I long since sent to you, in order to exchange with him. I am obliged to you for the drawing of the Lion, Mr. Edwards says it is a faithful representation. I wish I had as good a one of the Wolf, the form and shape of which is so variously and contradictorily represented to me by different people that I am quite puzzled as to its real appearance. I am glad to find that a large collection of animals is now on its way to this Town. They are expected here on the latter end of this month. They consist of various kinds of the Ape tribe, Porcupine, Tiger-Cat, and Tiger, Greenland Bear, and one of the finest Lions, very lately brought over, that ever made its appearance on

* The Misses Bewick having shown me these letters of their Father and Uncle, and having no objection to their being printed, I thought the perusal of them might interest some of the Members of the Natural History Society and of the Field Club.

this Island; so I expect to have the opportunity of doing such of them as I want, from the Life. Our Natural History* will be put to press in a little time. The first Edition will be done by subscription. You will perhaps in the course of a month see it advertised in the N'Castle papers, at the Hole in the Wall, Fleet Street. I wish you would send your account paid and recd. on my acct. in London. It is best to keep all square once a year at least. I paid for Gay's fables £ s. d. (I told you at the time, but have forgot). I shall conclude with wishing you the compls. of the season. My Bell also desires her best respects. Give my thanks and compls. to Mr. Collard. I am much obliged to him for the Hermitage of Warkworth). I am sorry for the loss he has met with in the death of his Brother, and my old Friend.

I am, Dear Brother, Yours, etc.,

THOMAS BEWICK.

Mr. John Bewick,
Engraver,
No. 7, Clerkenwell Green, London.

London, June 16th, 1790.

Dear Brother,

Since I wrote last I have been with my good friend Mr. Sharp, who has shown your work to the famous Mr. Barry, Painter—which pleases him so much that he wishes to have a dozen copies more. Mr. Sharp (and several of my friends) wish to know whether they can have the Animals printed in a copy without the letter-press with the names only. I could sell a great many in London. I think it would answer your purpose well, to do it. I have not a Book left and between twenty and thirty bespoke, so that I wait with the greatest impatience to hear from you. If you have not an immediate opportunity of sending them by sea let them come by land; the expense will not be much. Mr. Ord of Bradly, hearing the work was in London and impatient to see it, sent Matthew to me for three copies which I let him have, though I suppose this number has been sent to Bradly

* As the first Edition of the Birds was not published till the year 1797, this notice refers most likely to the first Edition of the Quadrupeds.

J. H.

for Miss Simpson. I shall have the opportunity through Mr. Sharp to introduce your Royal Paper Copy to the first Artists in London. The general cry here with people that wish you well is, "Why does not he come to Town."

I am, Dr. Brother,
With compliments to all Friends,
JOHN BEWICK.

Wycliffe, Aug. 8th, 1791.

My Dear Bell,

I never opened a letter with more anxiety nor read one with more pleasure in my life than I did my Bell's, last week. To hear of you being all well gave me the greatest of pleasures. How desirous am I to hear of your still continuing so.—My dear little Boy is hardly ever out of my mind. I hope the Sea will mend him. If upon my return I find him recovered I think I shall be frantic with joy.—Indeed if upon my return I find you all well I shall look upon my fireside at the Forth like a little Heaven.—I hope I shall, when I return, but I think it will be about 3 weeks yet before I have that pleasure. The young Gentleman has sent Mr. Collier notice that he will not be at this place till the latter end of the month. I have plenty of work before me to keep me closely employed a much longer time but I am tired out already and wish it was over. I have dulled myself with sticking to it so closely. In short I lose no time in order to get through with the business. When you write again tell me when you will be at the Forth lest I should be at a loss where to direct to you. Also tell me how you all are for that is every thing with me. Take care when you return to the Forth lest the beds should be damp by your long absence. Tell Jane and Robert that if they behave well I will let them see a vast of little pictures of Birds when I come home, and I hope my little Bell will be able to say more than *dadda* when I see her again.

I am, with compls. to all,
My Bell's loving husband,
THOMAS BEWICK.

VI.—*A Naturalist's View of the Extension of the Close-Time of the Sea-Birds Preservation Act in Northumberland, and on the protection of wild Birds generally.* By Chas. Murray Adamson.

A few weeks ago I observed in the newspapers that the Home-Secretary had extended the close-time in this county, Northumberland, from the 1st day of August to the 1st day of September.

I presume this has especial reference to the birds breeding at the Farne Islands. These Islands are I believe private property, and are let at an annual rental: the consequence of this is that a great number of the eggs are gathered for sale. In addition to this the poor birds during the summer are disturbed and ill-treated by the numerous steamboat loads of people, often lawless, whom I am told sometimes overawe the few persons residing on the Islands who ought to be the bird protectors. Under the circumstances, however, I rather question their being so. If they are allowed to make as much money as they can from the eggs, they of course take those eggs which are most uncommon, and which bring the highest prices, and thus the rarer species suffer most.

When I visited these Islands early in July, 1875, the keeper of the outer lighthouse, who said he had been there only a short time, told me his predecessor had a large family, and that during the summer time they had lived almost entirely on the eggs. He had himself a number of eggs ready blown, several of which I bought for my children at three shillings a dozen. At that time there were some young birds, among them Puffins nearly full grown, one of which we took from a hole and returned: there were also eggs of most of the kinds of birds which breed on the Islands. Near the end of the month there were young Gulls and Terns, some flying, on the inner Islands, but we could not find one young Oyster Catcher, nor did we see old Oyster Catchers flying about and showing, as they always do by their anxiety, that they had young. I therefore presume none got away that year, for we looked pretty closely, as the commander of the gun-boat whom we were with wanted one for a pet. That year one Sheldrake's nest was found on the Island, but our informant living there told us he had taken the eggs himself.

That year I do not think any young Cormorants got away, as, late in July, this species all had recently laid eggs, many nests having only one egg, and not a young bird was to be seen. Several young Terns were flying, but there were still plenty of Terns' eggs. Probably many of these, in consequence of the lateness of the season, would never be hatched, and if they were, the old birds would very likely forsake the young before they arrived at sufficient age to take care of themselves, as the old birds of some species seem to leave their breeding grounds at a fixed time, probably to get to some other locality in time to moult or for some other reason we do not understand. The consequence of the destruction of the eggs is, that the birds do not hatch their young at the time Nature intended they should, and their season is altogether disarranged.

We saw no young Eider Ducks following the old females, many of which were in flocks. I am quite willing to admit the gross cruelty practised at these Islands by summer visitors, but the worst part is perhaps not the shooting; the young birds are wantonly destroyed, and in 1875 the grass on the Island inhabited by the Puffins was set on fire and many of the old birds, as well as the young, were burnt in their holes. How is a repetition of this to be prevented? In 1874 some young Black-backed Gulls were not able to fly in September, and we saw at that late season a young Eider Duck only recently hatched.

During our visits to the Islands in 1875 we did not see the Roseate Tern; nevertheless it might be there amongst the number of birds and escape our observation, although this bird's cry and flight make it conspicuous to any one knowing it. One of the Outer Farnes was frequented by the Arctic Terns, and one of the Inner Farnes by the Common Tern.

Under the present law it would appear that the owners of land have no more right to take the eggs on it except such as are especially protected by Acts of Parliament, than a stranger; and I have been informed, that some years since the question about the right or legality of taking the Farne Island eggs was put to the test. Some men were summoned for taking them; they employed a lawyer to defend them; and when the case was to have come

on it was withdrawn, the prosecuting parties having discovered there was no law to reach the accused. Generally speaking, the kinds of birds which suffer most are such as breed in numbers together. When they breed in such numbers together and the eggs are so easily found, great destruction may be made in a very short time. It is not so where the birds are evenly distributed over a large tract of country. The only remedy against such wanton mischief would be an Act of Parliament causing eggs and all other produce on lands to belong to the proprietors of the soil. This might be done, perhaps, by a Permissive Bill, whereby the proprietors might be able to protect their property or not as they thought right.

Now, I would not for one moment defend the destruction or wanton molestation of breeding birds; I would have them strictly protected; but it does seem unnecessarily hard to close the time for shooting birds in a whole county in order to protect them on a small portion of ground where they ought to be private property. At the present time it would appear to be contrary to law to prevent any person landing on the Farne Islands between high and low water mark, and even if they landed above high water mark, it would be difficult to prove damage on such barren ground.

In the latter part of July, some years since, Mr. John Hancock and I visited, with Mr. Losh who then resided in the neighbourhood, a breeding place, in Lancashire or Westmorland, of the Lesser Black-backed Gull, the commonest Farne Island bird; and they, young and old, had left the district, excepting one young bird, which was fully fledged, and an old bird, probably its parent. We then went to Walney Island where the birds were protected, the Black-headed Gulls and the Sandwich Terns, the latter also a common Farne Island bird, had all flown and gone; whilst at Fowley, where the birds were not protected, the Common Tern, and the Roseate Tern, which was there far from uncommon, still had eggs and young. We were told that on this Island the eggs were gathered to be used in making varnish.*

* It was during this expedition Mr. Hancock shot the Tern with a cockle on its beak, which he mentions in his Catalogue. It was a rather exceptional bird, I think an imma-

Now from this fact I cannot help thinking, that if the Farne Island birds had fairplay, the young would have nearly all flown by the beginning of August.

A naturalist knows that we have on our coast Whimbrels and Arctic Gulls by the end of July or earlier, whose nearest breeding grounds are the Orkney and Shetland Islands. The Redshanks' young, when not molested, can fly by the middle of July; they and the Dunlins have by that time left the moors and wastes to come to the sea side. The Turnstones have come from Norway by the middle of August, and by the end of the month some of the young birds even from the Arctic regions have arrived. By the middle of August the Spotted-Redshank has come from Lapland, the Wood-Sandpiper and Green-Sandpiper from Sweden; and not only this, but by August nearly all the Curlews and Golden-Plovers have left the moors, and it seems hard if these and such like migratory birds may not be shot on the shores away from their breeding grounds before September. Landowners would hardly like not to be able to shoot Snipes, Plovers, Wild-Ducks, or Teal, should they meet with them when Grouse shooting in August; or because some extensive proprietors chose to take all the first Grouse eggs off their manors to set under hens, or for any other purpose whatever, whereby there were nothing but cheepers on the 12th of August, to have the general shooting postponed for a month.

A general close-time till September would prevent several sorts of birds being procured at all in this country, some migrating entirely before the end of August; and it seems almost superfluous to mention that the sea-birds we have generally in summer are almost entirely a different set from those which are with us in winter. So far as the mere existence of species is concerned, it is doubtful whether the total destruction or driving away of

ture Common Tern, a young bird of the previous year, having the front of its head white. From birds in similar plumage, which are only occasionally met with, we may almost suppose they do not breed the first year after being hatched, but that probably the immature birds wander over the ocean and do not congregate with the breeding birds at their breeding stations till they arrive at maturity. The circumstance was singular in this respect; it showed that Terns feed otherwise than by dropping on their prey from the air into the water, a fact which I was not aware of before.

those at the Farne Islands would materially affect them as species, so numerous and so widely distributed are they, any more than the drainage of the Fenlands did the interesting species formerly inhabiting them. Wholesale destruction at one breeding locality drives the birds to other places, but does not extirpate the species.

Under these circumstances, I rather doubt the utility of extending the close-time. If the public become aware of the injury they could do by robbing the eggs and young there might be a still worse chance for the birds rearing any young at all. The birds are persecuted in this respect far too much already; but if by extending the close-time you exasperate the public, they may retaliate and do more mischief still.

The shooting naturalist's real pleasure in meeting with a rare bird, or a bird in a rare state of plumage, far exceeds any fancied pleasure a man can have in slaughtering birds and unoffending animals by hundreds for any other purpose. All laws should be as much for the advantage of the poor as of the rich, and it is hardly right that the rich man should be able to break the law on his own extensive domain with impunity, and yet desire to deprive many a poor man unnecessarily of an almost innocent recreation, and this merely because some persons abuse the privileges so long accorded to Englishmen.

The Act alluded to omits the poor Cormorant from the protected list because Nature directed it to eat fish: rather a curious reason! Probably in Scotland they ascend the rivers and take a few young Salmon, and in consequence they are considered "vermin." Now, if the charge against them is that they feed on fish, why preserve the other fowl at all? They all eat fish, and if the quantity required to provide those at the Farne Islands for a single day was taken into consideration, I wonder the fishermen do not take alarm at once, for fear they would clear the sea of all the young fish. Even the fishes themselves, as the Cod and others, not only prey on other species, but even on their own; why are they not considered vermin also? Probably the fishermen are trying to clear the sea of them; at any rate they take

all they can for their own profit, but still the numbers decrease not, except, perhaps, in a few localities.

Nature understands her own arrangements best; she provides food for all her creatures. It seems impossible for a thoughtful man on fair consideration to imagine that the few fishes Cormorants eat could interfere with the Salmon supply. When the young Salmon go from the rivers to the sea, they have to run the gauntlet of many dangers before again entering the rivers. All Nature's creatures must pay their portion of debt; they were all made to eat and to be destroyed or eaten. In Nature's wonderful arrangement there are, with very few exceptions indeed, generally plenty left to continue the species and for all other purposes.

It may I think be taken for granted that there are always more than double the number produced of every species than is necessary for reproducing and multiplying the species; the rest are for the good of other species in the shape of food.

I would hope that the extended close-time may be treated as a dead letter except in cases where punishment may be justly merited. There are several species of shore-birds not mentioned in the Act. Are we to understand the order to be a prohibition to carry a gun at all till the first of September? or who is to decide what may be shot? A person surely should not be summoned for shooting birds not mentioned in the Act; but how is this to be managed, as it is not possible to turn either a magistrate or an informer at once into a naturalist? The only method, I can see, to preserve the birds, would be to make the eggs belong to the owners of the ground, and leave it to them to prosecute for theft or not as they choose.

I cannot help thinking that some method might be adopted for preserving the birds and their eggs on the Farne Islands. These islands are one of the most interesting of the breeding places of sea fowl on our coasts, and if they were in the keeping of Government or the Trinity House they could be easily protected (as it is only in fine weather that boats can land) by the men who are in their employ, who, having good glasses, could distinguish boats at a great distance. Could it not be arranged to

grant to some boats license to land, the licensed boat-owners to be answerable for the conduct of the parties they take; and for a rule to be made that no guns were to be fired within a prescribed distance of the Islands during the time the breeding birds are there without special permission?

Since the foregoing remarks were written the Act commencing close time from February 15th has come into operation, and at the risk of appearing presumptuous and wearisome I offer some further remarks on the apparently confused legislation respecting the protection of sea and other birds which seems to me to be entirely in the wrong direction.

The various species of birds, except the few wingless species, whose distribution appears always to have been extremely limited, and many of which have become, and others appear to be becoming, extinct, are nearly all more or less migratory, either from one part of the world to another, or merely from one district to another, and often these migratory flights are to a great distance and very extensive. Nature seems to have guarded against the possibility of these species becoming extinct by the great extent of country over which they are distributed. Most persons seem to suppose that the comparatively few individuals of each species which visit us represent the whole of the species, instead of their being only a very insignificant portion of it.

As stated above, I have almost come to the conclusion that, with few exceptions, it would be immaterial, so far as the existence of the species is concerned, if all of those which come to us in one year were destroyed. I believe in a remarkably short time we should be as well supplied as before with such species as are suitable to the face of the country under any altered conditions.

It would seem, if we look at the north polar region of a globe, that there is a portion of the world extending probably four hundred miles about the pole uninhabited by birds. Then comes a belt of many hundred miles, partly of land, over a very great portion of which no civilized man has yet traversed. This is the tract of country which produces the hosts of migratory wild fowl which spread themselves over the globe southward in winter to

get food and to form food for others. The few birds killed from these hordes by man with all his contrivances, nets and decoys included, both in going to and coming from this breeding ground, amount to nothing. The prohibition against taking these birds whenever they can be procured in this country is simply of no use so far as extinction of the species is concerned. Each species undoubtedly has a very extensive breeding ground, and the supply from it is and will be next to inexhaustible so long as those lands remain in a state of nature. Neither can you bring back the birds which have been forced to leave us; not that they have been shot, but because the character of their former breeding grounds is altered and limited to such an extent as to prevent them having room to obtain sufficient subsistence. This cannot be helped; but what is wanted is protection for the species which will condescend to remain with us under the altered circumstances. It is entirely out of man's power to make a migratory bird remain a day beyond its appointed time, and it always will be so.

There are no such things as rare birds; those which appear such to us are in reality only birds out of their regular places, and they require no protection. The birds requiring protection are those which either are or ought to be our useful and familiar friends. We should take care of these. The others are not worth protecting; they only afford interesting specimens for a Natural History Collection, which really is their fittest place, as they illustrate the extent to which these erratic species travel.

It is not shooting migratory birds or even snaring and trapping them in decoys which materially lessens their numbers; this is proved by the extraordinary number of wild fowl often taken in a single day, and their constant replacement day after day so long as the locality suits their habits and the season is favourable. Also the number of Quails taken in Europe, even when journeying to their breeding grounds, which practice has prevailed a length of time, does not materially lessen the supply for the next year. The number of Skylarks netted each winter and sold in the London markets also corroborates this. None of these methods of destruction appear to have thinned their ranks to any

appreciable extent; but what drives away the birds from us are chiefly the alterations made by man in the enclosure and drainage of the land.

No one can determine Nature's reasons for having assigned peculiar limits to the breeding grounds of birds, nor can we extend those of migratory species. Man may, and has introduced and acclimatized some species, but these are very limited in number, and perhaps those which he has succeeded in acclimatising or domesticating were especially intended to be made subservient and useful to live in this especial manner.

I do not in the least like sentimental grievances, but any law prohibiting the killing of migratory birds on mud flats and such like unreclaimed places is both unjust and unnecessary. No one can pretend that birds frequenting such places either do or ought to belong to him. One day they are perhaps in Africa or on the shores of the Mediterranean; they are perhaps next observed on the Norfolk coast, and the next place they may be met with is, perhaps, in Lapland, Iceland, or even North America; besides, it is only those who are at the trouble to follow them into their haunts who see them alive. So soon as they have rested long enough, off they go, and the flats are left bare, and no one would follow the few birds left, except perhaps some enthusiast in the hope of meeting with something rare, which, if procured, would do no harm whatever, as it would only be a straggler out of its proper place. Such migratory birds are totally independent of man and all his devices to extirpate them, and against these they can and will hold their own. Should man be able to control the tides, even still he could not prevail against these birds; for if their feeding places were entirely destroyed here, their powers of flight would enable them to pass on unheedingly to another place; but so long as man cannot control the tides, there will remain plenty of resting places for them, where they are often unapproachable even with punts or other contrivances; and if they are approached and a few are shot, the remainder seldom alight again within any reasonable distance, and cannot be followed. It is totally different with such birds as Partridges and other game birds which are local in their movements, and at times

may be followed up and the whole covey obtained on a limited tract of land.

Many persons believe they can treat the Woodcock like the Pheasant, and suppose he will alter his character by protection during the breeding season. He is a wanderer by nature, and you cannot clip his wings in order to make him stay, and no protection here in summer will make any appreciable addition to his numbers in winter. Far be it for any one to imagine I wish him interfered with during breeding time, but as he generally keeps to woods, let the owners look after him when there, and do not enact new laws for his safety.

Nothing having life except man can be cruel; he alone is endowed with mind, and is capable of knowing right from wrong. Lions, Tigers, Hawks, and Dragon-flies were all created to be selfish, and in all their depredations they are only carrying out their Creator's intentions, and we have no right to call them cruel. Our doing so is setting aside the Creator's wisdom in having made them. I contend that any one killing the apparently most innocent and inoffensive creature for inspection or admiration is not cruel; in fact quite the reverse, for by so doing he is honouring his Creator by admiring and wondering at the operation of His power. Cruelty consists in the wanton and thoughtless killing, or sanctioning the killing, unnecessarily, of any kinds of living things, all of which, even the most repulsive, were created for some good purpose, which perhaps man, with all his intellect, cannot at once perceive. There are many who would be very severe in condemning another for killing a rare bird or butterfly, but who daily sanction the killing of a Hawk, when there is really this difference only, the one is probably killed for a good purpose, and the person who killed it has some thing to look at for the remainder of his life with pleasure, whilst the other is killed for mere caprice or fashion, as in all probability the day after it would have been far away from the district never to return, and therefore the injury it could possibly inflict was only imaginary. Perhaps, too, the treasure the former had secured might have been destroyed immediately after in the ordinary course of nature, so that it mattered little to it,

bird or insect, whether it was taken or shot by man, or had been caught and eaten by a Hawk or other bird, its natural end, for Nature seems to have ordained that few, if any, of her creatures, birds, beasts, fishes, or insects, should die what we call a natural death. All, as soon as they get feeble, and very often before, merely form food for others.

The only legislation really required is protection for all our summer residents during breeding time, including eggs and young of all breeding birds, great and small, at this season, on the grounds of humanity alone, unless they become a positive nuisance.

The war of extermination carried on during breeding time against Hawks, Owls, Crows, Magpies, Jays, Wood-Pigeons, and others whose real habits we really know little of, is at the least cruel and unjustifiable when we take into consideration the numbers of young birds left to die in the nests when the old birds are trapped. Morally there is no greater harm in any one torturing a domestic animal than there is in starving a wild one. I would not think it right to prevent a person shooting any of these birds he chose on his own land, but I hope the time will come when we may not all be so addicted to fashion, and that some large landed proprietors will take delight in having on their estates all kinds of birds Nature intended to be there, and in observing their habits and hearing their cries, all of which add charm to a country life. One of the greatest drawbacks to the country is the absence of the various birds which ought to be there; and which of us will or can take upon himself to say that the good such birds as the Magpie and Jay do in destroying insects and their grubs during the whole year, does not quite compensate for any injury or imaginary injury they do or are supposed to do during their breeding season.

I would ask whether Rooks do not take eggs when they can find them? Birds are generally cunning enough to conceal their eggs, but they are probably as likely to be found by a Rook as a Magpie. Why then make enemies of the one kind and spare the other? The chief reason seems to be custom only.

As matters are at present, persons living near villages and

towns are continually annoyed by having their gardens entered entirely against their wish, by boys and others seeking birds' nests, but there seems to be no legal remedy for this. The only way to protect birds successfully would be to make them, their eggs, and young, belong to the person or his tenant on whose ground they are, and to enable such owner or occupier to have any one who takes either the one or the other punished, at any rate if he chooses. Thus all trespassers looking for any kind of eggs, and whatever comes in their way, might be stopped; and we might really do without game laws altogether; and be so much the better in this respect, that each person might then do what he liked with what ought in my opinion to belong to him, but which in reality does not legally.

All legislation should be on the plan that what is morally right should be legally right, and *vice versâ*.

The laws respecting the time when our resident game may be sold and taken do not seem to be very hard, as no one who wants a bird is deprived from getting it during the greater portion of the year, but still there is not so great a difference now-a-days between the value of a Partridge and a Golden Plover, and the eggs of each should equally belong to the persons on whose grounds they are. There certainly is this difference, that the Partridge remains where bred or near to it, the Plover, as soon as he can fly, will change his ground, but so long as they have their nests on a man's ground they should be his property.

As I said before you can do no harm by shooting birds so long as they remain in flocks, and it seems very hard and quite unnecessary to legislate that birds, whose breeding places are confined to the extreme north, such species as the Grey Plover, Common Godwit, Knot, Sanderling, Pigmy Curlew, Little Stint, Temminck's Sandpiper, Spotted Redshank, Turnstone (Greenshank and Whimbrel rarely breeding in Scotland), and others which visit us on their migration northward so late as April and even May may not be shot by the naturalist or sea-side gunner, in order to secure specimens in the interesting plumage many of them put on at this season. No legislation will make these

birds linger a single day, and as they never did breed in England, even in its wildest state, they certainly never will now.

Many species of birds, the Spotted Redshank, Common Godwit, Little Stint, Temminck's Sandpiper, and Pigmy Curlew come to our own coast, almost exclusively in the young state, immediately after being able to fly, and after staying a very short time, perhaps a few days only, leave us never to return. What harm arises from shooting these? It is quite clear *they* do not come back. The fact is, that for many of our migratory birds, Geese, Ducks, Sandpipers, and others, the immense morasses in the North of Europe are their summer home; thither they wend their way, arriving late in May perhaps, and taking only a week to get there, as soon as the grounds are fit for them after the long winter, and then of what consequence is it how many we can capture at this season? Each species differs in some respects; but after the young of several species are sufficiently strong, in about eight or nine weeks, off they come back again scattering themselves southwards over the face of the earth, not only to find food for themselves but to form food for other creatures, and also to afford instruction and amusement to man in studying their habits. Those who are not above doing this are not always unprofitably employed, and any legislation preventing this is wrong. We find this habit also to be common to our summer residents which depart with their young, hatched and reared here, but which return the following spring in about the average number only of previous years, all the rest having most probably formed food for other species during their absence. For this purpose they were made in accordance with one of Nature's laws, and it teaches us that what may be called over protection or care for them often avails nothing.

I mentioned before that so long as most birds continue in flocks little harm arises from shooting them, and I think this is so. When in flocks they are generally not near their breeding grounds: when they come to these, they generally do so in a quiet and unobtrusive manner, and spread themselves widely in pairs.

Birds coming from southern climes to breed with us, take for

instance Shovellers, generally arrive at a pond about the 20th March. They know that by that time there will be no lasting frost to prevent their getting food, but when they do come, they come so quietly that you find them at the pond and there only, none being observed perhaps for miles round about, either in coming or departing after having reared their young.

During the present close-season Gargenies would never be killed in England, as they only arrive about the 20th March when they do come, and depart as soon as ever the young can fly, August at the latest.

Those extensive landed proprietors who have honest servants, and who possess large tracts of waste land with shallow water which stands long enough to produce the food the birds require, are independent of all laws. So long as the marshes are extensive enough to enable the birds to take long flights on being disturbed and to get into a place of security, then they will congregate and remain in them, but only so long as Nature has taught them. If often disturbed, or if the tract of ground is not sufficiently large to guarantee them security from frequent molestation, they will not remain.

This district is so much what is called improved, that there is now hardly room for real wild fowl anywhere. Even when there are ponds, the country round about is not wild enough and extensive enough for them to remain at.

Many persons have what they call wild Ducks on their ponds. These have been placed there by themselves or their predecessors. They are very different from the truly wild birds in their nature, seldom going far from home. The truly wild birds will not be controlled in their habits. They prefer being free as the wind, and as changeable. They pair in spring and keep themselves aloof from the half-castes, very seldom indeed having any variation in their colour. The others are polygamous and often change their colours, having always coarser feet and other parts. They are no doubt valuable as ornaments, as well as for food, when you cannot have the true wild birds. Nature does not countenance variations in colour generally in wild birds and animals, but there is no rule without an exception, instance the Ruff in

summer. Almost all her productions are similar according to the seasons, ages, and sexes, but why some species vary more than others according to age, sex, or season, is perhaps what we can never find out. All Nature's species were created perfect, and if left to themselves remain so and constant. The several varieties produced by man's intervention, and such as he takes pride in producing and keeping up are not so; if they were left to themselves they would soon cease to exist as such.

There are large tracts of land in England now which were formerly and are still inhabited by birds in summer. The recent acts perhaps prevent the destruction of the old birds, but if the eggs are constantly gathered you may almost as well be without the old birds. They, in consequence of their eggs being taken, after a time assemble in flocks, leave the places, and are as wild as in winter; whilst if the eggs and young were protected, any one would have the pleasure of seeing the old birds near when attending to their young.

It is perhaps little use trying to alter this state of things. Civilization and population increase so rapidly that the wild birds must give way, but it is a pity not to help them as much as possible, and this should be done by the owner of the land, who should legally have the power.

All laws should be made to inflict as little injury as possible on individuals, and they should not be made at all unless for the public good in some way or other. I cannot see how any possible good arises by preventing birds being shot during their migrations, and which are here to day and probably hundreds of miles away to-morrow.

Real injury accrues to individuals when resident birds are shot, or their nests taken in private grounds. Most persons who have any kindly feeling generally take interest in having birds and their nests in their grounds, and having them often destroyed is as great an injury to them as it would be in having something generally thought much more valuable taken away or stolen.

It would I think be better not to have a close time at all for mud flats and such like places. No birds breed on these, and as soon as the birds disperse to breed, then such places are almost

entirely forsaken by them. Let the landed proprietors look after their own grounds, give them the birds and eggs on them, but make laws so as to enable them to punish trespassers and robbers, at any rate if they choose, and if they do, the birds will increase. It is no use protecting such birds as have ceased to breed in England from altered conditions of the face of the country, such as drainage of fens, and certainly none whatever protecting such birds as never did breed in this country. No protection will make them do this, and all the protection you can give is not even likely to increase their numbers here.

All naturalists must regret the circumstances which have rendered it impossible for such species as the Spoonbill, Avocet, Black Tern, Black-tailed Godwit, Bustard, etc., to remain and breed with us; but these altered circumstances were for the good of the country generally, and the consequent loss cannot be helped. How much more should we regret the extinction of the Kite, Moor Buzzard, Common Buzzard, Hen Harrier, and some other equally ornamental species, which have nearly become extinct from man's personal greed: birds, too, which frequently were satisfied with food which was entirely useless to man.

There is one thing I think which good taste should immediately put a stop to, and that is, the extensive slaughter of game by persons in high position, so often reported in newspapers. It is said imitation is the sincerest flattery. If an ignorant man reads that some great man has killed several hundred head of game or Pigeons, if he thinks at all, he must see that it was done merely for the love of slaughter and not for love of manly sport. Well, he of course has not the game to shoot at, nor can he pay for the Pigeons, but instead of these he gets amongst some unfortunate young Gulls or Terns, and he goes on slaughtering them till he has, as far as he can, matched his beau ideal of a shooter; and how can we blame the one without condemning the other? If persons having the means and the desire to kill such numbers of birds or beasts do it, it would be well if they kept their exploits to themselves. Besides this, by informing the public they invite poachers to try their preserves, and thus often get their keepers into trouble.

Taking the whole system of game-preserving into consideration and the expenses attending it, it would seem almost a question, now that money is taken into account in all such transactions, whether the great expense required in preserving is compensated by the equivalent amusement and money returns for the game got and sold. That is, it seems a question if what are considered vermin were allowed to exist, and trusty servants only kept to protect their master's property, birds, eggs, and other things, whether the great saving in expense would not be met by having a sufficiency of game, and a great deal more pleasure in obtaining it, than by the present system of heavy bags, got at enormous expense, and in such quantities at a time, as to be almost useless to the proprietors except in the return he gets in money from the dealers.

I am quite unable to imagine how any liberal-minded naturalists could sanction such changes as have been made by recent bird legislation. Even supposing that they had individually found out all they cared to know concerning the habits of British birds, still they had no right to stifle future investigation by their juniors either in age or learning. Some kinds of birds require different times to arrive at maturity; several species of Gulls take four years. I have not yet met with any one who can determine the age of some individuals of these, met with during immaturity. Now we may take it for granted that there are quite as many immature as mature Gulls in existence. The latter only congregate at their breeding grounds, where the owners of such ought to be able to protect them. The former are probably scattered over the coasts and seas in many parts. Now, what harm accrues to these species by killing for observation these immature wanderers? I would ask, do these naturalists think that all information required by a student of nature can be acquired from either stuffed birds or skins already obtained? If not, how is it to be got? Perhaps by looking at the birds with binoculars. If they have to get their information from skins already obtained, I fear they will be as likely to get it as a surgeon would be who expected to learn anatomy from a mummy. A true naturalist requires the recently killed birds to

judge of their shape, and see the colour of their eyes, legs, beak, and feathers, which in so many species change during the growth of the bird and with the seasons. He wishes to admire and contemplate their wonderfully different forms, and the arrangements of the layers of feathers, as adapted to the bird's requirements.

I would ask, can any one yet satisfactorily explain the change of plumage, from winter to summer, of so many of our shore birds, which takes place about April? even of the Dunlin, comparatively speaking a common bird? and how much of this change is acquired by moulting? and how much by the change of the colour in the feathers themselves? or can any one explain the length of time birds of these genera take to change from white to black or from white to red? or the cause of such changes? or can they account for the change in the plumage of the males of the surface feeding Ducks, which takes place about July, when they acquire a plumage somewhat resembling the females? and then again the change to their full plumage about October?

The Wigeon and Wild Geese which remain longest on our coasts in spring are most probably not those which would remain in Scotland to breed. The birds breeding there have most likely nests before the flocks leave our more southern shores, where they are lingering till the distant northern morasses are ready for their economy, which would not be till about the middle of June. It appears to me, therefore, to be quite unnecessary and useless to prevent these coast birds being shot, so long as they remain with us in flocks, or at any rate, until the end of March.

It remains for me to ask forbearance from my listeners in their criticism of what they have heard. I have written down my thoughts as they occurred to me, and am afraid I have used a great many repetitions, but they are used as explanatory arguments, and in consequence of my not being accustomed much to writing I have used a crude style, which I hope will be overlooked.

In conclusion, I feel uncertain whether I have thrown any light upon a subject which apparently is very little understood by our legislators.

VII.—*On the Discovery and Exploration of Roman Remains at South Shields in the Years* 1875–6. By the Rev. R. E. Hooppell, M.A., LL.D., F.R.A.S.

Towards the end of the year 1874 the Ecclesiastical Commissioners laid out for building purposes a considerable piece of ground in the Borough of South Shields, which, with the houses and streets already erected on its fringes, may be described as bounded on the south by Ocean Road, on the west by Mile-End Road, on the north by the Tyne, and on the east by the German Ocean. It contained what had for many years been known as the Heugh Farm, within which was situated the well known "Lawe."

The Ecclesiastical Commissioners having determined to dispose of the freehold of this land for building sites, made several broad streets through it: one, Baring Street, running north from Ocean Road; another, Fort Street, crossing Baring Street at right angles, and extending from Mile-End Road to the sea. The ground was thus divided into four large (and approximately speaking) quadrangular divisions. Sites were speedily sold, one of the first being on the western side of the north-eastern quadrangular division, which contained within it the northern face and slope of the "Lawe." (Near *a*, on the General Plan. Plate V.)

It had always been known that the "Lawe" at South Shields was the site of a Roman Station. Leland repeatedly mentions it. In his Collectanea, Vol. II., p. 290, he says:—"The monks of the Tyne say that there was a city (civitas) on the further bank of the mouth of the River Tyne, Caer Urfe by name, where king Oswy had been born." And in Vol. III., p. 43, of the same:—"In the neighbourhood of Tynemouth was a city (urbs) devastated by the Danes, Urfa by name, where king Oswin had been born." In his Itinerary he says, that "the foundations of the city still remained." He also says that one of the great Roman roads from the west of the Island had its terminus at the mouth of the Tyne. And again:—"They say, indeed, that St. Oswin the king was born in a certain fortress anciently called Burgh, the foundations of which still remain in part on the southern

side of the water of Tyne, near South Shields, in the territory which now belongs to the Prior of Durham." See the Collectanea, Vol. II., pp. 370, 371; also pp. 396, 397.

With these ancient testimonies agree more modern ones. Nearly two hundred years ago a very large and handsome Roman altar was discovered at the "Lawe," which created great interest at the time. It was the subject of a communication laid before the Royal Society in 1682 by Dr. Lister, who had by great exertions obtained possession of it. It was figured and described in Gibson's Camden. Its history is told in other works of the early part of the last century. For a long time afterwards it was lost, but Professor Hübner found it again at Oxford, and at the expense of J. C. Stevenson, Esq., M.P., it has been beautifully figured in Dr. Bruce's noble work, the "Lapidarium Septentrionale." Another altar was found subsequent to this one, and very many Roman coins have been picked up by women and others working in the fields from time to time; one, as particularly interesting, I may specify, a first brass of the Emperor Antoninus, with inscriptions in Greek characters,—AYTK. M. AYP. ANTONEINOΣ. B., on the obverse, and EΦΕΣΙΩΝ. Δ. NEΩKOPΩN, on the reverse.*

When the new streets began to be made by the Ecclesiastical Commissioners several gentlemen resident in South Shields, to whom the past history of the Lawe was more or less fully known, watched with lively interest the progress of the workmen. Their vigilance was rewarded. In the course of the excavations necessary to make Baring Street, numerous pieces of Samian ware were turned up, (near *b*, on the General Plan, Plate V., and at many other points); some of these were beautifully figured, and others had potters' marks plainly legible upon them. Then a paved road was come to, (near *c, c,* Plate V.), the road I believe from Menevia to Tinæ Ostia, and close beside it a striking sculptured stone, which was conjectured with great probability to

* This extremely interesting coin, after being in the possession of Mr. George Nicholson for some years, was presented by that gentleman to the Museum of the Free Library, South Shields.

have been connected with some funeral monument. Near it also were the remains of a shallow stone trough.

About the same time many coins, pieces of Samian ware, and bones of animals were found in the north-east quadrangular portion of the land, and the purchaser of the site already mentioned, (*a*, Plate V.), came, at a depth of about seven feet below the present surface of the ground, upon a beautiful patera of Samian ware, perfect, except one piece which had been broken out of the side, showing the potter's mark, and a scratched inscription.

The discovery of all these relics gave a great impulse to research. A Public Meeting was held in South Shields, a Committee was formed, leave was obtained from the Ecclesiastical Commissioners to thoroughly search the ground, and active exploration was pushed on during many months. This systematic investigation began on the 15th of March, 1875. Before that, a perfect column, and parts of others, had been found (at *n*, Plate XIII,) near the place where, as above mentioned, coins, fragments of pottery, and bones had been discovered. The first thing done by the regularly appointed Committee was to begin from the same spot and carry a trench east and west till the ramparts of the Station should be reached. Then the central portion was entirely uncovered. Then a trench north and south was carried to the bounds of the Station, and after that other portions of the Station in various parts were laid bare. In giving an account of the results of the exploration it will be unnecessary to take note of the chronological sequence of the various operations. It will be sufficient simply to describe as faithfully as possible the Station and its contents as revealed by the excavations.

The spot first commenced with turned out to be the site of the forum, and proved with its surroundings to be fraught with immense interest. It is matter for the deepest regret that no effectual steps have been taken thus far for its permanent preservation. On the contrary, it has already suffered greatly from the total neglect to which it has been for some time abandoned. The extreme length of the forum is seventy-four feet, its extreme breadth thirty-four. With the exception of about ten feet at

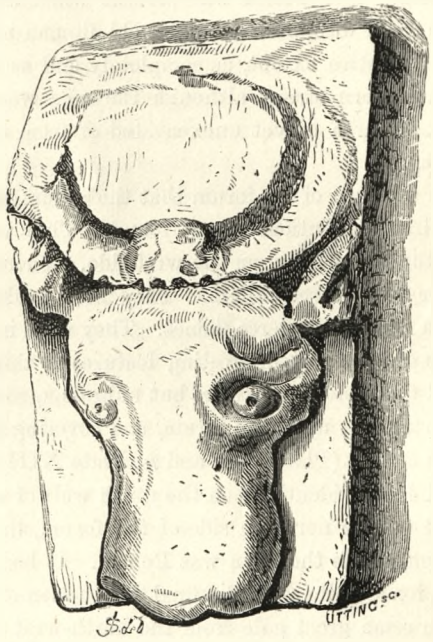
either end, the whole area is paved with flag-stones. The paving is bounded on the east, south, and west sides by a line of massive squared stones sunk in the earth, not a few of which have been worn into deep depressions by the passage over them of innumerable feet, and, at a distance from these massive stones of from three to four feet, a continuous line of channelled stones, around the same three sides, carried off the rain from the side paths lying between them and the outer sunken blocks, and from the paved area in the centre. Other accompanying drainage arrangements were complete. It was interesting to see how perfectly they acted the first time this ancient pavement was directly exposed to violent rain after the lapse of more than a thousand years. The writer was present when this occurred, and saw the flood disappear from the old Roman market-place, throughout its entire extent, as completely and as rapidly as it does from a modern street, although the area was surrounded with a bank of earth as yet unexcavated of from three to four feet in height.

It was on the floor of the forum that the pillars and fragments of pillars already mentioned were found. They were lying in and about the channelling on the west side. There were in all, in whole or part, three pillars. They bore evident marks of having been exposed to fierce flames. They were in close proximity to one of the most interesting features of this remarkable spot, a wall completely prostrate, but unbroken, save at the extremities, lying flat upon the forum, and covering about a sixth of its whole area. (Plate VI.; and *n*, Plate XIII.)

This wall had evidently been the south wall of a lofty building situated on the northern side of the forum, the prætorium, in my opinion, while the town was Roman. It had stood, in all probability, for a while after the final destruction of the Station, and then, in some great gale from the north-west, had snapped from its foundations, and fallen in one piece. I am led to conclude thus from the fact that there are a few inches of soil, in some places perhaps a foot or nearly a foot of soil, between it and the pavement of the forum. The first few courses also are standing upright in their original position. The height of this

wall must have been thirty feet at least, nearly that extent being still in one piece when it was uncovered by the excavations, and numerous loose stones, which had broken off, in or after the fall, lying on the margin. The outline of the wall when uncovered was irregular, and it was not easy to conclude where windows or doors had been. It was evident there had been none in the portion which lay unbroken, but the writer thought the appearance not inconsistent with a window at the south-east portion as it lay on the ground, and a door towards the north-west portion.

Near the eastern edge of the wall, on the floor of the forum, was found the keystone of an arch, having sculptured on it in relief the head of a bull, *Bos longifrons*, exactly similar to many



No 5.

skulls of that animal which were found in the Station with evident marks of the butcher's axe upon them. A Woodcut (No. 5) of this keystone is here inserted, on account of its interest, both archæologically and zoologically. It had suffered much

from fire. From its position it appeared to have belonged to the doorway leading from the forum into the prætorium. Close by the spot where it was found was the threshold of that building with depressions in it manifestly caused by the wear of tens of thousands of footsteps.

This latter evidence of busy and long continued traffic is manifest, as already intimated, on every side of the forum. At the eastern end are several enclosures, which mark the site apparently of shops; near them the stones are plainly worn by footsteps. So also are the stones in places at the western end. Other stones, which from their size appear to have formed portions of large gateways or other important buildings, bear evident marks, as many at Borcovicus do, of having served as whetstones for innumerable spearheads, knives, or other sharp edged instruments. Some stone steps, to be mentioned presently, had been turned, when deep indentations had been made in them by traffic, and the new surface had been worn down by the continued stream of human feet as the old had been before.

In the forum there is a well or pit, built round with stone without mortar, which the explorers excavated to a depth of several feet. When I saw it, soon after it was opened out, it was quite dry: it is near the enclosures I have conjectured to have been shops.* (Plate VI.)

The large building, already alluded to as having joined the forum on the north side, extended the whole length of the forum, a distance as already said of seventy-four feet. This is inside measurement. The portion of it in immediate proximity to the forum appears to have been a noble hall, twenty-two feet wide, across the centre of which, from the threshold of the gates opening into the forum, ran a broad pavement, fourteen feet in width, to a most remarkable chamber beyond. The rest of the area on

* The reader will have no difficulty in recognising the position, and outline, of the various points of interest above described, in the Detailed Plan (Plate XIII.), and in the photo-lithographed view (Plate VI.) The latter, together with the views which follow, has been executed from a series of admirable pen-and-ink etchings, made from photographs, by Mr. John Storey, of Newcastle-on-Tyne. The General and Detailed Plans, Plates V. and XIII., have been prepared by S. Oswald and Son, Architects and Surveyors, of Newcastle-on-Tyne, of whose disinterested and valuable aid to the work of exploration of these highly important Remains it is impossible to speak too highly.

each side of the pavement was floored with concrete. The chamber at the end of the pavement is sunk fully four feet below the level of the hall. A flight of five stone steps in perfect preservation leads down into it. Its walls are four feet thick, composed of stones of great size, which evidently belonged to another building before they were used to construct this massive room. They are most curiously marked, and many have cramp holes, which once were filled with lead,—not, in my opinion, since they formed parts of the present building, though others I know have expressed a different opinion,—and one appears certainly to have previously been a massive door jamb. (Plate VII.)

Besides the stairs this chamber had a window looking on to the pavement of the great hall, with jambs deeply splayed, and holes in the sill for three upright iron bars. The floor of this chamber is paved with large flags, and in it is a rectangular, oblong, bath or cistern or impluvium, the sides and floor of which are also composed of slabs. In this chamber was found a vast mass of stones and rubbish, and among other interesting relics the capitals of some pilasters, the base of a pillar with many step like mouldings,* and great part of a human skeleton. On each side of the chamber are the red concrete floors of rooms on a level with the floor of the great hall, but parted from it by a substantial wall, and heated apparently by flues, several of which were opened by the explorers; and indications seem to warrant the conclusion that this great block of buildings extended to a distance of about twenty-two feet beyond the sunken chamber towards the north, and abutted throughout its length upon the main street which ran direct from the western to the eastern gate. The eastern wall of the block abutted in like manner on the main street, which ran from the southern to the northern gate, and the breadth of which is known from the excavations to have been fifteen feet from the wall of these important buildings to the extremities of the buttresses of another important edifice on the other side.

The Station of South Shields was a large one, and evidently a

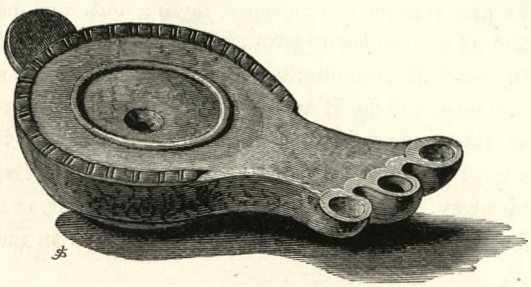
* It has been suggested that this may have been the base of an altar, an altar with a base very similar to this having been found many years ago at Elenborough.

very important one. The area within the ramparts was five and a third acres. The exploration has yielded many discoveries of very great interest, if not actually unique. As far as I am aware, a table altar, in the forum, to be described presently, of an age immediately subsequent to the Christian Romano-British epoch, the sunken chamber with its stone steps, window sill and jambs, and impluvium, and the prostrate wall of thirty feet original height, are unique in Great Britain. If the whole is ultimately destroyed, if the stones are carried away, (as they are being daily carried away to furnish materials for the foundations of new houses and for the erection of garden walls,) and if no steps are taken to preserve relics so valuable to science, and which, rightly considered, reflect such lustre on South Shields, the disgrace to the town will be indelible. The block I have been describing, and which comprises the forum, prætorium, etc., together with all the interesting relics I have thus far particularised is included in a space of thirty-five yards by twenty-seven yards. Is the purchase, enclosure, laying out, and perpetual preservation of that space of ground beyond the means of any of the public-spirited inhabitants of South Shields? Are there not many who could do it without feeling the expenditure required for the purpose in the least; and, when this is the case, shall the most precious heritage the town has within its borders be thrown away, because a Committee is unenergetic, or a public body, like the Ecclesiastical Commissioners, slow in answering letters?

But the portion I have described is not the only deeply interesting spot revealed by the excavation. The explorers were determined to fix the position of each of the four ramparts and to uncover each of the four gateways. In this they succeeded perfectly. More than ninety yards of the eastern rampart are laid bare, and in one place no fewer than six courses of facing stones are in position, for many yards together, a splendid piece of masonry. The rounded corner of the rampart is likewise shown to great advantage, (Plate VIII.), great chamfered blocks running round on the outside, a few courses from the foundation, and giving a noble appearance to the wall. The ramparts

throughout were somewhat more than six feet in thickness. In many places the facing stones are gone, but the core remains. At the eastern gateway the explorers found a room, with fireplace, and doorway with place for bar as fastener, and, next to it, another room, with plastered wall, and colour still distinct upon the plaster. Of the antiquity of this there could not be the slightest doubt, for in close proximity is a hypocaust with pillars of single stones, and the whole is on the Roman level, many feet below the surface of to-day.

In another spot, not far from the eastern rampart, the remains of a large and wealthy house were found. Here was a very perfect hypocaust, with sooty flue, coal, and many rooms. A portion of the wall of one room was within a few inches of the surface of the earth, though the concrete floor adjoining was five feet below the surface. Here was found a bronze lamp, not a common find in the Stations "per lineam valli,"* (Woodcut, No. 6,)



No. 6.

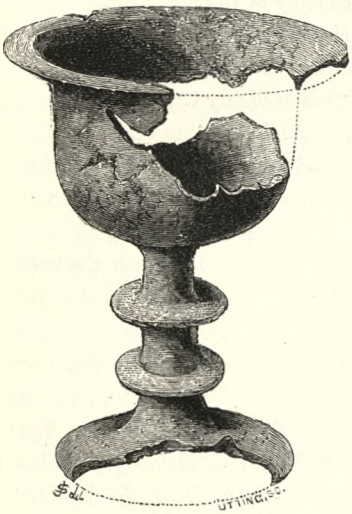
a writing stilus, of which the following Woodcut (No. 7) is an exact representation, of the precise size of the original, a bronze

No. 7.

* Since writing the above two more lamps have been found, one of bronze, and the other of earthenware. The latter is very curious, of a design somewhat resembling a scallop shell, pierced for *five* wicks.

cup, (Woodcut No. 8,) with foot and stem of beautiful design, though much decayed, and many minor articles.

Near the south-east corner of the rampart were found some choice enamelled ornaments, more perfect than anything of the same kind in the British Museum. A Woodcut, (No. 9,) is given of the most perfect one, the exact size of the original. The rest,



No. 8.

No. 9.

there were four in all, were very similar, though not identically the same. I would direct particular attention to the boars' heads, included in the design. The boar was the badge, or emblem, of the twentieth legion, stationed at Chester, and the finding of these ornaments, taken in conjunction with other circumstances and considerations, seems to point to a somewhat close connection, or at any rate frequent intercourse, between Deva and the Lawe.

On the southern side of the Station many walls still many feet in height have been excavated. There were evidently numerous

large buildings in this direction. In several cases the doorways are plainly visible. It has been suggested that these edifices were barracks. Their walls were probably those standing above the ground in Leland's time, for the explorers found some of them within a few inches of the surface of the soil. In the neighbourhood of these buildings, and in other localities of the Station, large well-made drains were found. This was particularly the case along the bed of the street leading from the south gate to the north. Two drains, built of stone, sides and bottom, and covered with large flags, ran down side by side, and passed under *double* flags beneath the roadway of the north gate, and so discharged down the river bank the drainage of the town. (Plate IX.) In excavating the northern portion of the Station an interesting fact was disclosed, which is probably true of other steep hills besides the Lawe at South Shields. One effect of time during the last fifteen hundred years has evidently been to flatten, so to speak, the hill. The accumulation of soil has been very considerably greater on the slopes than on the summit.

There remains to notice a fine building situated near the western rampart, abutting on the main street leading from the west gate to the east. This building is about seventy-seven feet long by fifty-one feet broad, outside measurement. The walls are flanked by a great number of buttresses placed very close. It therefore most likely had an open roof. It is paved with flags throughout. In one corner, the south-west, it has a deep sunken chamber, which was arched and stepped over. (Plate XI.) What was the use of this chamber, the construction of which and its surroundings is somewhat complicated, has not yet been clearly discovered. Many of the stones used in building it show by their markings that they had belonged to earlier edifices. On the south side this building had apparently a noble portico, for the bases of three or four columns were found in their original place. (Plate X.) Some call the building a temple. I do not see why it may not have been a Christian church. Christianity was the religion of the Roman Empire long before the Romans abandoned Britain, and there is strong reason to think that the

Roman city at South Shields was held by the Roman-Britons for a time at least after their protectors withdrew to the Continent.

Not the least interesting of the results of the exploration are the evidences of subsequent occupation revealed by the excavations. All round the Station, within the ramparts, there run paved causeways, several feet above the Roman level, made, in one case at least, upon the very walls of one of the noblest buildings the fortress contained, the temple or basilica last mentioned. These paved causeways have all the appearance of streets, of some town, built, perhaps mainly of wood, above the ruins of the old Roman city. In the case of the one which runs along the west wall of the building, near the western rampart, its bed is made of smooth stones from the neighbouring shore, and with such stones the chamber I have already described in the south-west angle of the building was also filled. The final destruction of the town was evidently by fire. Above the level of these paved causeways, throughout the whole area of the Station, is a sheet of ashes. Mingled with the charcoal of joists and rafters are fragments of roofing tiles. The author quoted by Leland says, Caer Urfa was burned by the Danes. The causeways may belong to the age of the early Saxons, who we are also told called the fortress Burgh. The only circumstance wanting to confirm the tradition that the Saxons occupied it is the finding of Saxon coins. As far as I am aware, no Saxon coins have yet been discovered. But there are plain proofs that the Lawe was resorted to for some purposes or other, most probably religious or judicial, or both, at no great distance of time after its final destruction as a city. For in all parts of it subsequent erections have been discovered. Some of these took the form of simple stone walls, built without mortar. But two were far more curious. In the forum, towards the eastern end, a table altar, already alluded to, (See Plates VI., VII.), was found most perfect. It was composed of two stones, one long and narrow set upright as a pillar, the other broad and flat, poised on the pedestal. The latter has a shallow mortice in which to receive the head of the pedestal, and both it and the pedestal were covered all over with a thin fine white plaster like plaster of Paris. Round this remarkable erection, on

three sides, was built a dry stone wall; the fourth side, the western, being left open, and the western ends of the north and south walls being (as builders say) returned. What was the use or purpose of this erection it would be interesting to discover. I have called it a table-altar, and that appears to be its most probable character. At the same time I do not think the upper stone bore any marks of blood ever having been shed or placed upon it. I cannot but think, however, that it was the erection of a heathen people, either Saxons or Danes, after the expulsion or subjugation of the Christian Roman-Britons.

The other peculiar erection is a semi-circular wall, or bench, near the western rampart, also facing the west. This spot appears to have been designed for judicial proceedings. That the various "Lawes" of Durham and Northumberland were used as places of assemblies, and for holding of courts, there seems to be some evidence, and certainly the "Tors" of Devonshire and Cornwall were scenes of such gatherings till very recent times. This spot appears to me to have borne this character. But the "Lawe" cannot long have been put to these religious or judicial purposes. A time soon came when superstition threw a preserving shield around it. Formed only of loose, unmortared stones, these scattered walls, this table-altar, and rude semi-circle, were left untouched for centuries, till the mould of ages grew around them, and gently buried them in its fruitful lap; then, returning knowledge chased away superstitious terrors, and the builders of mediæval Shields, by the river's bank, sought for stones among the decaying ramparts and mouldering walls of the ancient city; and then, when all above the new surface of the earth had disappeared, the plough came upon the scene, and corn grew where once Tunnocelum, or, if the claim to that appellation be disputed, Caer Urfa, was.

I have said that no Saxon coins to my knowledge have been found, nor have any mediæval ones; but a good many of later date, beginning with Philip and Mary, have been.

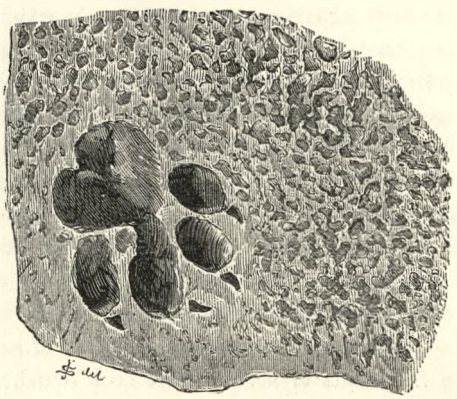
The Burying ground of the Station was to the south-west, probably stretching along each side of the great road leading from the fortress in that direction. The southern side only has thus

far been explored. Many graves and skeletons have been disclosed. One tombstone, very like our modern gravestones, has also come to light. Its inscription, beyond "D. M.," is hardly legible. It has been a disappointment to many that so few inscribed stones have yet been discovered. That such exist is almost certain; but where to seek them is beyond prediction. We may hope that, ere the whole area is built upon, some find of altars, or other written stones, will be accomplished. It would be of immense importance archæologically to be able to decide indisputably the Roman name of South Shields. The Station was very large, and evidently of great importance. Numerous inscribed tiles have been found which bear the letters "COH. V. G." One only interpretation of these seems possible, namely, "Cohors Quinta Gallorum," the Fifth Cohort of the Gauls. Another inscription, $\frac{A}{C}$, has been found, which some suggest means "Aelia Classica." For my own part I think the Station was Tunnocelum, and that it was garrisoned by the "First Marine Cohort called the Aelian." Whether that cohort was also the "Fifth Cohort of the Gauls," or whether *two* cohorts can have been quartered in the Station at one and the same time, I cannot say. The fact that an altar, distinctly mentioning the Fifth Cohort of the Gauls, has been found at Cramond, near Edinburgh, does not appear to me inconsistent with South Shields having been their head quarters; for the famous altar, discovered at the Lawe two hundred years ago, and described by Dr. Lister, shows, by its inscription, that it was dedicated in consequence of the safe return of Caracalla,—from an expedition against Caledonian enemies, it is believed. The altar found at Cramond may easily have been dedicated by an officer of the same cohort during the expedition. A remarkable number of scratched inscriptions on fragments of pottery have been found, which may hereafter prove to be capable of imparting more information than has yet been obtained from them.

I am glad to be able, through the kindness of the photographer, Mr. Haggitt, to lay before the Meeting a series of photographs taken by order of the Ecclesiastical Commissioners for England, to whom the land containing the more interesting of the relics

which have been excavated still belongs. They show the forum, with its channelled stones, a portion of the prostrate wall, and the curious table altar, (Plate VI.); they show the sunken chamber with its steps, its window, impluvium, and massive walls, (Plate VII.); they show also the perfect drains, (Plate IX.); the masonry of the eastern rampart; the south-east corner with its broad chamfered stones, (Plate VIII.); a hypocaust; the rooms on the ground floor of a house; the temple or basilica near the western rampart, (Plate X.); and a Roman grave with its occupant *in situ*, (Plate XII. This latter was found near *d*, on the General Plan, Plate V.)*

Through the kindness of the Committee of the Free Library and Museum of South Shields and their Librarian and Curators, I am also enabled to lay before the Meeting a few of the interesting articles contained in the very valuable collection, historically speaking, that has been formed by the explorers. I have here fragments of tiles, with the inscription "COH. V. G."; a fragment of brick, with the inscription $\frac{A}{Q}$; another fragment of tile, with the impress of the foot of a Dog; here are also the marks made

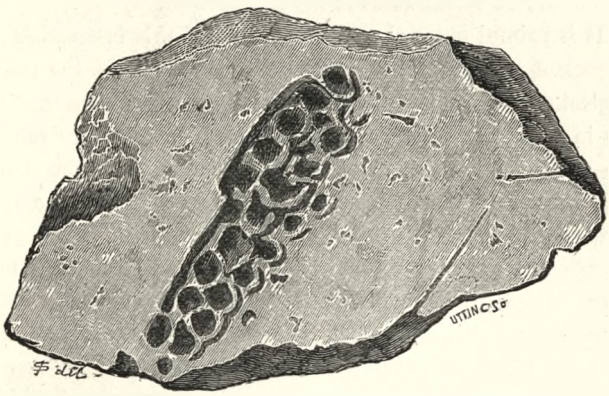


No. 10.

on the soft clay by the violent beating of Raindrops, (Woodcut No. 10); and still another fragment, with the impress of the

* By the kindness of J. Broughton, Esq., the Agent for the Ecclesiastical Commissioners at South Shields, the Club has been allowed to reproduce, by the aid of Mr. J. Storey's facile pencil, some of the more striking of these views, for the illustration of this paper.

nails in a Roman Military Boot, (Woodcut, No. 11). I have also another lettered fragment, a piece of an amphora, (nearly the whole of the vessel, of which it is a part, having been at the same time found in fragments,) with a portion of an inscription



No. 11.

upon it. I have also the patera I have already spoken of, and the central portion of another with scratched inscription. I have also brought specimens of figured Samian, of a Samian mortarium, of a white mortarium, and of many different kinds of ornamented pottery. I have here also a portion of a sword, a portion of a spear, a whetstone, a bone knife-handle or other implement, the lamp, a curious piece of glass, the spur of a fighting cock, and several scores of small articles, many of them very curious, comprising, amongst other things, several fibulæ, the writing stilus, an unguent spoon, an ornamented, glass bead, a large metal ring, and several smaller ones of bone and metal, the very handsome enamelled, equestrian ornaments, a curious, jet pyramid, many pins, and some spindle whorls. I have also a stone axe head or chisel, which was found immediately *above* the Roman level, and belonged, in my opinion, to the builders of the dry stone walls, the altar table, and the semi-circle.

I have, too, a very curious, holed stone, which was found among the pebbles which had been brought from the shore to fill the chamber in the southwest corner of the temple, or basilica, near the western rampart, and the most feasible explanation

of which is, I think, that which makes it a weight used by fishermen to sink their nets, accidentally lost by the owner, and afterwards brought with the stones from the shore, to fill the chamber, and make the bedding for the paved causeway which later occupants erected on the ruins of the temple wall.

It is painful to see the explored parts of this interesting and important Station at the present time in a state of the utmost neglect. The forum, the adjacent buildings, the sunken chamber, are in a state of second ruin. Builders' labourers are robbing the edifices of stones; children, and, judging from the size of the stones, even men, are hurling masses of stone into the excavated chambers, overturning pedestals, and smashing the great boundary stones of the forum. Everywhere destruction is rampant. Happily the remains are too massive, and too firmly bedded, to be obliterated in a day, and, though so much mischief has been done, enough remains to be invaluable if preserved. If none of the Station should be preserved, the disgrace to South Shields will be eternal. Men, in years to come, will not accept the excuses that one hears now on every side, such as that "The Ecclesiastical Commissioners ought to preserve it," "The public spirited leaders of the Borough ought to come forward," "The Committee ought to be more energetic," "The Town Council should take it up." The only thing remembered will be that the thriving, populous, and ought-to-be-cultured town of South Shields had, within its borders, a citadel of Roman power, a relic and a witness of its own greatness and importance in far-off days, a powerful attraction to visitors, a priceless educational boon for its own children, and, through apathy, or devotion to all absorbing monetary pursuits, suffered it to be wiped out, to be swept away, to be stamped out of its midst. That such a consummation will, even at this late period, be allowed to be completed, I cannot bring myself to believe; but, if it is to be prevented, action, and energetic action, must be taken, without a day's more unnecessary delay.

It is, perhaps, desirable to supplement the preceding paper with some brief statistical information respecting the Committee of Exploration, and its operations, inasmuch as such records always prove interesting in after years.

The Public Meeting, alluded to above, was held in the Lecture Room, (now the Museum,) of the Free Library, South Shields, March 8th, 1875. The Mayor of South Shields, J. Broughton, Esq., presided, and among the gentlemen present was our colleague, Dr. Bruce. The Meeting was very fully attended, and gave a cordial and unanimous support to the object for which it was called.

A large General Committee was formed, of which the Mayor was appointed Chairman, Mr. George Lyall, Vice-Chairman, Mr. Luke Mackey, Treasurer, and Mr. Robert Blair, Secretary. An Excavating Sub-Committee was also chosen, comprising, besides the above-mentioned Officers of the General Committee, Mr. Thos. Lincoln, Mr. Thomas Vint, Mr. T. J. Bell, the Rev. T. N. Roberts, Mr. Thomas Pyke, Mr. John Hutchinson, Mr. Charles Wawn, Mr. John Hinde, Mr. John Lincoln, Mr. Blagdon Dawson, Mr. Archibald Stevenson, and the writer of this paper.

The sum of £279 16s. 8d., in all, was raised, and expended, the account being finally closed August 16th, 1877. This sum was made up of the contributions of very many persons, among them being the Duke of Northumberland, the Bishops of Durham and Carlisle, the Earl of Durham, the Earl Ravensworth, and Sir W. G. Armstong. Mr. John Williamson gave the munificent sum of £50, Mr. J. C. Stevenson and Brothers more than £47, and Mr. Ralph Carr Ellison, besides a liberal donation in money, provided a Superintendent of the Excavations, at his own cost, for many months.

Besides the Collection of Roman Antiquities, from the Station at South Shields, deposited in the Museum of the Free Library, a very fine Collection has been made by Mr. Robert Blair, fine ones by Mr. T. Vint, and Mr. T. J. Bell, and a large number of articles have been dispersed among the inhabitants generally of South Shields and its vicinity. Since the Exploration Committee ceased their operations, private speculators have assiduously dug

and sifted the ground, finding, as their reward, numberless articles. These they sell, for the highest prices they can obtain, to those anxious to possess Roman relics; and it is a matter of certainty that some of the men, who thus employ themselves, are reaping a considerable harvest, as the fruit of their industry.

SPECIAL LISTS

OF ARTICLES FOUND IN THE ROMAN STATION AT SOUTH SHIELDS.

I. COINS.

For the following List of all the Emperors, Empresses, etc., whose Coins have been found at South Shields, either during the Special Excavations of 1875–1877, or previously, I am indebted to Mr. Robert Blair, who has kindly added also the dates corresponding to each reign. These, it is scarcely necessary to remark, are all A.D.

	NAMES.	DATES.
b	Consular	(Quadriga type).
b	Consular	(Antony's Legions).
c	Nero	50–68.
b	Vespasian	69–79.
a	Domitian	81–96.
d	Nerva	96–98.
a	Trajan	98–117.
a	Hadrian	117–138.
a	Antoninus Pius	138–161.
a	Faustina Senior	(wife of preceding).
b	Marcus Aurelius	161–180.
b	Faustina Junior	(wife of preceding).
b	Lucilla	(wife of Lucius Verus).
b	Commodus	180–192.
b	Crispina	(wife of preceding).
b	Septimius Severus	193–211.
a	Julia Domna	(wife of preceding).
a	Caracalla	211–217.

NAMES.	DATES.
b Geta	211–212.
b Elagabalus	218–222.
b Severus Alexander	222–235.
a Julia Mamæa	(mother of preceding).
b Gordian III.	238–244.
a Philip	244–249.
c Valerian	253–260.
a Gallienus	253–268.
b Postumus	258–267.
a Victorinus	265–267.
a Tetricus Senior	267.
a Tetricus Junior	267.
a Claudius Gothicus	268–270.
c Quintillus	270.
b Aurelian	270–275.
b Tacitus	268–276.
c Probus	276–282.
a Diocletian	284–303.
Maximian	286–305.
a Carausius	287–293.
a Allectus	293–296.
a Constantius I.	305–306.
a Helena	(first wife of preceding).
a Theodora	(second wife of same).
a Maximin II.	308–313.
a Licinius	307–323.
a Constantine The Great	306–337.
a Urbs Roma.	
a Constantinopolis.	
b Crispus	317–326.
a Constantine II.	337–340.
a Constans	337–350.
a Magnentius	350–353.
a Decentius	(brother of preceding).
b Constantius II.	337–361.
a Valentinian I.	364–375.

	NAMES.	DATES.
a	Valens	364–378.
c	Gratian	375–383.
b	Arcadius.....	383–395.

a Romano-British Minimi.

It would not be possible to ascertain how many coins of each of the above princes and princesses have been found, as they are far too widely scattered. Many hundreds in all have been obtained, some in very fine condition. The Museum of the Free Library has specimens of those marked (*a*), and, of the rest, Mr. R. Blair has specimens of those marked (*b*), Mr. T. Vint of those marked (*c*), and Mr. T. J. Bell of those marked (*d*). Each of these gentlemen possesses also many specimens common to one or more of the other Collections specified. The single Maximian found I have been unable to trace. The reverses of several coins of later Emperors in the above list have Christian emblems.

II. BONES.

For the following List of Bones found, during the Excavation, some in very considerable numbers, I am indebted to the Rev. T. N. Roberts, M.A.

MAN. Cranium, nearly complete, but in pieces; and many other bones, most of them apparently belonging to one person, but some of them belonging to others; in all, apparently, three individuals; all found in the Sunken Chamber, or on the floor of the Forum.

Frontal portion of Cranium, found near the Western Rampart.

Cranium, and other bones, found in GRAVES, near *d*, on the General Plan, (Plate V.)

Ashes of bodies, which had been burned, found enclosed in URNS, near *d*, on the General Plan, (Plate V.)

Dog.	Cranium; jaw.
Wild Boar. (*Sus Aper.*)	Tusks in abundance.
Swine. (*Sus Scrofa.*)	Tusks, teeth, and bones of various kinds, in abundance.
Cattle. (*Bos Taurus.*)	Many skulls and other bones. Some of the skulls are believed to belong to the species, *Bos longifrons*. Several are preserved in the Museum of the Free Library, and it would be well if some Members of the Club, who have bestowed more attention than the writer has done upon the characteristics of that species, would carefully examine them.*
Goat.	Jaws.
Sheep.	Jaws.
Red Deer. (*Cervus Elaphus.*)	Great Quantities of bones, especially lower jaws and teeth. Fragments of horns, many of them with marks of knives and saws.
Elk.	Piece of palmated antler.†
Horse.	A few teeth.
Whale.	Part of vertebra, found on the floor of the Forum.

* In the "Guide to the Ruins of the Roman City of Uriconium," by the well-known antiquary, Mr. Thomas Wright, it is stated that the Crania of the *Bos longifrons* were found during the exploration of Uriconium in 1859, "More than one bearing," as at South Shields, "evident marks of the fatal blow of the axe on the forehead." Remains of animals of the same species are also recorded by Mr. Roche Smith, as having been found amongst Roman relics, at Colchester and in London.

† It is noteworthy also that Mr. Wright also states that "Fragments of the horn of a species allied to the Elk of Ireland," were found at Uriconium. He gives the scientific name as *Strongyloceros spelæus*. I incline to the opinion that the fragment found at South Shields belonged to the *Cervus megaceros*.

III. SHELLS.

Great numbers of Shells were found in various parts of the Station, under circumstances which admitted of no doubt that the molluscs which once tenanted them had been used as food. They were mostly mixed up with bones, broken pottery, and other refuse from the kitchens of houses; and the greater number were found near the ramparts. Snail shells were also found, but not in sufficient numbers to render it at all certain that they had been used as food. For the following List I am indebted to Mr. George Lyall, F.G.S.

Oyster. (*Ostrea edulis.*)	Numerous.
Mussell. (*Mytilus edulis.*)	Very numerous.
Common Winkle. (*Littorina littorea.*)	Numerous.
Limpet. (*Patella vulgata.*)	Very numerous.
Snail. (*Helix aspersa.*)	Some, but not very many.

IV. BUILDING MATERIALS.

Several kinds of Stone were used by the builders in the construction of the edifices of the Station, and in paving the Forum, the halls, and the streets. Thin stone shingles were also used, as well as tiles, for roofing purposes. For the following List of the different kinds of Stone, and Building Materials generally, employed, and of the nearest Localities, whence similar kinds can be obtained at the present day, I am also indebted to the kindness of Mr. George Lyall.

LIMESTONE.

KINDS.	LOCALITIES.
Compact Magnesian.	The Trow Rocks, near South Shields.
Subcrystalline Magnesian.	,, ,,
Flaggy Magnesian.	Quarry near Westoe, now filled in, and at Marsden.
Laminated Magnesian.	,, ,,

SANDSTONE.

Red.	The Deans, near South Shields.
Coarse Yellowish White.	Billy Mill, near North Shields.
White.	Billy Mill, and Quarry near Lawe, long since filled in, and Quarry near St. Mark's Church, South Shields, now filled in.
Flaggy.	,, ,, ,,
Micaceous.	,, ,, ,,

MILLSTONE GRIT.

The Millstones found were composed of a very coarse grained brownish grit, the nearest localities for which at the present day are in Weardale and North Northumberland.

RIVERINE PEBBLES, CLAY, SAND, ETC.

Pebbles of Sandstone, Carboniferous Limestone, Porphyry, Basalt, etc.	These, according to the testimony of the Pilots who live at the Lawe, were, without question, from the Mussel Scarp, a bank at the mouth of the River, which was finally removed by dredging a few years ago.
Clay.	Clay for Tiles and Bricks exists in abundance on the Lawe itself and its slopes, particularly to the southward and westward. But the Romans seem to have used bricks but sparingly in their buildings at the Lawe.

SAND.	Found plentifully on the south-western slope of the Lawe.
LIME.	Might have been made at the Trow Rocks, and other Limestone Localities; or, in abundance, and of excellent quality, at Fulwell.

V. POTTERS' STAMPS.

A vast quantity of Fragments of Pottery of all kinds was found; among them many pieces bearing Potters' Impressed Stamps, either in whole or part. The following is a List of all such Stamps, as far as I have been able to trace and examine them. Those marked *a* are at the Free Library; those marked *b* in the Collection of Mr. R. Blair; those marked *c* in that of Mr. T. Vint; and those marked *d* in that of Mr. T. J. Bell. Those marked also with a star are Variations, hitherto, as far as I am aware, unpublished in British Lists, while those marked with a double star are, I believe, wholly new to the same. The lettering is given exactly as it appears on the fragments.

SAMIAN.

1. *a.* MARTIOM *

On patella, seven inches in diameter, one inch and five-eighths high, found on shore of river by boys. Exposure to the air is crumbling the glaze, an effect not observable in any other specimen.

2. *a.* GENMORF * *

On patera ten inches in diameter, three inches high. The middle letter is imperfect, but looks much more like M than like I T.

3. *a.* DAGOMRI *

On patera, seven inches and three-quarters in diameter, one inch and a half high. The third letter distinctly G.

4. *a.* ADVOCISM

The last letter is indistinct, and is possibly not M.

5. *a.* LMVF* *

The lower part of letters V F not perfectly plain.

6. *a.* DITTV* *

The first letter appears to be plainly D not P.

7. *a.* NAM - - NIM*

The two letters in the centre almost entirely gone, but probably M A.

8. *a.* MACRIAII -

The last letter broken off. The whole was probably MACRIANI.

9. *a.* AI - - - - VI

The central letters illegible, apparently four in number.

10. *a.* IANVARI

Fragment of ornamented patera of superior material and glaze.

11. *a.* REGVLI.M

All distinct, except lower parts of L and I.

12. *a.* SIIVIIRIANV - *

An S apparently wanting at end. The first S is reversed. The double I is no doubt used for E.

13. *a.* QVIN - - - -

Fragment of ornamented pottery, of superior glaze. Whole consisted apparently of about eight letters.

14. *a.* —— BVSA

This appears to be more than half the name.

15. *a.* EVATTVSF* *

Badly stamped. The tops of A and first T gone.

16. *a.* SVIVA* *

Very rough. The S not vertical, but horizontal.

17. *a.* QVADRATI 18. *a.* SACRILLI *

19. *a.* - - - MOR

Whole consisted apparently of six letters. The letter preceding O is imperfect, but appears to have been M.

20. *a.* POTTACI 21. *a.* CELSIAM *

22. *a.* —— IS . E

23. *a.* DIV ——

Whole consisted apparently of about nine letters.

24. *a.* —— VSF

Whole consisted apparently of about seven letters.

25. *a.* —— IM

Whole consisted apparently of about six letters.

26. *a.* MEN - - - INVS * *

Reading doubtful. The first N may be R, and the second N may be M.

27. *a.* —— IVVII

Upper part of last three letters gone.

28. *a.*, and 29. *a.*

Letters too fragmentary to be reproduced in type.

30. *a.* A rose, of eight compartments.

31. *a.* A wheel, of six spokes and pellets.

32. *b.* LVPIM

Remarkably clear and distinct.

33. *b.* CARATILLI 34. *b.* —— TV

35. *b.* CASVRIMA *

The M and A united by ligature.

36. *b.* —— VLLIM

Apparently four or five letters preceded the V.

37. *b.* ALBVSA 38. *b.* CIRRVSF

39. *b.* ATT - - I

Apparently two letters between T and I.

40. *b.* *CNDEO* **

Rough letters, slanting like italics.

41. *b.* MAR - - - INV

Three or four letters apparently between R and I. The latter indistinct.

42. *b.* MINILLM *

On figured Samian, incused, on side of vessel, on a raised band. The L L reversed.

43. *b.* VITIR *

Incused. Somewhat difficult to read. There is possibly a third I after the R.

44. *b.* MARCIM

This stamp is wholly reversed. The last letter given above is imperfect. There was besides it apparently one letter more.

45. *b.* - LBVSA

One letter, which preceded L, gone.

46. *b.* Two or three letters, very illegible, possibly VIM

47. *b.* ——— HEVI

Very illegible. Reading doubtful. The first letter appears certainly more like H than any other.

48. *b.* A rose, like 30, *a.*

49. *c.* MARMIN ** 50. *c.* VENERAM *

51. *c.* ——— MANV

The last three letters ligulate. Three letters apparently preceded M.

52. *c.* M ———
Rest, about seven letters, illegible.

53. *c.* IINICIISI * *

54. *c.* VER ———
The original number of letters was apparently about nine.

55. *c.* BEL ———
The original number of letters was apparently ten or eleven.

56. *c.* VVV —— * *
Apparently about three letters wanting.

57. *c.* —— ITOLINVS
Three letters apparently wanting before I. The I and T are ligulate, as also the L and I.

58. *c.* R . L * *

59. *c.* M * *
The M very rough.

60. *c.* INF or INIF * *
Reversed. The NF or NIF ligulate.

61. c. LMVF * *
The strokes of the V not joined at the bottom. Might be double I.

62. *c.* A circle, with seven half-radii and central pellett.

63. *d.* MARCIF

64. *d.* MARTIM

65. *d.* LVGIITV - - - - * *
The II not very distinct. Apparently four letters followed the second V.

66. *d.* - MANVF
The MAN ligulate. Apparently only one letter preceded the M.

67. *c.* MACRINI - -
Apparently two letters followed the second I.

BLACK WARE.

68. *a.* IINICIISI**

This stamp is the same as 53 *c*. It is the only example of a stamp on black ware that has come to my knowledge from the Station at South Shields.

MORTARIA.

69. *c.* ANANS or AVAVS or SVAVA**

The first and second letters are ligulate, and the third and fourth are so too. It is impossible to say whether N or V is intended. If the inscription is reversed, as it may possibly be, the third rendering given above would be the correct one. The inscription is perfectly plain. It is on a fragment of coarse reddish ware.

70. *c.* NV

On a fragment of coarse reddish ware.

71. *c.* OCGFLI**

On a fragment of fine white ware. The letters are of an ornamental character, about three-quarters of an inch long, between ornamented borders. The last two letters are imperfect, and there may have been more, both preceding and following. The G is somewhat doubtful; it may really be C.

VI. GRAPHITIC INSCRIPTIONS.

The Excavations at the Lawe have yielded a number of Graphitic Inscriptions; such, for example, as the names of the owners scratched on the undersides of vessels of Samian, and other, Ware. The following is a list of all such Inscriptions, as far as I have been able to trace and examine them. The letters prefixed to the Inscriptions have the same significations as in the preceding lists.

SAMIAN.

1. *a.* XXII

On under side of 1. *a.* in preceding List.

2. *a.* REMVLI

On under side of 9. *a.* in preceding List.

3. *a.* X

On under side of 19. *a.* in preceding List.

4. *a.* NEPV

Very deeply scratched on under side of 22. *a.* in preceding List. The strokes of the V are not joined at the bottom.

5. *a.* LINDITI

On under side of 29. *a.* in preceding List. There are also two other marks, apparently imperfect letters, separate from the above, but they appear to be of recent origin.

6. *a.* V

Imperfectly formed. On under side of 4. *a.* in preceding List.

7. *a.* LVC

This inscription had been afterwards deleted by scratching numerous lines across it.

8. *a.* L or V

It is hard to say which letter this was. It is on a very small fragment of apparently a patera, and it appears, contrary to the usual custom, to have been scratched on the inside surface of the vessel.

9. *a.* XXVV

The second X has a double line, instead of a single one, from left to right. The V V like small y y reversed.

10. *b.* PNM

On under side of fragment of patera. The central stroke of the N has gone.

11. *b.* A mark consisting of four lines

On under side of 38. *b.* in preceding List. It is like the mast of a modern ship with two yards, and a rope from top of mast to upper yard.

12. *c.* B

On under side of 61. *c.* The letter is formed like a K, with upper ends joined by a horizontal line, and lower ends also.

13. *c.* H

On back of fragment of patera.

14. *c.* VIM

On back of catinus, or deep basin-like cup.

BLACK WARE.

15. *a.* A "broad arrow."

On under side of 68. *a.* in preceding List.

16. *a.* V

On under side of fragment of patella.

AMPHORA.

17. *a.* BELSIM

On two fragments, but evidently adjacent ones.

18. *a.* MVIIS

On a fragment of the same amphora as the preceding, but apparently not an immediately adjacent fragment. The M imperfect, first half being gone, and rest not made in the same style as the M of preceding fragment.

TILES.

19. *a.* VOO
OSYY

Several letters imperfect, particularly the last O in first line, which may possibly be C, and the last Y in second line. The last two letters in the second line may possibly be V V.

20. *a.* CALI
S
BVS

Several of these letters doubtful, in particular the A, L, and B.

VII. STAMPED AND SCULPTURED INSCRIPTIONS ON TILES, BRICK, AND STONES.

The following is a List of all the examples of Inscriptions stamped on Tiles, or cut in Brick or Stone, found during the Excavations, as far as I have been able to trace and examine them. The letters prefixed have the same significations as before. The Inscription on the Altar, found at South Shields in the seventeeth century, is given in Dr. Bruce's Lapidarium Septentrionale.

TILES.

1. *a.* C O H $\overline{V}$ G

Faint. But the whole legend complete on a band. There appears to have been some kind of slight ornament before the C and after the G.

2. *a.* C O H $\overline{V}$ G

The G imperfect.

3. *a.* H $\overline{V}$ G

The H imperfect. On account of the great importance of these inscriptions, Woodcuts, (Nos. 12 and 13,) are here inserted of these two fragments, which together contain the whole legend.

No. 12.

No. 13.

4. *a.* H V̄ G

The G imperfect.

5. *a.* H V̄ G

6. *a.* O H V̄ G

The O imperfect.

7. *a.* C O H

The H imperfect. This tile has been stamped with a different die from that, or those, used in the preceding instances. In this there is no trace of, or room for, any ornamental mark on the band before the C. The letters, also, are slightly different in form.

8. *a.* Too faint to be legible.

9. *b.* C O H V G

The V and G imperfect. No trace of a line over the V. The die used in stamping this tile was the same as, or similar to, the one used for stamping 7 *a*.

10. *b.* C O H V̄ G

The C, O, and G, and the line over the V imperfect.

11. *b.* C O H V G

Faint. The C gone, the V nearly.

12. *c.* H V G

The line over the V gone.

13. *c.* C O H

The H imperfect. The inscription stamped on the clay, in nearly the same place, twice or thrice.

14. *a.* A C

The C placed within the angle of the A. As the occurrence of these two letters, in combination, is probably indicative of an

important fact in connection with the history of the occupation of the Station, a Woodcut, (No. 14,) of this stamp is inserted.

No. 14.

BRICK.

15. *a.* A C

The only inscription found on Brick. It is cut in the face of the brick, not stamped upon it. The C is placed horizontally under the A. The following Woodcut, (No. 15,) represents it accurately. To the left of A is a sculptured mark.

No. 15.

STONES.

16. *a.* A C

Roughly cut on an oblong rectangular block of Magnesian limestone.

17. *a.* D. M.
- - - - - -
IVLI

Cut in a slab of sandstone, which has, without doubt, been a sepulchral monument. The D. M. is within a triangle at the head of the stone; the I V L I in what appears to have been the second line of the longer inscription below the triangle. The letters of I V L I are between three and four inches in length, and the breadth of the stone would probably have taken ten such letters in each line.

18. *a.* OCVLVS PP

On a fragment of sandstone, with moulding below the letters, which have every appearance of having formed part of an inscription of considerable length. The reading is somewhat doubtful, but the above appears the most satisfactory rendering of the portion of the inscription which remains visible.

VIII. INSCRIPTIONS ON LEADEN BULLÆ.

The interest of the Excavations at South Shields has been enhanced by the finding of several leaden bullæ with inscriptions stamped upon them. They resemble in shape, size, and general character, the impressions made upon wax by seals. I believe no similar leaden bullæ have ever been found in Roman Stations, except in England, and only in two or three Stations in this country before these were discovered in South Shields. One of these few other Stations is Brough, in Westmorland, where large numbers have been found. It is extremely probable that the leaden bullæ found in England will prove hereafter of very great archæological importance. The following is a complete list, as far as I am aware, of those as yet found at the Lawe. The letters prefixed have the same significations as before.

1. *c.* On one side LVI. On other side DVA

One is tempted to think that the first legend must signify "Legio Vicesima," the twentieth legion; and the second legend "Deva," Chester, where the twentieth legion was stationed.

2. *b.* On one side A S A. On other side V R N

Can A S A signify "Ala Sabiniana," the Sabinian Regiment of Cavalry; and V R N "Uriconium," or Wroxeter; and, if so, what was the connection between the two?

3. *b.* On one side C V̄ G. On other side T V̄ M

The first legend is the one we are so familiar with on the Tiles found at the Lawe. Of the second legend the first two letters are indistinct, the last letter very plain. If the rendering given above be correct, the conclusion is irresistible that the combination stands for "Tunnocelum."

4. *c.* A V G G

Above three heads, two of them very fine, the third imperfect. The Central one appears certainly, from the likeness to the head on his coins, to be Severus. If it be so, the others are doubtless Caracalla and Geta. The date, when this bulla was stamped, was therefore, in all probability, A.D. 209, or thereabout.

5. *b.*

A bulla, which, Mr. R. Blair informs me, was similar in all respects to the preceding, but which has unfortunately been lost.

6. *b.* On one side D - - - A V

A fragment of a bulla stamped with a head, or heads, on both sides. The only letters remaining are D, and, at a distance equivalent to the space required for probably three letters, A V ligulate.

The Writer of the above Paper and Lists must here, for the present, cease his labours. He had intended to give a "Catalogue Raisonnée" of the Miscellaneous Objects discovered, but the "Finds" have of late so increased, in number and interest, that the Miscellaneous Objects, if ever catalogued as intended, must form the subject of another communication to the Club.

EXPLANATION OF THE PLATES.

PLATE V.

General Plan of Site of Station.

This Plan shows the mouth of the Tyne, with the relative positions of Tynemouth and South Shields. The foreshore, and lofty ground of the Lawe, are plainly shown. The Roman Station, untouched for centuries, except by the making of the Ballast Railway, occupies a commanding position. Though there were four gates to it, there appears to have been but one road, that which crosses Baring Street at *c, c*. The grave yard, *d*, where skeletons in graves, and ashes in urns, have been discovered, seems to have been on one or both sides of the road, which, at or near the junction of Ocean Road and Mile End Road, must have crossed the inlet from the Mill Dam, which formed a subsidiary outlet of the River Tyne and rendered the Lawe an island. When on the South of this Channel the road doubtless parted, a branch going to Westoe, Harton, Cleadon, and Wearmouth, and the main road, Wrekendyke, going to Wardley, Leam Lane, and Eighton. The long "Low Street," along the shore of the River, was the site of mediæval Shields, and contains at this day the oldest houses in the town. It *may* have been a paved road in the time of the Romans, leading to a Ferry to North Shields.

PLATE VI.

Forum.

The immediate foreground is unexcavated. To the right are seen the massive stones forming the outer margin of the Forum. The deep depressions caused by innumerable footsteps are very visible in a stone right in front. Just behind is a gap, whence a huge stone had been taken in early times. Behind that is seen the Channel, which carried off the rain from the footpaths. Its continuation is seen turning the angle at the right hand edge of the Plate. Filling the middle of the plate is the prostrate wall, blown down in some great gale from its foundations, which are seen extending in a long line on the left of the Plate. The entrance to the Prætorium is about where the man with the pickaxe in his hand is standing, and on that man's left is seen a large extent of the original pavement of the Forum, and beyond that again the table-altar, and the remains of its encompassing wall. The depth of the Remains below the present surface of the ground is shown by the high bank of unexcavated earth behind the table-altar.

PLATE VII.

Sunken Chamber near Forum.

The Chamber is in the foreground, with its massive walls, composed of huge stones, with many crampholes, destitute of metal. On the right, at the outer edge of the wall, is a figured stone: to the left of this, the steps connecting the Chamber with the Hall of the Prætorium: to the left of the steps, the window, with one jamb erect, one hole for iron bar in the outer sill, the inner sill perfect. In front of the window, near the left hand side of the Plate, is the cistern, or impluvium. Above the Chamber, in left hand upper corner of Plate, is the concrete floor of a large room: to the right of this the floor of the Prætorium, the walls of the shops at the end of the Forum, the table-altar and rough walls around it, the pavement of the Forum, and, finally, in the right hand upper corner of the Plate, part of the prostrate wall, and the still remaining lower portion, from which the prostrate portion was broken off.

PLATE VIII.

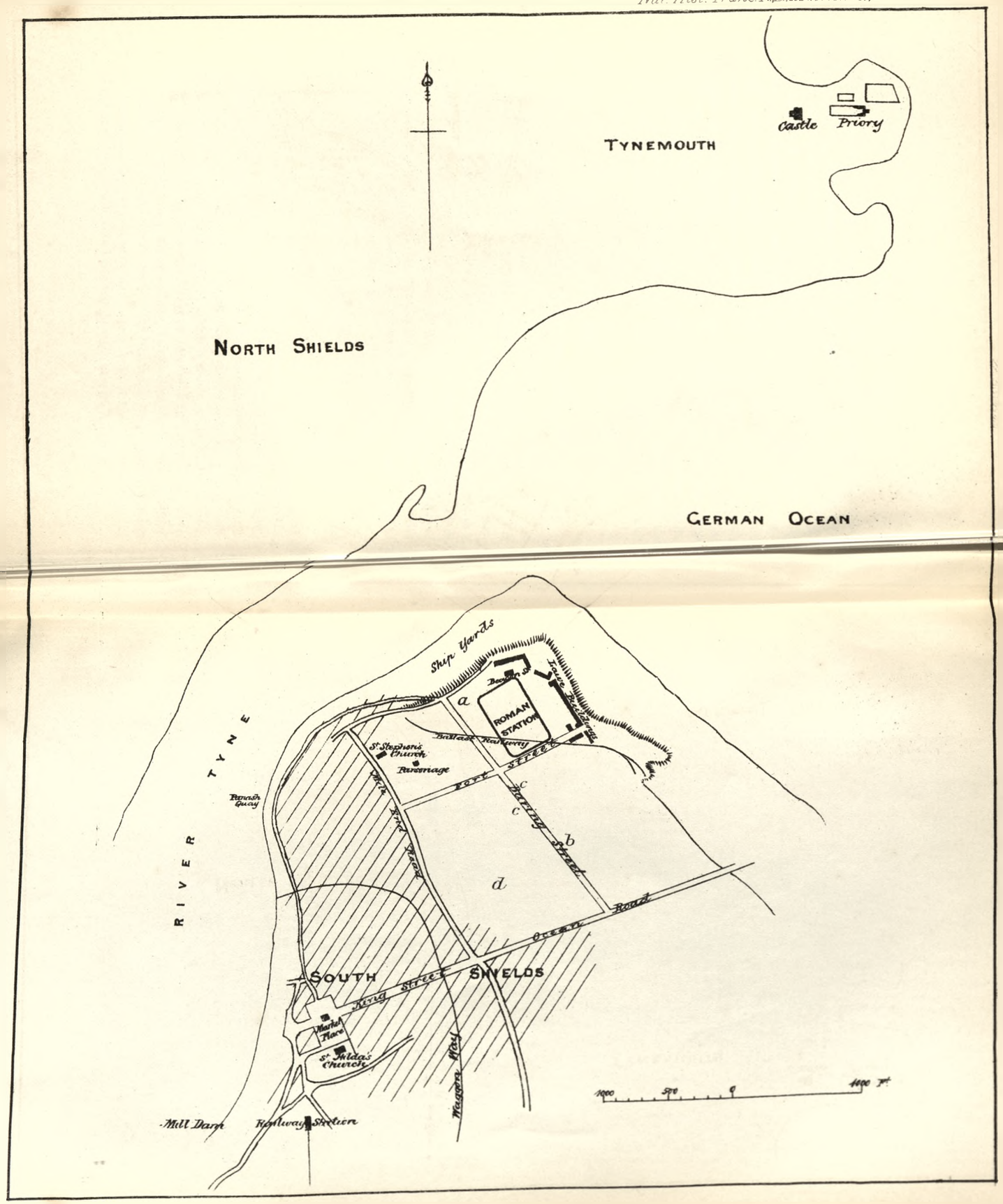
South East Corner of Rampart.

In the foreground is the massive masonry of the rounded corner of the rampart, which encircled the whole Station. The lower courses of the masonry, the chamfered blocks, and remains of the first course above them, are seen with great distinctness. To the right the rampart runs on, in a direct line, to the north east corner, denuded throughout almost its whole course of its massive facing stones. To the left is a wall on the inside of the rounded corner, "tied" to the rampart. Near the angle it forms with the rampart, on the right hand side, numerous fragments of swords, and of equestrian ornaments, were discovered.

PLATE IX.

Main Drains.

In the foreground is a portion of the great drains, which ran northward from the centre of the Station out of the North Gate, which was uncovered during the Excavations. Beyond are seen the flagstone coverings of the rest. The Northern Gateway of the Station was near the end of the trench. The large house beyond, the back of which is shown in the Plate, the front overlooking the Tyne, is that which has been so long occupied by R. H. Bell, Esq.. The immense depth of these drains below the present surface of the earth is very visible in the Plate. The trench has been filled up, leaving the drains as they were found, and before long, it may be presumed, the whole surface shown in this Plate will be covered with houses.


TYNEMOUTH
Castle
Priory
NORTH SHIELDS
GERMAN OCEAN
Ship Yards
ROMAN STATION
a
Ballast Railway
St. Stephen's Church
Parsonage
Parish Quay
RIVER TYNE
West Street
Long Row
Henry Street
b
c
d
Ocean Road
SOUTH SHIELDS
Market Place
St. Hilda's Church
Mill Dam
Railway Station
Maggots Wynd
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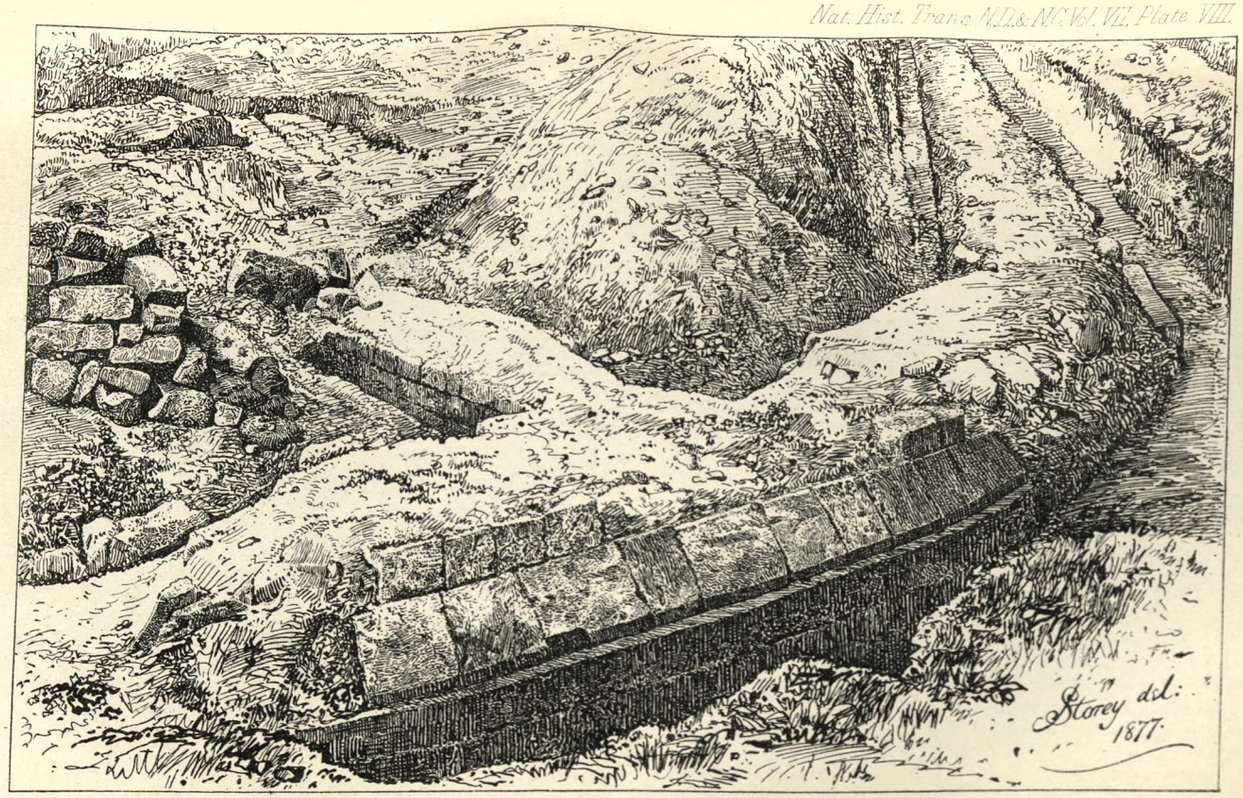
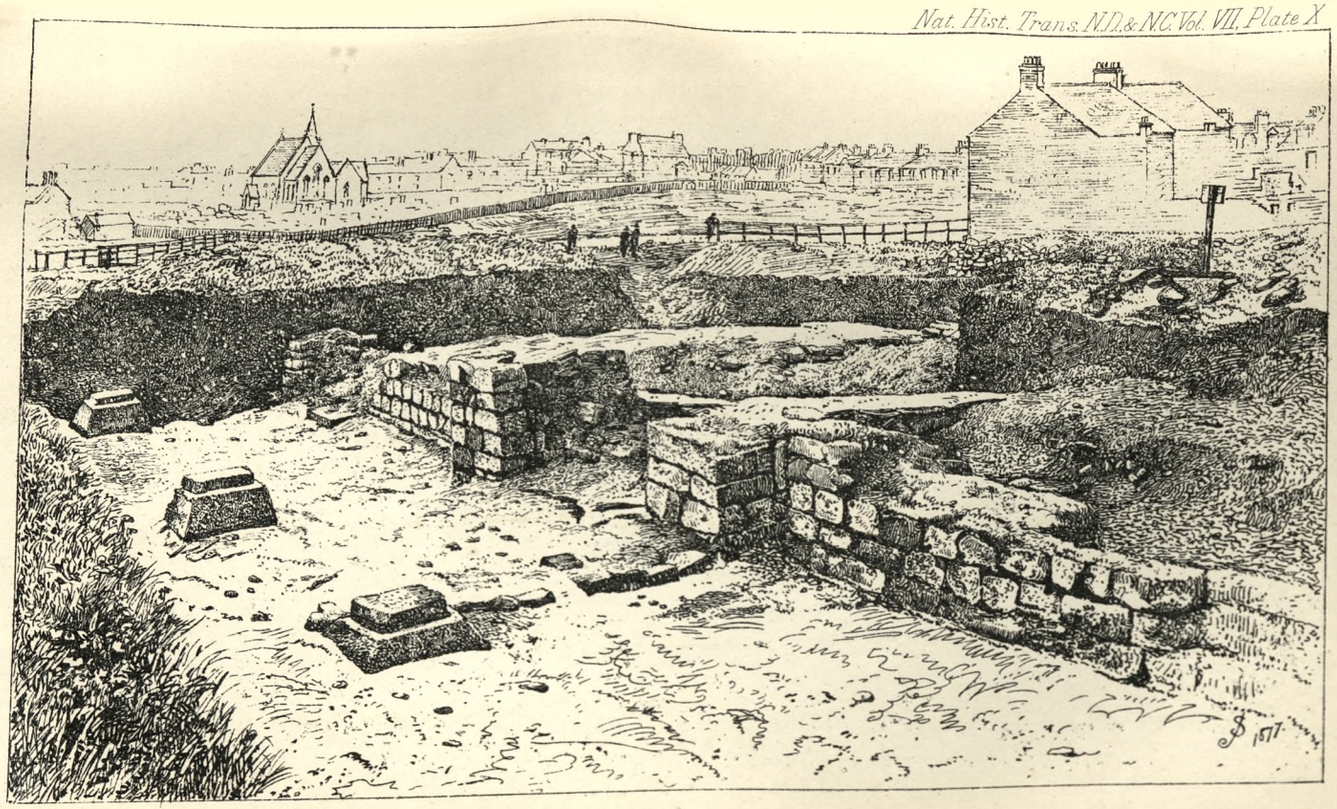
M & M. W. LAMBERT. PHOTO-LITHO.



M. & M. W. Lambert. Photo-Litho

M. & M. W. LAMBERT, PHOTO-LITHO.



M & M.W. Lambert Photo-Litho.

M. & M. W. LAMBERT. PHOTO-LITHO

M. & M. W. LAMBERT. PHOTO-LITHO.

PLAN OF THE ROMAN STATION AT SOUTH SHIELDS

as excavated in 1875

showing the Streets intended to be formed on the Site

S. OSWALD & SON
Architects & Surveyors
Newcastle on Tyne

Beacon Street
Edith Street
Henry Street
Roman Road
BALLAST RAILWAY
Baring Street
Robertson St
Fort Street

PLATE X.

Large Building near Western Rampart.

To the left are seen the pedestals, which appear to have once supported the pillars of a portico. There can be little doubt the entrance was between the piers opposite the two nearest pedestals. Since the photograph was taken the whole area, not represented as excavated in the picture, has been uncovered. The building was found to be very large, a rectangular oblong in form, with buttresses outside, and pavement throughout its whole extent, except in the south-west corner, within. In the Plate is shown a very singular pier, not part of the above, of apparently British, Post-Roman, work. It is at the end of the large building, opposite the farthest pedestal. It was built of stone, bedded in clay instead of mortar. From that pier, along the side wall of the large building, ran one of the curious, paved, footpaths, raised on pebbles from the mouth of the River, and manifestly of later date than the Roman occupation of the Station.

PLATE XI.

Arched Chamber.

This Chamber is at the south-west corner of the great building shown in Plate X. It is near the pillar built of stone and clay. When found it was quite full of clay and stones from the shore. Many of the stones employed in building it had evidently been used in previous edifices. It had been filled with arches, which supported the floor above. One perfect arch was left, and the piers of five or six more. These are shown in the Plate, inside the Chamber, on each side.

PLATE XII.

Grave with Skeleton.

Situated in the burial place of the Station. The skull is seen at the left hand end of the narrow structure of stones built round the corpse. The soil above and below is sand. Many others were found thus buried in this place: many urns also, with calcined ashes within, and marks of fire around.

PLATE XIII.

Detailed Plan of Site of Station.

This Plan shows the exact site of the Station, and of all the Excavations made by the Committee of Exploration, together with all the Streets, either built or laid out, upon the site to the present time. It will, consequently, enable future discoveries, should any be made, to be identified as to locality, and to be compared, as to results, with those already achieved.

The general outline of the Walls will be immediately perceived, and the four Gateways, *N*, *W*, *S*, *E*. At *N*, *d*, *d*, are seen the Drains. At *W*, the Pavement of the Street passing through the gateway remained, as did also the pavement of the same street where it abutted on the Large Building, *a*, immediately to the right of *W*. The ground plan of the gateway, *S*, was very perfect. To the right of *S*, at *b*, is the rounded corner of the Rampart, exceedingly well developed, with the wall, *c*, inside, "tied" to it in building. Near *c* were found the swords and enamelled equestrian ornaments. For a long distance, from *b* towards *E*, the wall was uncovered, as indicated in the Plan, the facing stones on each side being gone, but the broad core remaining, except at one or two points, and in particular at *f*, where a noble piece of several yards in length remained on the inner side quite perfect. It will be observed that the gateway, *E*, is not exactly opposite to the gateway, *W*. At *g*, another rounded corner of the rampart was uncovered, but the inner part was not excavated, so that it is not known whether there existed there a wall, or not, inside, as *c* at *b*.

At *h*, *h*, *h*, are ancient Paved Roads, crossed by the trenches cut by the explorers, at a considerable height above the level of the Roman buildings, and running apparently all round the Station, in lines parallel to the ramparts. Similar raised roads, constructed of pebbles, with paving flags above, ran along the west wall, *j*, *j*, of the building *a*, and then at right angles in the direction *k*, crossing the upper part of the Arched Chamber, *l*, which was filled with stones from the Mussel Scarp and clay tightly puddled in. On the left side of the building, *a*, outside all, is seen a drain, which ran the whole length of the wall, and drained the foundation. At the lower end of this was the pier, *m*, already noticed as evidently not of Roman work, but probably Romano-British, composed of stones bedded in clay instead of mortar. In front are seen the three Pedestals, *p*, *p*, *p*. The arched chamber, *l*, was probably connected with the heating. The northernmost arch remained, the rest were all broken.

At *o* was a building, apparently part of a larger one, the rest of which was not excavated. In front of it is a pavement, part of a street apparently, leading into the Forum. The pavement reappears to the right of *o*, approaching the Forum, and another pavement also, crossing the former at right angles. The fallen wall, *n*, is plainly seen on the floor of the Forum, and the channelled stones running round three sides of it. At *q*, is the Table-altar of later date: to the right of *q*, the Shops: at *r*, the Well: *t* is the great hall of what I suppose to be the Prætorium: *u* is the Sunken Chamber, with the steps and impluvium or other object: *w* is the Wall of another important edifice.

At *x*, to the right of the Forum, near the rampart, many interesting articles were found; amongst them the bronze lamp, the writing stilus,

unguent spoon, and bronze cup. The Hypocaust is shown, and the foundations of the Rooms, etc. At *y*, near the East Gate, was another hypocaust, the pillars formed each of one stone: the wall behind, represented in the Plan by a single line, was plastered and painted; two colours, red and blue, being distinctly visible. The fireplace and doorway, in the building just below this wall, are shown upon the Plan.

We do not know where the fine altar discovered in the seventeenth century was found. The later find, now at Durham, was obtained in making the Ballast Railway, shown on the Plan. The buildings South of this appear to have been possibly of the nature of Barracks. In building the houses recently erected in Edith Street, many very interesting objects have been brought to light, a sphere of glass, rings, leaden bullæ, and enamelled personal ornaments for example.

ADDENDUM.

The following additional Potters' Stamps have been found since the completion of the preceding Lists.

72. *c.* OIVST —— * or OLVST —— * *

On outside of fragment of elaborately ornamented Samian bowl, in raised letters, each one-third of an inch long. It is matter of doubt whether the second letter is I or L.

73. *b.* QVADRATI

On a fragment of *black* ware.

74. *b.* SECVNDINI 75. *b.* VICTOR . F *

76. *b.* MAIO —— 77. *b.* —— TTA

78. *b.* —— TIAN 79. *b.* —— VM

Another tile inscription has also been found:—

19. *b.* COHV̄G

Another graphitic inscription:—

21. *b.* X

And two leaden bullæ, 7 *b.*, and 8 *b.*, with inscriptions, which I am not at present at liberty to give.

VIII.—*Note on the Bar-tailed Pheasant* (*Phasianus Reevesii, Gray*).

By the Right Honourable the Earl of Ravensworth.

These beautiful Pheasants were presented to the Earl of Ravensworth in a perfectly fresh state by Sir Dudley Marjoribanks, M.P., by whose care the species has been introduced from Pekin (China) into the Scottish Highlands, Inverness-shire, where they are now naturalized in a wild state. The leading points of this memoir are furnished by the Honourable Baronet. It appears that the first pair of these birds were received by Sir Dudley from Pekin in the year 1870, from which date broods have been reared at Guisachen, and some fresh blood has been introduced by the acquisition of two brace of male birds from the Zoological Garden of Antwerp.

The Bar-tail is a true Pheasant well able to take care of himself in any climate at any altitudes, and is more easily reared than the common species. He is very shy and wild, difficult to approach, and taking to his legs long before other Pheasants are conscious of any danger. His flight is prodigiously rapid and straight, and he will travel thirty miles on end, which of course is an objectionable practice except in such extensive forest grounds as the Highlands of Scotland present. These Pheasants travel in troops of fifteen or twenty, and present a grand and bewildering effect when they rise in such a company. Any attempt to walk up to these birds in brush covert is utterly hopeless, for they are exceedingly vigilant and go straight off like a dart, not more than six feet above the ground, far out of reach.

A fight between two old cocks is a beautiful exhibition of activity and spirit. They spring up five or six feet in the air before striking, and such is their agility that the bird assailed hardly ever allows himself to be struck: so much the better for him, for it will be observed that the legs are garnished with spurs as long and sharp as those of a Game Cock.

The last peculiarity of this species worth naming is, that when they set out on a jaunt, they make for the highest point within range, whereas the Common Pheasant is accustomed to travel downwards along the course of the valleys.

Such is the summary of Sir Dudley Marjoribank's observations.

from the Natural History Society's Transactions of Northumberland for 1877.

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IX.—*Miscellanea.*

Some observations on the Breeding Place and Egg of the Knot, Tringa Canutus, L.—I have wondered ever since the last Arctic expedition started why this ~~species~~ was especially mentioned, as I think there are many others ~~species~~ of which almost as little is known, which breed in the Polar regions.

I find amongst my ornithological memoranda, an extract I made in 1839, at Wallington, from Captain Sabine's account of birds found at Melville Island and the North Georgian Islands during Parry's voyage, which is as follows:—

Sanderling. Breeding abundantly on the North Georgian Islands.

Golden Plover. Very common, North Georgian Islands.

Ring Dotterel. Common, both places.

Turnstone. Very common.

Dunlin. Rare.

Knot. Breeding in great abundance on the North Georgian Islands.

Purple Sandpiper. Breeding all along the coast of Davis' Straits and Baffin's Bay, but not met with in the Polar Sea.

Grey Phalarope. Breeding abundantly on the North Georgian Islands; and amongst several other species is mentioned that lovely bird the Fork-tailed Gull as occurring on Prince Regent Island, and on three small Islands in Baffin's Bay, in lat. 75·5°.

Now this seems to me a very satisfactory proof of the Knot's breeding ground being ascertained in America at least.

I am not aware whether any eggs of the Knot have been brought to England, but I should think it very probable they may have been. Some thirty years ago I was staying at a house in this county, when I was shown a collection of eggs, and there was one amongst them named Knot. The original collector had died, but I enquired about the egg, remarking on its rarity, if authentic. My kind correspondent (also long since dead), a few days afterwards, wrote to me as follows respecting it.

"The Knot's egg," he says, "he had from a Captain Howard some years ago. He was a great collector of eggs from all parts,

and he believes it to be certainly correct, I therefore send you the egg, hoping you will put it into your collection if you think the information worthy of belief." The person referred to was the keeper, and I believe was a clever man, and was much interested in birds and eggs, and had helped to form the collection. This egg agrees pretty well with Yarrell's description of what the egg is said to be like. It is about the size of a Reeve's egg, but is rather broader and not so pyriform, the ground colour being a very rich pale brown with a pinkish tinge in it, and the spots are rich brown, with some inclining to lavender colour. Now from the shape of the bird one might expect it to lay an egg shaped like the Woodcock's egg. I admit shape goes for very little, as I have Dunlins, Common Sandpipers, Curlews, and even Snipes' eggs, all of which are generally very typically pyriform, as broad and round as Woodcocks', but I think I never saw a pyriform Woodcock's egg. In the days when this collection was made, and previously, collections of such like things were more often to be found in country houses than they are at the present time,* but the opportunities of getting from home were not then so numerous and consequently public collections were not so easily seen, and those who had any taste for such things collected for themselves, and I think generally, in consequence, the collectors acquired more information than the generality of those you now meet with care to possess.

I would remark that it is possible the Golden Plover and Ring Dotterel or the Dunlin mentioned, may not be those of Europe; it is very difficult to say whether the American forms of these birds are the same species as the European.—*Charles Murray Adamson.*

Notice of Testacella Haliotoidea, Drap., a Mollusc new to the District.—In November, 1876, when at Mr. Edmond Crawshay's, Bensham Hall, the gardener brought me two Slugs, one of which was found in the Vinery, and the other on the outside of the wall. None have been found there before or since.

* There was a collection at Unthank Hall, the late Mr. Dixon Dixon's, and one at Little Harle Tower, then Mr. Murray Aynsley's seat, part of which collection was given to us when he left the county; and the one at Wallington, which contains the Great Auk's egg, and also an authentic egg of the Great Bustard, taken in England, and probably one of the last which will ever be taken in a wild state.

On taking them to the Museum, where they are deposited, they were found to be *Testacella Haliotoidea*, Draparnaud.

Some Morella cherry trees were got from Crewkerne, Somerset, in the spring of 1876, with which they might have come.

I am told by the Rev. A. M. Norman that he has not heard of them in the North of England before.—*R. Y. Green, January*, 1877.

Note on the Discovery in 1836–7 *of a Fossil Fish* (*Acrolepis Kirkbyi*, n. s.) *in the Upper Division of the Magnesian Limestone at Marsden.*—Last year, 1876, I had an opportunity of examining at Whitby a fossil fish which was found in Marsden Bay so long ago as 1836–7 by Miss Green, of South Shields. It was presented by Miss Green to Dr. Young of Whitby, and eventually deposited in the Museum of that town. This specimen is interesting as being one of the earliest ichthyolites found in our immediate locality, and its occurrence in the lowest bed of the Upper Division of the Magnesian Limestone is equally noteworthy. Those who visited Marsden Bay before Peter Allan excavated his remarkable grotto, and became a permanent resident at the Rock, know how different the place was at that time. The north part of the Bay was exceedingly rocky, so much so, that at low water scarcely more than a narrow margin of sand was to be seen close up to the cliff, the rest being covered with rough rocks at low tide. Keels came round from the Tyne, and workmen were employed to wedge up the thick beds of marly limestone and load the keels during low tide, and at high water the load thus obtained was conveyed to the Jarrow Chemical Works to be used in the manufacture of Epsom Salts. In course of a few years this supply of limestone became exhausted, and the north portion of the Bay assumed more of its present appearance, and one source of profit was closed to the industrious Peter who had in the meantime excavated for himself a home in the grotto which will ever be associated with his name, and had moreover made the Bay a place desirable and delightful to picnic parties from Shields, Newcastle, and Sunderland. Many traces of these soft marly

beds may be seen here and there in the present cliff-section broken up and confused in the most fantastic manner. In a fall of this kind of rock from the cliff, the fish, whose discovery I wish to record, was found by Miss Green, and conveyed with much care and inconvenience to Shields, for the specimen bears evident marks of having been cut out of a large block of limestone.

The fish belongs to a genus not hitherto noticed as occurring at Marsden, but the same species, along with others, were found at Fulwell Quarries, near Sunderland, and a long and interesting account of them has been given by my friend Mr. Kirkby, in a former volume of your Transactions. Mr. Kirkby at first identified this fossil with *Acrolepis Sedgwickii*, Ag., but afterwards found that it differed in many particulars from that species. As no specific name has been attached to it as yet, we shall to-night give it the name of the gentleman who first drew up an account of the occurrence of these fishes in the Upper-Division of the Magnesian limestone.

Since this discovery of Miss Green's, traces of fishes have been occasionally found in Marsden Bay, by Mr. Fryer of Whitley, many years ago, and by Mr. Kirkby in more recent years, but the impossibility of excavating the cliff section where they occur will for a long time at least prevent any successful search for them being made.

The fish found at Marsden by Miss Green is about nine or ten inches in length and very imperfectly preserved, but sufficient evidence is afforded by the specimen to refer it to one already mentioned by Mr. Kirkby, and it was found in exactly the same geological horizon, though at Marsden these beds are much more disturbed than the corresponding beds at Fulwell.

At Fulwell these ichthyolites are associated with fragments of land plants, remains of a Coniferous plant, and a Calamite. It may be asked, are these fishes of marine origin? and it may be stated in answer that the genera Palæoniscus and Acrolepis are generally considered freshwater types, and we think it most probable that these small fishes, which are associated with remains of land plants, were swept out to sea by periodical floods and deposited

John Storey del.
1877.

in its depths along with the plants which are undoubtedly of land origin.—*Richard Howse.*

Preliminary Notice of the Occurrence of Archanodon (Anodonta), Jukesii, Forbes, in the Lower Carboniferous Rocks of North Northumberland (Plate XIV.)—On the last day of our special meeting at Wooler and the Cheviots, on the 28th of July, 1877, I had the pleasure, through the kindness of Mr. Weightman of Wooler, of becoming acquainted with the existence in the Lower Carboniferous Rocks of Northumberland of a very large freshwater shell, much resembling in shape the large Anodon of our present rivers and lakes. The two specimens which this gentleman showed me were of unusual size for fossil bivalve mollusca, measuring respectively eight and nine inches in length, by three and four in breadth, and even these measurements could not be taken as extreme, owing to the partial destruction of the margins of the shell in the friable sandstone in which they are imbedded. Through Mr. Weightman's kind direction, I was enabled to find Mr. James Waldie, who had found these shells, and also to secure the sandstone matrix from which the casts had been carefully taken, and to obtain some account of the stratum from which the shells had been obtained; all which facts will be of great use hereafter in working out exactly the divisions of our Carboniferous Rocks, and will also enable us to correlate them more exactly with those of Scotland and Ireland.

At first sight the species seemed altogether new, but on my return home a careful comparison of the shells, which have been obligingly presented by Mr. Weightman to the Newcastle Museum, with the figures of *Anodonta Jukesii* of Forbes, leads undoubtedly to the conclusion that our shell must be identified with the Irish species collected from the Kiltorkan beds of Kilkenny, a group of sandstones and shales placed by Jukes and most of the Irish geologists in the Upper Devonian or Upper Old Red-Sandstone series, though previously Sir Richard Griffiths had considered these beds to be of Lower Carboniferous age. Eventually, no doubt, this last opinion will be generally adopted, for in Northumberland, as in Ireland, the beds of sandstone pass

upwards conformably and regularly into the undisputed limestone series. Associated with these shells in Ireland are the fronds of a magnificent fern *Cyclopteris Hibernicus*, Forbes, and several other species of plants, some of which pass up into higher and better-known, Carboniferous beds.

The bed of sandstone in which this shell has been found forms a very thick stratum in the North of Northumberland, and is a striking physical feature on the east side of the Till for many miles. It is a fine grained sandstone, hard and suitable for building purposes in many places, with patches of very friable nature between the hard layers filled with reddish, irregular nodules of clay.

Remains of *Ulodendron ornatissimum*, branches of a Lepidodendroid plant, and stems of a Calamite not yet identified occur in the same stratum. This sandstone bed is below all the beds of Carboniferous limestone, and forms probably an upper member of the Tweedian group of the late Mr. George Tate, a group of strata closely identical with the lower portion of the Calciferous sandstones of Scotland. The supposed Upper Old-Red Beds of Kilkenny will also no doubt be eventually and correctly correlated with these.

On Plate XIV., a figure, *a*, is given of the largest specimen about the natural size. The length when perfect would be about nine inches, and the breadth three inches and one quarter. The anterior extremity is imperfect. The dorsal margin arcuated with slight indications of the umbones, before which there seems to have been a slight thickening of the shell. The hinge-margin is slightly arched. The posterior margin slopes downward, and the ventral is slightly curved upwards under the umbones. The general form resembles the recent *Unio margaritifera*, Linn., of our northern streams. The hinge-line shows no trace of teeth and was, as far as the preservation of these specimens shows, quite straight. The shell appears to have been very thin, as indicated by fine concentric undulations on the surface of the cast. There are no traces of muscular impressions. The smaller specimen, fig. *b*, is more unioniform in shape, which has partly arisen from the circumstance that it was resting in a sloping direction

with the ventral margin uppermost against the free margin of the larger specimen at *a*, and thus the free margins are compressed together and the original contour of the shell destroyed. The hinge-margin is also more slightly arcuated, the umbones more distinct, and the thickening between them and the posterior margin more defined. I hope shortly to give a fuller account of the geological position of the bed in which these shells were found. The generic term *Archanodon* is proposed for this huge freshwater bivalve.—*Richard Howse, Newcastle-on-Tyne, August* 4, 1877.

Notes on a Paper by R. H. Traquair, M.D., F.G.S., F.R.S., on the Structure of the Lower Jaw in Rhizodopsis and Rhizodus.—In the First Volume of the Fourth Series of the Annals and Magazine of Natural History, Vol. XIX., p. 299, were published "Notes" on *Rhizodopsis*, by my late friend Mr. Albany Hancock and myself, in which the præmaxilla is described as a long, narrow, wedge-shaped bone, with a row of small teeth along the margin, and two laniaries; one large, the other small, the latter placed in front of the former, and near to the symphysis.

Since then a large number of specimens of the cranium of *Rhizodopsis*, several showing the præmaxilla *in situ*, have been obtained from the black shale at Newsham.

From three of the largest of these the matrix has been carefully and entirely cleared away, so that all the bones can be well seen. In these specimens the maxilla and our præmaxilla evidently form the margin of the upper jaw, along which is placed a row of small teeth, with two laniaries, one smaller than the other and lying near to the symphysis, quite as in our description.

The outline and the outer surface of the mandible are also well defined, with the row of small teeth along its alveolar border interlocking with or being overlain by those of the maxilla and premaxilla. On upwards of half a dozen mandibles in my collection, with their inner surfaces exposed, there is distinctly seen the row of small teeth along their upper margins, with the large laniary in front and the other three laniaries behind; these

are placed at about equal distances from each other. On not one of these mandibles do I find the slightest indication of a suture which might divide the bones bearing the laniary teeth.

If, as the author of the above-named paper states, our præmaxilla is the alveolar border or dentary piece of the mandible detached from that bone, how does it happen that in all the large series of mandibles of *Rhizodopsis* in my collection the alveolar border or dentary piece with teeth, which is supposed to represent our præmaxilla, is not wanting in any specimen, whilst the præmaxilla, which is much more common in our coal-field than either the maxilla or the mandible, is absent from a good many of the more perfect specimens of *Rhizodopsis* (which is, from the lax connexion of this bone with the cranium, what might have been expected)?

Of the largest specimen the maxillæ measures 1·4 inch in length; their upper margins are injured; the lower, bearing the row of small teeth, are intact. The præmaxillæ, articulating with the front of the maxillæ, unite together on the median line, forming the fore part of the mouth below the snout; each bone is 1·6 in length and 0·2 inch in height next the symphysis, gradually diminishing backwards.

That we have here the real præmaxilla is beyond a doubt.

X.—*On Pteroplax Cornuta, H. and A.* By THOMAS ATTHEY. With two Plates by WILLIAM DINNING.

IN the "Annals and Magazine of Natural History," Ser. 4, Vol. I., 1868, appeared "Notes on the Remains of some Reptiles and Fishes from the Shales of the Northumberland Coal-field," by my late friend Mr. Albany Hancock and myself.

In those notes were described two crania of *Pteroplax cornuta*, the upper surface of the smaller one being figured of about two-thirds the natural size (Plate XV., fig. 1); subsequently the matrix having been more carefully removed from the surfaces of both

crania, two well-defined sutures on each have been brought to light, and are seen to divide the bone which had been named postfrontal into three distinct parts, namely, the postfrontal proper, the postorbital, and the squamous.

In the present communication I propose to describe and figure, of the natural size, the upper surface of the smaller and the under surface of the larger cranium, also some ribs and vertebræ, three bones of an extremity, and some scutes, all of which most probably belonged to the same amphibian.

The crania have undergone immense pressure and are consequently much flattened. Together with the other bones they are from the black-shale, a stratum varying from three to four inches in thickness, overlying the Low-Main seam of coal at Newsham Colliery, near Blyth, Northumberland.

Upper surface of the smaller cranium (Plate XV. of natural size and as seen after careful removal of the matrix).—A rib is seen lying along upon the left side of the cranium; and near its distal end a fragment, which may have belonged to it, partially overlaps the left occipital region; a third piece, the vertebral end of a rib, lies under the fore part of the skull.

It is worthy of remark that the premaxillary, nasal, prefrontal, and maxillary bones, which naturally form the anterior end of the cranium, are absent from all the three skulls of *Pteroplax* as yet known. Such a deficiency has never been met with in skulls of *Loxomma* or *Anthracosaurus* The skull of *Pteroplax*, as we find it, consists of frontals, parietals, so-called supraoccipitals, postfrontals, postorbitals, squamous, occipitals, epiotics, and quadrate bones, all firmly united by suture.

Dimensions.—The skull thus composed measures in length, from the median line in front to the posterior ends of the epiotic horns, six inches and a half, and from the same point to the posterior margin of the occiput on the median line five inches. The distance from this last point to the point of the right epiotic horn is very nearly two inches, and that between the points of those horns two inches and nine-tenths. Breadth of the skull at the occipital margin two inches and a half, at the broadest part two

inches and nine-tenths, between the posterior ends of the orbital curves two inches and a half, between the anterior ends of the same one inch, over the anterior broken ends of the frontals rather more than one inch.

The pitted sculpturing is irregularly disposed over the surface, the pits varying much in form, size, and depth, being on the whole smaller and less deep than those of the crania of *Loxomma* and *Anthracosaurus;* on the parietal bones they are prolonged into grooves radiating from the centres of ossification on each side of the parietal foramen. The pits are most strongly marked on the postfrontals and postorbitals, and are largest and groove-like on the frontals. On these bones there is besides a channel or groove at each margin, studded with pits, probably a mucus-groove. The pits on the frontals are all inclined forwards, and look as if they served to lodge blood-vessels. None of the small punctures which exist at the bottom of the pits in *Loxomma* are visible in the pits of *Pteroplax*, any more than in those of *Anthracosaurus*.

The orbits appear to have been large for the size of the skull; their internal, concave, osseous margins, formed of the postfrontal and postorbital bones, alone remain to testify to this. They are placed where the skull rapidly tapers to the elongated frontal region. The rest of their outline was probably partly membranous or ligamentous and cartilaginous.

The prolonged and narrow anterior end of our specimen terminates abruptly at a somewhat oblique transversely fractured surface.

The frontal bones constitute nearly the whole of this narrow part of the skull, which appears slightly deviated from the straight line, as if it had received after death a blow on the left side of the anterior end, which had started the posterior end somewhat from its articulation with the parietal bones. This part is rather broader at its distal end than elsewhere.

The frontals are united to each other on the median line; behind, and at each side of that line, they form together a retreating angle, into which are received the united ends of the parietals;

external to this they articulate with the postfrontals, the posterior extremity of each frontal being received into an angle formed by the parietals and postfrontals.

The parietals occupy the chief part of the middle region of the cranium, and are of a triangular form, the base being posterior. In the middle of the median suture is the oval parietal foramen. It is large, being two-tenths of an inch in length, and rather more than one-tenth of an inch in breadth; it is surrounded by an elongated oval space, which is somewhat elevated, the bone here being thick and strong; and outside of this is a depression of the same form, gradually rising outwards to the ordinary level of the surface of the skull. At the anterior part of the parietals the median suture has an irregular course to the left, no doubt a mere individual irregularity. On their outer borders these bones articulate, from front to back, successively with the postfrontals, the postorbitals, the squamous, the epiotic, and the so-called supraoccipitals which lie behind them.

The postfrontals are narrow, curved, and elongated, pointed in front, where they abut upon the frontals, and broader behind, where they meet the postorbitals; their internal borders, irregularly convex, articulate with the frontals and parietals; their external borders form the greater part of the concave and smooth inner margin of the orbits.

The prefrontals, which may have formed the anterior part of the inner margin of the orbits, and *the lachrymals* are absent.

The postorbitals, articulating in front with the postfrontals, internally with the parietals, and posteriorly with the squamous, are short thick bones which form the posterior part of the inner orbital margin, and present an external projection which marks the termination of that margin and to which, as well as to the similar process on the postfrontal, ligaments and other structures forming the outer wall of the orbit were attached. Behind these projections the borders of the postorbitals, as they go to join the squamous, are concave.

The squamous, a little larger than the last, are four-sided: the external side is convex, longer than the others, and the upper

surface is convex like that of the postorbitals; these bones join in front with the last named, internally with the parietals, and behind with the epiotics. The surface-pitting is much less strongly marked on the squamous than on the two bones in front of them.

The supratemporals, the jugals, and the quadrato-jugals are not visible on the upper surface of either of our specimens.

The epiotics complete the ring of bones around the sides of the parietals, and form the posterior external angles of the cranium; these angles are produced backwards, in a conspicuous and remarkable manner, into what have been called horns, whence *Pteroplax* has received its specific name *cornuta*. The parts of the skull from which these horns project are thick and strong, standing up in a ridge, which from above the base of the horn passes forwards and then, curving inwards, is merged into the upper surface of the occiput, its external side gradually subsiding to the level of other bones.

The epiotics are narrow bones wedged in, as it were, between the so-called supraoccipitals and the squamous and reaching the parietals; they also form a portion of the occipital surface, and with it and their horns give attachment to muscles stretching down the neck.

The so-called supraoccipitals or superior occipitals are rather narrow, elongated transversely, joining each other on the median line, and the epiotics externally, overhang the occipital surface; their external posterior angles are more or less acute; below they articulate with the exoccipitals and the quadrates.

The occipital surface, concave vertically, is much arched from side to side, owing greatly to the epiotic horns, and presents the same slightly overhanging border that we see in the other two Labyrinthodonts of this district. Three occipital protuberances exist, one at the upper margin, another near to or at the base of the skull, the third, which is small, just below the first. These are bisected by the median suture. From a little distance on each side of these projections the vertical concavity of the surface is divided by a rather rough ridge into an upper and a lower

groove; and in each runs a delicate rather obscure suture; the upper unites the so-called supraoccipitals to the exoccipitals, the lower these latter bones to the quadrates.

The true occipital is undistinguishable, and the basioccipital probably absent. The height of the occipital surface near its middle is three-tenths of an inch; at its outer part at the base of the horns, where the bones are very strong, and have been able to resist pressure better than other parts, it is five-tenths of an inch.

Upper surface of the larger cranium.—This has not been figured. Having been carefully cleared of the matrix it shows all the sutures; but the bones are badly preserved and the pittings almost all obliterated. The following are its dimensions:—from the median line of the anterior broken end to the point of the epiotic horns seven inches, from the same point along the median line to the posterior edge of the occiput five inches and a half, from the middle point of occipital border to point of left opiotic horn one inch and a quarter, between the epiotic horns three inches and nine-tenths. The breadth of the skull at the occipital margin three inches and six-tenths, over the posterior margin of the parietals three inches and eight-tenths, between the posterior points of the orbital curve three inches and four-tenths, between the anterior points of the same one inch and seven-tenths; the breadth of the broken anterior end of the frontals is nearly one inch.

The right epiotic horn is broken off at the end; otherwise the outline of this cranium is on the whole nearly the same as that of the smaller specimen; it is rather broader, and perhaps belonged to an older animal: the frontals are worn as it were in front; but the right side appears to have the normal length, whilst the left is shortened.

Under surface of the larger cranium (Plate XVI., fig. 1).—In this the entire under surface of the cranial vault can be seen; all the parts below are gone; the median suture of the vault throughout with the parietal foramen is visible; the palate, maxillary, and premaxillary bones are wanting, and may have been more or

less cartilaginous or loosely attached; the presphenoid and sphenoid median ridge and the basioccipital, which are seen in the skulls of *Loxomma* and *Anthracosaurus*, are also gone. The quadrates at the base of the epiotic horns are the only bones of the base of the skull that remain. The horns are a good deal damaged. The articular condyle for the mandible is not to be seen. The under surface of the frontal bones is grooved on each side of a median ridge, along their whole length, as if they had formed the roof of a double nasal cavity extending from the snout to the throat.

The parietal foramen is large, open, and funnel-shaped, widening out greatly as it passes through the thickness of the cranium; it is here six-sixteenths of an inch long and four-tenths of an inch broad, whilst on the upper surface of the skull it is only a quarter of an inch long by two-tenths of an inch broad. Its margin is surrounded, except in front, by a sharp ridge of bone, from which pass off laterally smaller ridges, which, dividing, enclose small smooth depressions that extend to near the margin of the cranium. The wall of the cranium is very thick around the foramen; and from this to the occiput there extends on each side a broad raised space with a depression outside of it; the region of the posterior external angle is thick and very strongly ossified, as are also the epiotic horns. At the posterior end of the orbital curves, and corresponding to a part of the postorbital bones at their under surface, is a rough pitted space which looks like the articular surface for another bone, which is lost, but which may have formed the posterior border of the orbits.

It is possible this skull may have been much decomposed before its entombment.

The dentition of *Pteroplax* has yet to be discovered; and no mandible has yet been obtained.

Vertebræ.— These are not figured, being imperfect. On a piece of black shale, five inches and a half long by three inches and a half broad, in my collection, are imbedded the vertebral centra and portions of two vertebral processes. Two of the centra are much less than the third, which measures in height nine-tenths

of an inch, in breadth one inch and one-tenth, in length one quarter of an inch; its sides are slightly excavated, it is bi-concave, and has a small notochordal foramen. One of the processes, a transverse one, is six-tenths of an inch long by the same in breadth, and is much crushed. A zygapophysis is present, but too much injured to admit of description. The remaining process is of about the same size and in the same condition.

Ribs.—On the same piece of shale there are fragments of three ribs; the proximal ends of two are present, and, though much flattened, show well the head and tubercle; the distal end of the third exists, but is much flattened. It is the under surface, somewhat concave, which is exposed. In close relation with the head are three portions of ribs: one large fragment, showing head, tubercle, and groove, lies on the left side of the cranium; another fragment with head and tubercle lies obliquely under the cranium; a short piece of the sternal end of a rib rests in part on the occiput.

These are shown in Plate XV. The first is five inches and a half long, by three-tenths of an inch broad; it is well and regularly arched; the curve of the bone is continued as far as the head, which ends in a concave articular surface; the tubercle, four-tenths of an inch posterior to the head, ends likewise in a concavity for articulation. A groove runs along the under surface from near the tubercle for two-thirds of the length of the rib; beyond this the surface is flattened.

The head, tubercle, and part of the groove are seen on the rib which lies under the cranium. Nothing is worthy of note with regard to the third fragment, which may be a part of the first-named.

These ribs, lying in contact with the skull of *Pteroplax*, must be taken as having belonged to the same animal.

The ribs imbedded on a piece of shale cannot, perhaps, be proved to have belonged to *Pteroplax;* but they are of the same size, and are in other respects very like those on and under the cranium, and were found in the same part of the mine.

If this inference be correct, then the vertebræ lying with the

ribs on the piece of shale are, there can be little doubt, vertebræ of *Pteroplax*.

Bones of an extremity.—These are figured on Plate XVI., fig. 3, and are only three in number, small and dislocated from their normal relation, but still very near to each other; they lie surrounded by many scutes on a slab of shale eight inches by five inches and a half. They appear to be the terminal bones of a digit, but whether of an anterior or posterior limb is not easy to determine. They diminish in size like digital bones: the biggest is one inch long, and half an inch wide; the next is shorter and more slender; the third or smallest is pointed at the further end; with this exception the ends of these bones are concave, and the sides contracted at the middle.

Scutes.—On the last-mentioned slab, and on its counterpart measuring five inches and a half by four inches and a half, are bedded altogether one hundred and four scutes, lying in the same plane, but scattered about without any order; besides these I have only one other scute on a small bit of shale in my collection.

These scutes vary in size from one to three-quarters of an inch in length; and from one-sixth of an inch at the anterior end, which is rounded, they taper to a rather sharp point behind; their upper surface on the whole is convex and their under surface concave from end to end. On their upper surface is a strong ridge nearer to one margin than the other; the former is the thicker edge and also the longer, whilst the surface slopes gradually to the other side, which is quite thin. Two of these scutes are represented in Plate XVI., fig. 2.

It is presumed that the above are the scutes of *Pteroplax*, as they are different in form from the scutes of the two other larger Labyrinthodont Amphibia, and are also much smaller and of more delicate make, and we know of no other animal-remains in our coal-field to which they could belong. They are from the same part of the mine as the other remains herein noticed, and bear a certain proportion of size to the crania described.

The small size of these crania, their form and the smaller number of bones entering into their formation than into those of

Loxomma and *Anthracosaurus*, and the invariable absence of the snout, maxillaries, and mandibles are the chief characteristics of *Pteroplax cornuta*. The inferior parts of the skull being also wanting in both our instances, renders it probable that *Pteroplax* had a skull much less completely ossified than either of the two animals above-named, and that it partook more than they did of a batrachian or piscine character.

That it had two pairs of limbs, feet or paddles, is very probable, and that it was an air-breather is evidenced by the form, length, and breadth of the ribs, and perhaps also by the grooved state of the under surface of the frontal bones.

Of its body we know nothing beyond the scanty vertebræ, fragments of ribs, and scutes.

If, with the desire to form something approaching to a definite idea of the comparative size of our three Labyrinthodonts, we suppose the length of the animal to be seven times that of the skull, which is about the proportion in *Keraterpeton Galvani* (a comparatively short species), and if we allow two inches for the lost part of the larger specimen of *Pteroplax*, the skull of this animal, from the end of the snout to the end of the occiput, will be seven inches and a half long, and the whole length of the body four feet eight inches.

By the same rule of the body being seven times the length of the head we find that *Loxomma Allmanni*, with a skull twelve inches and a half long, must have measured seven feet seven inches; and in like manner *Anthracosaurus Russelli*, with a skull of thirteen inches and a half, must have had a total length of eight feet two inches. The correctness, however, of this rule is questionable; and it is not easy to say what was the length of the tail in each case.

As was noticed in the "Annals and Magazine of Natural History" for August, 1876, the præmaxilla figured in a previous number as that of *Pteroplax*, and the teeth, as since shown by an examination of their minute structure under the microscope, as well as four or five fragments of mandibular bones, which had been described as "most probably belonging to the same large Labyrinthodont amphibian," all belong to *Loxomma Allmanni*;

whilst the vertebræ and sternal plates, also figured and described as belonging to *Pteroplax*, are probably remains of *Anthracosaurus Russelli*.

My acknowledgments are due to my friends Dr. Embleton and Mr. William Dinning; to the former for his assistance in the above description, and to the latter for the accurate and beautiful drawings illustrative of that description.

EXPLANATION OF THE PLATES.

PLATE XV.

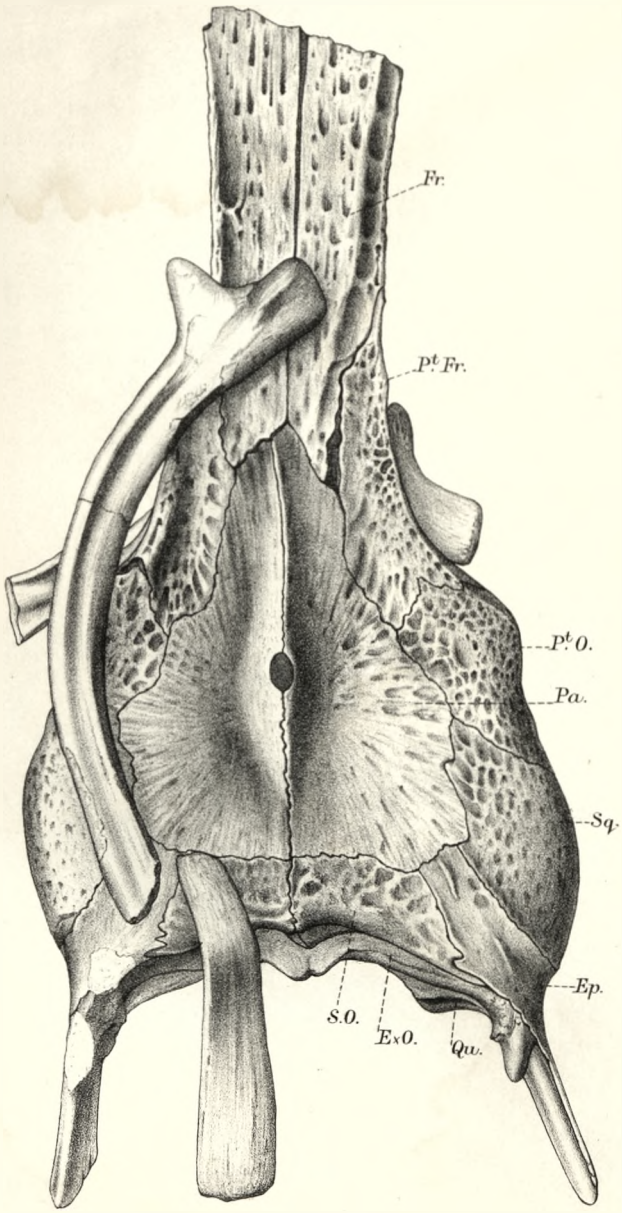
Upper surface of the smaller cranium of *Pteroplax cornuta*, of the natural size; the portions of ribs mentioned in the text as lying upon and under the cranium are seen. *Fr.*, frontal bone; *Pt.Fr.*, postfrontal; *Pt. O.*, postorbital; *Pa.*. parietal; *Sq.*, squamous; *Ep.*, epiotic; *Q.*, quadrate; *Ex. O.*, exoccipital; *S. O.*. so-called supraoccipital. The parietal foramen and the epiotic horns are sufficiently evident.

PLATE XVI.

Fig. 1. Under surface of the larger cranium of *Pteroplax cornuta*, of the natural size. *Fr.*, frontal bone; *Pt. Fr.*, postfrontal; *Pt. O.*. postorbital; *Sq.*, squamous; *Ep*,, epiotic; *Q.*, quadrate; *Oc.*, occipital.

Fig. 2. A, B. Scutes: A upper, B under surface.

Fig. 3. A, B, C. Three digital bones.



Wm. Dinning del. R. Mintern lith.

Mintern Bros. imp.

PTEROPLAX CORNUTA. H. & A.

nat. size.

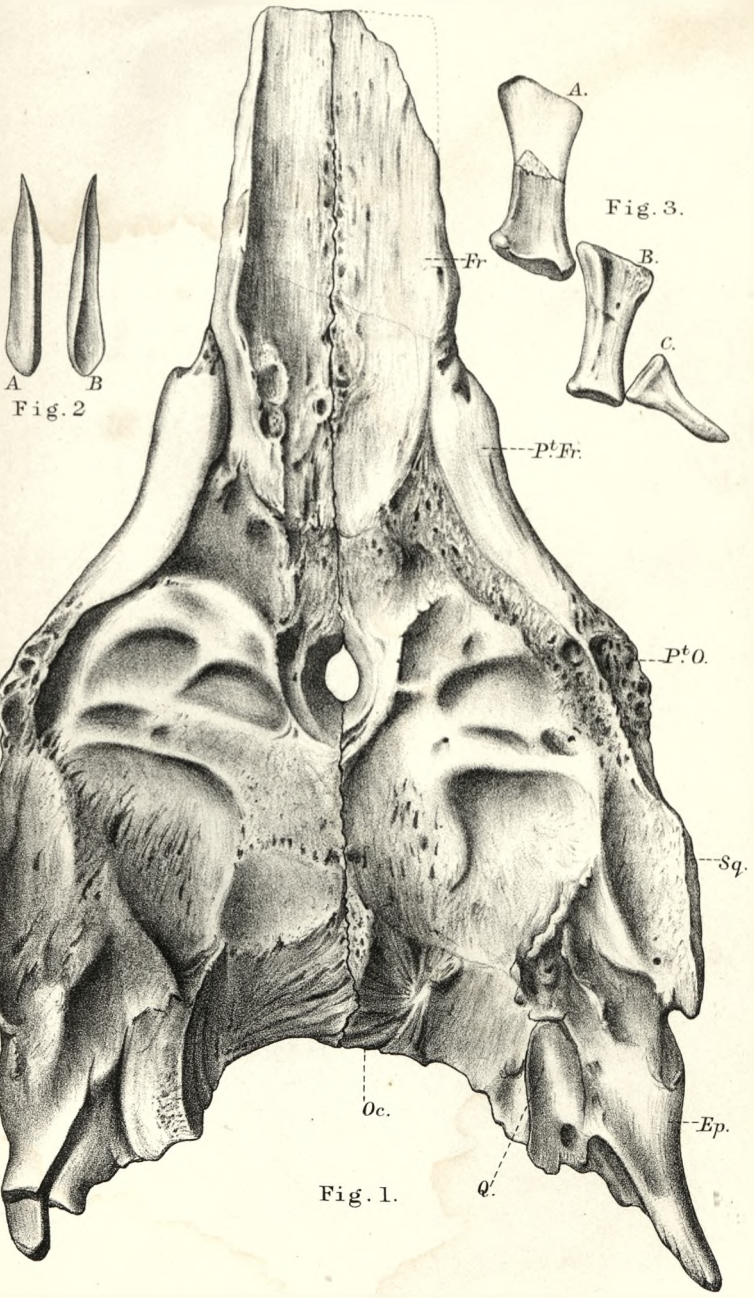


Fig. 1.

Wm. Dunning del. R. Mintern lith.

Mintern Bros. imp

PTEROPLAX CORNUTA. H & A.

nat. size.

ADDRESS TO THE MEMBERS OF THE TYNESIDE NATURALISTS' FIELD CLUB,

READ BY THE PRESIDENT, THE REV. R. E. HOOPPELL, M.A., LL.D., F.R.A.S., AT THE THIRTY-SECOND ANNIVERSARY MEETING, HELD IN THE MUSEUM OF THE NATURAL HISTORY SOCIETY, NEWCASTLE-UPON-TYNE, ON THURSDAY, MAY 2ND, 1878.

LADIES AND GENTLEMEN,—Permit me to take this, the first opportunity which presents itself, in the ordinary course of things, to thank you for the honour you did me at the last Annual Meeting of the Club, in electing me your President for the year now ending.

As such, it is my allotted task to give you a *résumé* of the Meetings held, and the work accomplished, during the past year. It was not my good fortune to be able to be present at all the Field Meetings, but kind friends, upon whom I can rely, have supplied me with information respecting those from which I was unavoidably absent.

The FIRST FIELD MEETING was held at Middleton-one-Row, on the Tees, on Whitsun Monday, May 21st. The morning was somewhat dull and bleak, but a goodly number of members and their friends assembled at Croft Station a few minutes before eleven A.M. From Croft they proceeded by road to Hurworth, where, under the guidance of the Rev. J. Irwin, the Rector, and the Rev. G. H. Ross-Lewin, the Curate, they inspected the Church, which has within the past few years been admirably restored by the munificence of the Patron and former Rector, the Rev. R. H. Williamson. The Church is beautifully situated on the summit of a cliff overhanging the Tees; and it contains several objects of interest, particularly two effigies of Knights Templars from Neasham Abbey, one supposed to be Robert de Ros, whose body was interred in the Temple Church, London, and the other Baron de Greystock of Cumberland, a connection of the Lawson family. There are also the mural tablets of several successive Rectors, from which it appears that from the time of the Commonwealth to the institution of the Rev. R. H. Williamson in 1865, a period of two hundred and fourteen years, there had

been but six incumbents of the benefice. These were Leonard Wastell, appointed in 1651; Cuthbert Chambers, 1712; John Johnson, 1714; George Bramwell, 1761; John Theakstone, 1784; R. H. Williamson (the father of the present Patron and late Rector), 1832. To Mr. Williamson his son succeeded; but, after holding the living a few years, he resigned it, and appointed as his successor the present Rector, the Rev. J. Irwin.

From Hurworth the party proceeded to the site of Neasham Abbey; but there are but faint traces now existing of this ancient ecclesiastical edifice. It was granted, at the suppression, to James Lawson. It was a Benedictine Nunnery, dedicated to the Blessed Virgin. The date of its foundation is not clearly known.

On the way to Neasham Hill, where, from the grounds of Mr. Ward's house, a magnificent view up Teesdale for many miles was obtained, Mr. Wilkinson's pack of Otterhounds was passed. There appears to be still plenty of sport for them in the lower reaches of the Tees. A singular circumstance occurred a few months before the visit of the Club. An Otter, migrating from the Tees to one of the brooks which fall into the river on the north side, was killed by a passing train, which came up as it was crossing the railway to reach its destination.

Dinsdale was the next halting place of the party, and here many objects of interest presented themselves. The Rev. J. W. Smith, the worthy Rector, though not a member of our Club, has long been a regular contributor to our Meteorological Observations. He received us very cordially and hospitably. In his garden we saw a fine bush of mistletoe growing upon an apple tree, which was loaded with blossoms; and in various places we saw birds sitting upon their eggs, in nests which they had built open to the gaze of the passer by, and close to the elbow of the gardener when working in the adjoining beds. One singular case was a wooden letterbox, hanging just inside the gate, which had been regularly built in by Blackcaps for the past ten years. These facts were eloquent, though silent, witnesses to the kind-heartedness and genuine love of Nature of the worthy Rector and his family, and also to the quiet and retired character of the

spot, though I cannot help thinking Dinsdale, and the whole neighbourhood, must have once borne a very different character. We were drawing near the place where the great Roman road to the North-East Coast crossed the river, and where encampments and garrisons doubtless existed in ancient times. The site of Pountys Bridge (Pons Tisæ) is scarcely a mile off, and Middleton one Row, (Middleton on the Row, that is, Middleton on the Road,) but little farther. At Middleton are manifest indications of the forts which guarded the northern end of the Bridge, and at Dinsdale are very strong appearances of Roman occupation. Opposite the Rectory is the Old Manor House, a quaint edifice of ancient date, and exceedingly interesting for its architecture, curious internal arrangements, and decorations. Mr. Scott F. Surtees lives in it, and cherishes all its remarkable features in the true spirit, and with the genuine love, of a real antiquary. The moats and ramparts round enclose several acres, and the ground where it has been disturbed is filled with the foundations of massive walls. Various articles Mr. Surtees showed us had every appearance of being Roman. We did not hear, I do not know that we enquired, whether Roman coins had been found. But the great antiquity of the place was attested by the Church, which adjoins the Rectory. The sacred edifice is very small, with walls exceedingly thick. It has lately been entirely and excellently restored, but the evidences of its great antiquity are to be seen on all sides. In the Churchyard is an elaborately ornamented stone coffin, with sculptured lid, the remains of a Saxon cross, and Saxon mouldings.

From the Church a detour was made to a Sulphur Spring, and to the Fishlocks. The former was very curious, the presence of the Sulphur in the water being abundantly manifested to the eye as well as to the palate. At the Fishlocks several Salmon were seen to spring. Before reaching it we saw two very fine ones, which had just been caught, and were still living as they lay on the grass.

At Middleton one Row an excellent dinner awaited the members at the Davenport Hotel. Thence by flies and on foot we reached the Station at Fighting Cocks.

The Second Field Meeting was held at Castle Eden Dene, on Monday, June 25th. The day was remarkably fine, and a fair number were present. The party breakfasted at the Inn at Castle Eden, and then proceeded, by the kind permission of the Rev. J. Burdon, previously obtained, from Hunter's Pool, through the Dene, to the sea coast, returning by the same route. The objects of interest observed were principally botanical. The Lily of the Valley was seen in great abundance, the Fly Orchis was also observed, the Butterfly Orchis, the Tway Blade, the *Geranium sanguineum*, and the Common Comfrey. Mr. Grace captured a specimen of the Clouded Yellow Butterfly, *Colias Edusa*, which he afterwards presented to the Museum. At Ferry Hill on the way home, during a short stay between trains, some of the members gathered the *Primula farinosa* at Thrislington Gap, close to the present Ferry Hill Railway Station.

The Third Field Meeting was held at Brampton, on Thursday, July 19th, and was a very successful one. To suit the convenience of members two routes were arranged, a longer and a shorter one, for an "early" and a "later" party respectively. The "early" party, consisting of about twenty gentlemen, started from Newcastle by the 6.25 A.M. train, and alighted and breakfasted at Gilsland. Thence they visited the Spa Well, near which they found the *Saxifraga azoides* in great abundance and beautiful flower; explored the Roman Camp at Bird Oswald, and admired the splendid view, embracing Skiddaw, Saddleback, and Helvellyn, on the one side, and Cheviot and the Dumfriesshire Hills, on the other; traversed the line of the Roman Wall to Banks, in the fosse of which they found numerous specimens of the Butterfly Orchis; and, passing masses of the *Erica cinerea*, richly in flower, on the north of the road near Banks, finally met the "later" party at Lanercost, at about one P.M. The "later" party, consisting of about thirty persons, several of whom were ladies, had left Newcastle by the 10.20 A.M. train, and had walked through the grounds of Naworth Castle, and wandered in its beautiful woods, climbing to the pretty log-house built by the Hon. George Howard, in memory of his marriage, and admiring

the charming panorama of lovely scenery, extending to the Solway Frith and the hills of Scotland, towards the west. After they reached Lanercost Abbey and joined the "early" party, the many beautiful and interesting features of the spot were inspected together. The Vicar, the Rev. E. W. Chapman, kindly acted as cicerone, and explained the various points of detail of the architecture, and showed us the fine collection of Roman altars in the vaulted cellar under the Refectory, and the many objects of interest around. On leaving Lanercost the lately united party was again broken up into several fragments. One detachment went off to seek for the ruins of the Roman or Mediæval Bridge, higher up than the present Abbey Bridge, which in former days connected Naworth and Lanercost, and having found the stout stone piers on the land, and the rapidly disappearing oaken beams in the water, crossed by a ford still higher up, and, traversing the woods by a short but romantic path, stood again under the shadow of the Castle walls; another detachment went by another road to the Castle, and, by the kindness of the family, were allowed to go through the building, and inspect the many objects of interest it contains; a third party went direct to Brampton. There at five P.M. all gathered to an excellent dinner at the Howard Arms. The evening turned out wet, but the heavy shower, through which the party walked to the Station, did not seem to diminish the enjoyment which all had received from a thoroughly delightful day.

Between the Third and Fourth Field Meetings interposed a SPECIAL EXCURSION, of three days' length, to the Cheviot. Eighteen members joined in this expedition, starting from Newcastle on the morning of Thursday, July 26th. The railway was left at Alnwick, and the journey thence continued in brakes. The day was very fine, and the drive to Wooler was greatly enjoyed. At Eglingham a halt was made, and the Church was inspected. At Old Bewick the conveyances were ordered to proceed to meet the party farther on, while the members ascended the hill and examined the site of the double camp with its deep trenches, and the foundations still remaining in places of the ancient circular dwellings of our rude forefathers of the British period. Some

of the stones with the curious circular sculptures, which were figured some years ago by the late Mr. George Tate of Alnwick, were found, but exposure to the weather is rapidly deteriorating and obliterating them, and, in the case of some at least, it would be hard, if they were now being viewed for the first time, to affirm that they were really the work of men's hands and not of Nature. A swift descent, through fir trees, fox glove, and bracken, soon brought the party to the little chapel, restored by Mr. Langlands, and which well repaid inspection. Near the monument, erected at the junction of the road leading from the chapel with the main road from Alnwick to Wooler, the party rejoined their conveyances, and were soon at Hepburn Farm, where Mr. McKie was in waiting for them, and escorted them through the Park to view the celebrated wild cattle of Chillingham. Unfortunately a near inspection could not on this occasion be obtained; but this need not be so greatly regretted as it otherwise might be, as the Club possesses an excellent account of the distinctive features of this interesting breed, in the sixth volume of the first series of its Transactions, in the valuable Catalogue of the Mammalia of Northumberland and Durham, by Messrs. Mennell and Perkins. A visit was paid to the old Peel House in the south-east corner of the Park, and to the village of Chillingham, whence the members drove without further break to Wooler, to the Black Bull Inn, where an excellent dinner awaited them, and where a pleasant evening was afterwards spent, in sauntering in groups around the village, admiring the beautiful sunset, the darting flight of the Swifts, and the quaint circling of the Bats.

The following day, Friday, July 27th, the brakes were in readiness by nine A.M. The drive was by Humildon, Akeld, Yevering, and Kirk-Newton, to the College Burn, which the party ascended on foot, under the guidance of Mr. M. T. Culley of Coupland Castle, our fellow member. Hen Hole was the first spot of special interest visited, a deep fissure in the west end of Great Cheviot, retaining its original Keltic denomination, for Hen Hole is evidently Hen hollt, "Old cleft" (like Hen knowle near Hexham, and again near Bishop Auckland, "Old hillock," and Hen Gap, near Chollerford, "Old crown.") The steep sides of the

chasm were scaled, and the climbers walked along the north side of Great Cheviot to the east end. Some of the party had preferred to make the ascent by Cairn Hill, and they kept along the south side of the Hen Hole. Cottongrass, Cloudberries, Bleaberries, Crowberries, Whortleberries, and Cowwheat, were the principal plants noticed. In fact, if I add a few kinds of coarse Grass, a sprinkling of Ling, and a few species of Club Moss, the whole list will be exhausted. The naturalist, exploring Cheviot, must be on his guard against marshy pools, and half-hidden holes and furrows, worked out in the peat by heavy rains, which are numerous and dangerous upon the summit, and the caution is the more necessary as the view from the top, on a clear day, is magnificent. Though not perfectly clear, in the distance, on the present occasion, the prospect was exceedingly fine. After enjoying it awhile our members descended towards Langleeford Farm House, where they were refreshed with tea, and entered again their conveyances, and were soon en route again for Wooler. They held a meeting in the evening, and elected two new members, and on the following day broke up, returning to their several destinations by such routes as they severally preferred.

The Fourth (Ordinary) Field Meeting of the Club was held on Monday, August 6th, at Newbiggin. About thirty members alighted at the Widdrington Railway Station at 9.10 A.M., and proceeded thence to Druridge Bay, Cresswell, and Newbiggin. On the way many interesting wild plants were observed, among them the *Rosa spinosissima*, *Geranium sanguineum*, *Astragalus hypoglottis*, *Cynoglossum officinale*, and *Thalictrum minus*. At Cresswell the skull of a Sperm Whale, in the Park, was examined, and the visitors were conducted by Mr. Robson along the magnificent avenues of evergreen trees, which were planted by the present proprietor, Mr. C. J. B. Cresswell, who is now in his ninetieth year, many years ago. Mr. Cresswell must be congratulated on enjoying, what few planters of trees can look forward to, the sight of the work of his hands attaining in his own life time a great portion of its full glory and perfection. The party inspected also the house containing the tree ferns and other

exotic plants, and everything drew forth their lively interest and admiration. Unfortunately rain began to fall, and a bivouac on the sea banks at Cresswell, which had been projected, had to be given up, but after the arrival of the party at Newbiggin the weather cleared again, and the rest of the excursion was again attended with pleasure. At Newbiggin some excavations, for sewerage purposes, had revealed a bed of peat, seven feet below the superincumbent sand, with trunks of trees, hazels, and nuts embedded in it. The sea banks repaid a stroll upon them, and the Church was visited. Dinner was served at Sumner's Hotel, and a paper was read afterwards by our Secretary, Mr. Thompson, in the absence of his colleague, Mr. Howse, the author, "On the Occurrence of the *Anodonta Jukesii* in the Lower Carboniferous Rocks of North Northumberland." The paper, which is a very valuable and interesting one, has been printed in the Part of our Transactions at present in course of issue to the members.

The Fifth (Ordinary) Field Meeting of the Club was held at Bishop Auckland, on Tuesday, September 11th. Special interest was attached to this Meeting, from the circumstance that the Bishop Auckland Naturalists' Field Club, a younger Society than our own, but one manifesting a good deal of enthusiasm and vigour, had resolved to welcome us in force on our visit to their head-quarters. About seventy of our members alighted from the train at Brancepeth Station a little after ten A.M., and were met by over thirty members of the Bishop Auckland Society, headed by their President, long a fellow member of our own, Mr. Joseph Duff. After greetings and introductions had been reciprocally exchanged, the whole party proceeded to view the very interesting Church at Brancepeth. The fine architecture, mostly of the perpendicular period, the handsome screen, the elaborate tombs of the Nevilles, the hagioscopes, Sanctus bell, and other special features, were duly pointed out and discussed. From the Church the members went to the Castle, which, by the kind permission of Lord Boyne, was examined in every part, and afforded much gratification to the party. Thence a pleasant walk through the Park to the lane leading to Page Bank, a halt near the spot

where the Great Whinstone Dyke crosses the lane on its course from Howden-le-Wear to the neighbourhood of Hett, a march past the Coke Ovens and cottages of Messrs. Bell Brothers' extensive Colliery, a stroll up the green lane leading from the bridge, by which the Wear was crossed, to Whitworth, where, at the gate of the little Churchyard, we were met by the courteous Vicar, the Rev. Charles Carr, the brother of our Vice-President and former President, Mr. Carr Ellison. Mr. Carr kindly showed us his small but pretty Church, and the curious effigies of crosslegged knight and lady in his Churchyard, which are figured in Hutchinson and Surtees, but the originals of which, to preserve whose memory they were sculptured, are not known. Mr. Carr showed us also the blackened ruins of Whitworth Hall, the seat of Mr. R. E. Duncombe Shafto, for eighteen years M.P. for North Durham, consumed by fire in January, 1877. On leaving Whitworth the members proceeded to the Railway connecting Byers Green with Spennymoor, one of the oldest lines in the North of England, having been made about the year 1834, and called the Clarence Railway, after William 4th, Duke of Clarence. From Spennymoor it runs to Port Clarence, once dreamed of as a coming emporium for trade, before Middlesbrough rose into greatness and wealth. Along the sides of a deep cutting for this Railway two seams of coal are very marked for a considerable distance, and were surveyed with much interest by the members. Thence the route lay by Old Park, an ancient gothic mansion, beautifully situated, long the residence of the Claxtons, but now occupied by a farmer. Some fifty years ago it was a Boarding School, kept by a Mr. Gillespie, and frequented by the sons of gentry in the county. After that it was tenanted by the Rev. Robert Gray, late Bishop of Capetown, at that time Vicar of Whitworth. From Old Park we proceeded by fields to Bellburn Wood, obtaining from the summit of Byers Green Hill on the way a very extensive and pleasing view, which embraced Durham Cathedral, Merrington Church, Brussellton Tower, and the Hills of Weardale above Stanhope, with the intervening country. Before we reached Bellburn Wood it began to rain, which somewhat interfered, though not greatly, with the

remainder of our programme. The wood was charming, and, but for the shower which caused us to hurry, the walk through it would have been delightful. Emerging from the wood, and crossing a few fields, the members were on the site of the famous Roman Station, Vinovium. A solitary farmhouse stands now where, first, one of the most populous towns of the Brigantes, and, next, one of the most important of the Roman garrison towns, was situated. The rich pasture around covers doubtless innumerable relics. In days gone by numberless Roman coins have been found on the spot, so many that the term "Binchester Pennies" was once commonly applied to them, and numerous altars have been disentombed, most of them unfortunately only to be destroyed. At the present time the chief relic of Roman greatness to be seen is a most perfect and most interesting hypocaust, to which access is obtained by a trap door and a flight of steps. About eighty perfect pillars of Roman brick are standing, with tiled covering above, and the height is sufficient to enable any person with little difficulty to explore the whole. Our party descended, eight or ten at a time, until all had visited it.

From Binchester we descended the Hundred Steps to the bank of the Wear, and then walked through the beautiful Park, attached to Auckland Castle, to that interesting pile. At the entrance to the Chapel the Bishop met us, and most kindly explained everything to us, and took us into the State Rooms of the building. The portraits in the Great Drawing Room are very interesting, as also are the valuable paintings of Jacob and his twelve sons by the Spanish painter Zurberan in the Great Dining Room. The Bishop showed us also Antony Bec's sword. After thanking his Lordship for his great courtesy, the party hastened to the Talbot Inn, unable through the rain to visit the cliffs in the Park, which so strikingly display the strata of the Coal Measures of that locality. At the Talbot a capital dinner, excellently put upon the table, and the genial company of our Bishop Auckland brother naturalists banished all sense of fatigue and all thought of the rain, and a most agreeable hour was spent. As a memento of our visit, and of our pleasant fraternisation, the Bishop Auckland Club begged our Club's acceptance of a copy

of Mr. Matthew Richley's history of their town, a handsome quarto replete with interesting matter. Mr. Richley was present with us. The presentation was made by their President, Mr. Joseph Duff, who had occupied the vice chair at dinner. I need not say that I felt sure I should be acting in accordance with your heartiest wishes in most cordially accepting the volume in your name, and in expressing the pleasure with which the Tyneside Naturalists' Field Club would hear from year to year of the continued prosperity and success of the Bishop Auckland Club. Before we finally broke up, a large number of the members visited Mr. Duff's house and inspected, as fully as time would allow, the splendid collection of fossils, mostly from the Coal Measures of the district, which, in the course of a number of years, Mr. Duff has, with remarkable assiduity and devotion, gathered and arranged.

The Sixth, and Last (Ordinary) Meeting, was held at Marsden, on Monday, October 15th. Between thirty and forty members were present. A few of the party proceeded viâ Cleadon Lane Station, and visited the New Colliery at the Lizards, and Byers' Quarry. The majority proceeded viâ South Shields, where they inspected the objects in the Museum of the Free Library, and the Site of the Roman Station at the Lawe. Thence they walked by the coast to Marsden, where ample justice was done to a bounteous tea, provided by Mr. and Mrs. Hawkes at the Grotto. In the absence of the President, our late venerable Vice President the Rev. G. C. Abbes ably filled the chair, and received a cordial vote of thanks from the Meeting, few thinking it would be the last time they would meet him there, or in his well loved beautiful grounds so often visited on the way thither.

I regret very much to say that, during the past year, not a single Evening Meeting has been held. During the preceding year the comparatively large number of four Evening Meetings were held. I hardly know whether it is allowable to suppose that the energies and accumulating materials of our members and associates were thus somewhat severely taxed, and that the past year was needed for recuperation. But, seriously, I think

it would be well so to avail ourselves of our resources as to secure at least two, if not three, Evening Meetings every winter season.

A very interesting Part of our Transactions is in process of issue to the members, containing, besides my immediate predecessor's able Address, a capital paper on Eggs, and especially on the mysterious processes involved in their Coloration, by our highly esteemed Vice President, Dr. Embleton; several shorter, but very valuable, notices of new, or rare, occurrences in Geology and other branches of Natural Science, including one by our late lamented friend, though I believe not fellow member, Earl Ravensworth; some very interesting letters of Thomas Bewick, hitherto unpublished, for which we are indebted to our friends and fellow members Sir Walter Calverley Trevelyan, Bart., and Mr. John Hancock; an exhaustive paper on the Sea Birds Preservation Act, and the protection of Wild Birds generally, by Mr. Charles Murray Adamson; and an account of the Discovery and Exploration of the important Roman Remains at South Shields during the past two or three years. This last paper, and several of the others, have been largely illustrated by excellent Woodcuts and Plates. In the case of the Roman Station the Plates are of exceptional importance, for I regret to say that, up to the present time, no steps have been taken to permanently preserve any portion of the deeply interesting and exceedingly important sites, walls and other erections, uncovered during the exploration; and, but for the account the Club has published, and the plates with which it has adorned the narrative, the whole would infallibly, in the course of a short time, have perished from amongst us. Both in the History, and in the Plates, the strictest accuracy has been observed, that future antiquaries may be able to rely with the fullest confidence upon everything recorded in the text, or shown in the illustrations.

Before proceeding to such suggestions and remarks as the successive occupants of this Chair are allowed, if not expected, to make, I cannot refrain from expressing the great sorrow with which I fulfil the mournful duty of recalling the loss the Club

has sustained in the demise of our former President, and late Vice-President, the Rev. G. C. Abbes. I need not speak of his genial manners and venerable appearance, so familiar, for so many years, to many, if not to all, of us. Beneath a somewhat eccentric exterior there was the kindliest heart, a richly-stored mind, sound intellectual judgment, and intense love of nature. Some disappointment in early life had made our venerable friend somewhat different in some respects from other men, but his cordial sympathy with our pursuits, his hearty welcome when we penetrated to his sylvan retreat at Cleadon, his unaffected pleasure in conversation on any and every topic of natural history, never varied. He loved, too, to recal old scenes and incidents in which he had taken part; his life at Cambridge, his travels in Norway, his experiences of the road in old coaching days. One of the former I think should be put on record. He was an undergraduate of St. John's College, Cambridge, when the Princess Charlotte died. That terrible blow to the nation's hopes diffused universal grief. The national sorrow found vent in national mourning. Up to that time, the young men of Cambridge had never been allowed to lay aside the eighteenth century knee-breeches. The blue coat boys of London are still doomed to wear a similarly antiquated attire. By the resolution of our lamented friend, however, the undergraduates of Cambridge were delivered from the bondage full sixty years since. It came about thus. The mourning, as I have said, was general. An edict went forth at Cambridge, that undergraduates should appear in trousers one term as mourning; the next term to resume their ordinary attire. The mourning trousers were duly worn; the ordinary breeches were resumed by all but George Abbes. Having experienced the pleasure and relief of the change of dress, he was averse to return to the ancient style. The dons remonstrated with him. He manifested obstinacy. They deprived him of his term. He nevertheless stood out. The next term came, and he still appeared in trousers. Again he was deprived of his academical reckoning. But, as the term drew near its end, other undergraduates, admiring his boldness, and stimulated by his example, began to tread in his steps. The third term many

did so, and the authorities began to doubt their power to resist the general rebellion which seemed threatening to set in. They yielded to Mr. Abbes's persistency with a good grace: cancelled the long-standing æsthetic regulation: restored him to his collegiate status: and saw before long the substitution of modern trousers for the more ancient garb universally adopted. Mr. Abbes's undergraduate career terminated in 1821, when he took his degree of Bachelor of Arts. To go back awhile to his birth and earlier years, he was the eldest son of Mr. Bryan Abbes, of Walworth Castle, near the Tees, where he was born in 1798. His grandfather was the Rev. Cooper Abbes. He was sent to school, first to Ovingham-on-Tyne, to the Rev. Mr. Birkett, and afterwards to Witton-le-Wear, to the Rev. Mr. Newby, thence he went to Richmond Grammar School, and thence to Cambridge. Two years after leaving Cambridge he was ordained Deacon, and the following year Priest, both by Bishop Barrington. He held successively the Curacies of Dalton-le-Dale and Gateshead, and was Chaplain to the late Earl of Beverley. At a subsequent date he was Curate of Whitburn. But he retired from active life as a Clergyman nearly forty years ago, and busied himself in his garden at Cleadon Hall, and in his favourite studies and pursuits, during the many subsequent years allotted to him. He had amassed by observation an immense fund of knowledge respecting the features, characters, and habits of the fauna of our district, and I often pressed him to put some of his interesting remarks on paper, and give the Club the benefit of them, in a form which could be embodied in their Transactions, but he never did so; and even his admirable Address from this Chair, delivered some years ago, and widely commented upon by the Press at the time in the most favourable terms, he could never be prevailed upon to make ready for permanent publication. In losing him, therefore, we lose his wealth of local scientific knowledge also, and are as a Society of local naturalists and archæologists doubly impoverished.

The last sentence has reminded me of a great desideratum, which I think would fall entirely within the province of our Club to supply. I mean a Catalogue of the Antiquities of our

District. The Club was formed for the out-of-door study of antiquities, as well as of meteorology and the manifold branches of Natural History, and most admirable work has it performed in all its departments. Its Catalogues of the Mammalia, Mollusca, Insects, Birds, Plants, and Fossils of the district are exceedingly valuable. So also are its past Meteorological Reports. It should add to these most important documents another, which, as years went on, would become absolutely priceless. I do not mean that it should produce an elaborate account, or history, of all the objects of archæological interest in the two counties,—that it could not do, nor would it be desirable for it to attempt, even if it were capable of accomplishing it. What I mean is a Catalogue similar in plan to its Catalogues of the Birds, Plants, etc., of the District. It should be arranged under heads, such as Prehistoric, British, Roman, Romano-British, Saxon, Norman, Mediæval, Elizabethan, Caroline, Jacobæan, Georgian, etc.; and it should enumerate, under each head, all the antiquities of that particular class known at this present time to be in existence, stating accurately the places where they are to be found, and describing them just sufficiently to create interest and to secure identification. Nothing would conduce more to spread an intelligent knowledge of, and interest in, the antiquities of our district; to excite enquiries after the precious relics existing amongst us; to ensure a watchful eye being kept upon them; to give effectual means for tracing them when they disappear; to deter heedless, or senseless, or mischievous persons from making away with them; and generally to promote effectually the study of archæology amongst us. If it be said that some one of the Antiquarian or Archæological Societies should take such a work in hand, I should demur. Their work lies more in indoor study and research. It is theirs to hunt into every detail of history and circumstance connected with a building, an entrenchment, an object of ancient art, or coin of an ancient dynasty; to compare them with others, and to draw forth the light they are capable of throwing upon the annals of the past, or the new information they are able to impart to us respecting the races or the generations which have preceded us. In this they resemble those other Societies, Zoological, Geological,

Linnæan, with whose functions our sphere of operations no more conflicts than it does, or need do, with the Archæological. Our work is essentially out of door and observational, and bears a relation of the highest importance to, and at the same time in the strictest harmony with, that of the learned Societies to which I have alluded; and, in projecting and carrying out such a Catalogue of the Antiquities of our district, as I have suggested, we should be proceeding in the direct line of our programme, fulfilling another portion of our own special vocation, and strengthening most efficiently the hands of our fellow-labourers for the advancement of science.

There is another work which, it has always appeared to me, would be of great utility, and which I think might well be taken in hand by our Club, and that is a Geological Directory. If ordinary members of the Club, and commencing students of Geology, and ordinarily educated men in general, had a work, which they could refer to with ease, and find in it the geological features of any spot, say any town or populous village in either of our counties, it would be an immense assistance to them in their excursions, their early studies, their efforts to acquire some knowledge of, and to take some interest in, the science which lies at their feet and at their doors. The plan I would suggest is one similar to that on which ordinary business directories and gazetteers are formed. Let the names of places be arranged alphabetically, and let the reader find under the name of each place, the geological character of the locality described, succinctly but clearly, and the rocks and fossils enumerated which he might meet with in the district, say within four miles of the place in question, together with any remarkable geological features or characteristics existing in the locality. And let the order of the rocks be given from the surface downwards. Begin with that which will first meet the observer's, or student's, eyes, and go from that to those which lie deeper down, and which will have to be sought for in order to be discovered. I am convinced that a mistake is made in writing *all* works on Geology in an inverse order. I am sure that immensely more persons would be interested in the subject, incomparably more who commence the study would pursue it

farther than they do, if *some* at least of the works on the science were written in the order in which Nature herself presents the objects to our view. I know the inducement to commence *ab ovo* is always strong, but it is not the way Nature herself presents her works to us; and I am sure if a comprehensive work on Geology were written by an able man, commencing with the vegetable mould and going down to the oldest gneiss, instead of commencing with the gneiss and coming up to the material which forms our gardens and fields, it would both be exceedingly popular, and it would do more than anything else to interest a vastly increased number of persons in Geology, and to carry them on, in the study of the science, to limits far beyond those now reached by nine-tenths of those who buy books on the science and commence to read them. In fact, by exclusive adherence to the present system, the interest and opportunity of a large proportion of those, who think they would like to know something of Geology, is exhausted, before they come to anything they have seen, or are likely to see, in the rocks, earths, and clays they meet with in their daily walks, or can visit on their casual holidays.*

But I must pass on to other topics. My predecessors have generally, I think, given on these occasions a *résumé* of the scientific progress, as regards the special branches in which we are interested, made by other labourers in other districts within the year. This the labours of a populous parish in the County of Durham, to which I have been called, in place of the Superintendence of Dr. Winterbottom's Nautical College at South Shields, forbid my doing. But, as a Clergyman, and a scientific man at the same time, I may, perhaps, fitly say a few words on the supposed conflict between Christianity and Science, which some persons think exists. For my own part I do not believe in any such conflict. I do not believe that, between Science rightly so-called,—that is, between real, ascertained, established, scientific truth,—and the Holy Scriptures, or the Gospel of Christ, or

* I know of only one work on Geology written on the plan recommended above. That is, however, a very important exception to the rule which has hitherto so generally prevailed. I allude to "The Student's Elements of Geology," by Sir Charles Lyell, the first edition of which was published in 1871.

the faith of Christians, founded on the Holy Scriptures and the Gospel, there is the slightest contradiction, or need be the slightest difficulty. But I do not call guesses Science, nor theories Science, nor brilliant ethical discourses, though uttered by men eminent for their attainments in scientific study and research, Science. We must be exact in our definitions. The thoughts, the fancies, the speculations, of men like Charles Darwin and Professor Tyndall, for example, may be utterly erroneous, while their scientific acquirements are of the highest possible character. Because their apprehension of Science is real, it does not follow that their theories are sound: least of all should we be misled into confounding their theories with the Science they have attained to, and into dignifying all the imaginations of their fertile brains with that appellation, which should be conferred only on truths which are established beyond possibility of overthrow or doubt.

For my own part nothing that I have ever read, or searched into, or traced, has invalidated to my mind, in any way, the truth or the authority of the Holy Scriptures. To my mind all history, ethnography, and archæology, rightly read, point to but a short sojourn of man upon earth. All laws of evidence, all study and experience of the constitution of man's mind, all scientific estimates of probabilities, lead to the conclusion of the truth of the claim of Christianity that a Revelation, or rather that successive Revelations, have been made to man. Mr. Darwin has put forth an elaborate theory of Development by Evolution. To my mind the difficulties besetting the reception of it, in any case, are enormous, but were they otherwise, it would still be only a *possible* mode, which certain information on the subject, derived from a trustworthy source, would either confirm, or set aside, immediately and finally. Such certain information, derived from such a source, Christians, without ignoring any real scientific attainment, believe they have. Professor Tyndall has laboured to promulgate a gospel of negation. I call it a gospel, for, in a letter to me, speaking of the doctrines he had enunciated in his famous Belfast Address, and of those he had in his mind to proclaim in succession to them, and which I presume

are those of his article in the "Fortnightly Review" for November, 1875, and of his Address to the Midland Institute last October, he said "He trusted that in them many would find peace." But what power has this new gospel to overthrow the Gospel of eighteen centuries ago? In his Belfast Address he insisted that everything proceeded from Matter—that Matter was the sole and supreme existence in the universe. But then he intimated that we must enlarge our ideas of Matter, so as to take all other things in. In this way it is possible to be a Materialist on very easy terms; and I need not point out that, with this condition, notwithstanding the immense stir his Belfast Address made, he really left every debateable question just where it was before.

In his Article in the "Fortnightly Review" he admits that "The world will have Religion of some kind," and so knocks away altogether the foundation on which he seemed desirous of standing. For if "the world will have Religion of some kind," it must, on his own principles, be because Religion is necessary to the world, because it is, in other words, a need of human nature, because *some* Religion is *true*. Again, in the last sentence of the Article, he demolishes even more completely his whole theory of negation, for he affirms that "He looks forward to a better time, when there will be purer and mightier minds than ours, purer and mightier partly because of their deeper knowledge of matter, and their more faithful conformity to its laws." Without waiting to dwell upon the obvious fact that there must be something else than matter involved in man, *whatever* Professor Tyndall's definition of matter be, if man is a rebel to matter's laws, if he does not conform himself to them, if he is not faithful to them, it is clear that the Article leaves all the great questions regarding Religion precisely where they were, and men still have to seek what is the true Religion, what is the Religion which will satisfy the world's need, appease its craving, and teach it the laws, and supply it with motives, adequate enough, and powerful enough, to induce it to keep the laws, which it ought to observe, but to which it has hitherto proved itself, on the testimony of Professor Tyndall himself, more or less unfaithful.

Again, in his Address, delivered in his capacity of President, to the Midland Institute at Birmingham, last October, he affirms that "Thoughtful minds, finding no trace of evidence in favour of any other origin, are driven to seek in the interaction of social forces the genesis and development of man's moral nature." But he tells us not what he considers the term "Social forces" to include, upon which evidently hinges the whole importance of the statement, except, apparently, that preaching is one of them, and thus again he leaves every question with regard to the moral nature of man not only unsolved, but practically untouched.

I need not pursue the subject farther. While it is a matter for great regret, that one, so gifted as Professor Tyndall, should, leaving those subjects in which he has justly won world-wide renown, occasionally bring forward, in the name of Science, speculations, theories, and conjectures, which have not the faintest resemblance to her distinctive beautiful lineaments, it is very satisfactory to know that they are in reality utter strangers to her, in no way related to or connected with her, and that we may court her to the utmost of our opportunities, follow her indications, and seek her, through every path, without disturbing our own inmost convictions on deeper subjects, or distressing others, or exciting distrust of our fascinating mistress in their breasts.

The following gentlemen were elected members of the Tyneside Naturalists' Field Club during the year 1877–8:—

At the Anniversary Meeting, April 19th, 1877:—Henry Dalton, Stella Brewery, near Blaydon-on-Tyne; M. W. Brown, West Rainton, Fence Houses.

At the First Field Meeting, May 21st:—W. Boyd, Major E. R. Jones, Grey Street, Rev. G. C. Watt, B.D., Newcastle; W. E. Adams, West Jesmond; J. S. Watson, Dr. Mearns, Gateshead; Geo. Hadaway, North Shields.

At the Second Field Meeting, June 25th:—G. C. Greenwell, Tynemouth.

At the Third Field Meeting, July 19th:—John Hardwieke, John Richardson, Newcastle; Henry Relton, Bulman Village; Geo. Smith, Jesmond; Chas. J. Bertram, Gateshead; G. Heslop, jun., Sunderland; William Atkinson, Fence Houses; Rev. A. T. Coates, M.A., Percy Main; David Jeffrey, Winlaton; Rev. C. E. Streeter, East Denton.

At the Special Cheviot Meeting, July 26th:—Geo. Pickering, Newcastle; William Topley, F.G.S., Alnwick.

At the Fourth Field Meeting, August 6th:—G. W. Crookes, 9, Havelock Terrace, Sunderland.

At the Fifth Field Meeting, September 11th:—G. H. Fedden, Queen Street, Newcastle; Robert Bartram, Hylton, Sunderland; R. B. Paverley, Challoner Terrace, South Shields.

At the Sixth Field Meeting, October 15th:—Rev. A. J. Griffith, George Wood, Newcastle.

The Field Meetings for 1878 were arranged to be held as follows:—

May 15th.....	Axwell.
June 10th	High Force, Teesdale.
*July 3rd	Ripon.
August 5th	Housesteads and Northumberland Lakes.
August 23rd.....	Whittle Dene.
September 20th ..	Warkworth.

* It is intended to hold a Special Field Meeting at Whittingham in July.

THE TREASURER IN ACCOUNT WITH THE TYNESIDE NATURALISTS' FIELD CLUB.

FROM MARCH 29TH TO DECEMBER 31ST, 1877.

Dr.		£	s.	d.
1877.				
March 29.	To Balance brought forward	66	19	5
,,	Subscriptions	95	11	0
,,	Sale of Transactions	6	18	0
		£169	8	5

Cr.		£	s.	d.
1878.				
March 19.	By Commission	4	7	9
,,	Williams and Norgate	0	10	4
,,	Postage, Printing, etc.	41	15	2
,,	Engraving and Printing Plates	100	3	6
,,	Expenses of Meetings	14	17	8
Dec. 31.	,, Balance	7	14	0
		£169	8	5

1878, April 30.—Examined and found correct,

T. P. BARKAS, AUDITOR.

THE following gentlemen were elected officers of the Club for the year 1878–9:—

PRESIDENT.

Dennis Embleton, Esq., M.D.

VICE-PRESIDENTS.

E. C. Robson, Esq. | Thomas Atthey, Esq.
William Maling, Esq. | John Hancock, Esq.

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H. B. Brady, Esq., F.R.S.
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Rev. G. R. Hall, M.A., F.S.A.
G. H. Philipson, Esq., M.D.
Rev. R. E. Hooppell, LL.D.

TREASURER.

Robert Y. Green.

HONORARY SECRETARIES.

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John T. Thompson.
Emanuel Young.
Joseph Blacklock.
Rev. J. M. Hick.

AUDITORS.

J. S. Foster. | T. P. Barkas.

XII.—*Notes on a Find of Pre-historic Implements in Allendale, with Notices of similar Finds in the surrounding District.* By the Rev. W. Howchin, F.G.S.

The County of Northumberland, if not so rich in objects of pre-historic archæology as some of the southern counties of England, has, nevertheless, yielded no inconsiderable proportion of objects in this field of study. Pre-historic camps and tumuli are common within the limits of our district, as any good map will show; and through the industrious researches of the Rev. Canon Greenwell, some of these, when opened, have yielded a few small implements of flint; whilst an occasional hatchet, or some such implement made of stone, has now and again been turned up by the plough, or exposed by the draining operations on the land.

We have now to record, however, in addition to the above, a true surface find of a very rich and interesting character, and under such circumstances as may lead, by its suggestiveness, to a more extended search among the fells of our northern district, which cannot fail to reward the patient worker with encouraging results.

The *locality*, where the stone implements in question have been secured, lies in the south-western portion of Northumberland, on the top of a ridge of fell-land lying between the East and West Allen, at a height, as marked on the Ordnance Survey Map, of fifteen hundred and fifty-four feet, and at a distance of about two-and-a-half miles south-west of Allendale Town. The site is well-marked by two chimneys connected with the smelt-mill of W. B. Beaumont, Esq., situated in the valley near the town, from whence the chimneys are carried up the hill-side until they terminate in short vertical vents near the top of the fell. These chimneys convey the fumes arising from the lead smelting process to a high altitude, and as they have to pass through several miles of tortuous passages, the lead that has gone off in sublimation falls in large quantities as the smoke ascends; and thus, by this means, what would be highly deleterious if dissipated in the atmosphere, is retained and turned to

good account. But the fumes, as they are finally emitted from the chimneys, are still so strongly charged with sulphureous gases, that the ground for many acres around the point of their termination has been totally bared of its vegetation. When the grass is thus destroyed and gone, a thin bed of peat, averaging about a foot in thickness, becomes exposed to atmospheric waste. This peat is so rotten as to resemble the finest silt, and when dry the wind catches up the fine particles as they lie bare and exposed, transporting them in clouds to great distances. I ascertained, from enquiries made on the spot, that, at times, when the wind has been strong over the hill top, parties working in the fields on the opposite side of the valley, fully two miles away, have been compelled to leave their work in consequence of an incessant drift of this almost impalpable dust, which, by the irritation it causes, becomes unendurable.

The action of the pernicious fumes, the wash of rains, and then the force of winds, have, in their combined action, absolutely bared a very considerable portion of ground—the peaty soil having been removed from the greater part of the ground as effectually as the vegetation,—and by such means the implements referred to can now be picked up on the new surface caused by these denuding agents.

A gentleman, living in the neighbourhood, informs me that the spot has been long known as a locality for flints, and that he himself, when a boy, frequently passed over the site in company with an old gamekeeper, who was accustomed to look for these flints to light his pipe with. How many of these precious relics have been sacrificed by popular ignorance no one can tell, but there can be no doubt that a large number have been destroyed or lost in this way. In my first visit to the ground, in company with one or two friends, a shepherd and his dog passed us whilst pursuing our eager search. It had already become known in the neighbourhood that these flint stones possessed some interest, and not a few of the curious had been upon the ground and carried off several arrow-tips. Thinking that our friend of the "*plaid*" might be able to give us some information of importance, one of the party hailed him, and said—"Do you ever find

pieces of flint on this ground?" and we got the characteristic reply—"Aye, wheyles: but Ah set nowt b' thim. Ah teake a few heame wo' me sometimes ti pleese th' bairns—they amuse theirsels wi' strickin' fire wo' thim."

The objects that have been secured in this find are of a somewhat varied character, and are represented, as far as known, by the following list.

Implements in Greenstone.

No. 1. A somewhat ambiguous instrument, that measures two inches by four inches and three-quarters superficially, and rather more than one inch in greatest thickness, which occurs at the middle. It is roughly oval in shape, but tapers somewhat at the upper extremity; decreases in thickness towards either end, and the upper or narrow extremity has been ground on its upper and under sides so as to terminate in a blunt ridge. A shallow groove runs longitudinally nearly the entire length of the instrument on both sides, and on one side there is a circular cavity cut into the stone to a depth of rather more than one-eighth of an inch; it is cut within the groove, and rather below the centre, towards the thicker end. The instrument has been finely polished, but through long exposure is much corroded. This is seen especially on one side where the surface has assumed a rough, irony, and granular appearance, which is characteristic of the local trap rock.

The implement bears some general resemblance to a stone hammer; the grooves and circular cavity would assist the operator very materially in holding it firmly, if used by the hand. If it was intended to be shafted, we must then consider it of unfinished workmanship, and that the circular indentation shows the commencement of the boring process where it was intended to insert a handle. The Rev. W. Greenwell, however, on examining the instrument, has hesitated to denominate it a hammer at all, as it differs from the usual forms known as such, and this experienced archæologist would rather suggest that it may have been used as a polishing stone; the two facets seen on the upper extremity being some evidence of this. On the other hand, the symmetrical

structure and fine polish given to the implement would seem to indicate that it was intended as a finished article rather than the rough tool.

No. 2. Two fragments of what has apparently been a greenstone celt or hatchet, showing respectively the middle and upper portions. The lower part, containing the cutting edge, is unfortunately missing. These fragments must have formed part of a good-sized implement, as they jointly measure four inches in length, three inches in breadth, and one and a half inches in thickness. The upper or butt end tapers considerably, and from the shape at the line of fracture fully one half of its original length seems to have gone with the missing portion. In general shape it accords very well with Mr. Evans' 3rd class of polished celts, giving an oval section in profile, and has been finely polished. The fracture is undoubtedly ancient, as the split surface shows the same degree of discoloration, through weathering, as the proper external surface; but it is curious to note that the two pieces have taken a slightly different colour, undoubtedly arising from some diversity in the conditions of weathering to which they have been exposed. The first of these fragments was found by my friend Mr. T. Allison, of Allendale Town (a gentleman who has taken a lively interest in all relating to this interesting find), and the other was picked up by myself, on the following day, at a distance of twenty yards from the site of the former—the two pieces on being put together were found to match with great exactness. It would be a curious coincidence indeed, if at some future time, a further search should lead to the turning up of the remaining portion to complete the instrument.

No. 3. A fragment of greenstone that has been used as a grinding or polishing tool. It is roughly parallelogram in shape, measures two inches by two and a half inches superficially; has been very coarsely fractured, and shows six smooth facets as the effects of the grinding that it has done.

Implements in Flint.

1. A very fine *Celt*, composed of white flint, and measuring about four inches in length and one and three-quarter inches in

greatest breadth. Convex on both sides, the edges rounded, and the butt end terminating in a sharp fracture. It has been polished over the entire surface, and still retains a sharp and uninjured cutting edge. Some of the fractures, left by chipping the stone into shape, were found too deep to be removed by the subsequent grinding, and are left as indentations upon the surface of the instrument.

2. *Arrow-heads.* These have been picked up in considerable numbers, and embrace, in their diversified shapes, nearly all the leading varieties known to occur within the limits of the United Kingdom. They are leaf-shaped, stemmed, with single and double barbs, triangular, etc. I am sorry to say that, although several very fine leaf-shaped arrow-heads have been obtained, no very good example has come into my possession.

Of the single-barbed variety, a characteristic specimen of this form is in the possession of Mr. A. Shield, of Burn Laws, and which agrees very well with Mr. Evans' fig. 338, p. 351, "Ancient Stone Implements of Great Britain."

The double-barbed arrow-head is decidedly the most common form in this find, and embraces some very fine examples indeed. The two most elegant examples of this variety that have come under my observation are in the respective possession of Messrs. A. and H. Shield, Burn Laws, and through the kindness of the latter gentleman I am enabled to exhibit the one in his possession. It is shaped with an almost geometrical exactness, sharply pointed, and finished off with serrated edges, being chipped to a fineness almost microscopic. By the aid of a pocket lens it can be seen that the serration was added after the instrument was, what may be considered, normally finished; and notwithstanding the minuteness of the chippings, they are made with such precision as to show a wonderful uniformity in size, and occur in about equal numbers on both edges. The barbs are continued in a line with the edges of the arrow-head, broad throughout, with their terminating edges forming obtuse angles with the outer lines of the instrument. The angles thus formed at the termination of the barbs are carried forward to the tang, where they are made to intersect each other immediately in the centre of its

terminating edge, and thus the tang, which is generally finished off with a straight basal line, is in this instrument, furnished with a blunt point. It measures one inch and four-fifths in greatest length, and one inch and three-tenths in breadth, and is composed of amber-coloured flint. This arrow-tip closely resembles one found by Rev. W. Greenwell, in a barrow, at Rudstone, near Bridlington (Evans fig. 318, p. 343), but the example from Allendale, now exhibited, is a larger and more finely finished object. The companion arrow-tip to the one just described, and which is in the possession of Mr. A. Shield, Burn Laws, agrees very closely to the one exhibited in general outline and finish, but is a trifle larger.

Another example of this class is a slender and rather uncommon variety of arrow-head, carefully chipped, and furnished with serrated edges. One barb is slightly longer and sharper than the other, the tang strong and chipped to a sharp edge. This implement has been made from a dark-coloured flint, and carries on one side a depression, in which the original skin or coating of the flint, of a chalky character, is clearly shown. It is one inch and thirteen-twentieths in length, and seventeen-twentieths of an inch in greatest breadth. The only example like it, figured by Mr. Evans as a rare form, at p. 342, fig. 316, of his work, was found in Reach Fen, Cambridgeshire.

A few other examples are exhibited of the double-barbed variety of a medium size, averaging from three-quarters of an inch to one inch and a quarter in length, and represent, in a typical way, the commoner examples of this find. One is a very small form, and is remarkable in being broader than it is long, measuring thirteen-twentieths of an inch in length and seventeen-twentieths in breadth.

The triangular variety of arrow-heads has proved a rare form in this as in other finds, only one or two examples of this kind having come to my knowledge. The one thus labelled in the present collection, must, I think, be classed as an arrow-tip of this variety. It is a very thick example, shaped on one side only, the other illustrating very markedly conchoidal fracture. The point is attenuated and somewhat curved. Another very

interesting object in the collection looks like an intermediate example between the triangular and leaf-shaped forms. It is certainly a very peculiar and uncommon shape, and is much more semi-circular in its basal outline than the intermediate form figured by Mr. Evans p. 352. The point has been unfortunately broken, but otherwise it is a very symmetrical specimen. The triangular arrow-head exhibited in another tray may be mentioned in this place, although it was not got in Allendale, but found on the Fell top at Ramshaw, Upper Derwent, on bared surface, close to the smelt works chimney of the Derwent Lead Mining Company. It has been constructed of hard shale, now weathered quite white; rather thin, and showing many facets left from working it into shape.

About fifty arrow-heads are known to have been found and carried off from this one spot in Allendale up to the present time. Of these eight are leaf-shaped, thirty-eight double-barbed, one single-barbed, one triangular, and a few carried out of the district the features of which are unknown. Although the writer has used every diligence in attempting to secure a full record of all objects obtained at this spot, there are undoubtedly others, scattered through the district, of which no account has been taken.

It has been the arrow-tips especially that have excited the curiosity of the rustic population, and it is to be feared that, unless those that are now held somewhat tenaciously by the country people are placed in safe keeping, ere long the greater portion of this valuable find will be scattered or lost.

3. *Flakes.* These are very numerous, averaging from an inch to two inches in length. In shape they answer to the sub-divisions—"external," "ridged," "flat," and "polygonal." They nearly all carry the bulb of percussion, or conchoidal fracture, on the flat or inner face, many show secondary chippings, and a few are finished off with great care; whilst there are others, which appear to have been simply struck off the cores with a few dexterous blows, and then used without any further manipulation. About one hundred and twenty of these flint knives and splinters,

and about sixteen of various coloured chert, have been counted from Allendale.

4. *Scrapers.* This class of implements is fairly represented in the find. The examples are mostly of the ordinary types, answering, in their general features, to the classification adopted by Mr. Evans. They may be described as "circular," the "horseshoe-shaped," the "duck-bill" form, and doubtfully the "kite" and "spoon-shaped" scrapers. A few that are broader than they are long may be considered "side" scrapers; whilst several others, in which both sides are made flat by lateral fractures, finished off at their edges in the usual form given to scrapers, should probably be classed with the "straight" variety—those in my possession answering very closely to that figured by Mr. Evans under such a designation at p. 286 of his work. This latter form is thinner than the typical scraper, and they are often broken as though spoiled in use. In this class of objects I have also about a dozen very small circular or sub-circular examples, averaging about half an inch in length, or little more; and which are generally very carefully finished off by secondary chippings: these are very beautiful little things, and seem to belong to what has sometimes been designated the "thumb scrapers." There is also one good-sized implement in the collection which instead of having its edge convex, as is usual with scrapers, is furnished with a concave outline, bearing a very close resemblance to one figured by Mr. Evans of this character, p. 287, and which he has chosen to call in the type the "hollow scraper." With the scrapers in this find I have included another class of objects, which, whilst bearing some resemblance to them, are of an ambiguous character. They are bi-convex in shape, looking very much as though two scrapers had been put face to face, and thus united. Some of these are irregularly circular, chipped to an edge all round; and others are semi-circular or half-moon shaped. Including this last-mentioned anomalous form, about forty-six scrapers, including two of black chert, have been counted in the Allendale Find.

5. *Saws.* Of these, two well-marked examples have been obtained. The first is a slightly curved flake, three inches in

length, plainly fractured on the one side and bevelled on the other. The second is about two and a quarter inches in length, straight, and chipped with even facets on either side of the cutting edge, which has been left by this mode of fracture as a central ridge. In both examples the teeth are very fine and numerous.

6. *Cores and Chippings.* We may count I think about twenty cores of flint as having been picked up on the spot in question; but they are mostly small, and have been apparently thrown away because of no further service in implement manufacture.

The flint that has been brought into requisition for the construction of the foregoing articles is of various colours and quality. The chalky matter left in the indentations of a few would imply that they have been made from the freshly quarried nodule: whilst, in other instances, the outer surface that has been preserved, shows that the implements have been manufactured from rolled pebbles, such as can be picked up in great abundance on the sea beach where the Cretaceous rocks occur.

The small chippings of flint, knocked off in the shaping of the various tools of these "old stone-folk," are, as might be expected, the most numerous of all the objects that indicate their residence in our district. Nearly a thousand of these chippings have been counted from Allendale alone,—a fact which, of itself, is sufficient to prove that many implements were manufactured on the spot, as also that the time over which their occupation of the fell-top in question extended, was a long one. It is interesting to note, further, that these flint chips usually occur together in considerable numbers, scattered around some central point, so that where one is picked up, there is the strongest probability that others will be found closely associated with it—as though a stone-age warrior or huntsman had sat down at the spot, to replenish his resources in the instruments of war or the chase.

The situation where this most interesting Find has occurred is a very eligible one for an encampment. The ground is in the form of two undulating knolls, of moderate elevation, which nestle under the east side of the crest, and are thus protected from the heavy winds which blow in this district from the west.

A clear stream of running water occupies the depression between the two hills,; the subsoil is sandy and dry, whilst the great elevation commands an outlook that takes in all the surrounding country. The two vales of the Allen that run on the eastern and western flanks converge into one on the northern side, whilst the transverse valley of the Tyne can be followed by the eye for many miles, together with an immense stretch of high land further to the north. Here are then all the conditions which we may suppose would regulate a rude and nomadic people in the choice of a temporary settlement: a dry situation, the proximity of water, and a good outlook coupled with some degree of shelter.

It would be very interesting if we could determine the sources from whence these "old folk" obtained the raw material for their various implements. The hill top in question is capped with the Millstone Grit beds; and in descending order, the Yoredale or Upper-Carboniferous Limestone series occupy the lower parts of the valley. None of the substances referred to in this paper (unless it be the greenstone) can be considered purely local.* *Greenstone* occurs in the surrounding district in the form of dykes, "the great Whinsill," and as boulders in almost every section of Glacial clay. We may therefore reasonably conclude that the implements of this material were constructed from stones gathered from some of these sources, at no great distance from the site where they were picked up. A close comparison, however, with these local varieties of trap is rendered almost impossible, in consequence of the very considerable oxidation or crust, which covers the articles through long exposure to the weather. *Chert*, so far as the writer is aware, is only found in the district associated with the well-known limestone bed, which, in the local classification, is called the Four-fathom Limestone.

* Since writing the above I have picked up a few small rolled flints amongst the gravels on Plenmellor Fell, at the respective heights of 500 feet and 755 feet above sea level, or 140 feet and 390 feet above the existing river level. Mr. R. Howse has also kindly called my attention to a bed containing flints that can be seen at the mouth of the Tyne. These flints are always angular, and are scattered sparingly through a bed of bluish clay, resting upon true Boulder-clay. (See Synopsis of the Geol. of Durham and Northumberland, p. 7.) Whether these slight indications of flint in our district ought to lead us to the conclusion that the implements made of this material, and scattered so generally over our hill sides, were obtained from such limited sources, is open to serious doubt.

But in this situation it occurs simply in small nodules, set firmly in the surrounding limestone, and is seldom found of sufficient size and homogeneity to allow it to be used for such practical purposes. The Chert found in such considerable quantities on this hill top was probably brought from the valleys of the West Riding of Yorkshire, or even further southwards, where it can be obtained in much better condition and in larger quantities than the northern counties yield.

The most abundant and interesting substance is certainly *Flint*. It has been picked up of all shades of colour, white, red, black, etc. Some fragments occur with a portion of the rind still adhering, by which it can be seen, in a few instances, that the tool has been constructed from a rolled pebble, that may have been picked up from the beach; others are found having chalky matter adherent on the exterior surface, and filling up the indentations, as though worked when fresh from the quarry. Amongst the objects of this class are some very fine black flints, which seem unmistakably to belong to the noted layers of this material in the beds of the south of England. Does the presence of these flints on our Northumbrian hills carry us back to a remote period, when the population of this country consisted simply of a few petty tribes, wandering from end to end of our island, bringing with them, in their migrations, the raw material out of which they could construct their few and simple tools, as need required? Or does it prove a state of inter-tribal commerce, when the raw flint of the south was exchanged in barter to the northern tribes for some corresponding advantage?

Finds in other Localities.

The discovery of pre-historic implements in such large numbers on the Allendale Fells, led, very naturally to the inference, that if carefully searched for, similar objects might be found on the surrounding hills. This was at once tried, and in the few months that have elapsed since entering upon this general search, the writer has been fairly successful, as the following list of localities and the objects they have yielded will show. All the articles are of Flint except otherwise described.

1. *Kilhope Fell*, near Nenthead Smelt Mill: Six Flakes, six Chippings, and two Cores.
2. *Welhope Fell*, Weardale: Nineteen Flakes, one hundred and thirty-three Chippings, and four Cores. These were picked up on the north side of the stream, where the sods have been removed in building a reservoir in connection with the Lead Works.
3. *Langley Mill Fell*, near the Chimney of the Smelt Works: Three Flakes and two Chippings.
4. *Ramshaw Fell*, Upper Derwent: One triangular-shaped Arrow-head made from indurated shale, also one Flake of same material; two Flakes of flint and two Cores. I also picked up at this spot a number of ill-shaped flakes, lying close together, made from a very hard siliceous sandstone. There seems to be an evident intention in their similarity of shape, and they are probably the abortive and rejected attempts in shaping tools from a not very tractable material. These siliceous flakes, with a few cherty nodules gathered at the same spot, are not enumerated in this list.
5. *Plenmellor Fell*, near Haltwhistle: Worked flints have been picked up at six different points on this Fell by Mr. Thomas Bell, of Coanwood, and myself. Mr. Bell was fortunate in picking up a double-barbed Arrow-head from amongst the shingle in the West Burn, measuring about an inch and a half in length. It has one barb broken, and is weathered white. In addition to the above Arrow-tip the findings of Mr. Bell and myself comprise ten Flakes and twenty-six Chippings.
6. *Tow's Bank*, Coanwood, South Tyne: One good-sized Flake picked up by Mr. Bell.
7. *Old River Terraces*, near Haltwhistle: Two Flakes, two Chippings, and one Core, gathered from ploughed land or worn paths through the fields.
8. *Haltwhistle Fell:* One Flake and one Chip.
9. *Cowburn District:* Three Flakes and three Chippings; one flake is carefully worked.

10. *The Banks,* near Lanercost: One Chip.
11. *Brampton:* One Flake, made from very close-grained siliceous sandstone, and one Chip of Flint. These were taken from subsoil, under about eight feet of peat that had been worked for fuel.
12. *Hallbank-Gate District:* Two double-barbed Arrow-heads and one Flake; taken from under sods when cut for drains.

The following Table will show at a glance the various localities from whence the foregoing objects have been gathered, and the totals in each case.

Localities.	Hammers.	Celts or Choppers	Arrow-heads.				Flakes.	Scrapers.	Saws.	Polishing Stone.	Chippings.	Cores.
			Single-barbed.	Double-barbed	Leaf-shaped.	Triangular.						
Allendale Fell.....	1?	2	1	38	8	1	136	46	3	1	1000	19
Kilhope ,, ...	..	...	...	...	...	..	6	...	...	...	6	2
Wellhope ,, ...	...	...	...	...	...	...	19	...	...	...	133	4
Langley Mill ,, ...	...	...	...	...	...	...	3	...	..	..	2	...
Ramshaw ,, ...	...	...	...	...	...	1	3	...	...	. .	...	2
Plenmellor ,, ...	...	..	...	1	...	...	10	...	...	...	26	...
Tow's Bank	...	...	...	...	...	...	1	...	...	...	...	...
River Terraces, Haltwhistle ...	...	...	...	...	...	...	2	...	...	...	2	1
Haltwhistle Fell.....	...	...	...	...	...	...	1	...	...	...	1	...
Cowburn District ...	...	...	...	...	...	...	3	...	..	...	3	...
The Banks	...	...	...	...	...	...	...	...	...	...	1	..
Brampton	...	...	...	...	...	...	1	...	...	...	1	...
Hallbank Gate	...	...	...	2	...	...	1	...	...	...	...	...

My acknowledgments are due to the Rev. W. Greenwell, M.A., to whose matured judgment several dubious specimens in this Find have been submitted; to Mr. H. Shield, Burnlaws, for the free use of some of the most important objects referred to in this paper; and to other gentlemen who have aided me by local information, gifts of specimens, etc.

November, 1878.

XIII.—*Memoir of the Life of Mr. W. C. Hewitson, F.L.S.* By Dennis Embleton, M.D. With Portrait.

Mr. William Chapman Hewitson was born in Percy Street, Newcastle-upon-Tyne, in a house opposite the Haymarket, now converted into a circus, on January 9th, 1806, and died at Oatlands, near Walton-on-Thames, Surrey, on May 28th, 1878.

His father, Middleton Hewitson, Esq., was a gentleman in independent circumstances, but without any bias to scientific pursuits. He died at Tynemouth. The family consisted of five sons, of whom the subject of this memoir was the second, and one daughter; all are now dead.

The early education of William Hewitson was begun at Kirkby Stephen, Westmorland, and finished at York; probably under the care of the Rev. Mr. Graham. How far his studies were prosecuted is not known; he probably obtained the ordinary education given at a grammar school of the period.

He often visited his uncles, Mr. Henry Hewitson of Seaton Burn, and Mr. Joshua Hewitson, of Heckley, near Alnwick.

Soon after his return from school he was articled to Mr. John Tuke, land surveyor, of York, and during his apprenticeship became acquainted with Mr. afterwards Professor Phillips, whom he frequently accompanied in their common Entomological excursions. How long he remained at York is not known, but he was residing there in 1828. In 1831 he was living in his native town, and practising his profession of a land surveyor. It was in April of that year that the first part of his British Oology appeared, the last of which was published June 1st, 1838.

From letters in the possession of Mr. John Hancock, we find that in 1838 he was at Bristol with the Messrs. Sturges, land surveyors, by whom he was employed in the survey of the country for the line of railway between Bristol and Exeter.

On this occasion he himself writes that "they worked day and night, Sundays and week days," and the reason was as follows: The landed proprietors being then much against the progress of railways, did all in their power to prevent the works being carried on; in consequence, much of the levelling had to be done

surreptitiously, and the surveyors had recourse at nights to torch light. Watchers were employed by the landlords to keep off intruders, but the railway surveyors circumvented them, by hiring men to go round to the neighbouring public houses to find out the hours at which the watchers were engaged with their refreshments, and those hours were utilized by the surveyors to accomplish their objects.

In 1839 he was again at York, and also at Newcastle. About this time he seems to have moved a good deal from place to place.

When quite a boy he showed a great love for the natural objects of this beautiful world, and whilst at school collected insects and birds' eggs. Soon after leaving school he became acquainted with several young men, students of nature, living in his native town, who were following similar pursuits with as much ardour and enthusiasm as his own. Prominent among these self-educating naturalists were George Wailes, entomologist; the brothers Albany and John Hancock, entomologists, conchologists, and ornithologists; Geo. Clayton Atkinson, ornithologist; Wm. Robertson, botanist; John Thornhill, botanist and entomologist; Robert B. Bowman, botanist; Joshua Alder, malacologist; and William Hutton, geologist and palæontologist; a band of students who made several good collections of British birds and their eggs, mollusca, insects, and plants, and who have given a world-wide celebrity to our town, and to whose influence we mainly owe the Institution of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, as will presently be mentioned. They were all acquainted with Richard R. Wingate, an ornithologist, and a celebrated professional bird-stuffer of the town, who possessed a considerable collection of stuffed birds and eggs, and to whose skill our Museum was indebted for the setting up of the birds in the department of British Ornithology, and whose works were at that time of a high order.

Mr. Hewitson being a neighbour of Mr. Wingate often visited him, and spent much time in looking over his collections, and it is very probable that during those interesting visits he formed the idea and the determination of making for himself a collection of eggs, which idea and determination he never lost sight of, and

which, increasing as years rolled on, culminated in his well-known work, the "Coloured Illustrations of the Eggs of British Birds."

Bird-nesting and Egg-collecting were followed out with the same ardour that he exhibited in prosecuting Entomology; the two studies were equally prosecuted, and appear to have occupied the almost undivided attention of his after life.

In 1827 and 1828 his collections were rich in British Coleoptera and Lepidoptera, and his name was about that time frequently mentioned as that of a collector of authority in Stephens' "Illustrations of Entomology," and has been often quoted since then in the Lists of Insects in the first and second volumes of the "Transactions of the Tyneside Naturalists' Field Club," and in the Lists of Insects of Northumberland and Durham, by T. J. Bold, in the fourth volume of the "Natural History Transactions of Northumberland and Durham," along with those of Wailes, Hancock, and others.

In February, 1829, a project to form a Society for the study of Natural History was started amongst a few members of the Literary and Philosophical Society. This, in July of the same year, had so far made progress that a list of those favourable to it was drawn up, and therein we find the name of Mr. Hewitson, along with those of his friends, Mr. A. Hancock, Mr. R. B. Bowman, Mr. Joshua Alder, Mr. George Wailes, and Mr. Wm. Hutton. On the 19th of August, of the same year, the first meeting was held, and the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne was established. Mr. Hewitson was a member of the first Committee, and in 1833 and 1834 was one of its Secretaries. He took an active interest in the affairs of the Society, and contributed several papers to its meetings. At the time of his death he was one of its Vice-Presidents, and a liberal subscriber to its funds.

In 1832 he visited the Shetland Islands, and brought home a large collection of eggs for the illustration of his work on British Oology.

In the year 1833, in pursuance of his favourite object of Ornithology, he went with his two friends, Mr. John Hancock and Mr. Benjamin Johnson, on an expedition to Norway, to collect

specimens of Natural History generally, as birds' eggs, insects, and plants, but more particularly to add to our knowledge of the breeding localities of some of those birds which regularly migrate from Norway to this country to pass the winter months.

This was an original and somewhat bold enterprise at that time, when few Englishmen had as yet found their way to Norway, and when the facilities for travel and accommodation in that country were very different from those of the present day.

They started from Newcastle on May 6th, 1833, by a Scotch brig, for Trondheim, which they reached in seven days. After the necessary preparations, they started for the north on foot, with a cart to carry their outfit and their collections. The farthest northern point they attained was Rodoe, a small island south of the Lofoden group, but a little within the Arctic circle, and where the sun was visible at midnight.

The more northern part of the journey was by boat, and very many islands, as well as a large extent of the mainland, with its mountains, waterfalls, and lakes, were visited and examined. Mr. John Hancock and Mr. Hewitson kept a journal of the expedition, and the latter has written out his in a neat small hand, and illustrated it with drawings by T. M. Richardson, jun., from sketches made by Mr. Hewitson. A map, drawn by himself, shewing the track they took in going and returning accompanies this manuscript.

They had so much difficulty at times in getting food that they had to live on the birds they shot, and on one occasion were compelled to fast for twenty-four hours on an island, which they could not leave on account of bad weather, having nothing but a little tea and sugar, which happened to be left of their stores.

After a sojourn of about three months in Norway the party landed at Leith in August, and arrived safely at home.

Eggs of the following species of birds, at that time unknown in England, were part of the results of the expedition, namely, the Capercailzie, Fieldfare, Turnstone, and Golden-eyed Duck. The nest of the Redwing was discovered in two localities, and specimens of the young bird in first or nest plumage were brought home, and still enrich the museum of Mr. Hancock.

In April, 1834, Mr. Hewitson read a portion of his journal before the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, and in February, 1835, "Notes on the habits of Birds observed by him in Norway."

A few notes on the Ornithology of Norway were contributed by him to the second volume of Jardine's "Magazine of Zoology."

In 1840 Mr. Hewitson left Newcastle to reside in the south of England, first at Bristol, next at Haverstock Hill, Hampstead, and finally at Oatlands, Surrey.

In 1843, March 19th, his uncle, Mr. Henry Hewitson, of Seaton Burn, died, and by his death Mr. Hewitson and his brothers inherited his property. Being thus placed in independent circumstances he gave up his profession of land surveyor, which till then he had been engaged in, and devoted himself to the study of Natural History. A few years afterwards his uncle, Mr. Joshua Hewitson, of Heckley, near Alnwick, also deceased, and having made Mr. W. C. Hewitson his heir, our friend came into the possession of the estate of Heckley, which he soon afterwards sold to His Grace the Duke of Northumberland.

In the summer of 1845, in company with his old friend and companion, Mr. John Hancock, he made a Naturalist's excursion to Switzerland and the Alps, and which resulted in their capture of a fine series of Diurnal Lepidoptera, and as a result Mr. Hewitson published in the "Zoologist," Vol. III., p. 991, "Remarks on the Butterflies of Switzerland."

In 1848 Mr. Hewitson purchased between eleven and twelve acres of land of Oatlands Park, formerly the seat of the Duke of York, and here he employed the late Mr. Dobson, architect, of Newcastle, an old friend of his, to build him a charming house, in which he passed the remaining thirty years of his life. His residence at Oatlands is exceedingly beautiful, partly on account of the grand old oaks and cedars of Lebanon that adorn the grounds, and partly from its fine situation. His love for the *Coniferæ* early induced him to plant the rarer examples of this family, and in consequence the collection of these trees in his grounds is perhaps not surpassed for growth and beauty in any

part of the kingdom. The house designed by Mr. Dobson occupied one of the most commanding sites in the park, having a view over all the well wooded country, as far as Windsor Castle, about fifteen miles distant. The grounds sloping to Broadwater, and laid out by Mr. Hewitson and his friend Mr. John Hancock, with much taste, left nothing to be desired.

The following notice of Mr. Hewitson is from the pen of his friend, Prof. Alfred Newton:—"His villa at Oatlands, with its beautiful view and charming garden, was a sight not to be forgotten, to say nothing of the glorious contents of his cabinets. Here he passed the last thirty years of his life, seldom leaving home; always glad to welcome a visitor whose tastes agreed with his own, and occasionally returning to his old flame, birds' eggs, when he could assist a friend, as witness some of the plates in the earlier volumes of the Ibis."

He had not been long in the neighbourhood of London before his attention was seriously directed again to Entomology, and especially to foreign Diurnal Lepidoptera, which he had hitherto shewn indifference to. On one occasion he happened to be at an auction, where he saw a "lot," consisting of different species of *Heterochroa*, closely allied and yet distinct. This was a novelty to him at the time, and much engaged his attention, and he bought the whole. Turning round he saw Professor Westwood, who said, "What, are you buying foreign butterflies?" "Yes," he replied, "I am." His interest in the subject of foreign Lepidoptera commenced at that time, and one of his earliest publications on Exotic Butterflies was on the genus *Heterochroa*. He pursued the study of the characters of the Diurnal Lepidoptera with all the quiet earnestness and perseverance so characteristic of his disposition, and made, as Professor Newton says, "that wonderful collection of Diurnal Lepidoptera, and those works in illustration of that group, with which his name will be always associated, and by which it will probably be be most widely known."

Mr. Hewitson married about the year 1853, but his wife died within a year, leaving no issue.

Mr. Hewitson was a person of slender, wiry frame, and decidedly nervous temperament. He suffered from continual dyspepsia, which made him at times hypochondriacal; at long intervals he suffered from fainting fits. He often required and obtained medical advice, but did not always follow it. He was regular and very temperate in his habits, and scrupulous as to personal cleanliness. He was capable of enduring much bodily fatigue, and when a young man was a bold climber of sea-cliffs in search of eggs. He always anticipated great pleasure from his pursuits, but the attainment of his object failed to bring happiness, though in after years he could look back with some degree of pleasing recollection to what had been done.

It may be said that the spinal part of his nervous system was good, but the cerebral and ganglionic divisions peculiar. He was very sensitive to criticism, and often fancied that people about him were making observations on him, and yet he took as his motto "Let them talk," as if he cared not what the world thought of him, conscious that he was doing a good work for which he was well adapted.

He was always glad to see a few select friends interested in his favourite pursuits, and indeed any one who had a taste for them, but he disliked mere idle curiosity, and would resent it; and from all his friends he expected a certain amount of personal attention, and could not bear that a visitor for the day should go and amuse himself for hours strolling about alone or fishing; to such a person he would say, "I find you have not come out to see me but to amuse yourself."

Many anecdotes respecting his treatment of strangers might be told, the following may suffice:—On one occasion, at Oatlands, three young people, two ladies and a gentleman, had asked permission to look over his collection of Butterflies. This was readily granted; but when he found two of the party flirting behind his back, and making him, as he thought, the object of their mirth, he observed, "I see you do not care for these things, and as I can spend my time better than by shewing them to you, I beg to show you the door;" so he closed his drawers and bowed the party out.

He drew on stone all the figures of his Lepidoptera by line and rule and compasses with the minutest accuracy, and coloured them from the specimens himself, with extreme delicacy and beauty of execution, having an extraordinarily acute faculty for the appreciation of colour. His work was confined to the external characters of the Lepidoptera; into their internal structure, not being an anatomist, he made no researches.

He was an original member of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, was one of the Honorary Secretaries in 1833–34, and he continued for many years to be a member and honorary Curator, contributing periodically and handsomely to the funds of the Institution.

In London he became a member of the Entomological Society in 1846, of the Zoological Society in 1859, and of the Linnæan Society in 1862.

Owing to his generally hypochondriacal condition, and advancing age, about two years before his death he began to decline in bodily health. Towards the end of 1877 he became worse, and a surgical disorder came prominently forward, for this he refused to be operated on, and died exhausted on the 28th of May, 1878, aged 72 years.

He was interred on June 1st, in the churchyard of Walton-on-Thames, and a monument of granite was subsequently erected over his remains.

Mr. Hewitson's will was dated March 19th, 1878, and there was a codicil dated May 21st, 1878. The provisions in these testamentary documents shew the amiable and charitable bent of his mind, and that his prevalent ideas at the time of their being drawn up, were to do good with his considerable means, and to leave an impression of kindness on the minds of his numerous friends and dependants. The following bequests are contained in the will and codicil:—

£10,000 to the Newcastle-upon-Tyne Infirmary.

£5,000 to the Orphan Houses, Ashley Down, Bristol.

£3,000 to the London City Mission.

£3,000 to the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne.

£2,000 to the Wesleyan Missionary Society.
£2,000 to the Refuges for Homeless and Destitute Children.
£2,000 to the Surrey County Hospital.
£1,000 to the Metropolitan Convalescent Institution, Walton-on-Thames.
£1,000 to the Charing Cross Hospital.
£1,000 to the London Missionary Society.
£500 to the Hurley House Training Institution.
£200 to the Society for the Suppression of Vice.

In addition, in his will he states, "To the following, as worthy friends, some of them as brother Naturalists, I give, with my love, the following sums." These sums are in fifty-eight bequests, the whole of which, together with those to Charitable Institutions, amount to £51,200.

His entire Collection of Butterflies, together with the cabinets, he left "to the Trustees for the time being of the British Museum, to be held upon and for the trusts and purposes of the said Museum, but subject to the following conditions, that is to say, that the Collection shall be called or designed '*The Hewitson Collection*,' and shall be kept in good order, preservation, and condition, and in the same cabinets, and in the same order and arrangement (except as hereinafter mentioned), and under the same nomenclature as they shall be at the time of my decease, until the expiration of twenty-one years from the time of my decease; and I hereby express my earnest wish and desire, but not by way of condition, that after the expiration of the said term of twenty-one years, the said Trustees of the British Museum will keep the said Collection in good order, preservation, and condition, and in the same cabinets, and in the same order and arrangement, and under the same nomenclature as they shall be at the time of my decease, for a further period of twenty-one years. Provided always, and I declare that if the bequest of my Collection shall not be accepted by the Trustees for the time being of the said Museum, subject to the conditions aforesaid, or having been accepted, such conditions shall not at all times, until the expiration of the said term of twenty-one years, be duly observed, performed, and kept, then and from henceforth I give

and bequeath my said Collection, with such cabinets, unto the Society called or known as the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, to be placed in the Museum of that Society at Newcastle-upon-Tyne, to be held subject to the same conditions as I have imposed on the gift or bequest to the Trustees of the British Museum, or as near that as the circumstances will admit; and as to such part of my Collection as shall not be arranged in my cabinets I direct my said Trustees to incorporate and arrange the same in such a way as they shall see fit in my said cabinets, before delivering up the same to the said Trustees of the British Museum, or to the said Natural History Society, as the case may be. Provided always, and I declare that before delivering over my said Collection my executors shall, at the expense of my estate, cause a Catalogue to be made thereof, and two hundred and fifty copies of such Catalogue to be printed, and a copy to be sent to such public Museums and Lepidopterists as my said Trustees shall see fit, and that until my said Collection shall be delivered over, the same shall remain in the rooms in my house at Oatlands Park in which they shall be at my decease."

He also bequeaths certain pictures to the National Gallery, and all his books on Natural History, except "Gould's Birds," which he leaves to his old friend, Mr. John Hancock, to the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne.

His death has been noticed with much regret in all the scientific periodicals of the day, and it is only a proper tribute to his memory that some notice of his life and works should appear in the Transactions of a body whose objects are the same as his were, and of which he was during life a kindly and liberal supporter, and by his will a munificent benefactor.

List of Works by Mr. W. C. Hewitson.

British Oology, being Illustrations of the Eggs of British Birds. 2 vols., 8vo., 1831–38. Second Edition, 1843–4. Third Edition, 1856. In the Second edition the title of the work

was changed to "Coloured Illustrations of the Eggs of British Birds."

Doubleday's Genera of Butterflies; the illustrations by Mr. W. C. Hewitson. 2 vols., imp. 4to. 1846–52.

Illustrations of Exotic Butterflies. 5 vols., 4to, 1852–77.

Specimen of a Catalogue of Lycænidæ in the British Museum, containing 8 plates of Ogyris and Amblypoda. 1862.

Descriptions of some New Species of Lycænidæ. 1868.

Illustrations of Diurnal Lepidoptera. 4to. 1868.

Equatorial Lepidoptera, collected by Mr. Buckley. 1869–76. Issued occasionally.

Bolivian Butterflies, collected by Mr. Buckley. 1874.

List of Papers published in Proceedings of Societies and other Serials.

Notes on the Economy of Hedychrium (Chrysididæ). Entom. Mag., 1837, Vol. V., pp. 77–78.

Notes on the Ornithology of Norway. Jardine's Mag. Zool. and Bot., II., 1838, pp. 309–317.

Remarks on the Butterflies of Switzerland. Zoologist, III., 1845, pp. 991–994.

Descriptions of New Species of Butterflies. Ann. Nat. Hist., XX., pp. 257-264.

Description of a New Species of Butterfly of the Genus Agrias (A. Aedon). Zool. Soc. Proc., XVI., 1848, pp. 45–47.

Description of a New Genus and Species of Satyridæ (Corades Enyo). Zool. Soc. Proc., XVI., 1848, pp. 115–117.

Descriptions of some New Species of Butterflies. Ann. Nat. Hist., VI., 1850, pp. 434–440.

Description of some New Butterflies; also Remarks on the Sexes of some Papilios. Entom. Soc. Trans., I., 1850–51, pp. 97–100.

Descriptions of five New Species of Butterflies of the Family Papilionidæ. Entom. Soc. Trans., II., 1852–53, pp. 22–24.

Descriptions of some New Species of Butterflies from South America. Entom. Soc. Trans., II., 1852-53, pp. 245–247.

On the Sound produced by the Peacock Butterfly (Vanessa Io.) Entom. Soc. Trans., IV., p. 2.

Descriptions of some Butterflies from the Collection of Mr. Wallace. Zool. Soc. Proc., XXVI., 1858, pp. 464–466; XXVII., 1859, pp. 422–424; 1861, pp. 50–53.

Recent Discoveries in European Oology. Ibis., I., 1859, pp. 76–80.

Descriptions of New Diurnal Lepidoptera. Journ. of Entom. I., 1862, pp. 155–158.

Descriptions of Butterflies from the Collections of A. R. Wallace, and W. C. Hewitson. Zool. Soc. Proc., 1862, pp. 87–91.

On Pronophila, a Genus of the Diurnal Lepidoptera, with Figures of the New Species, and references to all those which have been previously figured or described. (1861). Entom. Soc. Trans., I., 1862–63, pp. 1–17.

Descriptions of two New Species of Diurnal Lepidoptera. Entom. Soc. Trans., I., 1862–63, pp. 517–518.

A List of Diurnal Lepidoptera, taken in Madagascar by Mr. Caldwell. Zool. Soc. Proc., 1863, pp. 64–65.

Descriptions of New Species of Diurnal Lepidoptera. Entom. Soc. Trans., II., 1864, pp. 245–249.

A Monograph of the Genus Yphthima, with Descriptions of Two New Genera of Diurnal Lepidoptera. Entom. Soc. Trans., II., 1865, pp. 281–294.

A List of Diurnal Lepidoptera, collected by Mr. Wallace in the Eastern Archipelago. Proc. Linn. Soc., VIII., 1865, pp. 143–149.

Descriptions of New Hesperidæ. Entom. Soc. Trans., II., 1866, pp. 479–501.

Descriptions of some New Species of Diurnal Lepidoptera. Entom. Soc. Trans., III., 1867, pp. 561–566.

Remarks on Mr. A. R. Wallace's Pieridæ of the Indian and Australian Regions. Entom. Soc. Trans., 1868, pp. 97–100.

Descriptions of twenty-two New Species of Equatorial Lepidoptera. Entom. Soc. Trans., 1870, pp. 153–163.

Descriptions of two New Species of Lepidoptera Rhopalocera. Entom. Mon. Mag., VI., pp. 177–178.

Descriptions of New Species of Erycinidæ, from Chontales, Nicaragua. Entom. Mon. Mag., VI., pp. 226–228.

Descriptions of five New Species of Diurnal Lepidoptera, from Chontales, Nicaragua, and of one from Minas Geraes. Entom. Mon. Mag., VII., pp. 3–6.

Descriptions of Four New Species of Prenophilæ. Entom. Mon. Mag. 1878.

For the principal facts in the above memoir the writer is indebted to Mr. John Hancock, and for the list of Mr. Hewitson's works to Mr. Joseph Wright, Keeper of the Museum, Newcastle-on-Tyne.

XIV.—*Short Memoir of the Life of Thomas Belt, F.G.S.* By Joseph Wright.

Died at Denver, Colorado, U.S. America, September 21st, 1878, Mr. Thomas Belt, F.G.S., aged 45. Such was the brief announcement by telegram which appeared in the newspapers, and told to his astonished friends in this district that he had passed away from their midst.

His attainments, and the high position he had won for himself in the scientific world, render it only fitting that some record of his life and labours, should appear in the "Transactions of the Tyneside Naturalists' Field Club," of which he was a member for many years.

Mr. Belt was born in Newcastle-upon-Tyne, in 1832, where his father carried on the business of seedsman and canvas and twine manufacturer, in the Groat Market, and which is still continued by his two surviving sons.

He received his education at the school of the late Mr. John Storey, one of the first Secretaries of our Club.

He early evinced a taste for Natural History pursuits, the departments of Botany and Entomology being his favourite studies. In June, 1850, he became a member of the Club, and in the Second Volume of the Transactions his name several times appears

as the authority for the habitats of some of the rarer plants of the district. On more than one occasion, his old master, Mr. Storey, acknowledges his obligations to him for help on these points.

In October, 1851, he discovered at Ryton a plant, new to the district, the Frog-Bit, *Hydrocharus Morsus-ranæ*. We also find him communicating lists of his captures amongst the Lepidoptera to the Club.

About this time the discovery of gold had been made in Australia, and, like a great many more, Mr. Belt left Tyneside for the new El Dorado.

This step, we may say, was the turning point in his life, and had a great influence on his future career. During his residence in Australia, although at a time when the whole colony was moved by the gold-fever, the same quiet habits of observation which marked him on Tyneside are seen. The new aspects of Nature with which he was brought into contact in Australia aroused his spirit of investigation, and in 1857 he was reading before the Philosophical Institute of Victoria a paper on the Origin of Whirlwinds. This paper is printed in the Philosophical Magazine for 1859, to which periodical it was communicated by the Astronomer Royal.

The auriferous quartz veins of Australia he made his peculiar study, the results of which he embodied in a work on "Mineral Veins. An enquiry into their origin." This book he published in 1861, and it at once lifted him into the position of an authority on the subject.

On his return to England, his services were greatly in request as a Mining-engineer, to which profession he now devoted himself, with an establishment in London. In the prosecution of his labours he travelled over both Asia and America; and in his long wanderings his keen powers of observation were ever on the alert to enlarge the domain of human knowledge.

In 1863 Mr. Belt went to Nova Scotia, where he had the superintendence of the Nova-Scotian Gold Company's Mines. Here the great glacial phenomena of North-America were unfolded to his view, and to the study of them he devoted himself

with enthusiasm. In his investigations into glacial phenomena, careful observations were made at the great lakes of the American continent, the gorge of the Niagara, and the valley of the St. Lawrence, followed afterwards by an examination of the steppes of Siberia and Southern Russia, and among the drifts and gravels of our own country. These results were from time to time communicated to the various learned societies and Scientific Periodicals. It was his intention to embody his accumulated facts and observations in this department of geological enquiry in a work on Glacial Phenomena; but this purpose of his life his early death has prevented.

Whilst in Nova-Scotia, where he sojourned for two or three years, he took an active part in the Proceedings of the Nova-Scotian Institute of Natural Science; and the first geological paper printed in their Transactions is from his pen; it is also in these Transactions that his paper on the Glacial Period in North America appeared.

After his return from Nova-Scotia, he was engaged for some time in examining the quartz rocks of North Wales, a project having been at that time started to seek for gold in these rocks. Whilst so engaged he examined carefully the geology and palæontology of the district of Dolgelly, where he resided, and the results of which he published in two papers in the "Geological Magazine," Vols. IV., V., 1867–8.

In 1868 Mr. Belt went to Nicaragua to superintend the mining operations of the Chontales Gold Mining Company. Here he remained until 1872, and to his residence in that district we owe the work by which his name will be best known. This work, "The Naturalist in Nicaragua," he published in 1874, and we have in it one of the most interesting volumes of Travel and Natural History in the English language. His observations on the various departments of Zoology, Botany, and Geology, which came under his notice in that district show the eye and the pen of a competent investigator, and render the book truly a classic one amongst our Natural History literature. In 1873, and again in 1875 and 1876, he was in Russia, and travelled over a large portion of that great Empire. The steppes

of Siberia, and also those of Southern Russia, he made his peculiar study; and the results of his observations on these vast plains he embodied in two papers, which he read before the Geological Society of London in 1874 and 1877, and which are published in their Journal.

In the early part of the summer of 1878 he was down in his native north, revisiting his old acquaintances and the scenes of his youth; for always, in all his wanderings, he turned lovingly to Tyneside. He at this time was in his usual health and genial spirits; and little did his friends think that it was to be his last visit to the place of his birth, and that they should see his face no more.

He shortly afterwards left England for Colorado, to fulfil a professional engagement. Here he was struck down with fever, which terminated fatally on the 21st of September. To the last he was an earnest student, and the latest record we have of him shews him still accumulating facts in furtherance of the work on Glacial Phenomena to which he had devoted himself. The letter of the Denver correspondent of the *Times*, published in that paper September 25th, announces the discovery by Mr. Belt of a human skull that might prove to be the oldest in existence, the deposits in which it was found being in his belief of the Glacial age.

It may be said of him "That his sun went down while it was yet day," and that the work to which he had dedicated so much of his life remains unaccomplished. Yet the name of Thomas Belt will not be forgotten. Though he has passed away from us in the flower of his age, the work that he has done has gained for him a position in the scientific world to which few of greater years attain.

He was a careful and accurate observer, and able with his pen to lay before the world the results of his observations clearly and temperately. Whatever he undertook he did it well, and in the departments of Natural Science to which he applied himself his name stands as an authority, and his work is quoted as that of a master.

Residing as he did at a distance from Tyneside, and actively

engaged in the duties of his profession (a profession which at one time took him to North America, at another to South America, and to Siberia), he could not take any active part in the work of the Club, which undoubtedly he would have done had he lived among us. Yet he took a warm interest in its welfare, and was always glad to hear of its progress. Our local Natural History may have lost somewhat by his long absence, but that of the world at large has the more benefited by his labours, and he adds another bright name to the roll of those who have so well upheld the Natural History fame of our district.

List of Works and Papers, by Mr. Thomas Belt.

An Enquiry into the Origin of Whirlwinds. Read before the Philosophical Institute, and published in the Philosophical Magazine, Vol. XVII., p. 47.

Mineral Veins. An enquiry into their origin. Founded on a Study of the Auriferous Quartz Veins of Australia. 1861. London: John Weale.

The Naturalist in Nicaragua. A Narrative of a Residence at the Gold Mines of Chontales, and Journeys in the Savannahs and Forests. 1874. London: John Murray.

Transactions of the Nova-Scotian Institute.

On some recent movements of the Earth's Surface. Vol. I., pt. 1, p. 19.

List of Butterflies observed in the neighbourhood of Halifax, Nova-Scotia. Vol. II., pt. 1, p. 97.

The Production and Preservation of Lakes by Ice Action. Vol. II., pt. 3, p. 70.

The Glacial Period in North America. Vol. II., pt. 4, p. 91.

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On the Loess of the Rhine and the Danube. Vol. XIV., 1877, p. 67.

On the Glacial Period in the Southern Hemisphere. Vol. XIV., 1877, p. 326.

On the Discovery of Stone Implements in Glacial Drift in North-America. Vol. XV., 1878, p. 55.

On the Superficial Gravels and Clays around Finchley, Ealing, and Brentford. Vol. XV., 1878, p. 316.

ADDRESS TO THE MEMBERS OF THE TYNESIDE NATURALISTS' FIELD CLUB,

READ BY THE PRESIDENT, DENNIS EMBLETON, ESQ., M.D., F.R.C.P., AT THE THIRTY-THIRD ANNIVERSARY MEETING, HELD IN THE MUSEUM OF THE NATURAL HISTORY SOCIETY, NEWCASTLE-UPON-TYNE, ON FRIDAY, MAY 2ND, 1879.

LADIES AND GENTLEMEN,—In March, 1850, I had the honour of being appointed President of this Club, and now, after the lapse of twenty-eight years, I have been the recipient of the same honour. In return I can only say that I look upon this as a mark of your kindness and not of my deserts, and I beg of you to accept my warmest acknowledgments for this repeated honour.

In the thirty-three years during which the Club has existed it has grown in numbers and flourished in importance, and, what is very gratifying, it has, by the judicious management of our Treasurer and Secretaries, been steered clear of financial difficulties, and has at the present time a respectable balance in hand.

From the year 1846 to 1864 the Tyneside Club had of itself published six volumes of Transactions, and since the latter date there have been published by the co-operation of the Club and the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, seven volumes, forming a new series. The quality of these contributions to local Natural History has been duly appreciated by Naturalists at home and abroad.

As we followed the example of the Berwickshire Naturalists' Club so our example has contributed to the means of calling into existence numerous other and similar Societies in many parts of Great Britain.

But I must not longer delay bringing under your notice the customary annual account of the past year's doings of the Club.

The FIRST FIELD MEETING of the year was held on the 15th of May, at Axwell Park, by the kind permission of Sir Henry A. Clavering, Bart.

The weather, which had for several days been most unpropitious, severe storms of lightning, thunder, and heavy rain having

passed over the northern counties from the south-west, appeared on the morning of the meeting to be more than usually threatening, and rain was falling, when about twenty members left the Central Station at 12·30, and on arriving at Swalwell the party numbered twenty-three. Under the guidance of Messrs. Thomas and George Thompson, the former one of our Secretaries, the party took the road to Axwell Park, which was entered by the north-east gate.

The park, which though within half-a-dozen miles of Newcastle, was now for the first time visited by the Club, was seen in all its early spring beauty; its surface is delightfully diversified with undulating hill, dale and plain, wood and water. The woods, of considerable extent, contain timber of much beauty and magnitude; many huge Beeches, a number of very old gnarled Oaks, of which one was of noteworthy size and form, an ancient Crab tree, and a venerable Mulberry tree, whose aged arms were carefully supported, arrested the attention and called forth the admiration of the spectators.

The Oak specially noticed was figured in our late fellow-member's, Mr. George Clayton Atkinson's "Remarkable Trees of Northumberland and Durham," to which I would refer for notice of the finest trees in Axwell Park.—*Vide* Nat. Hist. Trans., Vol. V., pp. 66–68.

The modern stone mansion, "built by the late Sir Thomas Clavering, from a chaste and elegant design of Payne" (the architect of High Gosforth also), is stately. "It stands open, but not unsheltered, in the midst of a soft-wooded park, which slopes gently to the Derwent, and is diversified with swells and undulations of ground." It is said to contain a number of artistic gems.

"The old family house was called Whitehouse, and stood at the distance of half-a-mile to the westward of the present mansion."*

The stabling, the grounds, and gardens are arranged in the most approved modern style and taste; the greenhouses and

* Hutchinson's Hist. of Northumberland.

hot-houses were to the visitors sources of much pleasure, filled as they were with choice exotic flowers and fruit.

The views from the high grounds embraced the valley of the Tyne from Heddon Banks to Newcastle, and a considerable extent of the tributary Derwent vale. The sweet grassy slopes, extending from the mansion down to the beeches bordering the lower Derwent, showed a rich pasturage of the most delicate vernal green, to which roaming herds of cattle and of Fallow Deer added life and interest.

The rain had ceased, and the sun shone out brightly, so that our members could thoroughly enjoy the many charms of the place, and the wonder was that so near to the smoke of a large town such a beautiful place could so long have remained unvisited. Very soon, however, fresh gathering black clouds driven by the south-west wind warned the party not to linger, and before they could reach the shelter of Mr. Battensby's cottage, at Hag Hill, the storm burst upon them; short, however, was its duration, and they were soon enabled, in clear and sunny air, to proceed by way of the sulphur spring, most appreciated in its immediate neighbourhoood, but worthy of wider fame, to Winlaton Mill. Thence they rambled on to Scar Bank, where, from the lofty abrupt edge of a precipitous bank, they saw at their feet an amphitheatre of verdant haugh land, encircled by the Derwent, at the foot of wooded heights; beyond this was the viaduct of the Consett Railway spanning the valley, and the celebrated woods and house of Gibside.

On returning to Winlaton Mill, they witnessed, with the cordial permission of the proprietors, in the works of Messrs. G. Miller and Co., the interesting processes of the re-working up of scrap iron, and rolling it into long rods, for the manufacture of bolts, horse shoes, etc.

On their arrival eleven members only of the party sat down to a homely but substantial dinner and tea at "The Golden Lion," where, owing to the disappearance before dinner of the majority of the party, nineteen dinners had to be paid for by the Secretary out of the funds of the Club.

After dinner, Mr. Thomas Thompson, the Secretary who accompanied the party, read a short notice of Axwell Park and the family of Clavering, and afterwards moved a vote of thanks to Sir H. A. Clavering, for his kind permission to visit the park and grounds, a vote which was carried by acclamation. Five new members were elected. The party then returned home from Swalwell by train, having had a most pleasant half-day's excursion.

During the walk from Swalwell to Axwell a heron was seen in the marshy ponds between the latter place and the Tyne. In passing through the grounds of Axwell the familiar notes of the Chiff-Chaff, Blackcap-Warbler, Redstart, Willow-Wren, Cornerake, Sedge-Warbler, Starling, and other birds were most pleasing to the ear. Mr. Battensby, whilst he sheltered the members, exhibited a very interesting collection of insects and of the eggs of Land- and Sea-birds.

Mr. George Bulman, of Corbridge, a member of the Club, mentioned to me, during our ramble, that the past winter had, for some reason not then ascertained, been very fatal to Bees on Tyneside, and that one Bee-keeper in particular at Corbridge had lost seventeen hives, others had experienced a partial and some a total loss of Bees, and the gardener at Axwell stated that they also had lost some hives. It will be remembered that the preceding summer had, on the whole, been cold, uncongenial, and therefore unfavourable to flowering. The Bees at Corbridge had been carefully fed during the winter, and in the hives of the dead Bees a fair supply of artificial saccharine food, that had been given to them, was found. The previous winter had not been exceptionally cold, but changeable and stormy. Mr. Bulman, by letter, further stated afterwards that "it is generally considered that the wet weather of last summer produced some disease among the Bees which rendered them unable to bear the cold weather of the winter. Some Bee-keepers, however, assert that the Bees got something off the Oak-trees last summer which produced disease and death amongst them."

On the banks and braes the spring beauties of the Flora were everywhere conspicuous, the Whin, *Ulex Europeus*, and the

Broom, *Sarothamnus scoparius*, were, in sheltered places, in as full bloom as Linnæus himself would have been delighted to witness: the Bird-cherry or Heck-berry, *Prunus padus*, and the Lilac, *Syringa vulgaris*, in the hedges and gardens, were charming.

In the woods and on the slopes were found the usual early flowers common to the district, as the Primrose, the Starwort, *Geranium sylvaticum*, *Arum maculatum*, Speedwell, *Galium verum*, Buttercups and Daisies many, *Viola sylvatica*, scarlet Pimpernel, and at least three species of *Cruciferæ*. The wild Hyacinth was in flower, but the Wood Anemone was almost done.

The scene, the time of year, and the weather, reminded one of Spencer's beautiful stanza on Spring:—

> "So forth issew'd the seasons of the yeare;
> First lusty Spring, all dight in leaves of flowres
> That freshly budded and new bloosmes did beare,
> In which a thousand birds had built their bowres,
> That sweetly sung to call forth paramoures;
> And in his hand a iavelin he did beare,
> And on his head (as fit for warlike stoures)
> A guilt engraven morion he did weare;
> That as some did him love, so others did him feare."

The weather during the month of May was very changeable, at times cold, at times rather warm; wet and foggy days alternated with dry ones, and thunderstorms were frequent all over the kingdom.

There was a partial plague of grubs, larvæ of *Tipula oleracea*, among the cereals, particularly the oats, at Gosforth, and in various parts of Northumberland, west and north of Newcastle, and the same was complained of also in the south of England. These larvæ lie, in winter, in the ground; they begin to be active in spring and attack the young green sprouts as soon as they appear, feeding on them. Caterpillars, too, troubled fruit trees much in May.

It was remarked generally in the middle of May that the Oak was much further advanced in foliage than the Ash, so that if the old saw prove true we are to have a fine, or at all events not a wet, summer. The adage runs thus:—

"If the Oak's before the Ash
You will only get a splash;
If the Ash precede the Oak
You will surely have a soak."

It has this year held good.

The SECOND FIELD MEETING was held on Monday and Tuesday, the 10th and 11th of June, at the High Force, Teesdale. One section of members of the Club left Newcastle at 5.10 A.M., another at 10.35. The first day proved favourable for the excursion. The earlier section, after viewing the Force, went westward by Widdy Bank and Falcon Clints to Cauldron Snout, returning by Widdy Bank Fell to the Tees in front of Cronkley Scar, having gathered many of the rarer plants of the locality, these growing mostly a good way above the Force.

The later section were not so fortunate, for time did not allow them to walk far; they went down to enjoy the sight of the Force, which was then far above its summer strength; there, among the rocks, and in the beautiful pine wood on the Durham side, they spent some time, and then dispersed in various directions until dinner, at which the whole party, numbering about thirty ladies and gentlemen, assembled, and were well provided for, though so large a party was not expected, by Mr. and Mrs. Walton of the comfortable High-Force Inn. The mountain air gave an appetite, which was the best sauce to the repast. After dinner seven new members were elected, and as no paper or important communication was forthcoming the whole party sallied out again to investigate the rocks and cliffs on both sides of the river. Their search however was not very successful.

In the evening the difficulty was for Mrs. Walton to find sleeping accommodation for the members of the Club and other visitors; she was, however, by the aid of the empty bath turned into a bed, enabled to satisfy every one.

Next morning it was raining heavily from a dull sky, but, in good hope, a plentiful breakfast was discussed. Some kept indoors and talked of Natural History, others more hardy went out and travelled far, despite the mountain wind and rain, and were repaid by the acquisition of some good botanical specimens. An

excursion, which had been projected to Cronkley Scar, to the Slate-Pencil Mill, and to Maize Beck, had to be abandoned. It had been raining the greater part of the night and it went on pouring, as it often does among the hills, till the afternoon, the result was that the Tees rapidly began to swell, the Force increased in magnitude and was soon seen in all its grandeur, heavy masses of turbid water filling up completely the lateral depressions and tumbling from above the central rock a height of seventy feet, were precipitated into the deep basin below with a loud thundering noise and reverberation, the spray and vapour springing up above a hundred feet from the boiling, eddying abyss. The Force was acknowledged to be, under these circumstances, a cataract of great magnitude and majesty, and is perhaps scarcely equalled by any in Great Britain. It is certainly superior to many much praised Continental falls. Visitors who see it in its quiet summer condition and when there has been a dry season, are apt to turn away with a sneer and say it was not worth coming so far to see.

The ancient Juniper forest, on the Yorkshire side of the Force, is itself well worth a visit, covering as it does many acres of land; its origin was perhaps anterior to the times of the Ancient Britons.

It is an old saying, that "If it rains at two you never know what it will do;" on this occasion, however, the rain ceased before four, when the party drove down to Middleton-in-Teesdale, and returned home by train to find that the heavy rain had not fallen only in the Vale of Tees.

The following list of Teesdale plants has been kindly given to me by Mr. Howse; it is much more copious than that in Vol. II. Transactions Tyneside Field Club, but still not so exhaustive of Teesdale Botany as the Catalogue Vol. II. Natural History Transactions Northumberland, Durham, and Newcastle-on-Tyne.

The names marked thus * were observed by members of the Club on June 10th and 11th.

FLOWERING PLANTS.—DICOTYLEDONS.

Thalictrum alpinum, T. flexuosum.

**Trollius Europœus;* abundant and in full flower.

Draba incana.

Thlaspi alpestre.

**Helianthemum vulgare.* *H. canum* (Cronkley Fell).

Viola sylvatica, var. *alba.* *V. lutea.* *V. arenaria.*

**Arenaria uliginosa.* *Alsine stricta.*

**Geranium sylvaticum.* **G. pratense.*

Polygala austriaca (near Maize Beck).

Dryas octopetala (Cronkley Fell).

**Potentilla fruticosa.* *P. alpestris.*

Rosa Sabini, etc., etc.

Pyrus Aria.

Epilobium alsinifolium.

Sedum Rhodiola (High Cup Nick). *S. Telephium*, var. *purpureum.* *S. villosum.*

**Saxifraga azoides.* **S. hypnoides.* *S. Hirculus* (on Whitmoss). *S. stellaris.* **S. tridactylites.* *S. nivalis.*

Peucedanum Ostruthium.

**Galium sylvestre.* *G. boreale.*

**Gnaphalium dioicum.*

Hieracium iricum. *H. pallidum.* *H. Anglicum;* and nine other species said to have been gathered.

Vaccinium Vitis-idæa.

Arctostaphylos Uva-ursi

Pyrola minor.

**Primula farinosa*, (and var. *alba* not seen).

**Gentiana verna.* **G. amarella.*

Myosotis alpestris (on Mickle Fell).

**Bartsia alpina.*

Melampyrum pratense, not common. *M. sylvaticum* (below High Force, on an island near Winch Bridge).

Armeria maritima.

**Polygonum viviparum* (common).

**Juniperus communis.*

MONOCOTYLEDONS.

**Orchis mascula.*

**Gymnadenia albida.*

Convallaria majalis.

**Tofieldia palustris.*

Juncus triglumis.
Schoenus monoica.
Carex capillaris.
Scirpus pauciflorus.
Sesleria cærulea.
Poa Parnellii.
Elyna caricina.

FLOWERLESS PLANTS.

Equisetum variegatum. *E. umbrosum.*
Botrychium Lunaria.
Polypodium calcareum.
**Allosorus crispus.*
Asplenium viride.
Cystopteris fragilis.
Polystichium lonchitis; probably extirpated.
Woodsia ilvensis; very rare, not gathered of late years.

On the 5th of June, at a monthly meeting of the Bishop Auckland Naturalists' Club, recently established, it was unanimously resolved (on the reception, through Mr. Douglas, of Witton-le-Wear, on behalf of Mr. Duff, the President, of twelve volumes of the Transactions of the Tyneside Naturalists' Field Club, voted at their last annual meeting, in recognition of a pleasant fraternization with the Auckland Club, on the occasion of their Fifth Field Meeting, near Bishop Auckland, in September last,) that the best thanks of the meeting be forwarded to the Tyneside Field Club for their gift of twelve volumes of Transactions, with the request that their President, for the time being, become an Honorary Member of the Bishop Auckland Naturalists' Field Club. On the 9th of March, 1879, your President was duly elected an Honorary Member, and returned thanks for the same.

As regards the weather prevalent in May and June; up to the 20th of June it continued to be uncongenial, wet and cold, with thunderstorms, heavy rains, and consequent floods, in various parts of England, and it was only at this date that vegetation in our district began to get fully out. The succeeding week was clear and very hot, and, the ground having previously been saturated with rain, crops of all kind shot up with great rapidity, and

haymaking began as usual in the last week of the month, the Newcastle Race Week.

During this hot weather the thermometer in London stood at 92·5° in the shade and 145° in the sun, a tropical temperature; at Newcastle the maximum heat was 82° in the shade.

On the 26th and 27th, being at Wooler, Yeavering Bell, and Chillingham, at a meeting of the Berwickshire Club, we experienced a heat on the flanks of Cheviot, where there is no shelter, which was overpowering.

On the 28th came two days' heavy refreshing rain, succeeded by fine weather.

I was informed at Wooler that during last winter they had quite as serious a loss of Bees as had been experienced in Tyneside.

The THIRD FIELD MEETING took place on Wednesday, July 3rd, a charming day, at Ripon and Studley Royal. The Club went, as at the previous meeting, in two parties; the earlier left at 5·10 A.M., and on arrival at Ripon breakfasted at the capital inn "The Unicorn," and afterwards went over the Minster; their inspection over, the later party, having left home at 8·30, arrived, and had the pleasure of being accompanied over the Minster by intelligent vergers full of information about the history and architecture of the edifice. Perhaps the most interesting part of their visit was that when they were taken down into the crypt under the nave. This crypt at once reminded several of the party of that under Hexham Abbey. These two crypts and that at Repton, Derbyshire, are the only three Saxon crypts that are known to exist in England. The two northern date from about 680 A.D., before the time of Bede, and were built by Wilfrid, at that time Bishop of the whole country north of the Humber. In the year 674 the Church of St. Peter, at Monkwearmouth, was built by Benedict Biscop, and in 685 the Church of St. Paul, at Jarrow, was dedicated.—(See Trans. Architect. and Archæol. Soc. of Durham and Northumberland, 1862.)

Through the north wall near the eastern end of the Ripon crypt is an irregular, rounded aperture, just big enough to allow

of the passage horizontally of a moderately-sized person from the ambulatory into the chapel. It is absurdly enough called Wilfrid's Needle, and there still exists in connection with it a ridiculous superstition, namely, that women passed through it become endowed with certain fortunate qualities which are to ensure their future advancement and happiness. Members of the Club actually saw two young unmarried ladies passed through from the lateral passage, evidently to their great satisfaction, and they received the congratulations and good wishes of their friends on the occasion!

The united parties of the Club after leaving the Minster proceeded by carriage to Studley Royal and the ruins of Fountains' Abbey. The park contains 650 acres, beautifully diversified with hill and dale, wood and water, the brook Skell running through it supplying the lakes and waterfalls. Many of the trees, especially some pine trees, are of magnificent growth, and the avenue of lime trees is very fine. The abbey was founded by Cistercian monks, of the order of St. Benedict, in 1132; it is partly of Norman and partly of Early English architecture, and the buildings are of great extent. Some old yew trees near it are said to have been planted by the monks, one of these looks a striking and venerable ruin; it is hollow, but still living and growing on its exterior. For views and descriptions of the abbey and its romantic surroundings I would refer to the good Guide Books to be had at Ripon, and Mr. Sopwith's work on the Abbey.

Swans and a variety of Ducks enlivened the waters of the Park, and among the wild birds were seen and heard the Swift, Chiffchaff, Starling, Thrush, Bullfinch, Redstart, Wagtails, pied and grey, Willow Wren, Green Linnet, Wren, common and golden crested, and Long-tailed Titmouse.

All available time was spent among the beauties of this, one of the most delightful spots in England, and then the party returned to an excellent dinner at "The Unicorn."

Six new members were elected after dinner, and the Club returned home from Ripon by the 6.40 train.

A special FIELD MEETING was held for three days, namely, the 18th, 19th, and 20th of July, at Whittingham and neighbourhood. Fifteen members availed themselves of this opportunity of examining the physical features, geological phenomena, and botany, of a considerable portion of the eastern and southern flanks of the porphyritic hills which form so marked a character of this part of Northumberland.

They left Newcastle by the 8.30 A.M. train for Alnwick, where they were provided with conveyances.

The weather was remarkably fine, but much too hot to allow them to carry out to a desired completion the details of their somewhat ambitious programme.

On the first day, after a most pleasant drive from Alnwick through Eglingham to New Bewick, they left their carriages at Rosedene and walked through the shady wood along the precipitous bank of Roddam Dene, examining in passing the enormous section of conglomerate (one hundred feet or more in thickness) which forms the peculiar and interesting feature of that locality; at the top of the Dene where the burn enters it and where a road crosses, the conglomerate appears capped with bedded, red coloured, sandstone, beautifully undulated, and in many layers, with strongly defined ripple marks.

Leaving Roddam Dene, near Calder, under the guidance of their fellow member, Mr. W. Topley, they followed a moorland track round the base of Dunmore to Greave's Ash and Linhope Burn, abandoning the attempt to climb the steep side of Hedgehope, though apparently so near and inviting. After an examination of the remains of the ancient British town and forts at Greaves Ash, at this time much covered with grass and tall bracken, and following the ancient road winding round the hill side to the west and north, they reached Linhope Burn, rousing up by the way a fine old Fox. One division of the party went up to the romantic Linn and complacently cooled their heated frames in the brilliant pool, another resorted to a neighbouring farm house for drink which "cheers but not inebriates," and were soon rejoined by the bathers who participated heartily in their potations.

The farmers were all making hay while the sun shone with its full summer force, the crops being plentiful and good.

The party passing down the valley of the Breamish were glad to resume their vehicles at "Ingram Glidders," and so drove onward by Powburn and Crawley Dene to head-quarters at the Castle Inn, Whittingham, where half exhausted nature was plentifully restored.

The only plant deserving special notice, though all the ordinary wild flowers were abundant, but much less varied than in Upper Teesdale, was the "Wood Vetch," *Vicia sylvatica*, "not uncommon," says Bentham in his Handbook of the British Flora (1858), "in Scotland, and occurs in most hilly wooded districts of England and Ireland." It was seen in luxuriant perfection in Roddam Dene, hanging from a high brae many feet down towards the path. It was met with again once or twice afterwards in Crawley Dene. The Wood Vetch as seen during this excursion quite justified what Sir Walter Scott has sung of it growing by the banks of Greta, in Canto IV. of "Rokeby."

> "Yon tufted knoll, with daisies strown,
> Might make proud Oberon a throne,
> While, hidden in the thicket nigh,
> Puck should brood o'er his frolic sly;
> And where profuse the wood vetch clings
> Round ash and elm, in verdant rings,
> Its pale and azure-pencilled flower
> Should canopy Titania's bower."

The second day's drive was in a westerly direction, by Eslington Hall, Netherton, and Biddlestone Edge, to Alwinton and Linbridge, where, by a succession of small but impetuous and boiling falls, the Coquet bursts from its porphyritic barrier and runs through a winding and gradually widening valley on its way to Harbottle. The deep clear pools of this justly celebrated stream afforded, every now and then, opportunities for a cooling bath and invigorating swim, which gave at least a temporary relief from the almost tropical heat of the sun. The party lunched in the shade of the banks of the Usway, a little above Shillmoor, where this burn joins the Coquet. During their drive to Alwinton they heard the Corncrake in a field mown the day before.

On their walk up the Coquet they found the nest of a Water Hen, *Gallinula chloropus*, with six eggs, built in a clump of rushes by the margin of a pool, and a Wild Duck, with one small Duckling. The Dipper, *Cinclus aquaticus*, was common, and the Ring Ouzel, *Turdus torquatus*, the Curlew, *Numenius Arquata*, Snipe, Grouse, Partridge, and numerous Wood Pigeons. The Heron was bold and conspicuous at Eslington. Squirrels were seen in the woods, and abundance of Rabbits. Among plants were found the Maiden Pink, *Dianthus deltoides*, the Golden Rod, *Solidago Virgaurea*, the Alpine Epilobium, and the little *Sedum villosum*. There is a list of several of the rarer Coquetdale plants by Professor Oliver, of Kew Gardens, to be seen in Vol. III., p. 68, of Trans. Tynes. Naturalists' Field Club, to which members are referred for further information.

After a refreshing tea at Alwinton, and a pleasant drive back through the green lanes traversed in the morning, the party returned to a late dinner at "The Castle" in the cool of the evening, a repast much needed and thankfully enjoyed after their exertions in the heat of a long day.

The third day's excursion began by a short visit to Eslington, where, by the kind permission of the Earl of Ravensworth, the party were shown the principal rooms of the mansion with their chefs d'œuvres of paintings, and wandered through the gardens and grounds so much loved by the late Earl, whose classic taste was everywhere conspicuous—a visit this to the Club of much pleasure.

Callaly Castle, formerly the seat of the Claverings, the owners also of Axwell Park, now the property of Major Browne, was the next bright spot visited, leave having been politely granted by Major Browne, through Mr. Tate, his agent. Here, as at Eslington, the woods, the park, the lake, the gardens, were much admired, the gardens being in their perfect summer splendour with the roses in full bloom.

From Callaly they drove round by Lorbottle to the west side of Thrunton Crags, where, leaving their carriages to return to Whittingham, they scaled the heights. Beneath them lay the whole rich vale of Whittingham to the north and west, and on the

opposite side, standing out from the bare moorland, was the principal elevation of the Crags, where once the Falcon, and still the Raven, annually breeds. The visitors had not time to enter the Wedderburn or the Priest's Cave, but passing along the northern edge of the Crags they picked up the Sundew, *Drosera rotundifolia*, which, together with the boggy ground, was almost dried up. Then, refreshed by the cool breezes of the Crags, one hundred feet high, they plunged into the deep woods clothing the northern escarpment, and revelled in the luxuriant crop of Bleaberries, *Vaccinium myrtillus*. Time pressed however, and by devious ways they returned to their comfortable hostelry and obliging hostess, Miss Dunn (whose death we have since been sorry to see recorded in the newspapers). Here, as on the previous days, the party, numbering fourteen members, were well and plentifully catered for and diligently waited upon. After dinner three new members were elected, after which the majority of the party drove back to Alnwick, by Lemmington Bank, and in due time regained Newcastle.

This Special meeting was one of special interest and of special pleasure. The weather was unusually hot, the days clear, the nights moonlighted; Wild Roses and Meadow-Sweet lining the roads, and fields of White Clover, perfumed the air for miles. Roses of all kinds, mingled with Woodbine, clustered on the porches and fronts of cottages and in gardens; new mown hay on the higher grounds lent its fragrance to the fresh and bracing air; and altogether the scene was all that fancy could have painted, and will long remain a pleasing recollection in the minds of all the party.

We were greatly indebted to Francis Charlton, Esq., and Mr. Topley, fellow members, for a variety of information respecting the different seats of the landed proprietors, and the topography and geology, as well as the history, of the district of Whittingham. Spenser's picture of Summer was at this time appropriate:—

> "Then came the iolly Summer being dight
> In a thin silken cassock coloured greene,
> That was unlyned all, to be more light;
> And on his head a girlond well beseene

He wore, from which as he had chauffed beene
The sweat did drop; and in his hand he bore
A boawe and shaftes, as he in forrest greene
Had hunted late the libbard or the bore,
And now would bathe his limbes with labor heated sore."

It is difficult to pass over a place like Whittingham, Saxonice Hwittingham, one, both politically and ecclesiastically, of such great historical interest, to say nothing of its local charms, without some fitting notice beyond what has been said of the Castle Inn. It is said to have been anciently called Twiford, from there having been two fords there over the river Aln, and there are now two bridges where those fords must have been; one of stone, for the high road, running from south to north, through the village, the other, for foot passengers, of wood, a little higher up, leading from that part of the village and tower, south of the river, to the church, which stands west and north.

The village itself is about a mile and a half west of the Roman road called the Devil's Causeway, which crosses the river close to the Bridge of Aln.

In reference to Whittingham, alias Twyford, we find in Kemble's "The Saxons in England," Vol. II., p. 244, the following passage of interest, in a list of Witenagemóts known to have been held under Saxon rule.

"Ecgfrid of Northumberland, A.D. 684. There was a gemót at Twyford on the river Alne, and Cuthberht was elected Bishop of Hexham." Bede, Hist. Eccles., IV., 28." *See Note A supra.*

If it be true that the place under notice was called Twiford in 684, it must have changed its name before the middle of the next century, for Ceolwolph's name for it was Hwitingaham.

It has been said that in the neighbourhood of Whittingham was the celebrated place called Brunanburh, where a great battle was fought and won by Athelstan against the invaders of Northumberland. Kemble, however, says, in a list of Saxon towns given in "The Saxons in England," Vol. II., p. 551, Append. C., "Brunanburh, Brunanbyrig, and sometimes Brunanfeld. The site of this place is unknown, but here Ethelstán and Eádmund defeated the Scots. Chron. 937;" others say that the Danes were

entirely defeated there, and that five sea kings, seven jarls, and an immense number of warriors were slain A.D. 937.

The church of Whittingham is generally believed to have been founded by King Ceolwolph in the early part of the eighth century, and is undoubtedly of Saxon origin, though it appears to have had additions and repairs in the Norman and Early English times, and to have been "restored" and injudiciously altered in 1840.

Almost the only remaining piece of Saxon work is the lower part of the tower, of rather rough masonry, "with long and short quoins." In the east wall of its interior are two rude arches, one above the other, standing where they were viewed by King Ceolwolph and St. Cuthbert more than a thousand years ago.

Symeon of Durham says, relative to the King, "Intravit autem Lindisfarnense Monasterium Sancto Cuthberto secum conferens thesauros regios et terras, id est Bregesne (Brainshaugh) et Werceworde (Warkworth) cum suis appendiciis, simul et ecclesia duam ibidem ipse ædificaverat, alias quoque quatuor villas Wudecestre, (Woodhorn) Hwitingham, Eadulfingham (Edlingham) et Eagwlfingham (Eglingham). (Tate, Proc. Berwicksh. Club, Vol. IV., p. 220.) *See Note B supra.*

There were two Pele towers once in Whittingham; one on the north side of the Aln and west of the church, and is now the Vicarage; the other stands on an elevated spot on the south side of the river; this is still a strong place, vaulted, with thick walls, and has, by the munificence of "Maria Susannah, Lady Ravensworth, been repaired and embellished for the use and benefit of the deserving poor. A.D. 1845."

For a notice of two remarkable trees at Whittingham see Nat. Hist. Trans., Vol. V., p. 95.

I have noted, under the head of weather, that, since July 20th, and with the exception of a few beneficent showers on the 27th and 28th of July, it has been of the finest character, and that our district has not been visited by the thunderstorms and rains that have occurred both north and south of us. The hay has been an abundant crop and well won. The grain crops promise a prolific

harvest, but the turnips and the mown grass feel the effects of want of rain exposed as they are daily to intense heat. Nightly dews, however, have been heavy, and fogs at sea and by the coast have been frequent.

The disease among Grouse is again prevalent in certain districts, though less so than 1877. The cause does not seem to have been discovered, and no remedy has been found; meanwhile the rents of moors have in consequence greatly fallen, and the Moor-proprietor begs of the Naturalist to tell him all about it. Would it not, in every respect, be better, but for themselves especially, that the game preservers should employ some competent person, and pay him handsomely, to discover the cause, and if possible apply a remedy, instead of waiting to see if peradventure, by the next year, the pest may have disappeared?

It was some time ago suggested that the Coalowners should combine to furnish a moderate yearly sum of money to give employment to some fitting person to collect the fossils met with in the pits, and if this suggestion had been carried into execution we might by this time have had a series of vegetable and animal remains unequalled in the world. These bad times forbid the hope that this suggestion should now be realised.

Our ingenious cousins in the United States have discovered that "the busy Bee" is too slow, wants help, and would 'move on' faster, if it did not spend so much time in making wax to construct its comb preparatory to laying up honey. They have therefore conceived the idea, and brought it to a practical result, of manufacturing "Comb Foundations," and these are now making their way in England. The only material used is pure yellow beeswax; this is made to pass through a sort of small rolling mill specially constructed, and is thus converted into thin sheets (in England about one-sixteenth of an inch thick) of convenient size, on each side of which is at the same time impressed the exact hexagonal pattern of honeycomb required. On these foundations, introduced into the hives, the Bees begin at once to build up their cells, as if conscious of the convenience, and thus, being saved much time and labour, begin to store their honey much

earlier than they could in the primitive way, and so the Beekeepers sooner get the honey—and the money. When the comb is taken the honey is driven out by centrifugal force applied by proper mechanism. A figure of the rolling machine is given in the last June number of "The Beekeepers' Magazine." (A. J. King & Co., 61, Hudson Street, New York.) My attention was called in July last to this subject by the Rev. Canon Whitley, Vicar of Bedlington, to whose kindness I owe the perusal of the above number, and thereby an item of information that may be interesting to some of our members. Comb foundations, had they been known here, and made use of last year, might have saved the northern Bees much time and toil, as the summer was late and unfavourable for flowers.

The Fourth regular Field Meeting was held on the 5th of August, at Crag Lough and the adjacent parts of the Roman Wall. On this occasion I was unable to be present, but Mr. T. Thompson, one of our Secretaries, who was of the party, has obligingly furnished me with the following account of the day's proceedings.

The members of the Club left Newcastle for Bardon Mill by the train at 6·25 A.M., and, after breakfast at the Greyhound Inn, went up by the banks of Chineley Burn (in a wood, called Cockton Wood, west of which burn, *Pyrola minor*, *Carduus hetrophyllus*, and *Rubus saxatilis* were once found) to the station of Chesterholm, the Vindolana of the Romans. There they inspected the remains of the station, the celebrated Miliarium, and the collection of Roman remains, inscribed stones, etc., in the adjacent cottage residence, once the habitation of the Rev. A. Hedley. They next proceeded to Crag Lough, where many forms of *Diatomaceæ* may be obtained, and where, among the rocks at the base of the basaltic crags, the Parsley Fern, *Allosorus crispus*, grows abundantly; they then walked along the line of the Wall to Sewing Shields, and visited the large station of Borcovicus, examining the gateways, the junction of the station with the Wall, and the excavations. After this they descended to

Haydon Bridge, and dined at the Anchor Inn. Five new members were elected.

Notwithstanding the great inclemency of the weather on the previous day, the fifth was all that could be desired for the excursion, with which all were delighted.

The following Butterflies were noticed during the walk: the Painted Lady, the Small Tortoiseshell, the Meadow Brown, the Red Admiral, and the Small Heath; and the undermentioned plants were seen: *Helianthemum vulgare, Viola tricolor, Epilobium angustifolium, Solidago virgaurea, Calluna vulgaris, Erica cinerea,* and *E. tetralix, Gentiana campestris, Thymus Serpyllum, Polypodium vulgare, P. dryopteris, Allosorus crispus, Aspidium aculeatum, A. filix-mas, Asplenium Trichomanes, A. Adiantum-nigrum, A. Ruta-muraria,* and *Cystopteris fragilis.*

Of Birds were observed a few Curlews, Bald Coots, Black-headed Gulls, Chimney Swallows, Wheatears, Whin Chats, and Kestrels.

The members returned from Haydon Bridge by the 7·54 train.

On Friday, the 23rd of August, the FIFTH FIELD MEETING was held at Prudhoe, Ovingham, and Whittle Dene, and proved to be a most enjoyable one in very fine weather.

A party of seventy ladies and gentlemen, several of whom came from Sunderland and Shields, left the Central Station at 10·20 A.M., and on arriving at Prudhoe Station proceeded to the Castle, the ruins of which, under the polite guidance of C. U. Laws, Esq., Agent of His Grace the Duke of Northumberland, were minutely explored.

An hour was pleasantly spent in examining the gateways, towers, and other defences, including the once deep fosse on the south side, now transformed under tasteful hands into a delightful garden. The keep, which rises out from the midst of an accretion of modern buildings, more remarkable for domestic convenience than architectural beauty, dominates the whole enceinte, and affords from its summit charming views of the valley of Tyne. The most curious part of this fortress is the small chapel over the inner gateway, at the east end of which is one

of the very few ancient Oriel windows, dating it is said from circa, 1300. Over the chapel was formerly a chamber, the supposed residence of the officiating priest.

For the history of this once important post, which is supposed to have been successively occupied by the Britons, Romans, Saxons, and Normans, I must refer the Club to the County Histories and Handbooks.

From Prudhoe Castle the Naturalists, crossing the Tyne by the ferry boat (a bridge there being a great desideratum), visited the village and the church of Ovingham. The tower of this church, like those of Corbridge, Bywell, Billingham, and Whittingham, is of Saxon architecture, and is said to be probably that of the church of Uulfeswell, where a Bishop of Hexham was consecrated in 731 (see Church Reports in the Trans. Archit. and Archæol. Soc. of Durh. and Northumb., No. III.) The church (restored) is of Early English, with beautiful lancet widows.

Our first President, Ralph Carr-Ellison, Esq., believes that the Saxon name of the village "would be Offinga-ham," literally, "of the Offings the home." See Vol. I. of our Club's Transactions.

The first meeting of our Club, on the 20th of May, 1846, was at Ovingham, and then, as now, we visited, at the west end of the church, the burial place of Thomas Bewick, who died Nov. 8, 1825; his wife also is buried there, and his brother John, who died in 1795. On the south side of the church there is a tablet to the memory of Robert Johnson, an artist, and a pupil of Bewick's. Mabel Carr, the mother of George Stephenson, the Railway Engineer, and her family lived and died at Ovingham, and there is a family tombstone of theirs against the east end of the chancel.

The members, by the kind permission of the Rev. J. Smithard Hind, passed from Ovingham to Whittle Dene. On arriving at the Mill they were agreeably surprised at the hospitable and plentiful preparations that had been made for their refection by Mr. Hind. Under umbrageous oaks and by the well of fine water, a specimen of which is said to have been sent up to the House of Commons as Whittle Dene water before the Company got their Act, the repast was thoroughly enjoyed and thanks rendered to

the reverend caterer. This well is perhaps the original Uulfeswell or Wolfs-well. Mr. Hind then accompanied the party up the Dene and pointed out its peculiarities. It is a dene of picturesque and varied beauty, and the Water Company have not altogether drained off its water. Mr. Hind pointed out a very fine old Larch tree, one hundred and three feet high, and having a circumference of nine feet three inches at five feet from the ground. It is a tree worthy of being photographed as one of the Remarkable Trees of Northumberland.* Some of the party pushed on to the Waterworks, others strolled about the Dene; all assembling at last at the well-known Boat House, near Prudhoe Station. In the school-room near at hand they relished the Tea bountifully supplied by Mr. Johnson.

The principal features of the excursion were summarised by the President, and as there were no papers to be read or new members to be elected, the whole party left by the last train for home, after hearty votes of thanks had been passed to Mr. Laws and Mr. Hind.

At this time of the year the woods are silent, the season of incubation being over, and very few birds were seen.

The Reed Mace or Bulrush, *Typha latifolia*, was seen flourishing in the quondam moat of Prudhoe Castle.

In Whittle Dene, in addition to the more common Ferns, the Oak and Beech Ferns were found. The Maiden's Hair was not found, as formerly, on the bridge at Long Lonkin's Hole, and the field to the east of the bridge, in which grew the Adder's Tongue and the Moonwort had been ploughed up. The former habitat of the Lily of the Valley, *Convallaria majalis*, knew it no more, and the *Primula farinosa* in a boggy field above the wooded part of the Dene was out of flower.

This year the Grouse on the Weardale, Teesdale, and Swaledale moors were numerous and strong; no disease was found among them.

The Sixth and last Field Meeting was held on Friday, Sept.

*It is noticed in Vol. V., p. 96, Natural History Transactions Northumberland, Durham, and Newcastle-upon-Tyne.

20th, at Warkworth. Twenty-five members left Newcastle at 10·20 A.M., and arrived at Warkworth Station at 11·46.

Some, by the conveyances in waiting, some, on foot, reached the town of Warkworth.

After the necessary arrangements for dinner and return to the train, the Club proceeded in the first place to the Church, where they were most kindly received by the Rev. J. W. Dunn, the Vicar of Warkworth, who, at great pains and with much patience, pointed out the characteristic features and sketched out the history of this ancient building, which he loves so much, and has done so much to preserve, repair, and restore. In the course of years Mr. Dunn has brought to light many of its peculiarities, which otherwise might have remained hidden. Among them Mr. Dunn has discovered, at the entrance to the chancel, masonry belonging to the chancel of a more ancient edifice than the present one, and apparently corroborative of the statement of Symeon of Durham, that a church was in existence there in A.D. 737, and most probably it was that which Ceolwolph, King of Northumberland, gave as Werceworde—the lands and estate of Warkworth (and other places, as before-mentioned under the heading of Whittingham) to the monks of Lindisfarne when he retired to that Monastery, about the middle of the eighth century. *See Note C supra.* The present Church, Mr. Dunn informed the party, had been erected on the old site by the Normans, with the exception of the south aisle,—the only one, which is of the time of the perpendicular order, whilst the vestry is Early English.

With many thanks to Mr. Dunn for his obliging courtesy the party went on to view the celebrated Castle of the Percies. They were shown over the precincts and the labyrinth of chambers in the lower part of the Donjon. The Keep had been restored by the late Duke of Northumberland, and some rooms at the top fitted up for occasional visits, but, as the party had no order from his Grace to be allowed to enter them, they passed on to the beautiful banks of the Coquet and visited the Hermitage. The Fishlocks and the dilapidated Fish Ladder next claimed a passing notice, after which the party, much gratified with what they had seen and heard, returned to Mr. Bowey's, "The Mason's

Arms," where, at 3·30, they found an excellent and ample repast well served, and enjoyed with sharpened appetite.

The majority of the party left for the early train, those who remained divided into two groups; one walked along the coast to Alnmouth, and caught the last train at Bilton; the other took the road down the right bank of Coquet to Amble and the mouth of the river, and, returning, drove back from Warkworth to the station and joined the former group. They arrived in Newcastle much pleased with the fine day's excursion.

At this late period of the season few notable plants were observed, and the migrating birds had, for the most part, early departed. There were, however, seen a Swallow or two lingering about their summer haunts, "where the air is delicate;" the Redbreast and the Hedge Sparrow were seen by the waysides, and Rooks, Pewits, Curlews, and a few Sandpipers were observed by the river side and the sea banks.

The Rev. J. W. Dunn very obligingly sent to the President during dinner a perfect specimen of the Death's Head Hawk Moth, *Acherontia Atropos*, which was passed round and admired, and the next day deposited in the Museum of the Natural History Society.

No papers were read and no new members elected at this visit.

"Then came the Autumne, all in yellow clad,
As though he ioyed in his plentious store,
Laden with fruits that made him laugh, full glad
That he had banisht hunger, which to-fore
Had by the belly oft him pinched sore;
Upon his head a wreath, that was enrold
With ears of corn of every sort, he bore;
And in his hand a sickle he did hold,
To reape the ripened fruits the which the earth had yold."

The district had been blessed with an early and an abundant harvest, so abundant and so good was the hay that some farmers were reported to have regretted that there was "ne bad hay for the kie." The mown fields were rich in aftermath, the turnips were doing well, and we had fine mild weather up to the end of the first week of November. Then came cold winds and frost,

and on the 11th of that month snow began to fall fast and thick, and the whole country, which was dry and hard, was soon deeply covered, and the cold became severe.

"Lastly came winter, clothed all in frize,
Chattering his teeth for cold that did him chill;
Whil'st on his hoary beard his breath did freeze,
And the dull drops that from his purpled bill,
As from a limbeck, did adown distill:
In his right hand a tipped staffe he held,
With which his feeble steps he stayed still;
For he was faint with cold and weak with eld;
That scarce his loosed limbs he hable was to weld."

From the 11th of November to the 15th of April, a period of five months, we have had a succession of eleven snowstorms, each covering the district for several inches. The storm on the 12th of April (Good Friday) was accompanied in the early morning with lightning, thunder, and hail. Snow fell again to a small extent on the 18th and 19th of April. Lastly, early on the morning of the 1st of May, a heavy shower of snow fell over this district. These storms, separated by two or three short intervening thaws, were severely felt over the whole of England and Scotland, and indeed over the whole of Europe, even to the shores of the Mediterranean; several were accompanied or followed by intense cold, which rendered all out-door work impossible, and occurred at a time when trade in all its branches was in a state of great depression, wages were falling and strikes of workmen going on. Men out of work, with their wives and families, suffered heavily, but never was charity so abundant and warm, or so freely and judiciously distributed, as during this exceptionally long and severe winter.

The Registrar General, in No. 9 of his Weekly Returns of Births and Deaths in London, etc., on March 1st, 1879, reports that "during the past four winter months of November, December, January, and February, the mean temperature at Greenwich was but 35·9°, or 3·9° below the average of one hundred years. The nearest approach to so low a winter temperature was 36·5°, in the corresponding four months of 1854–55, which included a frost of six weeks' duration."

The lowest reading of the thermometer of our Literary and Philosophical Society was 11° Fahr., on the morning of the 13th of December. Mr. Joseph W. Swan reported in the local papers that his thermometer, on the snow, at Low Fell, had registered 3° *below* Zero early on the morning of the 14th of December, and at 10 A.M. 4° *above* Zero.

The Rev. G. Rome Hall, Vicar of Birtley, near Wark, on the North Tyne, informs me that during the coldest weather he has seen the thermometer as low as 6°, 4°, and even 2° Fahr.

The Tyne, on whose frozen bosom I have walked on two occasions, namely, in January, 1814, and in December, 1860, was this year, thanks to the skill and energetic work of the Tyne Commissioners, not frozen over below Scotswood, but at and above Ryton it was closed altogether by ice.

By way of contrast to the state of our winter weather, allow me to read a short paragraph from *The Melbourne Argus*, showing a very different state of things at the Antipodes. The paper is of date February 21st, 1879, and the paragraph, which was brought to my notice by our fellow member, Mr. Henry Relton, is as follows:—"The weather we have had during the past month has been something terrific. There are some few who remember the celebrated Black Thursday, and, of course, they say that the weather we have had lately was nothing compared with that day. Other persons, who have some little knowledge of temperature, declare that with a few more degrees of heat we should all have been roasted alive. This appears very feasible when we find the thermometer at the Observatory, on the 20th of January, showing 106° in the shade and 146° in the sun. This is comparatively cool to what it is said to have been at Yarrawonga, a small township on the river Murray, where it is said to have been 120° in the shade on the hottest day we have had."

The general health of our population has, I am happy to add, been wonderfully good during a winter which will long be remarked in the annals of Meteorology for its unusual length and severity, for the abundance of snow, the prevalence of N. and N. E. winds, and the paucity of bright sunlight.

Owing to the severe winter few, if any birds of rarity have been observed in the game shops or in the country. Birds generally have greatly suffered, and many, as Thrushes and others, have been picked up frozen to death. The ground having been, for four or five months, more or less covered with snow, their usual supplies of food were not attainable. Even the sea birds have been, in some cases, fellow-sufferers with those of the land. Rooks were driven by hunger into the town, and were often seen in Eldon Square with Starlings and Redbreasts. Mr. Howse has had in his garden, at the back of Saville Row, Starlings, Thrushes, and Blackbirds. Mr. John Hancock has fed from his windows in St. Mary's Terrace, through the storms, Thrushes, Blackbirds, Hedge Sparrows, and the Blue and Greater Titmouse. Many Sparrows must have been killed, though they pick up the most of their food in the streets.

The higher temperature of the bodies of birds, being from 6° to 12° Fahr. above that of mammals, greatly enables them to resist the effects of external cold, but the want of heat-producing food during the prevalence of unusually cold weather enfeebles and destroys them.

Mr. John Hancock has very kindly furnished me with the following notes on birds:—"A specimen of the Turtle Dove, *Turtur auritus*, Ray, was shot at Woodhorn Grange on the 24th of October, by Mr. James Edward. Mr. Thomas Thompson, one of our Secretaries, bought a mature specimen of the brown variety of the Partridge at a poulterer's shop in Newcastle, on the 22nd of September, 1877. This is the last individual I have heard of.

"Mr. C. M. Adamson wrote to me on the 20th of August, 1878, from Holy Island, that he had shot a young Spotted Redshank. It was with another bird, probably of the same species. Several of the Little Auk, *Mergulus alle*, Linn., have been found on the coast, or a little way in-land, either dead or in a very weak state. One was taken alive on a pond at Mr. Lange's, Moor House, near Whitburn, on the 16th of November, 1878. It died very shortly after it was taken, and was in very poor condition. Mr. Lange presented the specimen to me and it is now in my

collection. Mr. Lange has one stuffed which was found on the same pond ten years previously.

"Mr. H. Bowman having informed me that a number of sea-birds had been found dead or very weak on the sands north of Newbiggin-by-the-Sea, and that he had observed them at the end of December and through January into February, I went down on the 2nd of March, and found, between Newbiggin and the river Lyne, five dead Razor Bills, all old birds, in their winter dress, washed up high and dry near the banks. I suppose that they had died from intense cold, as they could not want food, being purely marine birds."

The fish in small streams and shallow ponds have suffered great mortality from the intense frost. Mr. J. Hancock has seen quantities of Tench thus destroyed.

There is a question in pisciculture which has, up to a short time ago, been pending in mid-Northumberland, curious and interesting from a Natural History point of view, and important as touching a portion of the food supply of the district. It is this: Is or is not the Coquet a river specially adapted to the wants and necessities of that variety of the Salmon called the Bull Trout?

Attempts have been made for the last year or two to supplant this fish by the true Salmon, and the means used were the destruction of the former in the river and the introduction of artificially bred Salmon from the Coquet itself and from neighbouring rivers. Perhaps the experiment has not been carried out so long as to prove its efficacy or the contrary; but Mr. Carr-Ellison has informed me that His Grace the Duke of Northumberland has come to the conclusion that the Coquet shall be let alone, that all experiments shall be discontinued, and that the Bull Trout, which is not a bad fish when taken in proper season, shall be left alone to its own devices, a conclusion which will probably commend itself to Naturalists in general. If this fish could be extirpated for one season, it would infallibly return the next.

"*Naturam expellas furcâ tamen usque recurrit.*"

The Sturgeon, captured off the coast, has been seen three or four times in the fishmonger's shops during the past year.

No new Vertebrata have been discovered; no Mollusca, new to our district, have been announced.

With regard to Insects, I have been very obligingly furnished with the following report by our chief Entomologist, Mr. William Maling, under date March 28, 1879.

"As far as my observations go the year 1878 was by no means a good one for collecting insects.

"Owing to the cold, wet spring, many species of Lepidoptera, usually to be found in abundance, were last year exceedingly scarce; and although July was a very fine month, the Agrotes (*Noctuæ*) and other coast Moths I found in most cases represented only by individual specimens. Micro-lepidoptera (*Tortrices* and *Vineæ*), many species of which may be met with in swarms during most seasons, were conspicuous by their absence.

"The only captures of note worth mentioning, I find by my notes, are: one *Apamea fibrosa*, taken in August by Mr. Henderson, in Jesmond Dene; one *Leucania littoralis*, taken by myself at Newbiggin-by-the-Sea, in July: this and the former insect are very rare species in the north. I was also fortunate to meet with three or four larvæ of *Notodonta dromedarius* and one of *Acronycta leporina*, both feeding on birch in August, in Chopwell Woods. I also found a few larvæ of *Anisopteryx æsculana* feeding on White Thorn in Chopwell Woods; this, I think, is new to the district.

"Of insects destructive to vegetation I might mention the larvæ of the Crane Fly or Daddy-long-legs (*Tipula oleracea*) as having been very injurious to the crops of oats and barley in the spring, on several farms near this town, and also in several other parts of Northumberland; in several cases the land had to be ploughed up and re-sown; the larva is of a dirty-whitish colour, and feeds at the root of small plants and grasses: the perfect insect may be seen on any fine evening during autumn flying over the surface of the ground depositing her eggs one by one.

"This fly was very numerous last autumn; but, although I have dug in several places this spring where last year I found

the larvæ very numerous, I have not met with a single individual. I trust therefore that the crops of the farmers this year may escape the ravages of this destructive grub.

"It is difficult to account for the abundance or scarcity of insects: severe frost even does not seem to destroy the larvæ. If I might venture an opinion I should say that a wet season occurring when the parent deposits her eggs, and an unfavourable period happening when the hatching is in progress, may render the ova unfertile and destroy the newly hatched young.

"I noticed towards the end of June that the larvæ of the pretty little *Tortrix viridana* had almost defoliated the Oaks in Chopwell Woods, giving them the appearance of having been burnt with fire. This injury, however, is not permanent, for as soon as the larvæ are full fed the trees again put forth fresh leaves, and resume their usual appearance. The birds did not seem to feed on these larvæ, and it is a well-known fact that certain larvæ of insects are repulsive to the feathered tribes; their only enemies appeared to be the hordes of ants which abound in the woods; these ants climb the trees, ascending to the highest branches, and each one returns to the earth with a wriggling larva clasped firmly in its powerful jaws."

For this very interesting report my best thanks have been expressed to Mr. Maling.

The thanks of the Club are, however, due also to Mr. E. C. Robson, one of our Vice-Presidents, who, in answer to an application with which I ventured to trouble him, has favoured me with the following note on the subject of a most interesting plant:—"Thanks for your enquiry as to any object of interest to our Club. Nothing occurs to me except that our local Botanists (and indeed Botanists generally) may be glad to know that, in the past summer, Mr. John Cameron and I visited the spot where the *Cypripedium Calceolus* was found by us in 1874, and though there were upwards of twenty plants we were not fortunate enough to find a single flower, whereas in the summer of 1876 we gathered four well developed flowers. I do not, for obvious reasons, indicate the exact locality, but it is a satisfaction to know that the plant has not disappeared from our Flora, though

neither of its Yorkshire habitats can boast of its having survived the assaults of collectors and florists. Mr. Baker, in his "Flora," speaks of it as "now we fear nearly extirpated" in Castle Eden Dene, quoting my grandfather as his authority for its having been in that place, and this, mark, about one hundred years ago. Its complete vindication to a place amongst our indigenous flowers is now established. I have ventured to bring it under your notice as it may interest some of our Club. I have by me a dried specimen of one I gathered in 1876."

In the kingdom of Botany no discoveries have this year been made by the members of the Club; nor have they been more successful in the search for Fossils, either vegetable or animal.

Under the head of Antiquities it must be noticed that our late President, the Rev. Dr. Hooppell, has been engaged in prosecuting important and successful researches among the buried ruins of the Roman Station at Binchester (Vinovium), near Bishop Auckland; the results of which he communicated, in Lectures, illustrated by coloured drawings, to the Literary and Philosophical Society of Newcastle and to the Bishop Auckland Mechanics' Institute, in February last.

The First Evening Meeting of the two Societies, namely, the Natural History Society and the Tyneside Field Club, was held in the Museum of the former, on the 4th of March, Mr. Joseph Blacklock in the chair. There was a considerable attendance of members. The Rev. W. Howchin, F.G.S., read a paper entitled "Notes of a Find of Prehistoric Implements in Allendale, with Notices of similar Finds in the surrounding District." This will duly appear in our Transactions.

A hearty vote of thanks was given to the reverend gentleman for his interesting communication, which has opened out to us a new field of antiquarian research in relation to the ancient inhabitants of our district. No doubt further investigations will show that other parts of our northern counties are also rich in ancient British remains.

The Second Joint Evening Meeting was held on Monday, April 21st, at half-past seven, in the Museum, the President of the

Tyneside Club in the chair. Five new members were proposed and elected.

A paper was read by the President from Mr. Thomas Atthey, entitled "Notes on the Vertebral Column and other Remains of *Loxomma Allmanni*, Huxley," and a specimen of the fossil was exhibited. This was followed by a Memoir of the Life of W. C. Hewitson, Esq., F.G.S., by the President. After which "A Memoir of Thomas Belt, Esq., F.G.S.," by Mr. Joseph Wright, Keeper of the Museum, was read by him.

There was again a considerable attendance of members. Cordial votes of thanks were proposed and seconded to the authors of the above papers, and the meeting closed with the usual social tea and coffee and interesting conversation.

It is with deep regret that I find it incumbent on me to record the decease of four important, well-known, and highly-valued members of the Tyneside Naturalists' Field Club, namely, Wm. Chapman Hewitson, Thomas Belt, Thomas Sopwith, and, lastly, Sir Walter Calverley Trevelyan, Baronet.

Notices of the lives of Mr. Hewitson and Mr. Belt have already been communicated to you, and one of the life of Mr. Sopwith is, I understand, to be published ere long in London.

The Scientific Journals have devoted articles to each of these four worthies, but I should feel that I were neglectful alike of my duty and my friendship if I omitted on this occasion some, however brief, account of the career of our townsman, Mr. Sopwith, who was a member of our Club since its beginning, and who, some years ago, occupied in a distinguished manner this presidential chair.

Thomas Sopwith, M.A., F.R.S., M. Inst. C.E., was born in Pilgrim Street, opposite the west gates of All Saints' Church, on the 3rd of January, 1803, and died at his residence in Victoria Street, Westminster, on the 16th of January, 1879, having entered on his seventy-seventh year. He was one of many Northumbrians who have educated themselves, and thus risen to eminence; he began his self-education when a child. On entering school, at Mr. Miller's, St. Nicholas' Churchyard, he was set, as a matter of course, by the master to make strokes and pothooks

in a copybook; he quietly filled a page with these to him uninteresting characters, and at the bottom wrote in a fair round hand "Thomas Sopwith, his copy." From that time he ceased from pothooks and hangers! He learned mathematics under Mr. Henry Atkinson, of the High Bridge, at that time a very celebrated and popular teacher of arithmetic and mathematics.

On leaving school he was sent to Mr. Maxwell, a surgeon in good practice, living near his father, but he does not appear to have taken kindly to the position in which he was placed, and for a few years he was absent from Newcastle. On his return he was apprenticed to his father and uncle, well-known cabinet-makers in Newcastle, became afterwards a partner, and eventually took the management of the business with his cousin, Mr. John Sopwith.

When at school he was known for his fondness for drawing, and during his management of the business he evinced much ingenuity and accuracy, and showed a taste and an originality in designing and mechanical construction in advance of his occupation. He invented and had constructed the curious and useful Monocleid cabinet or business table, comprising drawers, compartments, and other conveniences, which could be entirely closed by a spring, and the whole opened by one key.

His faculties expanding and strengthening he made designs of much architectural merit, for example one for the New Gaol of Newcastle in 1822; this is represented in his Treatise on Isometrical Drawing, Pl. 26. "A model," he says, "of the design was made at the request of the Commissioners, who presented the author with ten guineas, at that time a gratifying recompense for the labour bestowed on the first attempt at architectural design he had ever made." He contributed many of the illustrative vignettes and views of churches and country seats to Hodgson's History of Northumberland. He surveyed and "laid out" a new line of road from Belsay to Otterburn.

Previously to 1834 he had published "Historical and Descriptive Account of All Saints' Church, illustrated with Plans, etc.;" and also "Eight Views of Fountains Abbey, engraved on copper, from drawings by Metcalf and Carmichael, with an Historical and

Architectural Description." He also discontinued active participation in the business of cabinetmaking, and was engaged as a land and mine surveyor, when his attention was attracted to railways, then in their infancy, but occupying the first talents. Railway surveying and engineering brought him into connection with George and Robert Stephenson, John Buddle, Messrs. Bidder and Brassey, and with them he surveyed extensively in England and in Belgium.

In 1833 he became a member of the Society of Civil Engineers. Mining next engrossed his ripe intellect, and led to his earnest study of Geology, and after that of Botany, and in all these he became proficient. Through Geology it was that he became associated with Professor Phillips, of York, and Dr. Buckland; he followed up this subject as a labour of love, and was enabled thereby, in conjunction with his already cultivated acquirements, to imagine and bring to perfection a series of Geological Models in coloured woods, of mining districts, showing the stratification of the rocks, the mineral beds or veins, the dykes or faults intersecting them, and the surface of the district, all in accurate proportion. These models soon found their way into all the great Museums of England and of the continents of Europe and America, and obtained for their author the Telford Silver Medal of the Institution of Civil Engineers, on the Council of which he had sat for three years.

In 1834 appeared the valuable "Treatise on Isometrical Drawing, as applicable to Geological and Mining Plans, etc., etc., with 34 Copper Plate Engravings, by T. Sopwith, Land and Mine Surveyor, etc." It went to a second edition, and was dedicated to John Buddle, Esq., Colliery Viewer and Engineer.

Before and about this time he published several works: "An Account of the Mining Districts of Alston Moor, Weardale, and Teesdale, in Cumberland and Durham;" "Plan of the Mining District of Alston Moor, etc.;" "Plan of the Vale of Derwent;" and "On the Mining and Geological Phenomena of Northumberland and Durham." He invented a set of Projecting and Parallel Rulers for working plans, etc.

In 1838 Mr. Sopwith was appointed Commissioner for the

Crown under the Forest of Dean Mining Act, and soon after made an elaborate survey of the Coal Field of South Wales.

In the autumn of the same year, at the meeting of the British Association in Newcastle-upon-Tyne, he rendered very important assistance in the establishment of the Mining Records Office, an institution he had previously advocated, as an absolute necessity, in his Treatise on Isometrical Drawing.

In the year 1845 Mr. Sopwith was appointed to the management of Mr. W. B. Beaumont's vast mining property in Allendale, and took up his residence at Allenheads. There he remodelled the whole establishment on an enlightened plan of his own. He established schools for the children and other useful institutions for the adults, and in a few years had immensely improved both the material and moral condition, and thereby augmented the happiness, of all around him. The great changes he had brought about in his district, educing order out of disorder, were striking and the subject of frequent remark among those who knew the miners of times gone by; among the present mining population his memory will long be preserved in love and reverence.

During his life he was anxious and ready to give a helping hand to any one whom he found deserving and yet struggling against adverse circumstances, and many a young man will recollect with feelings of gratitude the kind good offices of Thomas Sopwith.

It was in the year 1854 that Mr. Sopwith was unanimously elected, as successor to Sir W. C. Trevelyan, Bart., to the Presidential chair of the Tyneside Naturalists' Field Club, having been a member from its foundation. On resigning office at the end of the year he read an interesting and instructive address, which appears in Vol. III. of our Transactions. In it he shews the comprehensive grasp of his mind, the extent, minuteness, and accuracy of his knowledge, as well as the geniality of his character. He was an excellent artist with his pencil, and engraved many of his sketches and plans on copper with facility. He had a cultivated literary taste, and for sixty years kept a diary, in form of a Note Book, in which he entered every incident of his life that he thought worth recording. It extends to more

than forty volumes 8vo, is written out in a small, beautiful hand, and illustrated with numerous sketches, views, and plans of remarkable places he had visited. The last entry was made on his last birthday, a few days before his lamented decease.

He was a great traveller, having for many years during the summer visited in succession nearly every country of Europe, as well as Egypt and Palestine, with Mrs. Sopwith who survives him.

His was a well stored, well regulated, methodical mind, of the highest integrity, benevolent, social, full of kindly humour, and teeming with racy and instructive anecdote. Few persons perhaps have made, and retained through a long life, so many good friends as Mr. Thomas Sopwith. This Club has lost in him one of its most talented members.

In noticing the loss of Mr. Sopwith, I little deemed that it would fall also to my lot to chronicle in our Transactions the demise of another, though differently distinguished member and President of our Society, Sir Walter Calverley Trevelyan, Bart., of Nettlecombe, in Somersetshire, and Wallington, in Northumberland.

On the 22nd of March last he seemed, it is said, to be in his usual health; in the evening, however, he became ill, and died the following afternoon, at the advanced age of 82 years.

Sir Walter, who was the sixth Baronet, was born at Newcastle, March 31st 1797, was educated at Harrow and at University College, Oxford, where in 1820 he took the degree of B.A., and two years later that of M.A., and in 1846 succeeded to his father Sir John Trevelyan.

He was an enlightened, scientific, and liberal landlord, and soon brought his land into a high state of cultivation. He had at heart the welfare of his tenants, and was always ready to contribute largely, by his extensive knowledge and experience, to the happiness and welfare of his friends, his neighbours. and the people at large.

He devoted much time and attention, and with great success, to the study of Botany and Geology, was a Fellow of the London Geological Society, and was well versed in Antiquarian lore.

He contributed papers to various learned societies, literary and scientific, and took especial interest in the Society of Arts. He assisted materially, by his local and antiquarian knowledge, in the production of Hodgson's History of Northumberland. His correspondence with learned men, both in England and abroad, was considerable. The Museum and the Library at Wallington were, both of them, choice and extensive.

He was an ardent and consistent advocate of Temperance, having been President of the United Kingdom Alliance and a munificent contributor to its funds. He forbade the sale of intoxicating fluids on his estates, and set his face against the use also of tobacco: these two, alcoholic liquors and tobacco, he considered injurious to the individual and to the public weal.

Sir Walter was a Deputy Lieutenant of Somersetshire, and in 1850 was High Sheriff of Northumberland.

He was twice married, but leaves no issue.

Sir Walter was elected President of the "Tyneside Naturalists' Field Club in 1853, and delivered the Anniversary Address on March 15th, 1854; this is to be found in Volume II., at page 325, of the Club's Transactions. Though short it contains much scientific information and several useful suggestions. Sir Walter was a learned, observant, and philanthropic man, and his loss will be deeply felt in Northumberland, and especially at Wallington, which was his favourite seat.

On the long contested problem of the origin, not of Species, but of living organisms, the latest published information comes, I believe, from the Lectures of the Rev. W. H. Dallinger, in June last, at the Royal Institution; the same gentleman whom we had the advantage of hearing in the Lecture Room of the Literary and Philosophical Society in February, 1878.

"Mr. Dallinger showed that, by the aid of the most powerful lenses, (including an object-glass with one-fiftieth of an inch focal distance, though the most important part of his work was done with a Powell and Lealand of one-thirty-fifth of an inch,) he had been enabled to study the form, movements, and life history of a very minute creature of the Septic series of organisms,

and thereby added one more to six previous instances which prove that these lowest of all organisms arise, not in that which is not living, but, like all other living things, in that which has been vital.

"A further instance was brought forward to point out diversity and assist in generalization; and from the whole the reverend gentleman strongly maintained that even among these apparently structureless beings there was no caprice, their life-circles were as regularly circumscribed as those of a butterfly or a wasp. In short, the only forces seen in operation were those formulated in the great Darwinian law of the Origin of Species.

"Mr. Dallinger further pointed out the importance of knowing whether the spores or ova of the septic organisms could resist heat more successfully than the adult forms; for if they could, the heat which destroyed the matured organism in a putrefactive fluid would not necessarily prevent their re-appearance.

"The result of a large series of careful experiments proved that the spore of the organism he had previously described could resist a temperature of 250° Fahr. dry heat, and by the use of a very delicate apparatus it was proved that the limit of endurance of the spore *in a fluid* was 220° Fahr., and consequently it would take 30° at least more heat to destroy the spores *in the dry state* than in a heated fluid.

"With three other septic organisms there was found to be respectively 38°, 32°, and 28° of difference between the two methods of heating the germs.

"As the adult forms were destroyed by temperatures varying from 140° to 142° Fahr. the destruction of the organism is not that of its germs, and therefore to infer that the presence of an organism in a fluid after its exposure to a heat known to be destructive to the adult is determined by "spontaneous generation" is simply begging the question; and in a specific instance in which Dr. Bastian had made such an inference, Mr. Dallinger showed that the germs of the form in question had not been destroyed by the heat used, and therefore it had naturally reappeared.

"Finally, the evidence of variation under change of environment in these new forms was demonstrated, and the conviction was expressed that it is among these minute forms that the most marked and manifest evidence of variation and the survival of the fittest may be looked for."—*Nature, June*, 1878.

In conclusion, I am sure you will pardon me if I venture upon mixing somewhat of a darker tint with the usual rose colour, in order to keep that colouring which is necessary to the correctness of a picture that has to be exhibited in an Anniversary Presidential Address.

The fact is, that we are somewhat falling off in our work. This is matter of much regret, but may be accounted for partly by the lamented death of several of our principal members, partly by the idea that may be entertained by some of us that nearly all our contemplated work has been completed, and partly by the perhaps natural tendency of a body such as ours to allow the social gradually to preponderate over the scientific. Our Field Meetings, delightful and healthful as they have been, have not, this year at least, yielded a sufficient crop of scientific results. There appears to be a lack of young observers devoted to our pursuits coming forward to fill the places of the distinguished men who have been called away by death, and to whom Newcastle owes the reputation for Natural History pursuits which it enjoys.

We have yet in our district a great deal of work before us. Are there no new Fish, Mollusks, Crustaceans, or Insects to be found? Are the fossil Fauna and Flora exhausted? Very little has been done for the Infusoria, though microscopes now abound. The Antiquities of Durham and Northumberland are not by any means worked out. Local dialects, names of places and things, together with Folk Lore, will amply repay investigation.

It may be pointed out to young Naturalists that our best contributors have begun by sending in only a paragraph, descriptive of any new thing or occurrence, and that it is not necessary that we should always have long papers or dissertations. "The smallest contributions will be thankfully received." This method of communication has been adopted in all Naturalists Clubs.

The caution to students of Botany and to collectors of plants, for whatever purpose, to preserve, and to assist in preserving, in their natural localities, the rarer plants of the district, and to students of Ornithology, and others, interested in birds, to abstain from shooting rare birds, cannot too often be repeated.

Lastly, to render our Volumes of Transactions more useful and available, we much want an Index to the whole.

And now I have arrived at the end of my, I fear, too long address, of my year of office, and, I am sure, of your patience, and I resign my post to a successor who will do more ample justice to your affairs than I can pretend to do.

Note A for Page 256.

This statement that St. Cuthbert was elected Bishop of Hexham occurs also in the History of St. Cuthbert *auctore anonymo*, in Vol. 51 Surtees Society's publications, containing Symeonis Dunelmensis Opera et Collectanea. In Vol. I., at pp. 139, 140, we find, "Eodem tempore defunctus rex Oswegius est, et regnavit pro eo filius ejus Egfridus. Quo regnante Theodorus archiepiscopus Eboracensis et omnis populus communi consilio, et una concordia, sanctum Cuthbertum fieri episcopum apud Helstaldesham acclamaverunt.... ....Tunc rex Ecgfridus et archiepiscopus Theodorus, et omnis populus, congregata synodo, communi consilio decreverunt, ut eum, vellet nollet, de insula educerent et in episcopatu subrogarent. Quod et factum est."

Then follows the statement, "Eadem die Eata episcopus Lindisfarnensis, et Sanctus Cuthbertus, communi consilio Ecgfridi regis, et archiepiscopi et illorum septem episcoporum, et omnium majorum, sedes suas commutaverunt. Sicque Eata apud Helstaldesham sedit; sanctus vero Cuthbertus propter priorem conversationem Lindisfarnensem cathedram obtinuit."

But in Appendix II., in *Brevis relatio de Sancto Cuthberto*, at page 224, is given the following account of the Election in which Hexham or Helstaldesham is not mentioned.

V.—Hic eligitur in Episcopum.

"Anno Dominicæ incarnationis sexcentesimo septuagesimo sexto, anno regni Egfridi sexto, monachatus sui vicesimo sexto, intravit insulam Farne vir Domini Cuthbertus, per novem annos mira animi alacritate Domino militabat. Postea congregata synodo non parva sub præsentia piissimi regis Egfridi et beatæ memoriæ Theodori, Cantuariensis archiepiscopi, in loco qui dicitur Twiford juxta fluvium Alne, unanimo omnium consensu ad episcopatum Lindisfarnensem electus est. Qui, cum, multis legatariis pro se missis et literis, nequaquam suo loco posset erui, rex prefatus, et Trumwine

episcopus, cum plurimis religiosis et potentibus, veniunt, genu flectunt, et per Dominum adjurant, lacrymas fundunt, obsecrant, donec et ipsum lacrymis plenum ad synodum pertrahunt. Quo perveniens, licet plurimum renitens, compellitur ab omnibus episcopali officio collum submittere."

Note B for page 257.

Symeonis Dunelmensis Opera et Collectanea, Vol. I., p. 143. Surt. Soc. Mr. H. Hinde.

"Priusquam Scaldingi venirent in Anglicam terram dederunt Ceolwlfus rex et episcopus Esred Sancto Cuthberto quatuor villas, scilicet Wudacestre, et Hwitincham, et Eadwulfincham, et Ecgwulfincham, et ecclesias harum villarum consecravit idem episcopus."

Note C for p. 263.

Symeonis Dunelmensis Opera et Collectanea, Vol. I, p. 231. Surt. Soc. Mr. H. Hinde.

"Non multum post hunc Egfridum successit in regnum Ceolfus filius Cudwining, seque Sancto Cuthberto subdidit; et dimisso regno cum uxore pro amore Dei, se cum magno thesauro ad Lindisfarnense monasterium contulit, barbam deposuit, coronam accepit, et Sancto Cuthberto villam dedit nomine Werchewurde cum suis appenditiis."

The following ladies and gentlemen were elected members of the Tyneside Naturalists' Field Club during the year 1878–9:

At the Anniversary Meeting, 1878:—Rev. T. Thornton, Shadforth Rectory; Messrs. Edward Milburn, Langley; James Armstrong, Bardon Mill; W. A. I'anson, Geo. Thompson, Henry Relton, Philip Truttman, Geo. Hutton, Newcastle; Matthew Stainton, Westoe; Arch. Turner, Blaydon; G. W. Bulman, W. E. Bulman, Corbridge; Matthew Cay, South Shields; H. B. Slee, Gateshead; J. E. Marley, Hebburn; Robert Bewick, Whalton; William Stanger.

At the First Field Meeting:—Messrs. Washington Bagshawe, William Glendenning, Alfred Keifenheim, Edward Wilson, Wm. Sanderson, Newcastle.

At the Second Field Meeting:—Rev. Reginald Yeld, Sunderland; Mrs. W. Cochran Carr, Messrs. W. Cochran Carr, G. R. Hedley, Cuthbert Harrison, John Buchanan, Newcastle; Chas. Jno. Drummond; North Shields.

At the Third Field Meeting:—Miss Laura Blumer, Sunderland; Mrs. Elizabeth Branford, Messrs. J. H. Walker, James Richard Fletcher, Newcastle; R. Routledge, Rev. Wm. Johnson, Gateshead.

At the Special Meeting: Richard Charlton, Matthew Theo. Dixon, Newcastle; J. T. T. Reed, Ryhope.

At the Fourth Field Meeting:—Messrs. B. J. Snell, Joseph Jackson, Nat. Prov. Bank of England, Newcastle; John Heath Bald, Hebburn; H. B. Hemming, Capt. Broadhurst, Gateshead.

At the First Evening Meeting:—Mr. Thomas Eyton, Newcastle.

At the Second Evening Meeting:—Messrs. William Beer, H. J. Sopwith, John Wood, Newcastle; T. H. Davison, Tynemouth; W. H. Renwick, Gateshead.

The Field Meetings for 1879 were arranged to be held as follows:—

May 16th	Ravensworth.
June 2nd and 3rd	Harbottle and Rothbury.
*July 7th and 8th	Holy Island and Bamborough.
August 4th	Wolsingham and Bedburn.
September 5th	Blanchland.
October 3rd	Marsden.

* It is intended to hold a Special Field Meeting in July, for three days, at Cornhill, Ford, and West Side of Cheviot.

The Treasurer's Report (see p. 283) was read and adopted.

THE TREASURER IN ACCOUNT WITH THE TYNESIDE NATURALISTS' FIELD CLUB.

FROM JANUARY 1ST TO DECEMBER 31ST, 1878.

Dr.

1878.		£	s.	d.
Jan. 1.	To Balance brought forward	7	14	0
	,, Subscriptions	198	13	2
	,, Sale of Transactions	11	18	8
	,, Natural History Society	58	9	4
		£276	15	2

Cr.

1878.		£	s.	d.
January.	By Commission for collecting Subscriptions	10	14	7
	,, Printing Transactions	88	13	9
	,, Engraving and Printing Plates	78	9	0
	,, Secretaries' Disbursements, Advertizing, etc.....	15	6	7
	,, Postage	4	17	7
Dec. 31.	,, Balance	78	13	8
		£276	15	2

1879, April 20.—Examined and found correct,

T. P. BARKAS, AUDITOR.

THE following gentlemen were elected officers of the Club for the year 1879–80:—

PRESIDENT.

Rev. Canon Tristram, F.R.S.

VICE-PRESIDENTS.

Thomas Atthey, Esq.
John Hancock, Esq.
Robert Vint, Esq.
James Clephan, Esq.

Ralph Carr Ellison, Esq.
Rev. J. F. Bigge, M.A.
D. Embleton, Esq., M.D.
Rev. Canon Tristram, F.R.S.
George Wailes, Esq.
Rev. A. M. Norman, M.A.
Rev. J. C. Bruce, LL.D.
Rev. A. Bethune, M.A.
E. J. J. Browell, Esq.
Rev. R. F. Wheeler, M.A.
Prof. G. S. Brady, M.D.
H. B. Brady, Esq., F.R.S.
Rev. J. E. Leefe, M.A.
Rev. G. R. Hall, M.A., F.S.A.
G. H. Philipson, Esq., M.D.
Rev. R. E. Hooppell, LL.D.

TREASURER.

Robert Y. Green.

HONORARY SECRETARIES.

Richard Howse.
Thomas Thompson.

COMMITTEE.

J. W. Backhouse.
William Maling.
William Dinning.
John Glover.
D. O. Drewett.
John Philipson.
W. M. Wake.
T. T. Clarke.
John T. Thompson.
Emanuel Young.
Joseph Blacklock.
Rev. J. M. Hick.

AUDITORS.

J. S. Foster.
T. P. Barkas.

XVI.—*Tynedale Escarpments; their Pre-glacial, Glacial, and Post-glacial Features.* By HUGH MILLER, F.G.S., Assoc. R.S.M., H.M. Geological Survey.

TABLE OF CONTENTS.

General Description.—The tourist, in tracing the course of the Roman Wall westward, finds himself crossing, obliquely, the fork between the North and South branches of the Tyne. A little west of Sewingshields farm house he has reached the summit of a lofty crag, a main headland of the basaltic ridge there selected by the Romans for the line of their great military barrier. The "gods of the mountains," he may say, had assuredly deserved the worship

these ancients gave them. No configuration could have better served their purpose than this cresting ridge. Always steep, and often perfectly mural on its north side, facing the Caledonian enemy, on the south where the Roman camps lie, it declines in a long, easy slope. It was thus at once a favourable camping ground and a splendid natural vantage; and the cohorts could often overlook their enemies in triumphant security almost from their very dwellings. (See Woodcut No. 1.)

The northern outlook from this ridge—drearily familiar in its former aspect, doubtless, to Roman soldiers,—is over a series of huge billows, parallel with the main ridge, and with it disposed as if rolling before a gale from the S.S.E. Each billow rises evenly from a trough behind it, and on the further side can be seen either curving smoothly forward, or raising itself higher aloft and falling almost perpendicularly. Looked at sideways, these ridges are stiffer and more rectilinear. So viewed, they less resemble billows than a series of different-sized wedges, each broadening forward in a plane of some six to twelve degrees incline, until its gradual rise is checked by an abrupt descent, at the foot of which another sloping plane begins. The interspaces are wedge-shaped like the elevations, and might serve as their counterparts.

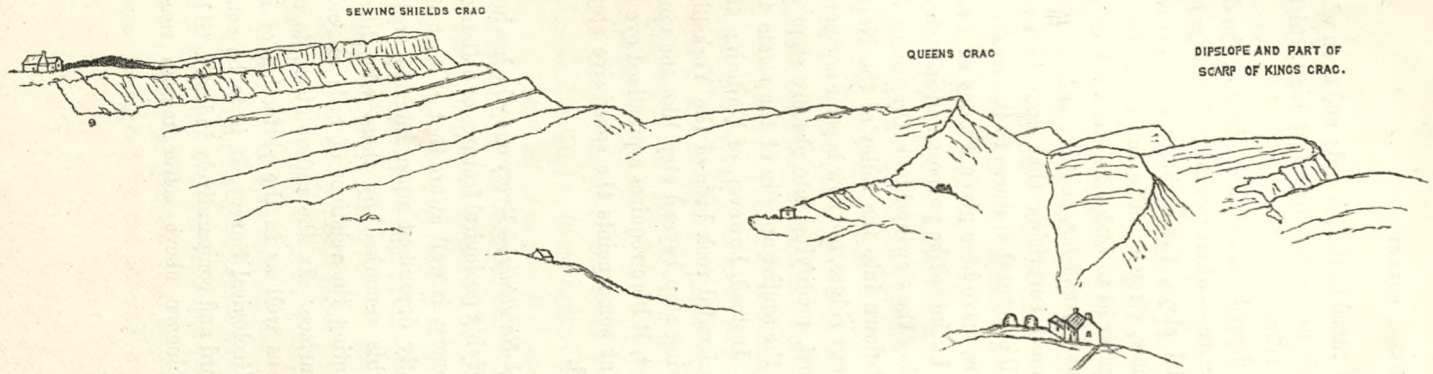
For another aspect of the scene we may choose some elevated stand-point facing the broad ends of the ridges,—the crests of the billows. In front of us now lies, as it were, a grand succession of ramparts and earthworks, sometimes serried in nearly unbroken ranks, sometimes breached by gaps or weathered into waved outlines, and sometimes represented only by detached and insulated embankments marking the decay of large intermediate portions. Darkly rising in the back ground, like a frowning battlement of which all in front are but outworks, is generally to be seen the Great Whinsill,—the basaltic ridge crowned with the Roman Wall; now ranging as if built upon a level basement, and again rising to some commanding height trenched and terraced in front. Its general appearance is one of grim impregnability, but none the less it is marked by all the symptoms of decay presented by the others; broken, gapped, occasionally

weathered down almost as if razed to the ground; and even when standing erect in a sheer wall near a hundred feet high, skirted by a sloping pile of its own ruin.

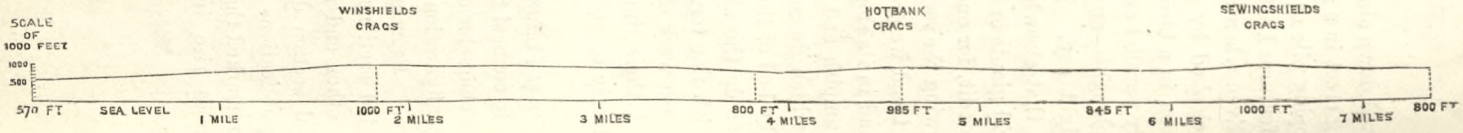
The features I attempt to describe are characteristic of the district. Even when more obscure,—when unmarked by crags and partly cloaked by superficial clays, these ridges and furrows, when seen in a bird's eye view, often seem to run for distances so nearly parallel and so regular as to look like the work of gigantic ploughs—an enormous *rig-and-fur*, as a Scottish ploughman might say. It is almost surprising that none of those legends that elsewhere ascribe natural features to the freaks of old-world giants or magicians, have here given Fionns or Frost giants credit, for once, with business-like purpose and industry.

Following the series fronting the Sewingshields Crag along its E.N.E. trend we are carried down into the valley of the North Tyne, and in its slopes find our ridges, ere now become comparatively lumpish and ill-defined, modifying into obscure steps or ledges, which descend with the southward dip of the strata towards the bed of the river. Instead, however, of bordering the valley, as do the almost horizontal rock beds of the Yorkshire dales, with fine terraces, rising step beyond step like the vine-clad terrace-work of the East, it here requires a practised eye to trace out their lines; but at some points the successive steps stand clearly enough defined.

Relation of Features to Rock-Structure.—Every one who has had occasion to connect the underlying geological features of a district with the character of its scenery, is well aware that at least its minor configuration is greatly dependent upon internal rock-structure. Especially is this remarked by those who have constructed sections representing the relations of beds of rock to each other and to the surface. In the rudest attempts at geological section drawing, as well as in the perfection of it in the publications of the Geological Survey, it is to be constantly remarked that the hard and comparatively indestructible rock-masses rise into prominence above softer masses near



Woodcut No. 1.—Escarpments on the Watershed near the Roman Wall from the East.



Woodcut No 2 shows the undulations of the base of the Great Whinsill Escarpment. Scale, vertical and horizontal, = one inch to a mile.

them, the form of both being moulded more or less in conformity with general characteristics of structure.

The ridges and furrows between the Tynes coincide with the peculiarities of the framework of rock in a very marked degree. That portion of the Lower Carboniferous series of the North of England to which these strata belong, consists of beds of sandstone, limestone, and shale, rocks greatly differing from one another in coherency and durability. The sandstones, thickest and most massive, are here always to be found in the loftier crags and bolder swells; the limestones, being thinner, are commonly subordinate elements in the projecting features; and the more yielding shales are to be found in the troughs and hollows that throw the ridges into relief. "It seems unnecessary," as Phillips long ago remarked of similar features in Yorkshire, "to offer any other explanation of the prominent and retiring parts of the profile than that afforded by a consideration of the relative resistances offered by the different rocks."* All those notions of vertically upheaving force, which the occasionally rugged and broken appearance of crags seem at first sight to encourage, are perforce abandoned on better examination. The uniform acclivities, where the heel may often strike upon the plane of the rock, have simply been uncovered by the removal of less stable beds, perhaps of shale, whose outcrop is now hid under the sheltering front of the crag overlooking them. They are the *dip-slopes*,—bared planes of separation between beds. The short steep faces in which they terminate are the *scarps*, the abrupt ending of strata whose upward continuation has been by some means cut away and removed. A feature thus composed of dip-slope and scarp is called an *escarpment*.

Locality treated of.—The area with which this paper deals is restricted to the space betwixt the North and South Tynes, and from the former over towards the Wansbeck. The general E.N.E. line of the Roman Wall from near Greenhead, South Tyne, to where it dips, beyond Carrowbrough, into North Tyne, will sufficiently indicate the trend of the outcrops there. Through the greater

* Phillips' Geology of Yorkshire, Part II., p. 169.

part of this distance the Great Whinsill is the conspicuous *carina* of a strip of ground marked off by a hollow from a rolling plateau stretching to the north of it. Its neighbourhood about Sewingshields, where it rises upon the water-shed of the country, is singularly free both from dislocations and from concealment by drift. The finer escarpments are found within a line drawn about three miles from its north side; in a second parallel band, about equally broad, ridges are more or less traceable under drift, but the local names, Rigg, Edge, and Bank, have there become less sharply characteristic, and are now associated with others,—Round Hill, Law, and the like. Beyond this second strip the strata lose their steady dip E. of S., and begin to undulate: escarpments and crags become more promiscuous,—less like a succession of Atlantic rollers than a chopping sea. Shitlington Crag, near North Tyne, displays in its arched form a segment of one of the first of these undulations.

Woodcut No. 3.—Sewingshields Crag and adjacent escarpments as they appear from near Bavington, twelve miles E.N.E. Those on the left are successive headlands of the Whinsill.

In the region N.E. of the North Tyne, the outcrops sweep round into a much more northerly trend. With some exceptions they are more subdued than to the West; but in the watershed of the Wansbeck they rise proudly.

It scarcely need be said that the southward-dipping strata, whose surface features these are, form part of an extended series at first deposited in water. How subterranean forces raised them into their present position and slope it is unnecessary to inquire, but the original beds were without any doubt continued northward, from where we now see them broken off, towards Scotland. Professor Ramsay first drew attention to the significance of facts of this kind in South Wales. In Woolhope, Herefordshire, for instance, a small but easily-described area, the strata originally rose in a form imperfectly resembling that of a cupola, bed arching within bed like the curving coats of one side of an onion,—Silurian Limestones and Shales within, and Old Red Sandstone

above. But now the summit of the cupola is away; the outer beds of Old Red Sandstone and Upper Silurians end like books laid sloping against an inverted bowl, and the scars of the outer envelope stand four or five miles apart. The missing arches have been *planed off*, and according to a moderate computation of Prof. Ramsay's, a thickness of three thousand five hundred feet has been wholly removed. And this is a very small figure compared with others to which his survey of South Wales led him.*

Since Ramsay first gave his explanation of these facts the world has become largely familiarized with it, but in order to initiate a few words upon the general subject of denudation, let us ask once more, How came these changes?

Denudants.—Rain, frost, and rivers; waves and currents of the sea, and glaciers; have all at one time or another lent their forces for the waste and destruction of what is now Britain. It is of course quite impossible to define the precise part taken by each in what has been accomplished, but although different geologists have often their favourite denudants, no geologist denies that they have *all* had their influence in geological ages even recently by-gone.

Every thunderstorm or winter "spate" gives loud proof in the noisy discoloured torrents that pour towards the sea, of the activity of *streams*. Rain obviously feeds them with water; frost and rain less obviously supply them with the solid discolouring materials. Every drop is charged with earthy stuff, and even in the most pellucid stream the chemist discovers an invisible burden in solution.

Taking first the earthy matter borne in mechanical suspension, as distinguished from the substances chemically dissolved, the materials lie to hand for an illustration of the amount by which the British Isles are being denuded through the medium of this kind of river action. It was early seen that as streams bear to the sea all that is worn from the general surface of the land, the aggregate amount of their burdens represents the total results of surface denudation. This method was elaborated first by Dr.

* Between the Avon and the Mendip Hills, e.g., he estimated the denudation at nine thousand feet—nearly a mile and three quarters.

Croll, and then from better data by Professor Geikie, from whose excellent memoir I slightly adapt the following.*

It has been shown that the river Mississippi, whose drainage-basin besides embracing a great extent of country, represents also a variety of climate, brings to the sea annually an amount of materials of which it is enough to say that they have been computed as the equivalent of a compact block a square mile in extent, and two hundred and sixty-eight feet high. Compared with some others this great river seems to be a slow worker; for while, at this rate, it would spend six thousand years in lowering its basin by one foot of solid rock equally distributed, the Po would take only seven hundred and twenty-nine years, and our own Nith only four thousand seven hundred and twenty-three years to lower *their* basins by the same amount.† The mean height of the British Isles being about six hundred and fifty feet, the wear and tear represented by the Mississippi, if taking place equally in uplands and lowlands, which of course it could not do, would level them with the sea in three millions nine hundred thousand years; the Po, actually, if the estimate is to be trusted, working more than nine times quicker, would, under the same conditions, level them in four hundred and seventy-three thousand eight hundred and fifty years; and the Nith would accomplish the same in somewhat over three millions of years.

Professor Geikie's data represent, as has been remarked, only the mechanical action, not the chemical. I superadd an estimate of the latter given by Mr. T. Mellard Reade, F.G.S., in an elaborate address as President of the Geological Society of Liverpool.

Mr. Reade, founding mainly on the Sixth Report of the Rivers Pollution Commission, calculates that an average of one hundred and forty-three tons and a half of material is annually carried away in solution from every square mile of England and Wales; representing a general lowering from chemical action alone of

* Trans. Geol. Soc. Glasgow, Vol. III. Also Jukes and Geikie's Manual of Geology, Chap. XXV.

† The estimates for these rivers are not to be placed at all on the same footing of reliability, however, with that of the Mississippi. That for the Nith is an estimate of solids deposited in the Solway, and therefore ignores the silt carried out to sea by its rapid tides.

one foot in twelve thousand nine hundred and seventy-eight years, nearly half the rate at which the Mississippi erodes its basin mechanically.* It would probably be too much to suppose Scotland as undergoing as much chemical action relative to its size as England, or, it may be added, Ireland, being much poorer in calcareous rocks, but, taking this estimate of Mr. Reade's as applying to the whole British Isles, we should have the estimate of three million nine hundred thousand years—the most reliable and moderate of those just given for mechanical action—reduced to rather less than two million six hundred and sixty-seven thousand years as the time in which these Isles, if equally denuded at the present rate, and not affected by elevatory forces, would exist as tracts lying awash in the sea.†

In taking this method of representing the work of river-denudation, geologists may seem to lay themselves open to the charge of dealing with millions of years as if they were drops in an ocean of time. But although we are certainly not justified in drawing illimitably on past time, it is certain that ages long enough to produce and *re*produce these effects of denudation have passed over the earth, and in dealing with a question of general denudation, it seems the directest way to illustrate the competency of existing agents to bring about what the subject requires me to postulate.

Special proofs of river action it is not necessary for me to give. Let the reader only, like the poet,

> Learn to wander
> Adown some trottin' burn's meander,

and in the undermined banks and raw scars he will learn summer lessons that the heavy and turbid rush of the winter torrent

* It is pleasant to see how nearly coincident this estimate is with that made by Prof. Prestwich for a restricted area—that of the Thames basin—in 1872. Solution, however can scarcely be considered as actually lowering the *surface* of the country by the total amount, as a proportion takes place underground. In limestone districts underground action is perhaps in excess.

† One of Mr. Reade's most interesting results, however, is the "curious way in which the smallest percentages of solids in solution, such as are contained in water from the granite and metamorphic rocks, rise in the aggregate, through the greater rainfall on these, high lying, formations, to the total solids in solution from such specially soluble rocks as constitute the Thames basin."

will further illustrate and more deeply impress. There can be no doubt in any candid mind, that branching systems of valleys, large and small, have in the main been carved out by such agencies, directed, and possibly aided, by others.

I have taken rivers first as productive of effects hitherto more successfully estimated than those of any other denudant. Let me now say a little about the sea,—a denuding force of vast importance, though restricted to the borders of the land. Every sea-girt cliff is the vertical scar that marks the work of a "great horizontal saw," of which, indeed, each billow may be said to be a tooth.* This vertical scar is only, of course, the index to work in progress; the sawn surface, as well as the debris, is hid under water. Where, however, receding tides bare a portion of it, we often find an approximate flat, or as Ramsay has called it, a "plain of marine denudation;" and, comparing this plain with the tumbled outlines of the country above the cliff, it seems possible to say that the sea is more of a *planing* tool than any other geological tool we know. Its importance, therefore, as probably the explanation of such wide-spread denudation as the shorn summits of Northumbrian escarpments testify, is evident. It is well known that in parts of the East Coast of England the sea is sawing its soft cliffs back at from two to four yards in the year,—that within historic memory populous and fertile tracts have been beaten down and submerged. We may take it as certain, that if not interfered with by subterranean movements,—by elevations or subsidences, the sea would convert Britain into a submerged plain, and deposit its sediments over the scars of upturned strata.

The sea, maker of uneven plains,—of *sawn* surfaces, and river systems, cutting them up, are the two great denuding agents of wholesale change; and it is unnecessary to go beyond them. In the broad aspect, however, the latter is servant to the former. "All go unto one place"—the sea level; and whatever may have been the myriad forms of the land between elevation as a raised plain of marine denudation and destruction to a plain again—the latter is the ultimate stage.† If slicing therefore has been done

* Dr. James Geikie.

† On this subject the reader is referred to Professor Ramsay's fine book on the Physical Geology and Geography of Britain, pp. 341, 496. 5th Edition.

on the summit of our Island it must have been slicing by the sea; and I now return to our proper question—How the present features have been impressed on the outcrops of the strata. Why do the hard beds rise into scarped ridges, and the softer ones retire into furrows?

Theories of Escarpment-Formation.—Geology has comparatively lately passed through what I may call her mythologic stage; growing away from which it was inevitable that the true should be accepted only after the false had been tried and found wanting. Hence it is that the answers to this question elsewhere have been at once various, and, in many cases, crude. It will serve as an historical *resumé* and otherwise elucidate the subject if we take up the several theories one by one, and try their virtue upon these Northumberland escarpments. The first clearly belongs to the mythological stage.

1. *Old Diluvial Theory.*—The Scottish capital is picturesquely broken and overlooked by grand masses of rock, long familiar as "the phenomenon of Crag-and-Tail." These were once the centre of such attention as escarpments received. "All its steeper precipices present their iron fronts to the west, while towards the east its slopes are prolonged and gentle. The Castle and Calton rocks, the erect front of Salisbury Crags, the western flanks and dark brow of Arthur Seat, the trap precipices that rise over Lochend, the low trap precipices of Hawk Hill, all look to the west, as if watching the advance from that quarter of an enemy who had wasted them of old."* The general opinion upon the Crag-and-Tail at the end of last century was that the deluge, sweeping eastwards, had torn away the softer rocks from around these more durable masses, leaving them rent and craggy in front. Long afterwards Sir James Hall, in an elaborate paper in support of this view, pointed to the Crag-and-Tail, as well as to widespread debris of Western origin, and to scores and scratches on the rocks, in proof of some such tumultuous diluvial wave.†

* Crag-and-Tail is now-a-days a term restricted to the glacial phenomenon of a boss of rock with glacial deposits preserved on its lee-side; which some of these are. Others—notably Salisbury Crags, are Escarpments.

† Trans. Royal Soc., Edinburgh, Vol. VII.

The pebble in the rivulet, with its eddying hollow in front and its little tail of sand sheltered behind, seemed to him the counterpart of the "ironfronted" rock, stemming the rush of waters with a slope of strata and debris in its lea. Modern geology ascribes the debris and scored rocks to a deluge, not of water, but of *ice;* but it has been content, in points not a few, to confirm Sir James' observations. It is interesting to note that it was at Gilsland, not far from the Crag-and-Tail this paper deals with, that an important point in his theory suggested itself to him. Low in the valley of the South Tyne, he remarked an *absence* of Crag-and-Tail, and having noticed the same elsewhere on the west, he bethought himself of a "back-draught" of water, that failing in its easterly rush to reach the summit level of the country, fell back by its own weight and smoothed away the scars its first sweep had made.

When the fact of a glacial period had come into recognition, an ocean-stream laden with icebergs, took for a time the place of the mythical deluge-wave. That this view of the Crag-and-Tail of Edinburgh still retains supporters I gather, somewhat doubtfully, from Mr. Milne Home's "Estuary of the Forth."* It is happily not necessary to enter here into the question of icebergs *versus* glaciers. Since the grounding and dragging of ice-floats in the supposed circumstances could only *abrade* the protuberances that might arrest them,—as Mr. Milne Home seems to recognise, the *current*, not the ice, must be the scooping agent. The possibilities of escarpment formation by the sea will be considered further on.

2. *Theory of Protrusion.*†—Although between the Tynes the nature of the outcrops,—regular almost as the sloping bars of a Venetian blind, precludes any idea of vertical upheaval of the crags, it must be admitted as possible that certain applications of subterraneous force might cause one bed to advance or retreat upon another, somewhat as the pieces of a telescope, with their ledge-like profile, slide out or in. This theory was, so far as I know,

* The Estuary of the Forth and adjoining districts viewed geologically. 1871.

† This name will serve to designate for the nonce a theory, that so far as I am aware, has not been distinguished by any. To be fully descriptive, it should be lengthened into *Theory of Protrusion or Withdrawal.*

first advanced by Scrope in 1825, as a probable explanation of the escarpments ranged round the central area of the Weald in South-East England; and he proposed to call the resulting hollows "valleys of elevation and subsidence," or "anticlinal valleys."* Abandoned by Scrope, for at least the Wealden Escarpments, in a later edition of his "Volcanoes," Mr. Kinahan in his recent book, "Faults, Fractures, and Fissures," has again brought it forth, and striven to apply it to them.† The Northumbrian escarpments also, Mr. Kinahan would perhaps say, have been protruded or withdrawn one upon another. It might even suggest itself that the Whinsill, the mid-rib of the escarpments, may have been an agent in effecting protrusion. The latter idea at least is not for a moment tenable. This intrusive Basalt has been thrust along the planes of strata evidently under the pressure of great overlying masses, possibly never even reaching the surface at all. As for the other, it will be found that the shales, along the line of which, and, as it were, lubricated by which, the sliding of bed on bed is supposed to have taken place, give, wherever visible, no signs of the crushing disturbance that must needs accompany the process. The smallest faults effect recognisable changes in these laminated shales, multiplying their joints or mashing them up into clays. This theory, which runs counter to the whole spirit of modern geology, is also for direct reasons quite untenable.

3. *Marine Theory.*—So far back at least as the controversies of Hutton with De Luc it has been asserted that channels may have been left upon the earth by the sea. In his "Rivers of Yorkshire," Phillips explained both the dales and the scarped features of that county mainly upon this theory.‡ In his later days, though occasionally appearing almost overwhelmed by proofs of present atmospheric action upon "bases of unequally resisting materials," he still seems to have held to his early views.‖ Without giving any opinion upon the part the sea *may* have taken in the excavation of valleys, whether at a time when currents

* Foster and Topley. Quart. Jour. Geol. Soc., Vol. XXIII., p. 460. † p. 201.

‡ Rivers, Mountains, and Sea Coasts of Yorkshire, 1855, p. 9.

‖ Geology of Oxford and the Thames Valley, 1871, p. 486

may have played upon the submerged surface, or waves and currents rushed through narrows or beat on emerging shores, I will apply this theory to the phenomena of the Northumbrian escarpments. Standing upon a line of shore-like banks, here advancing into rocky headlands, there retiring in sloped bays, one is fain to call up an expanse of sea in front and a whitening surf at base. No analogy, however, is apt to be so delusive as the analogy that appeals strongly to the imagination. The complete correspondence of these cliffs, if such they be, with the lines of outcrop, curve and undulate as these may, is enough to arouse strong suspicions of this plausible theory, even in its more obvious aspect. Borrowing from James Geikie, I have called the sea "a great horizontal saw." Just as a hand-saw cuts across the grain of wood at any angle that may be presented, so the sea tends to ignore stratification, sawing along or across or obliquely, just as comes. This improbability of constant correspondence between sea-cliff and outcrop becomes simple impossibility when not only repeated in every case, but accompanied by frequent undulations of level. The sea rules the base of its cliffs as straight as water-level can make them; in headlands and bays alike they conform at foot to horizontal lines.* On the indented Western Coast of Norway the eye may trace, mile after mile, in firth and on promontory, the bars that mark the old coast lines, whose parallelism upheaval even for hundreds of feet has scarcely impaired. Lines traced along the base of these Northumbrian escarpments, on the contrary, wind up and down continually; no amount of ingenuity could ever conform them to lines of water-level. The Woodcut (No. 2, p. 288) represents what the eye might take for the shoreline of the chief of them—the Whinsill. Its scale, in order to give the slopes as they are on the ground, is necessarily a small one, the breadth of a tolerably fine line representing nearly ten feet, and it is thus incapable of shewing any but the largest curves; but varying as these do between one thousand and about five hundred and eighty feet of elevation by gradual descents, there is enough to mark this

* The piling of beach is sometimes apt to interfere with the evenness at the bottom of an old coast line of cliff. This will be remarked as the case at Marsden.

escarpment as essentially differing from any possible coast-line. And what is true of this midrib of the features is true of all ribs collateral with it, down to ridges two steps high.*

There is another difficulty that imagination must contend with if it still clings to its surf-beaten shore lines. So closely serried are their ranks, that water, hemmed in in many cases by rows of complete break-waters, must lie almost as powerless as in a mill-pond or canal.†

Thus far the sea has been supposed as attacking the crags in front. Could it not take them in flank? A slowly rising or sinking coast, according to Phillips, might bring the ends of the bars gradually within reach of the sea, which "rushing in currents and falling in breakers" might "thoroughly explore" the rocky texture. "This view is based," he adds, "on the supposition, which no one will now dispute, of the gradual and successive uncovering of the land."‡ But alas for the shortsightedness of the human mind. Professor Prestwich, Phillips' first successor in the Oxford chair of Geology, gave a distinct opinion in his first inaugural Lecture, that equable risings and fallings of the earth are contrary at once to "dynamical necessity" and geological fact.‖ An ill-fitting drawer, to use a simple illustration, jerks as it is pushed home: energy gathers before each momentary overcoming of resistance; and thus, Prestwich argues, and others have argued before, must the subterranean energies accumulate and break out. I have alluded to the successive coast-lines above the present sea-level of Norway. I think no one could examine certain of these without being perfectly satisfied that they represent a quiescent stage, during which the waves in some cases

* The Rev. O. Fisher seems first to have used this argument against the sea-cliff theory. Quart. Jour. Geol. Soc., 1861. At that time he supposed outcrops to have been washed bare by a rush of waters divided by sudden upheaval from the sea. This view he has now withdrawn in favour of the ice plough, considered below. It is difficult to devise anything new to illustrate the once vexed question of sea cliffs and escarpments. I have since found that the method embodied in Fig. 2 has been already used by Professor Green to illustrate escarpments near Sheffield. Geol. Mag., 1868, p. 40.

† This argument is Professor Ramsay's; Physical Geology and Geography of Great Britain, 2nd edition. We may also ask, with him: Why should the ridges be scarped uniformly on one side, whatever the general slope of the ground?

‡ Geology of the Thames Valley, p. 488.

‖ "Nature," Vol. XI., p. 316.

cut a ledge upon the rock, succeeded by more rapid movement, when they had not even time to obliterate fine glacial scratches.* This view, early taken by Darwin, in the case of step-formed terraces in South America, receives a measure of confirmation from the old coast lines on our own shores, and is enough to make us chary of any theory based on "gradual and successive uncovering of the land." We look, quite in vain, for coast-terraces, like broad contour lines, intersecting the ridges as they descend from the watershed towards the valleys. The sea, moreover, has nowhere been pointed to as carving out ridges that slope longwise down to its shore: all the lines it engraves are more nearly parallel with its margin. I need scarcely object further, that these ridges, if old sea-work, should give signs of obliteration under the hand of time, or that marine debris and shells might possibly be expected,—arguments not of much value. Lyell, with the fine candour for which he was pre-eminent, frankly gave up this marine theory, long held by him in explanation of the large double amphitheatre of escarpments bordering the Weald. Even its most determined upholder, Mr. Macintosh, who devotes a hundred pages of his book on the Physical Features of England to this view, some of them scarcely, I fear, exemplifying the "Scientific uses of the Imagination," seems to have slackened in his support of it.†

In another more limited aspect I shall have occasion to revert to marine action in the sequel. The claims of a geological agent of such fundamental importance demand thorough consideration.

4. *Theory of Glacial Excavation of Escarpments.*—Among the denuding forces of nature there is no perfect planing agent. Phillips

* I have in mind more especially the fine terrace beneath Stenbjerget, at Trondhjem.

† It is far from my intention to deny that inland sea-cliffs may and do exist, and that some of the features described by Mr. Macintosh may be marine. It is enough, however, greatly to impair the value of Mr. Macintosh's researches that he describes as marine what, as was pointed out at the time by Scrope, seem to be merely the vestiges of former culture. Such "culture terraces" are not infrequent in North Tynedale, and have been fully described in a former volume of these Transactions by my friend the Rev. G. R. Hall, F.S.A. A conclusive summary of the differences between Sea-Cliffs and Escarpments has been given in parallel columns by Mr. Whitaker (Geol. Mag., 1867), whose half-amazed exclamation, "What can be more different than these two?" well deserved, when one or two inaccuracies of statement were corrected, to be "the conclusion of the whole matter."

has said of the sea that "upon a basis of unequally-resisting materials" it must work unequally. But this is true in a much greater degree of every other tool employed in earth-sculpture. It might be expected, then, that when the edges, so to speak, of the various natural tools were being examined as possibly originative of the features of the "Crag-and-Tail," the glacial tool, once so extensively used among the rocks of all Northern Britain, should not have been forgotten. In 1866 the Rev. O. Fisher advocated glaciers as probably connected with the baring of hard rock-ridges into scarped forms.* More recently also, Mr. Goodchild, of the Geological Survey, has contended for a similar origin for the limestone terraces of the Yorkshire dales.† Feeling convinced, from previous examination, of the identity of these terraces with the less pronounced ones of North Tyne, and through them with the outlying escarpments, which graduate into the valley, I endeavoured to test Mr. Goodchild's arguments. These observations formed the nucleus of this paper.‡

Between the Tynes a glacial sheet over-rode the watershed of the country from the westward, moving nearly parallel with the ridges. Here if anywhere, therefore, it might have ploughed out the furrows. Was it in truth, then, the great ice-plough of the frost-giant that left this gigantic "rig-and-fur?" I have no hesitation in replying in the negative. To carry out the analogy of a plough the ice must at least never have driven persistently against the face of the furrows. Yet only a few miles eastward, in the North Tyne valley, such was its direction, and must have been so, guided by the valley, during a great part of the period. Crags like the remarkable headland above Barrasford must have largely borne the brunt of its force; which must have tended, if glacialists such as Dr. James Geikie and Professor Green are accepted as judges, to plane them down. This view is supported by sufficiently clear proofs of the *pre-glacial* origin of the escarpments. The occurrence in the ridges of narrow

* Geol. Mag., 1866, p. 483. † Geol. Mag., 1875, p. 323.

‡ Geol. Mag., 1876, p. 23. Mr. Goodchild's papers were professedly intended to "evoke criticism," but I may say that neither to me, nor to two criticisms subsequently published by my colleagues, Messrs. Gunn and Dakyns (Geol. Mag., 1876, p. 97, and 1877, p. 17) has there been any rejoinder.

stream-cut notches filled with boulder clay, and the relations of the drainage, which dates from an earlier period, seem to me to point unequivocally in this direction.*

5. *Formation of Outcrop Terraces by Rivers.*—Attempts have been made to trace the flights of limestone terraces that border the Yorkshire dales to the immediate action of their rivers. This view, however, is rendered quite untenable when the terraces are found continuous with far-stretching series of ridges. It is of the essential nature of ridges to become step-like or *terrassé* when disposed in a common slope, and it is manifest that rivers cannot possibly have themselves originated features that range, not only alongside dales, but over heights and even water-sheds. Among the Tynedale streamlets, one may certainly notice a tendency to cut underneath the more solid beds, here and there along softer planes, leaving faint local indications of terraces; or more often little crescent-shaped recesses, like the dent of a heel on the bank, prettily overhung by trees and mantled by greenery. Such,—very different from the "steps and stairs" we now find,—may have been the beginnings of dale-terraces: but in valleys whose far-withdrawing sides have overlooked the river in ages much anterior to the glacial period this origin is a very remote antecedent indeed. The valleys must have been widened otherwise than by the river. What has widened them?

6. *Theory of Origin by Atmospheric Waste.*—At the end of last century, Hutton, the Father of Physical Geology, wrote some remarkable words about the Edinburgh Crag-and-Tail. "The isolated Crag and Tail of Edinburgh," he said, "hold their particular form from the joint operation of two different causes; one is the extent and casual shape of the . . . mass; the other is the degradation of that mass, which is wasted by the influences of the atmosphere, though wasted slower than the strata in which it is involved."† Here we have the enunciation, clear and forcible, of a belief that purely atmospheric waste is able to lower the whole face of a country just as it decays and crumbles away

* See postea, p. 316.

† Theory of the Earth, Vol. II., p. 417.

the handiwork of man. The more durable beds, Hutton asserts, will stand out from surrounding softer strata in shapes natural to their structure; much as a hard pebble stands out from the wasting stone and lime of a timeworn edifice. Nor does the title of Hutton as the originator of the Atmospheric Theory of Escarpments rest on a single sentence. "Upon the principles of decay," he says, "a horizontal bed of rock forms a table mountain; .... an inclined rock of this kind forms a mountain sloping on the one side and having a precipice on the upper part of the other side, with a slope of fallen earth at the bottom."

Though little embellished by graces of style, this enunciation is most distinct and precise. It is a notable instance of the powerful sagacity that freed Hutton from what may be termed the geological superstitions of his age; and it is sufficiently curious that while he is universally honoured as one of the Fathers of Geology, modern geologists should consider this theory as their own.

In repudiating the Diluvial theory, long afterwards the favourite one, Hutton was followed by his illustrator, Playfair, who, in language at once masculine and elegant, controverted the notion that any possible torrent could remove at a sweep "bodies of strata three hundred or four hundred feet, nay, even eight hundred or a thousand feet in thickness." On the dipping side, he said, these strata have the support of the neighbouring rock; at their broken edges of outcrop they lack it; and "become a prey, therefore, more easily to the common causes of erosion and waste on the upper side than on the lower."*

Adequacy of this Agent.—There can be no doubt about the adequacy of the wasting "influences of the atmosphere" to bring about the required results upon a *miniature* scale. A model, with sloping layers of wood and clay brought up to one level, would soon be carved into a series of ruts and ridges by the elements. But when the layers are many feet in thickness the ratio between cause and effect seems altered. Let us give some consideration, however, to the agents standing in the relation of *cause*. Two factors are required: one, to loosen or disintegrate the rock

*Illustrations of the Huttonian Theory, p. 403.

constituents; the other to move them when loose to the nearest stream. Such factors are *Frost* and *Rain*.

1. *Frost.*—Being the servant of larger forces, frost was not named in our general review of denudants. When showers of rain have saturated rocks, soaking into their pores, and filling their cracks and joints, a sudden change of temperature often comes to seal the moisture up into ice. The expansion that accompanies the process of freezing takes place with prodigious force. A very small wine-glassful of water tightly plugged into a bottle of cast-iron half an inch thick is enough to burst it; and in like manner each frost that may be seen ornamenting the face of some of these crags with glistening points and little colonnades, has set agoing within it a vast amount of disparting energy, expended both in sundering *en masse* and in separating grain from grain. And what so affects harder rocks does not fail to swell up and loosen the softer, as is familiar upon a roadway after a thaw. Vegetation is an important assistant to frost by lodging moisture and keeping it in contact with surfaces of rock.

2. *Rain and Wind.*—When pulverized or loosened the materials are ready for transport by *Rain*. Every drop of a heavy shower that beats on the soil of a hill side shifts a few particles one little stage downhill. It was the advice of one well fitted to be an adviser on such subjects, that "if your neighbour's land lies below you on a steep hill side, unless you wish to make him a present of your soil, pound it back on to your own land by a fence, and when it accumulates against your own fence cart it uphill again."* But though the travelling of loose soil is familiar to all culturers of hilly ground, it is impossible to measure the "portage" actually accomplished in this way. Streams, as being the first visible index to the transporting processes, are apt to get an amount of credit not justly their due. Yet no one has contradicted, so far as I know, the assertion of the late Col. Greenwood, than whom there could be no more diligent student of "Rain and Rivers," that "in comparison to the broad waste from the wash of rain, the waste by the *direct* action of rivers

* Col. Greenwood's Treelifter, 2nd Edition, 1853.

may be reckoned as nothing."* By rain, as distinguished from rivers, however, must be held to be included in this aspect those invisible trickling runnels that form the capillaries of the system of water-circulation; and true as Col. Greenwood's dictum may, in a measure, be of *mechanical* waste, it is much more applicable to *chemical*. It is while quietly wetting rocks and lying hid among vegetation that water mainly applies the carbonic acid which it sucks from the air and from decaying plants, to the decomposition of their carbonates and silicates.

To the general rule that work so unobtrusive as that accomplished by rain is measured only by general results there is a remarkable exception—familiar enough, perhaps, but worth recalling. On the slope of a bank of clay little semi-detached pillars may sometimes be noticed, each capped by a pebble, which by warding off the rain from the clay beneath it, has preserved a tiny monument of the rain-wash around. In valleys of the Tyrol, in this manner, forests of large columns of indurated clay, each capped by its protecting stone, some as much as a hundred feet high, have slowly become developed; the rainfall of every few years working noticeable changes among them.† I observed lately, in some excavations, a number of detached pillars of clay left standing by the quarrymen, and inquired the reason. "These," I was answered, "mark piecework." The Tyrol earth-pillars mark, in a very imperfect degree, geological piecework; and Rain was the quarrier; but very seldom is there any measure for its work. The great breadth of many of our own valleys is in large part the result of the imperceptible action of these silent forces.

To rain, as an assistant, may be added *Wind*. No one who has heard blasts hurtling among the rifts of a crag should overlook wind as a co-operator with rain in bearing away loosened particles of rock. Whilst climbing the steep sides of one of the grand natural pyramids of North-West Scotland—Coulmore, Assynt, I was assured by an intelligent shepherd that he had seen a slab of rock of more than a hundredweight lifted up bodily by a sudden gust; and having had personal experience only a

* Op. Cit., p. 189. † Lyell's Principles of Geology, 12th Ed., Vol. I., p. 329.

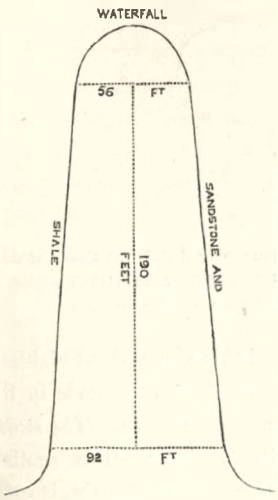
few hours before of the dangerous violence of winds at such heights, I was inclined to give some credit to the statement. On the summit of this Assynt mountain the Cambrian sandstone weathers into shreds that hang about its blocks like rags; and to mark these congeries of grains shivering to the wind is to understand by visible demonstration what must unperceivedly bear away many a grain of the harder sandstones of Northumbrian crags, and has in fact formed a covering of sand around some of them.

Illustrations of Atmospheric Action in Tynedale.—Such being an outline of the action of the wasting "influences of the atmosphere," one or two illustrations may be given of their actual effects upon rocks. Take first their effects in severing *en masse*.

In following, upwards, the course of a Tynedale streamlet, one can seldom go very far without finding the banks drawing together and becoming more and more precipitous, until the gorge, as narrow, and almost as steep-sided as a high-walled roadway, and all cumbered with fallen blocks, is barred by a waterfall. It is the well known tendency of waterfalls to cut back along the line of the stream course, so as to place themselves at the end of a steeply walled gorge of this kind. The walls at the lower end have stood facing each other since the waterfall cut away the rock from between them, and standing, as they often do, well above the running water, which in cases relevant to our purpose must shoot straight out with the incline, they are left to the attacks of frost and rain. Here, then,—as pointed out by my colleague Mr. Goodchild—we have a gauge to measure, relatively, the capacity of purely atmospheric forces for cutting back scarped walls of rock. By how much in a given case has each wall receded since left by the waterfall, and what is the ratio between its recession and that of the fall?*

A gorge or dene in the Dinley Burn, near Birtley, supplies sufficient answer for the purposes of an illustration (Woodcut No. 4). The full width in front of the waterfall, which was at first formed by a sandstone about ten feet thick and some twenty

* Geol. Mag., 1875, p. 325.

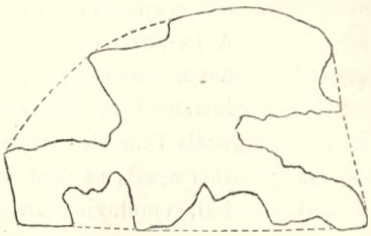


Woodcut No, 4.—Diagram of gorge in Dinley Burn, shewing enlargement by atmospheric disintegration.

feet of shale below it, is fifty-six feet. A hundred and ninety feet further down stream, the gorge's width has increased to ninety-two feet. Its walls thus stand thirty-six feet further apart, so that while the waterfall, employing its more powerful tools of erosion, has been cutting back a hundred and ninety feet, the quiet action of the atmosphere has removed eighteen feet of sandstone from each side. This is a considerable ratio, nearly one-tenth. A much smaller ratio to the erosion that has dug out our valley systems should be capable of working large effects upon the heights of a country.*

The fate of masses severed from the parent rock naturally is to moulder away grain by grain. A lesson of gradual waste may be learnt from a monolith standing in the grounds of Swinburn Castle. This stone, a shaft about eleven feet high, is a portion of a stratum of compact, fine-grained sandstone stripped from its outcrop and raised endlong. In its original position it would be exposed along one of its flatter sides, but since its erection waste has attacked its summit, and its point now resembles an Alpine peak in miniature. It is sharp and attenuated atop, and rugged flutings descend upon its sides, their direction determined by the slant of the stone.

* When the above was first written this instance was supplemented by two others taken from the Upper and Middle Falls of the well-known Hareshaw Linn, near Bellingham. I have since then remarked sufficient curvature in these gorges to make the stream probably scoop out one side. In a case adduced by Mr. Goodchild (loc. cit.) the ratio is only as forty to one and a half, *i.e.*, only one-twenty-seventh. This he states to be an "extreme case," but, in view of the immense effects produced by stream action, even this is significant. It must be remembered that the stream not only attacks with better applied force than the atmosphere, but in many cases has less and less to do as the fall recedes. Thus, in the Dinley Burn, instead of having eight or ten feet of sandstone to cut back through, as at first, the trenching of the stream above the fall has left only about two.



Woodcut No. 5.—Transverse section of Druid stone, near Swinburne Castle, at about one and a half feet from the summit. The dotted lines indicate the original outline, allowing nothing for disintegration of outer points. Scale one inch to one foot.

Woodcut No. 5 represents a section of this stone about eighteen inches from the summit, and shews the deep ruts made in the original quadrate form indicated for us lower down. The *modus operandi* which waste has taken will be described in another page. For the meantime, disintegration grain by grain, is sufficiently signallized by its effects within the human period upon this scarred "Druid" stone.

Suitableness of the Atmospheric Theory.—If, then, the wasting influences of the atmosphere are not inadequate to the developing of hard ribs of rock into escarpments, when time upon a geological scale is allowed, it is obvious that none of the objections found to weigh so heavily against the theories passed in review, have any prejudicial bearing on the atmospheric one. Shed broad-cast over the surface, these influences tend to pick out a configuration solely determined by the nature of the materials and the facilities for transport.

Development of the Theory.—As late as 1861 the Crag-and-Tail of Edinburgh was referred by an accomplished geologist "to some process not easily explained."* The late Beete Jukes, among the later school of geologists, seems to have first expressed, in the following year, the principles of the philosophical view so long before taken by Hutton and Playfair.† In 1863 and 1864 Professor Ramsay gave a remarkable digest of observations

* Prof. Geikie. Geol. of Edinburgh. Mem. Geol. Surv., p. 127. Greenwood, in 1853, had verged very closely upon the atmospheric theory in his "Treelifter," p. 187.

† Quart. Jour. Geol. Soc., Vol. XVIII.

upon the Weald, which contains within a few lines the essential pith and marrow of the argument.* Messrs. Foster and Topley, in 1866, contributed a comprehensive memoir on the same region to the Geological Society.† The controversy that ensued need not be followed. If it did not establish the atmospheric theory in all cases, or to the satisfaction of all minds, it at least demonstrated atmospheric waste to be equal to its task. Escarpment districts may have been rough hewn by other forces, like the marble that is first blocked into a form directly related to the sculpture ultimately produced; but few now really deny that atmospheric influences have modified the ground to a figure whose lines, at earlier times, lay hid within the solid. The controversy perhaps culminated with the production of Mr. Whitaker's conclusive paper on the Chalk and Tertiary Escarpments, which presents the arguments in a form wholly unanswerable by advocates of the marine hypothesis.‡

I must not pass to a consideration of the phenomena of the Escarpments I describe without recognising my obligations to the above-named authorities, and others elsewhere referred to, which are so great that references very inadequately represent them. Prof. Ramsay's teachings, especially, I have so long and so completely assimilated that it were scarcely more impossible to distinguish one by one the elements that lay the foundations of a constitution.

Development of Escarpments.—I have remarked that if a model constructed of sloping layers of wood and clay were exposed to rain, the clay would sink into grooves. But to induce erosion it must be provided that the water be able to run off. In like manner in Nature, the better the provision for free flow the more rapid and powerful the resulting action.

Suppose the elevated ground between two large rivers to be represented by the space between the upright lines of the letter

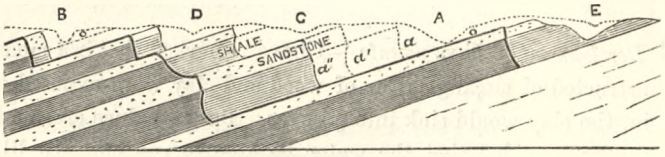
* Physical Geology and Geography of Great Britain, 2nd Edition.

† Quart. Jour. Geol. Soc., Vol. XXIII.

‡ Geol. Mag., Vol. IV., 1867.

H, or if the rivers are, like the North and South Tyne, convergent, the letter A; and let the single cross bar of the letter represent many bars of hard rock alternating with soft. Any grooves that may be formed between the bars will then descend in each direction on a valley; each bar will form an arch, with its watershed for summit, and the valley-slopes, in part, for sides. Now as long as the seaward slope of the river beds occasions a vigorously deepening flow in them, the convexity of the arch will be maintained, in spite of the attempts of atmospheric waste to flatten its summit. The flow and eroding power of water in the grooves will thus be provided for, and ready transport for the materials disintegrated in the flattening process will be always at hand. As in the model where free flow is arranged for, the hard bars will stand the best chance of being sculptured into relief.

1. *Development by Streams and Atmospheric Disintegration together.*—Let us trace the details of this development. Suppose the rivers represented by the limbs of the A or H to have just begun to flow, guided by hollows appreciable to the unerring selection of water. Rain falls on the higher ground between, and descends upon them. Streams of a hundred different sizes flow among the obscure bars, some along, some probably fewer across, at various angles.



Woodcut No. 6.—Diagrammatic section of Sandstones and Shales illustrating the development of Escarpments and Terraces by streams. A, B, C, D, E, transverse section of different-sized channels on the original surface. Successive stages of excavation are indicated by dotted lines, and light and dark shading.

Suppose the case of five different-sized streams flowing side by side *along* the bars. Woodcut No. 6 is supposed to be a section across outcrops of hard sandstone and soft shale near and parallel to one of the river channels represented by the limbs of the capital letters, which I shall begin to call *longitudinal valleys* in

contradistinction to the *transverse streams*.* Let a stream, A, be supposed to find its way along a homogeneous shale, in which deepening proceeds straight downward. A channel, V-shaped from the action of the elements upon the yielding sides, will soon result. It is shewn by dotted lines. On reaching the underlying sandstone the stream flows along a junction of softer with harder beds. The sandstone resists while the shale yields. Deepening proceeds obliquely, and by the shifting of the apex of the V sideways the section becomes unsymmetrical. The process is now an undermining one. Overlying beds lose their support and give way, and the scar, always travelling to the left, a a′ a″, becomes in time crowned by a sandstone.

If the stream flow, in the first place, along a sandstone, as at B, the result is ultimately the same. The sandstone is first trenched through into a gorge with upright walls, (hard rock retaining its steepness,) and the stream on reaching shale proceeds as before. The shales thus tend to become in the long run the conducting lines, and with the co-operation of atmospheric waste, which attacks, among the rest, any outlying masses such as o o′, the long-drawn hollows are flanked by sandstone ridges, and a "*rig-and-fur*" of escarpments is produced. Nor must this be supposed mere theory. Wherever streams run along the strike of variously-bedded rocks of tolerably regular dip, their channels tend to consist of a scarp and a dipslope.

Further steps of development commensurate with the continued deepening of the adjoining valley remain to be traced. Four of our streamlets, A, C, D, E, are of different sizes, and must carry on their work of uncovering dipslopes and making scarps at different rates. An advanced stage in the process of escarpment-making is shewn by the inner shading in the diagram. A, being the most powerful, has worked so rapidly as to overtake C, which it has obliterated; converting its at first distinct channel into a mere rain-washed ledge or terrace on its own bank. The stream D was feebler than C, but its position favouring it more, both its channel and escarpment remain as yet distinct. E, little more

* These terms, if I remember right, are Jukes'. They are now terms of common acceptance.

than a runlet, has been equal to the task of keeping the beds to the left of it well scarped, and as the sandstone is set off by a thick shale beneath it, and cleared above into a long dipslope by A, this escarpment is now the most imposing of the series. Yet its sandstone is not the thickest, and it will be noted that the thinnest sandstone of the group, that underneath B, has formed a distinct platform, compared with the ledge to which circumstances have limited the massive bed further to the right.

In these advanced stages of development it is important to gain a correct idea of the changes to be noticed in passing from the mouth to the source of a large transverse stream. The diagram will give an idea of this if all the gradations of the four streams, A, C, D, E, are traced in succession. At first we note the escarpments gathered up into terraces in the bank, but as we rise with the lessening stream their dipslopes lengthen, they open out, and take the escarpmental form.

2. *Development by Atmospheric Disintegration alone.*—If we keep strictly to the diagram, however, we ought, in thus ascending, to reach the initial stage of the runlet E, where no escarpment exists at all. But here will come in the influence of atmospheric waste pure and simple, to which, in the nature of the case, we are now restricted. It is obvious that in the advanced stages at which the ridges in the lower ground tend to become terraces, increasingly liable, as is evident from the development of the channel A, to entire obscuration, we may expect to find upon the watersheds escarpments of the completest type. Frosts and rains have been quietly working there for a greatly prolonged period, and if they have power to chisel out the structure, escarpments must be the inevitable result.

Ere this stage can be attained, however, the longitudinal valley may be expected to possess the characteristics of great age. In following out such parallelism as may exist between the escarpmental development as we actually find it and the foregoing hypothetical case, it is well first to look at the valleys.

Tynedale Valleys. 1. *Longitudinal.*—The vales of North and South Tyne are both, in the main, greatly widened, although not

of equal width throughout. Look along North Tynedale from the high ground between Wark and Bellingham, and it appears a broad and gently concave basin, as shallow in proportion to its width, you might say, as the hollowed half of an oyster shell, or even more so. Such valleys are evidently very far removed from the deep, steep-sided trenches which rivers cut for themselves when travelling through rainless districts, as is well known in the case of the narrow profound canons of the Colorado, which sometimes *exceed a mile* in sheer depth. Rains and frosts have evidently been long at work upon these far-withdrawing slopes. Tynedale has in truth reached an advanced stage of excavation; in common with all our large valley-systems it is greatly older than the glacial period. "It may be safely said," writes Prof. Ramsay, "that before the glacial period the river-systems of Britain were very much the same as now."* So deeply excavated is it into the body of the country, belonging, indeed, to a physical order of things when Britain stood higher out of the sea, that were the whole valley cleared from the glacial drifts that thickly line its bottom, an arm of the sea would extend far inland; how near to Hexham Bridge I will not venture to say; and in the greater part of the valley above it, the river, which now flows off and on its old channel, would run at a considerably lower level.†

The same great breadth which I have remarked upon, is seen in its main tributaries; and seems in them altogether disproportionate to their length. The Erring Valley, entering North Tyne, actually shews for its four miles of length (for above Hallington its stream is nothing) one and a half of breadth.‡ Erring and Houxty Burns, in North Tyne; Allendale and the vale towards Gilsland,—used in part by the Tipalt, in South Tyne; are examples of this surprising breadth.

Such are the main valleys, the great highways of transport for

* Physical Geol. and Geog. of Gt. Britain, 5th Edition, p. 530.

† Prof. Ramsay in the volume just referred to alludes to the Tyne as "this preglacial river," and quotes a description of a lower reach of its old course. All the places I know, from Falstone downwards, where the river runs on rock, are points at which it has failed to recover this ancient channel.

‡ It is worth remarking that this valley does not contain within it, so far as can be seen, a single sandstone massive enough to build with.

the materials denuded within the river-basin. It would be impossible to decide, from their mere breadth, which represent the longitudinal limbs of the H or A, and which are the main transverse entrances upon them. But what is the relation of the outcrops represented by the cross-bar?

2. *Transverse Valleys.*—In the lower third of North Tynedale the outcrops stretch* across the valley in the form of a bent bow pointing down the river. It would be difficult to find a better illustration of longitudinal and transverse than is here supplied. Observe first the condition of the outcrops in crossing the valley. From a good vantage point, such as the great bank south of Chollerton, the valley seems divided into compartments by broad bars pointing across from each side. In such a view the eye is misled as to details, but it is guided aright to the great fact that the denudation which carved out the valley-system, in leaving these spit-like ridges, has worked along the lines of the internal structure. In reality they are never quite *vis-a-vis;* the safest generalization to make is that they represent only the high grounds between wide-mouthed transverse tributaries, but they combine to give the valley the general aspect, as intelligent eyes have not failed to remark, of a succession of lake-basins strung upon a long winding hollow.

Following one of these broad ridges away from the valley it continues to be clearly manifested that the results of denudation have more or less opened out the lines of structure. The ridge is at once recognised as compounded of many various outcrops, which, as the streams lessen, and the transverse valley becomes lost in the rolling plateau within, become more individualized, each after its kind, and here and there rise in scars and crags. At length the watershed is reached, and so far from the ridges having disappeared, they generally crest it boldly; as notably happens about Sewingshields, on the west, and in the grand crags about the source of the Wansbeck.

The ridges pass over beyond Sewingshields in a direction verging towards parallelism with the lower half of the South Tyne,

* The geological term *strike* applied to the general direction of outcrops is just this word in another form. German *streichen.*

which is therefore much less representative of a longitudinal river than its more important turn. The analogy of the A fails here. Close to the fork, however, on the north side of that curious sentinel hill between the two, the Warden Hill, there arches over from one to the other, almost like the bar of the A, a series of escarpments, which present a tolerable epitome of some characteristic facts elsewhere spread over miles. Stand on the north-west side of the hill, and look along the furrowed hollow below. Towards the higher ground on the left,—the summit of the arching cross-bars,—the single ridges stand out comparatively broad, distinct, and high; but as the eye follows them down towards the North Tyne they gradually thin and lower, until they seem to sheathe themselves in the earth. In this bolder water-shed-configuration of the individual beds, clearly seen in profile from Chollerford Bridge, and this tapering and massing together of them in descending, we have what is repeated again and again in the watersheds of the district.

In this region of England we thus have two extremes of Escarpmental Development—the simple ridge and the compound; just as in the theoretical instance of a former page. In following the subject out further I will take the extremes last; and consider now several points about the system of "Rig-and-Fur" which stretches between them.*

The *Rig-and-Fur of Escarpments.* 1. *Relation of the Water-flow to the Ridges.*—It will be readily seen to be an important question bearing on the origin of the ridges—Did the waterflow choose its lines guided by the main gradients of the ground, or did it find furrows *ready-made* to coerce it along *them?* The question may be answered by taking into hand an ordnance map of the classic region of the Roman Wall between the North and South Tyne. The eye is at once struck by the number of streams flowing E.N.E. or W.S.W.,—the range of the "riggs." Nearly all the smaller streams are disposed in that direction, and it need hardly be said that they are guided by the furrows of the

* I adopt this expression as concise and descriptive. I am ignorant how far it is known in the South; but every Scotchwoman, at least, knows it well as applied to ribbed knitting.

"rig-and-fur." The larger streams, however, are less influenced by it. Some, indeed, such as the Haltwhistle Burn (Caw Burn) below Greenlee Lough, and the Simondburn below Townshields, occupy single grooves for long distances; but sooner or later they are apt to be found *shunting*, as it were, their line of flow. There are those, like the Knag Burn, that cross the ridges almost as if ignoring their presence, not a little resembling, with their furrow-guided feeders, trees with their branches trained along espaliers; and there are others, again, intermediate in character,—notably the Simondburn in its upper reaches,—which bend in a series of zig-zags composed of *longer* furrow-guided lines, and *shorter* gap-traversing ones. Most of the numerous streams that enter North Tyne between the Simondburn and the Houxty Burn have, as already partly indicated, worked into the trend of the ridges; presenting, in their general parallelism, a complete contrast to the unrestrained ramifying of Chirdon and Smale Burns further north. In this they seem to have only followed the general gradient; and, taking the region as a whole, obedience to the general gradient is the rule.

What is the interpretation of these facts? The streams, we see, are not absolutely coerced into single lines of furrow, but frequently break across through gaps. Now, before the true character of Escarpments was recognised, the question was sufficiently answered by supposing the narrow breaks giving passage to streams to have been open fissures, or low-lying points at which lakes ponded up among the ridges had overflowed and drained. Jukes, however, recognising, in the South of Ireland, as Ramsay, at the same time, was recognising in the South of England, that the gaps are *not* in lines of fissure, and not in positions where, barred by them, the stream would have chosen to run, concluded that their excision was accomplished *pari passu* with the formation of the ridges themselves; in other words, that the streams had flowed there before the ridges came into existence.*

* Jukes' River Valleys of South Ireland, Quart. Journal Geol. Soc., Vol. XVIII. Also Jukes and Geikie's Manual of Geol., p. 454. A vigorous sketch of the behaviour of these Irish Rivers is given in Hull's Physical Geol. and Geog. of Ireland, 1878.

Was this the case here? It would be easy to prove that gaps have here also been cut at points where no breaks, fissures, or even closed faults occur, and where the stream had an open course elsewhere. But, unfortunately, this would be vain in argument if it is possible that a barrier or *false bottom* of glacial drift may have helped the water across. Even in the spaces most free from drifts the occurrence of patches here and there in the furrows, or of preglacial notches brimful, suggests that their quantity may have formerly been sufficient to raise stream-beds up to the level of the lowest points of egress.* One strongly *feels*, however, after an examination of the ground, that Jukes' explanation is the philosophical and true one. It is a master-key to unlock all difficulties: without it we must have recourse to a whole bunch. And the feeling may become assurance when the behaviour of the ridges in the main valley, North Tyne, is considered. Grant, for argument's sake, that the ridges in the higher ground *did* originally dam up the water; and, keeping in mind that there is no question of an origin for the furrows by subsidence of the earth's crust, turn to the valley. The river there practically flows alternately in a wide basin, and a comparatively narrow gorge; the valley being constricted by compound ridges, strictly representing,—as the Whinsill ridge, which is continuous from the uplands, clearly demonstrates,—the usually

* It seems in place here to give some passing account of the several origins of partial gaps among a series of Escarpments such as these.

1. Some are due to accidents of structure. The *Nicks* so characteristic of the Whinsill are mostly of this class. Where this intrusive basalt has broken across from one stratum to another it is both less homogeneous itself and contains portions of the ruptured bed. In gaps traversed by faults a local shattering has had the same effect, that, namely, of rendering the ridge liable to excision by atmospheric disintegration.

2. Some narrow steep-sided notches in these escarpments may be the work of springs rising in them. The rock beside a spring, being especially liable to saturation, must be rifted by frosts elsewhere inactive; and transport for particles is always at hand.

If it were possible to find a sufficient number of preglacial gaps the difficulty referred to in the text might be overcome. But this can be proved only in a few special instances. These, however, demonstrate, I believe, that the escarpments are, like the valleys, preglacial. The glaciers between the Tynes passed *along* the ridges and could not cut narrow notches across them. They simply dropped stones and clay into a notch previously there. The best example of a drift-filled notch will be found by following the stream on the north side of Coldknuckles, a mile down to the first gap.

simpler ones of the higher grounds. If the latter ponded streams, the former must have ponded the river, and, the gorges being closed up, you would have a string of lakes occupying, as is postulated, *scooped hollows* or *rock basins*. Now it has been clearly brought out of late years, that neither the sea, nor rivers, nor any erosive agent but *ice* alone can possibly have the power of excavating basins of rock. It is also quite certain that Tynedale existed much as now before the glacial period. How can the basins have been made? We are, in truth, at a complete dead-lock, unless, indeed, recourse is had to *former* glacial periods, an evasion simply puerile, until it is granted that longitudinal and transverse stream-flow, assisted by widening rain-wash, has dug out the valley; broadening or narrowing according as the strata from one cause or another had more chance of survival.

Such streamlets as extend crosswise to the "rig-and-fur" generally reproduce in an interesting manner the circumstances and features of a great longitudinal river in its early stages. Looking, for instance, from the Whinsill slope towards Bardon Mill, on the South Tyne, you see single escarpments passing in deepening bars down towards the Chinely Burn. It is precisely the same distribution that we have already noticed on a larger and less obvious scale in North Tynedale itself; but here the descending streams merely uncover more of the simple scarps as they enlarge,—not great composite ridges. Comparing the two it is possible to realize very vividly the scenes that marked the youth of North Tynedale. Escarpments were then undeveloped on the watershed; and instead of a wide-bosomed valley, with soft slopes and large tributary vales, there was a narrow continuous gorge, bordered by innumerable sharp rigs and deep gullies. But Nature's scenes are shifting scenes. And the mind's eye may by slow continuous panoramic movement carry out the changes that Time's lapses have brought, the furrows lengthening and the ridges creeping out to the watershed, and leaving the low grounds smoothly massed, fused, and terraced; with many a bed, capable of standing out boldly, shrunk obscurely into the bottom and sides of wide affluents. It needs, then, only the smoothing hand of a glacial period, and the renewing

influences of the summer, to give us the beautiful vale of North Tyne.

I pass on to consider the features among the "Rig-and-Fur" that depend upon specialties of structure.

It has been already sufficiently indicated that it is the *composite* nature of these Carboniferous strata that occasions this diversity into ridge and furrow. We may see the same, to a certain extent, in the cliffy scaurs bared at the elbows of a winding stream, when bands of sandstone and limestone separated by shale exhibit their conduct under the weather, side by side. The face of the shales, where bare, is almost invariably hollowed, leaving the others projecting, and often so undermined by its decomposition, as to have little chance of becoming weathered themselves.

2. *Sandstone Escarpments.*—Among the several escarpment-forming beds the first in general importance, though less prominent than the Whinsill, are the sandstones. There is no one line of sandstone outcrop rising into crags throughout its whole length. Constantly varying in quality along their strike or *stretch*, the thickest and compactest sandstones are apt to deteriorate within a short distance. The crags coincide with hard, well-jointed developments. In the well-known Queen's Crag the main rock consists of one almost seamless bed, twenty-five feet thick, marked out into massive pieces by joints. Followed eastward this mural cliff sinks down within a few yards into a heathery bank; and a quarry some distance on shews the stone to have become divided up into easily separable pieces of the handy size favourite with builders of dry stone dykes. In other crags the change is yet more sudden and complete. About a hundred yards east of Colt Crag, near Watling Street, the sandstone has become so loosened that it can be dug with a spade, and the feature has wholly sunk from view. In this case the deterioration is probably due to the absence of the chemical binding principle.*

* Some sandstones *set* under weathering; surfaces eaten by the weather may be seen glistening almost as if porcellanized, and much more homogeneous than in the interior of the stone. The sandstone upon which the Romans have left their wedge-marks

Many of the local developments of crag are of the form called lenticular, a form represented by the diameter section of two watch glasses placed rim to rim. One of these crags bears some resemblance to a single watch glass cut across the middle, the fresh cut edge, declining bow-like at the ends, outlining the brow. Sometimes a crag is hollowed below, where the sandstone is generally more laminated, into a "mountain piazza:" a grateful shelter for the sheep. One of these has been happily described by Hodgson as "grotto-sided." Various modifications occur in details. If intersected by numerous joints a cliff presents jutting points bounded by irregular fissures. If the joints mark the rock into larger squares, large and tower-like buttresses may result.

Laminated and closely-jointed sandstones generally rise in rounded embankments. Where exposed, the rock has the appearance of what is expressively termed in the Lowland Scottish a Skelvy Scair; *Anglicè* a scar disposed in little shelves. Variations in texture and bedding are followed with considerable precision by changes in the appearance of the feature.

3. *Limestone Escarpments.*—The *Limestones* in this district lie among the sandstones and shales as well-individualized beds, of no great thickness, but sharply-defined character. Generally subordinate in mass to the sandstones, they could not be expected to rise so prominently; but in proportion to their thickness they are not less important. From their distinct character limestones ten and twelve feet thick often enter with their whole thickness into their scarp, and their features range with a constancy that similar sandstones seldom possess. Occasionally even here, they may be compared, without disadvantage, with the sandstones; as in the terraced profile of the Birtley Escarpment, as seen from above Wark; and among the Yoredale Rock-features of Yorkshire, where the sandstones have thinned, they become predominant.

and an inscription on Fallowfield Fell is one of this kind. These keen-eyed ancients seem to have chosen the best and certainly the most easily won stone in the neighbourhood. I may refer in this note to the great sprinkling of disintegrated sand to be met with about some sandstone crags. The well-known Shaftoe Crags, a favourite resort from Newcastle, are all littered about with it.

When it is considered that limestones are subjected both to mechanical disintegration and chemical solution, it may be some matter for surprise that this should be the case. Jukes likens the limestone rocks of the South of Ireland to "glaciers melting in the summer sun." There can be no doubt, however, that this comparison is overstrained, unless taken in a general sense with reference to the principles illustrated by Jukes when he used it. Neither in the South of England nor in Yorkshire are the carboniferous limestones conspicuously more liable to weather than the sandstones; in one case at least, when placed side by side with Millstone Grit, in the walls of Carnarvon Castle, Prof. Ramsay mentions their superior durability.*

The shape of the limestone features in this district makes the fact at once apparent that they are not moulded by chemical action. While the tendency of the mechanical agents is to use their vantage in front by driving back the scarp, chemical solution tends to dissolve it down and convert the angular feature into a rounded one. This is far from having taken place: limestone features are generally as angular in section as those of sandstone.

Frequently, however, the effects of chemical action are sufficiently well-attested in other ways. On the surface of a limestone dipslope the joints are sometimes so widened by solution of the sides of each block, that the slope displays a sort of check pattern,—squares bounded by excavated lines; a pattern which the green-sward peculiar to limestones exhibits at certain seasons of the year in shades of darker and lighter green like a tartan. In quarries each of the upper line of blocks has generally a somewhat conical shape owing to solution of the sides. There does not appear to be any reason to think that the surface of the dipslope has suffered much more from solution than the sides of any one of these blocks, an amount represented by only a few inches. Chemical action is distributed along the joints far into the depths of the rock.†

* See evidence gathered on this point by Mr. W. Gunn, Geol. Mag., 1876, p. 97.

† Mr. Tiddeman mentions erratic blocks in Lancashire, supported on pedestals, one and a half to two feet high, of the Carboniferous Limestone on which they were stranded: the

But if sandstone has the advantage of limestone so far as purely chemical action is concerned, the non-porous character of the latter renders it much less liable to be attacked in the grain by frost. How thoroughly even the most massive sandstones have been permeated by water is shewn by the fact that their felspar-constituent has been usually reduced throughout to the condition of kaolin by abstraction of the potash in solution. Their porosity is thus increased, and it seems probable that in the silent enemy which creeps within their substance and tears it apart, they have one no less deadly than carbonic acid is to limestone.

Upon these limestones frost acts by breaking up the cuboidal blocks, to which joints divide them, into angular flattened pieces, which get scattered along the scarp. And amid the moist vegetation, rich in carbonic acid, they are probably more rapidly dissolved than when *in situ*. I have said that mass for mass escarpments of limestone do not seem to recede quicker than sandstones. But an ordinary wall has no chance of resisting a demolishing hand as long as the thickness of a peel-tower. Seldom exceeding twenty-five feet, while the sandstones are sometimes three times as much, they shrink back towards the base of thicker beds behind, and often become a subsidiary portion of a sandstone feature,—a subdued ledge or knob in the talus-like skirt of a crag.

4. *Shale.*—Since shale tends to hollow out where associated in vertical surfaces with sandstone and limestone, it would almost seem superfluous to argue that in cropping to the general surface of a country it should do so likewise. But as this fact, so elementary to a student of physiography in Tynedale, has been disputed, it

unprotected surface having been dissolved away to that depth since the glacial period. Kinahan finds similar pedestals in Ireland to be seldom as much as three inches high, except near the coast, where they are six inches. A thin cover of glacial clay may have protected the rock for variable periods, until washed off. The brown unctuous clay, often associated in considerable quantity with Northumbrian Limestone, does not, I believe, consist purely of the insoluble residue of dissolved rock.

A curious limestone boulder, fantastically eaten into a network of holes, till it looks almost like a Brobdignag fragment of a coarse-meshed *Fenestella*, stands in the garden of my friend, Mr. Coppin, at Bingfield.

is worth while shortly to illustrate it. The decomposition of shale is in a great measure the *rationale* of escarpments.

There are situations, it must be allowed, in which shale is more lasting than when exposed to disintegration in a bare scar. In the waterfall in Dinley Burn, near Birtley, already alluded to, a strip of shale, upon which the water splashes step after step with considerable force, but which it protects from all but very severe attacks of frost, stands out as a buttress, while on either side are recesses, like the curves of a narrow B, where spray and drip are heavy. The forcible erosion is evidently less effective than the noiseless corroding waste. The same fact may be remarked in the calcareous grit below the main fall of Hareshaw Linn, near Bellingham. Among the furrows of our escarpments shale is attacked rather by the quiet than the forcible method. The impervious clay into which it softens allows fine threads of water, that sandstone or limestone would at once absorb, to flow freely along, while its fine, often impalpable, texture supplies particles suited to so slight a conduit, to which a large grain of sandstone might be a boulder.* Nor can a cover of grass prevent this invisible "portage" by capillary streams. Long ago De Luc argued that after a slope sufficient to render a country fertile for man's culture is attained, denudation must cease. "According to the doctrine of this author," says Hutton, in a vein of unwonted humour, "our mountains of Tweeddale and Teviotdale, being all covered with vegetation, are arrived at that period in the course of things when they should be permanent. But is it really so? Do they never waste? Look at the rivers in a flood: if these run clear this philosopher has reasoned right, and I have lost my argument."† It is small change of position to assert, upon the basis of Hutton's argument, that rain water cannot run off clay, even under grass, without becoming

* The hill-sides where they consist of clay are much more furrowed by stream-courses than where porous rocks form the surface, a fact very marked, as pointed out to me by Mr. B. N. Peach, among the shale and sandstone groups near Carter Fell. It is an interesting comment on the conducting power of clays, that in the argillaceous gault regions of S. England, the bridges have to be made *wider* than on the porous chalk. (Green's Physical Geology.)

† Theory of the Earth, Vol. II., p. 204.

impregnated with its particles. Take a homely illustration. Most tourists may know that a shower falling upon cloth of loose texture is unpleasantly apt to soak along the fibre and gather at the cuffs and borders. Let the tourist rough it a little, or, better still, let him be a *field-geologist*, and his coat will not lack *dust*. Now, water straining along the meshes of a cloth is not unlike water filtering through a felt of vegetable fibres. In both cases it must pick up particles and drip off turbid. As for the coat there is certainly no doubt about it; every geologist is the subject of a hundred such experiments.

One of the effects of vegetation, however, is to prevent the shale from receding beneath, or *undercutting*, the escarpments. Only when free from cover can it thus give way; as it is a line of rushes is usually the best mark of its position.

5. *The Whinsill.*—This oft-times lofty ridge I take last, as being an intruder among the more normal features. Intractable to the quarryman, from the building of the Roman Wall until quite of late years, the Whinsill might be supposed to defy also the hand of time. But although generally the dominant feature, its columnar jointing makes the dislodgement of its blocks easy, and its ruin is generally great. Its talus below the Barrasford Crag is no less than twenty feet thick measured at right angles to its slope, and at other points, Crag Lough, for instance, the rock has suffered probably to an equal extent. Granular disintegration seems to be but slow. Coats of oxidized basalt, to which I have been pointed by a farmer as clear demonstration of the notion that *stones grow*, are generally found peeling away.* But even at the bottom of the talus I noted the fragments to remain perfectly angular: and when the length of time during which these deep-laid fragments have been exposed to disintegrating damp is considered, it is evident from the mass of the talus that mechanical waste in the Whinsill enormously exceeds the chemical.

* William Hutton, in his almost ingeniously erroneous paper on the Whinsill, takes occasion to point a moral against *the* Huttonian school from the unweathered appearance of the huge whin blocks lifted out by the Romans from their fosse at Limestone Bank. George Tate of Alnwick, who has a word of admiration, and a diagram, for the Sewingshields and neighbouring crags, remarks this peeling skin, evidently with a quiet *caveat*

This has an important bearing on the preservation of the escarpment: for the time must come when a great talus will completely shield its front from further destruction except that by granular disintegration and solution. I believe this to be the cause, in great part, of the prominence of the Whinsill escarpment. Other escarpments may have been preserved locally in a similar way, but it seems inevitable, unless another Glacial Period sweep away the talus, as the last one did, that along a great part of its range the denudation of this escarpment should come almost to a standstill, while others continue to recede.

This may account for the sudden forward starts of crag met so frequently in the Northumbrian lake district. Without insisting on this, however, we may note in passing the narrow, rugged "gaps" and "nicks," some of which in the middle ages were such villainous turnpikes for robbers to exact tolls at. Most of these have been occupied by broken materials, and have easily been laid open.

Leaving the "Rig-and-Fur," we shall now take the outermost extreme.

Watershed Escarpments. It is not the main sheds only, but subsidiary ones far too numerous to detail, that present us with this phenomena. The crags upon the watershed between the Tynes, classic to all readers of Dr. Bruce's great work on the Roman Wall, may be selected as type specimens. These are the Sewingshields Crag and King's and Queen's Crags.

If truly carved out of the earth by frosts and rains these crags are a triumph. The King's Crag, including the talus-slope that descends steeply, skirt-like, in front, rears its crest a hundred and ten feet high upon the very saddle-back of the watershed; and sends its dipslope towards the Queen's Crag behind, into a trough not less than ninety feet deep. The finer escarpments of the district we find to consist of a main bed of rock above, forming the crag, and several minor beds gathered up under it: they are, so to speak, more than one story high; and such is the structure of the King's and Queen's Crags.

It is in view of this splendid development of Crag-and-Tail,

high above stream action, that the marine theory would probably make its last stand. I make no apology for anticipating objections that will occur to others as they did to myself.

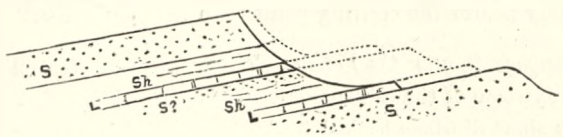
The most exclusive advocates of Rain and Rivers admit that currents of the sea possess great erosive power when streaming through narrow straits. Colonel Greenwood, for instance, who fiercely attacked Lyell for admitting that in *possible* cases the sea may hollow a valley, allows that "currents might decapitate a continent as it arose;" and of course it could carve grooves along the softer lines in the process. The troughs between these crags bear a sufficient analogy to the *passes* that often prolong valleys over watersheds to place it somewhat in the same category; and of such passes Prof. Geikie, certainly not one to call spirits wantonly "from the vasty deep," says, that though "the first and perhaps the main part was probably done by running water and frost, the sea and other powers of disintegration may have lent their aid."* It would not be without reason therefore that the theorist might point to these watershed troughs as the scene of rapid cross-rushes of water, such as sweep among the Orkney Islands at the rate, during storms, of thirteen miles an hour, enlarging the channels and occasionally bursting chasms through opposing barriers of rock; and might indicate how the water, forced into narrowing and shallowing space to and fro every tide like a handsaw, could clear out the shales from among the harder beds.

I have put the case strongly that the reader may choose his own hypothesis; but to this view I believe there are fatal objections, in that it leaves untouched many escarpments at lower levels, absolutely similar in character and in their relation to minor watersheds. Before elevating forces could bring all these within the range of "decapitating" currents the main watersheds would have been raised into broadening stripes of land, which would intercept the path of the tide. In truth nothing but that widespread action of currents and waves advocated by Phillips could account for all the features of which the King's and Queen's Crags are typical.

* Scenery and Geology of Scotland, p. 124.

I would not be understood to argue that the country left the sea unmarked. It may have been girded by coast lines and cliffs, and broken into at various points. But in the region I describe I find no evidence of this remaining; and to those who consider it impossible that the land could rise without it, I reply, so much the more remote a state of things whose familiar signs have been obliterated, and replaced by seams and scars of a different kind.

Look at the proof of atmospheric action upon these watershed crags. The Queen's Crag has not lost less, by a moderate computation of the debris visible at one point below it, than thirty feet of solid face since the glacial period. The Sewingshields Crag has a talus of broken basaltic shafts, apparently not smaller than at most other points along its escarpment. The King's Crag gives fewer signs of decay upon its talus-slope; but corroding waste is written along its whole length. It is broken throughout into irregular semi-detached blocks, divided here by dark rent-like recesses, and there by wide rectangular spaces, with fallen blocks tending to group in lines below them. In places it abuts in squares, like the peel-towers of the valley below; elsewhere the squares are wasted into rounded forms; side by side with these again, stand shapes constricted by waists and necks; while almost everywhere its surface is cut, slashed, and corroded. Much finer examples of "mushroom rocks" can be seen than in the King's Crag, but atmospheric waste has stamped itself deep enough upon it to attest its powers.



Woodcut No. 7.—Diagram of King's Crag, shewing its composite character and previous form. S. Sandstone. Sh. Shale. L. Limestone.

All this is only disintegration of the main rock-bed of these crags. But they rise, as I have said, in several stories. In the King's Crag the upper sandstone is about fifty feet thick: below *it* come other beds about equal in sum, including a limestone about ten feet thick, a shale, and probably a sandstone. (Woodcut No. 7.)

The reader will remember the fable of the bundle of sticks, difficult to break together, but easily disposed of one by one. In forming these crags atmospheric disintegration has taken the easy method. The smaller beds have been overcome singly. The limestone, for instance, once formed a separate escarpment, similar to the low grassy wave formed by another ten-foot limestone in the peaty hollow in front. The diagram will explain the process of retrogression. Each bed in turn has added to the height of the escarpment and the depth and breadth of the trough in front; and I need only add that if the signs of waste prove it equal to its task in the main bed, much more is it so in the minor ones, which have crept under its shelter, on any theory, because more rapidly destroyed.*

The stage of escarpment-formation so well exemplified in this watershed is obviously an advanced, but it is not the *ultimate*, stage of atmospheric denudation. Following out development upon the lines laid down, the ultimate stage would probably see the complete dominance of one escarpment or of a few. Of this we have a clear forecast in the appearance of the Whinsill at Sewingshields, with the semi-terraciform ridges, like flounces, in front, and the prolonged dipslope behind (see Fig. No. 1); but the contingency is evidently still immensely remote. Watershed-denudation, to the depth of many hundreds of feet, would be necessary in order to effect it, and as long as such small escarpments as that of the ten-foot limestone below King's Crag, with its forty-five feet of dipslope, have an independent existence, we are probably nearer the starting-point than the conclusion.

Escarpments near the Valley.—Terraces.—We pass on to the other extreme of the escarpment. It is self-evident that a scarp with a short dipslope backed by higher ground is a terrace; and from the tendency to fusion into compound ridges near the valley the terrace form may be expected there abundantly. No

* An allusion above to the peat seen one or two feet deep in front of the King's Crag may be amplified in a note. There are those who argue that the presence of peat is a sign of absence of disintegration. Probably it is, but only temporarily. In the summer time the watercourses are often full of trailing grass. But go there in winter and the very earth which it grew on may be washed away. Alluvium and peat generally lie in hollows, but where they do not they will not long interfere with atmospheric changes.

geologist can pass through the valley without observing how its lines seem drawn down the sides in the direction of dip, and develop here and there into terraces. Especially he will note how evidently the terraces on the south bank of Erring valley are escarpments thrown back and narrowed through its excavation; and how, in the group of terraciform ridges that has the scaurs of Warksburn at its base, we have the same process in a less forward stage.

As a rule the outcrops are poorly developed near the valley. This I believe to be due to several causes. There is, in the first place, an undoubted tendency to obscuration in the process which has opened the large tributaries upon the valley. But further, the fact that the valley is shallower than before the glacial period has prevented the features from developing again. They are much swathed in drift, and still retain underneath it the smoothed and curve-fronted forms into which they were abraded by the glaciers.

The master-ridge, the Whinsill, is one outstanding exception, and on the north-east side makes, with the beds sheltered under it, one of the large transverse partitions of the valley.

Age of the Valley-and Escarpment-System.—It is of the essential nature of geological evidence that it is circumstantial and cumulative. If, in piecing a complicated fracture, it is found that every point meets its hollow and every roughness its answering roughness, that the parts, in short, *fit*, there is no room for rational doubt that the correspondence betokens connection; though, in the nature of the case, connection may never have been seen. I have but poorly represented the circumstantial and cumulative evidence of this case if it is not seen that the facts and their explanation, so long ago seen, as from a mountain-top, by Hutton, fit, upon the whole, like part and counterpart.* If the continuous working of the river-system can be postulated its results are sure. But *time* is everything. The unceasing cry of the geologist is "Give! give!" How much can be given?

* There are generally a few insignificant points in such a fracture that prefer breaking to fitting. Two doubtfully such are mentioned in an appendix.

How long has the river system had to work in? How long is it since this neighbourhood of the backbone of England was part of a plain of marine denudation now raised above the sea?

Although theoretically it may not seem so, it is practically unnecessary to have the question of a "great submergence" during the *glacial* period decided. The traces of it are so few and far between as to make it possible for excellent geologists to hold that it never occurred at all. Evidence is too strong to admit of any doubt that the figure of the country was only modified in some details by the total glacial period, and in view of that fact it matters little to this subject whether it included a submergence or not.

Passing from it the question arises—To what extent if at all have these carboniferous regions been buried beneath marine deposits now removed? and with it is linked another—In how far can the *negative* evidence that a formation is absent be relied on as *positive* evidence that it was never there?

A severe shake has undoubtedly been given to assumptions of this negative kind by the very able researches of Professor Judd on the Secondary Strata in Scotland. The scraps of secondary formations which dot the geological map of Scotland have been preserved only by the most curious accidents. Powerful dislocations, sometimes, have fixed them deep down in niches among older rocks; enormous sheets of Tertiary lavas, now themselves, at best, only rags and shreds of what they were, have overspread them and preserved portions underneath; and but for such rare chances, geologically speaking, these "fragments of a world" might well have "left not a wreck behind." To use a homely illustration, the exposed remains of them bear no larger proportion to the country where they appear than do the black specks you may see in notches of the cut-glass ware of uncareful housekeepers, and all about them *where scrubbing could reach* has been washed and scoured. The most recent of the fragments belongs to the Cretaceous: and there is concurrence of opinion by such authorities as Ramsay* and Judd,† putting the Older Secondary

* Phys. Geol. and Geog. of Great Britain, 5th Edition, p. 233.

† Quart. Jour. Geol. Soc., 1878, p. 669.

aside, that in Cretaceous times "only a few insignificant islets rose above a waste of chalk-depositing waters," where Britain is now. One thing is certain; this region answered—if I may so express myself—to one of the smooth spaces of the cut-glass. Nothing can be founded on the mere absence of deposits.

It is important to observe, however, that the Tertiary lavas of Western Scotland and the North of Ireland were spread out upon a land-surface, on which waste was at work all through the fiery era.* Eocene and Miocene ages were passed in a vain strife of the two elements, water and air, against the other two; but in the Pliocene the scale turned, and the volcanic products have now suffered great denudation. By it the greater portion of these piles and sheets of lava and ashes have now been removed; and outlying caps of lava, separated by miles of ancient gneiss that bear no trace of its former covering, or by miles and leagues of sea, are some of its witnesses. I will describe the instance I personally know best. Voyaging up that western Scottish coast an island is seen with what might be taken for a huge peel-tower on its summit. The *island* is one of a group of insular outliers of Miocene lava, and is about eight hundred feet high; the *tower* adds well nigh five hundred feet to its height, and is a mass of newer pitchstone. It sounds like romancing that the pitchstone now crowning an island was once run into the mould of a valley perhaps as deep as Tynedale, in that Miocene basalt; but denudation, largely of an atmospheric kind, has assuredly worked this change between an old land surface and a tower-like height.† Other instances might be multiplied. The old volcanoes, that "rivalled Etna in height," are now wasted down to stumps,—and mountain-forms have been sculptured out of "intensely hard cores" of rock, by the same subaerial action that has in Tynedale produced escarpments on the watersheds; and it is probable that in this atmospheric denudation Northumberland shared. The scalpel of denudation, in laying open the anatomy of the country,

* As elucidated by the Duke of Argyll, Prof. Geikie, and Prof. Judd.

† Professor Geikie was the first, among many observers, to solve this curious puzzle of a river course "set on an hill in the Island of Eigg." Quart. Jour. Geol. Soc., Vol. XXVII.

may well have dissected out its structure of hard and soft parts upon watersheds.

In summing up the evidences for *time*, in the case of the Wealden Escarpments, Professor Ramsay concludes, from quite other data, that they have *at least* been exposed since the Pliocene; and he personally is inclined to think, from the physical evidence, that they were exposed *during* the Pliocene. Even the former estimate, he remarks, implies "a lapse of time so long, that by natural processes alone nearly half the marine mollusca and probably nearly all the terrestrial species of mammalia of the world have disappeared, and have been slowly replaced by others." Professor Ramsay continues, "This may mean little to those who still believe in the sudden extinction of whole races of life, but to me it signifies a period analogous to the distance of a half-resolved nebula, the elements as yet being wanting, by means of which we may attempt to calculate its remoteness."*

Effects of the Glacial Period upon Tynedale Escarpments.—Passing away from the larger section of the subject, a question of much interest awaits us. To what extent were these escarpments modified by the passage of the glaciers over them?

It is now one of the most familiar facts of geological science that all North Britain, and many northern lands besides, were invested with what was literally a *flowing* robe of ice.† In this part of Northumberland large valley-glaciers pressed down through Redesdale and North Tyne upon the main valley; also, however curious the fact, a spreading ice-sheet moved over the watershed from the west, bearing with it reddened clay from the vale of Eden, and granite boulders from beyond the Solway, and slid towards the North Sea. Tynedale crags, both near the valley and on the watershed, were deeply buried: some had the ice moving along them, others had to breast it; and all suffered more or less erosion.

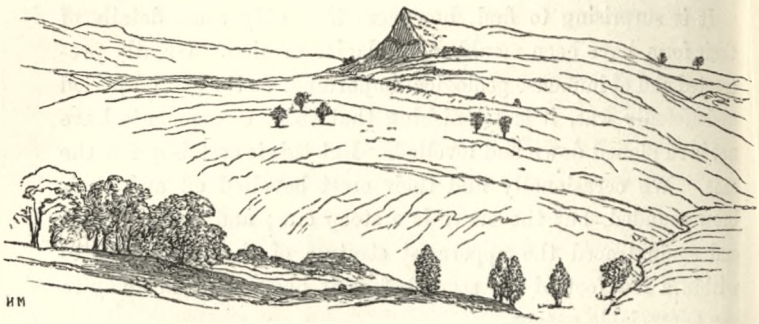
* Phys. Geol. and Geog. of Great Britain, 5th Edition, p. 345.

† The general fact that Northumberland was no exception has been long known. See Howse, Trans. North of England Institute Mining Engineers, Vol. XIII., p. 160.

It is surprising to find, however, that only some details of their form have been moulded by glacier erosion. Greatly protracted and of immense geological importance as the glacial period undoubtedly was, it is astonishing that these escarpments have not been planed down and levelled. But this is certainly not the case. We occasionally find their crest bevelled off and their brow rounded, but the curve is a steep one; and I have again and again traced the uppermost stratum of their dipslopes to within a few feet of the scarp before it began to thin away to any appreciable extent.

In order to bring these facts fully into light I cannot do better than select one representative crag in some pre-eminently exposed situation. No better representative could probably be found than the curious crag, interesting in many ways, which projects its great black prow along the eastern bank of the North Tyne below Gunnerton. From the direction of the glacial striæ in the Gunner Nick, close beside this crag, it is proved that the last movement of the ice was fair against its scarp. There is no positive reason to doubt that the Gunnerton Crag breasted the valley-glacier during the whole of the actively glacial period. But allowing for the possibility that during the height of the Ice-age, the sheet of ice, which passed athwart the valley in an easterly direction, occupied North Tynedale *to the exclusion* of the local glacier, a glance at the sketch will show what an obstacle the crag presented from that approach. (Woodcut No. 8.)

This crag is also especially suitable because its elevated position has enabled it to retain its talus undisturbed. Quarrying operations have opened large sections of the interior, presenting clear evidence of this fact. The large outer blocks, which falling furthest by reason of their weight had formed a bulwark to protect the more promiscuous debris within from the inroads of streams—scarce likely ever to have been near (see the outline sketch), and certainly not in such volume as to move blocks as large as the largest stepping-stones in the river, had evidently remained unshifted since they fell; and as for the effects of granular disintegration, the angular form of small fragments in its deepest and oldest part shewed how insignificant



Woodcut No. 8.—Gunnerton Crag from the W.S.W.

these had been. We have in Gunnerton Crag, in fact, unusually positive data from which to make a "restoration" of its glaciated form.

From measurements of this crag, I find that its apex stands one hundred and thirty-five feet *above*, and one hundred and sixty feet *behind* the foremost blocks of its talus, as the latter existed previous to the quarrying operations.* Now, whatever alterations in form the crag may have undergone since the first stone of that talus was laid, it cannot have extended beyond this space of one hundred and sixty feet. Even on the supposition that a line from the brow to the base represents the slope to which glaciers smoothed it, that slope is only forty degrees. But of course both these points have shifted; the one receding as it wasted, the other pushing forward as it received the products of waste; and it is safe to suppose that its glacially-curved front was contained within an angle of some forty-five degrees. We may conceive of the crag as rounded into a dome-like curve, but not at all as planed down or levelled.

Similar arguments might be applied to a dozen other crags with a like result, but Gunnerton Crag will stand for a type. The facts are sufficiently startling. They represent, however, what years of observation have slowly forced upon me, contrary, I may say, to expectation and prepossession. That glaciation in this district did not use upon these escarpments all the eroding

* The block measured-to must have been some feet beyond the talus itself. I have chosen to err on the safe side.

force claimed for it elsewhere is the natural deduction. It is characteristic of rocks moulded by glaciation, (*roches moutonnées,*) to present a long, smooth, sorely abraded slope towards the advance of the ice, while declivities sheltered from it are left comparatively short and steep. If the reader will compare the outline of a typical *roche moutonnée*, or *mutton*, as the vulgar geologist begins to say, (Woodcut No. 9,) with the profile of an escarpment, he will remark a resemblance, in that the dipslope of the latter would not inaptly stand for the *stress* side (*stoss seite*) of the ice-worn rock. But as long as the *stress* side of the escarpment stands at an angle of forty or forty-five degrees the cases seem hopelessly antagonistic, and the natural inference is that the glacier has somehow failed, in such instances, to mould the escarpments so completely as, given time and active erosion, it must have done.

Woodcut No. 9.—Roches moutonnées; Lochinver, Sutherlandshire. The arrow indicates the direction of ice-movement.

The effects of disintegration upon the scarps have made it unusual to find escarpments retaining a glaciated curve from brow to base, although there must be many in that condition under cover of drift. Exceptions may be met with, however. In an escarpment near Low Shield Green, N.N.E. of Birtley, which glacial markings near at hand prove to have also confronted the ice flow, the rounded profile is clearly enough visible, especially from a little distance. I could restore its broken smoothnesses to a curve bent upon an angle of about 35°. Curvature of the brow, however, is generally the only visible guide to the original steepness of the ice-worn scarp. The brow of this same escarpment, further towards Buteland Fell, can be seen descending at an angle of 38° before its slope is cut off by the vertical plane caused by postglacial action.

This escarpment forms the upper boundary of one of those crescent-shaped recesses commonly known in England as coombes,

Viewed from a hill west of Low Shield Green, the Marleymoor Crags, it is a somewhat striking object. Sweeping round for about two miles in an almost symmetrical arc of about one hundred and twenty degrees, its bounding escarpment may remind the eye of the crowning parapet of an amphitheatre; and the slope within bears out the resemblance by being partially "benched crescentwise" by minor terraces and ridges. The basin is nearly closed in from where the Rede and Tyne meet beyond the hill we are supposed viewing it from.

It does not lie in my way to enter upon a general discussion of the origin of coombes. I find it necessary, however, to advert to the glacial theory of their formation, since, if this coombe be purely "glacier formed," the escarpment above and those within must needs be so too. A good deal has been written, in connection with this theory, about the Alpine Corrie or Cirque—a gloomy precipitous bowl broken away on one side; but I am aware of only one writer who has treated specially of the shallow type here represented,—namely, my colleague, Mr. Goodchild. The bank of a stream opposite a point where it is joined by a powerful tributary, Mr. Goodchild points out, is apt to be scooped by the entering current bearing against it, into a bay or shingly coombe. In like manner, the resultant of forces at an obtuse-angled junction of glaciers, he argues, should hollow out one side of the valley. Now this Butcland coombe chances to face directly towards where the Tyne Valley joins Redesdale, and the ice-stream might, on this principle, very well *cannon*, as it were, somewhere about its position, and would have some chance to hollow it out.

To pass over such an obvious objection as that the eminences intervening—eminences not scooped on the outer side—would have taken the main force upon themselves, there is a feature about the coombe that seems curiously to negative this purely glacial theory of its origin. In the general sketch given above of its form, it was not mentioned that its length, two miles, is disposed along a slope. The amphitheatre, with its benches and balustrade—to use the resemblance metaphorically—is tilted one degree to one side. This arrangement naturally divides the

drainage of its basin, which flows away in front, into two unequal moieties, the larger of which is naturally that favoured by the general slope. Now between these unequal divisions the crowning escarpment, with the bank below it, obtusely projects, so as to make the curve of the coombe a distinctly double one, which the letter B will illustrate in an exaggerated way. *That this projection should coincide with the space between the two unequal basins* can scarcely be accidental. It signifies that each drainage basin has pushed back the escarpment bounding it; while between them, where there is less ready transport for waste, it has receded more slowly. If its present glaciation represents anything like what the coombe has suffered from the glaciers, this must have happened before the ice age, and although a feature which a cursory visit might overlook, it is to me a very marked and significant one. Such things do not happen by chance; and a corner of drift which now lies sheltered between the curves, while the streams have cleared out their hollows, clearly shows that work has been resumed under the old conditions.*

All the facts I have been able to gather uniformly tend to shew that Tynedale escarpments, when fully developed both in "Crag" and "Tail," have suffered but little from glaciation. But upon the terraciform sculpturing of the low grounds it told heavily. Terraces consist of little more than escarpment-fronts, and as the fronts have been rounded over, this to the terraces has often meant obliteration.

In casting the eye from the watersheds down to the valleys, therefore, we remark, that all the chances have favoured the preservation and re-development of the sculpture on the heights, and militated against these on the low grounds. On the heights the escarpments were fully differentiated, and suffered little more than a smoothing; the elevation and the comparative absence of

* It might be inferred from this that this coombe is only a deep symmetrical drainage basin, differing mainly from those often to be seen from a distance scooped in clam-shell-form on the sides of mountains in being deeper, and in having its interior ribbed by transverse ridges. There is much to be said for this view, which struck me—as I have pleasure in admitting—in thinking over the Rev. T. G. Bonney's theory of the formation of Alpine corries by a conjunction of waterfalls. To this subject I may hope to devote another paper.

Drift have allowed conditions of waterflow to be fully re-instated; and atmospheric action has enjoyed every opportunity to sharpen them anew. Near the valleys, on the other hand, glaciation promoted a suppression of the features already in progress, and drift still greatly covers the ground; and it seems certain that in many places, especially in neighbourhoods where proximity to the sea-level must prevent the river—the great adjunct to all the sculpture—from reaching the bottom of its old valley, the earlier features can never be reproduced while sea and land remain as they are.*

Post Glacial Atmospheric Action.—Pursuing a general chronological sequence we now come to the post-glacial effects of atmospheric action.

That the glaciers must have scoured away all loose debris, and effaced all shallow markings, need not be doubted. As post-glacial,

* Upon the subject of the glaciation of escarpments I regret to find myself in opposition to such eminent authorities as Dr. James Geikie, and Prof. A. H. Green (Great Ice Age, 2nd Ed., p. 286: Green's Geology, 1st Ed., p. 446). Professor Green thinks that many escarpments in the North of England have been "planed clean away" by the ice, and have only been re-developed on the heights by post-glacial waste. I must hold that the rounded brows of Tynedale escarpments tell a different tale; for since it is wear and tear *of* the face and brow that produces escarpments, the body of the features cannot have been formed anew while these have remained stationary. I have on this point confined myself to facts, having no theory to offer. It is hard to believe, however, that forces which could pile the moraine-mountains of the Dora Baltea, should have left such trivial marks upon Northumbrian escarpments.

A remark may be made here upon the "Northumberland Lakes." It has often been pointed out that hollowed basins, such as they are, occur in front of large glacier-obstructing masses of Crag-and-Tail. This statement the Crag and Broomlee Loughs, with the great projections of whin at their East ends, seem markedly to exemplify. I have elsewhere stated, regarding Broomlee Lough, that the escarpments about it bend round as if giving place to it; and have therefrom deduced its origin by glacier erosion. Geol. Mag., 1876, p. 286. The fact is correct; but since I have seen more of escarpments I am less sure of the deduction. If the glacier scooped these lakes in the midst of escarpments without planing them down, was it not a feat somewhat resembling the ancient ordeal of walking blindfold across red-hot iron bars without touching them? It is worth recording, that in a transverse section, which I obtained of that lough at Dove Crag, by swimming across with a line and sounding every twenty strokes, there is no symptom of any ridge, although one or two descend upon its shore. They may be silted over; but the lough is close to the watershed, is entered only by trifling streamlets or *sikes*, and *is said* to be fed by springs within it.

therefore, may safely be classed *Crag-talus*, *Swallow-holes* in limestone, and what I may call *Aerial Pot-holes* drilled in the rock surfaces. To these there must be added a fourth, less evidently connected with escarpments, viz., some of the Denes or gorges terminated by waterfalls. The last named may be taken first.

1. *Waterfalls and Denes.*—After the close of the glacial period many streamlets found themselves ousted from their old channels by glacial deposits. So choked and concealed did some considerable vales become, that their sites are now discoverable only by mining operations. The main valleys, although themselves much blocked up with *till*, remained sufficiently open, as a rule, to gather in their drainage as before, but the minor conduits were largely changed, and in picking their courses afresh down the valley slopes, streams often fell over terraces or ledges of outcrop lying in their way. An operation has proceeded ever since, singularly like—in the typical cases—the notching of a plank by a saw. The rock-bed is the plank, the terrace its convenient edge, and every one who is familiar with the typical Linn within its *cul de sac* will recognise its resemblance to the slit in the wood lengthened inwards by the vertical sawing. Such of them as I now refer to are recognised by having had, as it were, *the plank laid ready for the saw*. The Holywell Burn near Birtley, for instance, found two terraces laid across its line of flow; the Dinley Burn, before referred to, fell over another; and here and there among the dales, whenever a distinct preglacial terrace is crossed by a post-glacial stream, the indenting process has come into play.* In numbers of instances, indeed, waterfalls have not been formed thus at a stride. Given, a bank with a variety of beds cropping out on its slope, and the harder ones

* This process, even in our climate, would be rapid in its early stages. At Cawburn Rig, between Haltwhistle and Greenlea Lough, a drain was led over the face of an escarpment-bank within the memory of a man who died in 1856 at the age of ninety-six. It has now cut for itself a notch fifty-two feet broad and twenty-two feet deep, containing a cascade over sandstone steps, and a waterfall some six feet high. For its history I am indebted to Mr. Armstrong of Linacres, near Wark, whose grandfather it was that made the drain.

I omitted to say in the proper place that the shale in the sides of Dinley Gorge, except near the waterfall, is prevented from hollowing out by weathering. It is not preserved by vegetation, like that under escarpments, but by its own shivery debris.

will naturally project as rapids or falls. Observation is often able to distinguish the difference. Delightful spots to linger in are some of these secluded Linns and Denes! The freshness of morning lasts till midday; wild flowers of summer live far into the autumn, amid an almost primæval wealth of vegetation; the sun's fiercest heat is filtered out by overspreading green; doddered tree trunks, and stones covered with mossy arabesques, lie along and athwart the stream, and from its gleaming, whitening plunge at the head of the glen comes such a dreamy lullaby of sound as seems to still everything with one long *Hush*.

2. *Crag-Talus.*—It is not my purpose to enter in detail into the mode of the accumulation of screes or talus—the debris from the wasting scars of the crags. While, however, such details are trivial when having no general bearing, it is otherwise when they bear upon a large problem. An interesting subject of enquiry, but one demanding at the outset data of a somewhat unusual kind, would be the total amount of time during which these screes have been gathering, in other words, the distance from us of the glacial period. Such data are probably supplied by the discovery within its talus of *remanies* from the ancient Camp on Gunnerton Crag, which was brought by the quarrymen to my notice. This will deserve to form the subject of another communication, when the examination of the remains, and the exploration of the camp by my friend the Rev. G. R. Hall, F.S.A., shall have been completed.

There is a point of some interest, however, which may be referred to under the head of talus. In the front of sandstone escarpments masses of rock, separated from the parent crag by fissures of various width, may often be seen in positions suggesting that they are travelling down hill. The rent is far past the frost-wedging stage, and in the cases I mean the blocks stand on slopes insufficient to set them sliding. Such blocks are on their way to form talus—but how have they moved?

In one of his essays on glacier motion the late Canon Moseley gave an interesting instance of slow, sliding movement due to variation of temperature, in a sheet of metal roofing on the slope

of a house. Each expansion thrust the metal a little downwards; each contraction, having to pull up against weight, failed to draw it up as before; and the result was a downward gravitation. I have long suspected that the masses of rock in question were slowly travelling downwards from the same cause, but should scarcely have ventured to affirm the fact, but for the experiences of Sir J. S. Hooker among the Himalayas, and Sir Wyville Thomson in the Madeira Islands. The causes that set "stone rivers" in motion in these places, must be at work in a minor degree everywhere, and it need not be doubted that the partition of escarpments is aided by their means.

3. *Swallow-holes.*—It is common to find that when the roof of a colliery level, or underground gallery, gives way near the entrance, the surface of the ground, without breaking into a continuous trench, sinks down here and there into rounded pits and dimples. Limestone joints widened into fissures by aqueous solution may be likened to a network of levels, of which denudation is gradually uncovering successive portions. And when the roof of clay or shale becomes thinned until it can no longer support itself, it breaks through, probably at points where the fissure is wider, or a stone or nodule concentrates weight,—and pits the surface. Such is the origin of the swallow-holes that border many of the limestone outcrops in this district.

The greater number of swallow-holes intercept drainage and become sinks, but this, which is apt to be mistaken for their primary feature, is really a secondary and accidental one. It is the *ground* that is swallowed in the first instance, and as a subsequent act the hollow may become the centre of a little drainage basin. Without a covering of loose materials, such as shale, clay, or peat, the water descends, so far as I have seen, through simply a widened rift. The largest swallow-holes, on the other hand, are those opened through the thickest covers.

In their earlier stages swallow-holes are simple round bowls. When the swallowing is complete, the bowl becomes perforated, and of the form of the receiving part of a common filter. The lip is generally channelled by the little stream that enters. In size,

they vary, in this district, from mere dimples up to cups twenty or twenty-five feet deep. They are not generally permanent for any considerable time. The fissures that occasion them are at once so numerous, and of such varying width, that the opening of new holes seems to divert the centres of the little drainage basins from place to place, without allowing time for the elongation of the orifice in waterfall style. When discarded they seem to be liable to obliteration either by the filling up of the cup, or the removal of the cover which it perforates.

The formation of swallow-holes is well illustrated in certain streams. When the course of a stream flowing upon clay drift happens to coincide with the outcrop of a limestone, a point is by and bye reached in the deepening of the stream-bed at which the clay is swallowed into a fissure and the stream engulfed. The lower reaches of the course then become nearly dry: but above the hole, deepening progresses as before; new chasms open successively above the first, and bit by bit the stream is shortened. Sooner or later, of course, it diverges from the line of the limestone, and the hole last formed is, comparatively speaking, permanent. The old channel remains for a time a curiously irregular succession of burrows and saddle-backs, sometimes like the routings of a huge animal.

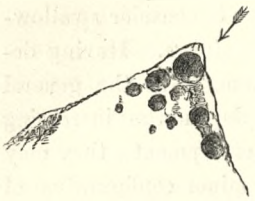
It is difficult to see how some of these more prominent swallow-holes can ever be superseded unless by the engulphing of the stream by another limestone. Yet so inconspicuous, generally speaking, are the effects of the water upon the limestone, and so inconsiderable the modification of the original circular form, that they can scarcely be otherwise than of recent formation. Enlargement to the extent of several cubic yards is exceptional, though it must be said that the full effects are rather apt to be masked by clay. But as we have seen, the solution of limestone is apt to be exaggerated. I may add, that the best examples in this district of streams burrowing in this fashion lie to the west of the Church at Thockrington. Ordinary swallow-holes are so numerous as to make it superfluous to name localities.*

* Artificial drainage, in these days, increases the importance, and will soon alter the appearance of many swallow-holes. I have seen half a dozen drains led into a single one.

It is not within the scope of this paper to consider swallow-holes in their relation to underground drainage. Having described their formation I pass from them, with the general remark, that in multiplying local watersheds, and thus increasing the unevenness of the furrows between escarpments, they may have had a considerable influence on the minor configuration of the ground.

4. *Aerial Pot-holes.*—There is scarcely an escarpment in an exposed situation that does not exhibit some of its surfaces drilled into little pot-shaped cavities. If the water collected in one of these be watched on a gusty day, it is seen to be in great commotion, restlessly beating the sides and swirling unsteadily round. Let a heavy shower come driving before the wind and its slanting drops—beating on one side of the cup only—lash the water into still more excited motion, and the attentive eye will discern numbers of granules scouring round and round against the smooth sides. The wind and the rain are making use of these to drill small potholes, like those larger ones that the eddies of a stream hollow among its rocks.

On points of rock well in the play of the wind pot-holes are usually small in proportion to their depth and set close together. In such positions surfaces may be literally honeycombed with pots of various shapes and sizes, some bowl-shaped, some undercut into wide mouthed flasks, some so merged and compound as to resemble nothing that I know, so much as casts of the "*finger-and-toe*" in turnips. On a sandstone boulder, perched upon the Queen's Crag, this close-set kind of pot-hole may be seen to perfection, one of them being large beyond the average, one foot three inches long, by eight inches broad, and seven inches deep. Around this boulder the wind can play freely, and the holes fret its whole upper surface; but on the angular projections of a crag they are apt to group in a sort of procession (Woodcut No. 10). In front, where the wind first breaks and eddies, is the chief, while behind, ranged in diminishing order, come the followers. Wind has little or no influence in making the pot-holes shift before it. When hollowed upon a plane surface, unless biassed



Woodcut No. 10.—Aerial Pot-holes on a point of rock. Arrow indicates direction of prevalent winds.

by jointing or lamination, pot-holes are round. Upon slopes, however, they always lengthen or travel downwards. On isolated points, for instance—such as the boulder referred to—they move away from the highest point as from a shed, and break in on one another, and become worked out, finally, on all sides. The lower side of their rim being channelled by the lapping over of the water, helps this movement.

In the early stages of pot-hole excavation, drilling is actively at work and the channel is in abeyance. But when the deepening recess becomes more sheltered from wind and rain, eddying grows feeble, and the ever-enlarging channel by and bye leaves it dry. This advanced stage being reached, a block, such as the Queen's Crag boulder, is found carved into a miniature Alps, with a central group of points and ridges, steep declivities, and a number of corries—the last vestiges of the pot-holes. And the process does not stop here. By the freezing and chemical action of what moisture the channels still conduct, even these vestiges are obliterated, and the block becomes simply fluted like the Druid stone of Swinburne (p. 308). Of this kind are the legendary comb-marks on the great sandstone block, that projects like a huge dog-tooth from the talus-slope of the Queen's Crag, attesting the marital perversity of King Arthur, and at once the cleverness and the *size* of Guinevere. Unfortunately for the tradition the comb-marks indent the two sides of a square.*

Pot-holes perforating *spreading surfaces* of sandstone generally differ from those described in lying well apart, and are of greater width than depth. The drilling processes are set up from fewer centres and are less active. On the Queen's Crag may be noted such distinctions as there are between these and the close set kind. Fine examples of this type are to be seen on a sandstone

* In a fit of the above common masculine failing Arthur flung this stone at his queen from the King's Crag as she sat combing "her back hair." She deftly turned it aside with her comb. It stands some twelve feet high, and the teeth of the comb were three feet long.

ridge within the wood, a few hundred yards west from Walwick Hall, near Chollerford. These were pointed out to me by Mr. Dickson of Walwick Grange, who thought that perhaps they might be large examples of the mysterious incised cups of the ancient Britons. But although in one or two cases well nigh as symmetrical as a wash-hand basin, and very similar in size, they are not artificial. The largest is one foot nine inches in diameter, by six inches in depth.

The most extraordinary pot-holes I know occur along with the Devil's Punch Bowl on the Shafto Crags. This remarkable group is borne upon an isolated cap of stone, raised on a short pedestal on the verge of the rock, in the full sweep of the westerly winds. Its outer edge is bordered by a deeply excavated fretwork of close set pot-holes, mostly worked out into channels, and resembling a crimped edging. The two largest pot-holes within, are each about three feet and a half in their largest diameter and have broken together, forming a considerable pool. A deep gutter slopes to one side. Near this, as if intended to drain into it, stands the central object of interest,—a spacious basin of perfect circularity of internal contour. The eye may take a lesson here between the artificial and the natural. The natural are all lengthened in the direction of slope; the artificial, although lying on the same slope, has not taken the cue, has been betrayed into no irregularities of form, and shelves too deep. I shall have occasion to revert to this stone.

Curious pothole-like perforations occur in limestone, and, though dry in all cases I have seen, these seem to deepen indefinitely by solution. On the Fox Green, near Lonbrough, S.W. from Wark, is a group which, so far as I know, is unique in the district. The largest of the holes, which are cylindrical tubes, is eight inches in diameter, and was excavated from the earth that filled them to a depth of three feet, without reaching the bottom: another hole close beside, whose orifice just admitted the hand, was hollowed eighteen inches, when its rim checked the arm from passing further in. The larger hole is smoothly turned to about a foot downward, beyond which the sides are rougher. They contained rich mould, through which moisture

and carbonic acid may have borne upon the bottom and elongated them.

5. *A Theory of the Incised markings on Stone.*—I have incidentally mentioned that symmetrical specimens of these aerial potholes are liable to be mistaken for the artificial cups so abundantly incised on the rocks and stones of the Northern part of this county. It would scarcely be possible for a closet antiquary to examine these crags without standing puzzled now and then over some neatly turned natural basin;—and, not to be unfair to the antiquaries, I have seen at least one sculptured stone that with its confluent artificial cups might almost deceive a hasty geological eye, save for its rough hewn appearance, and the presence of *circles* on other parts.*

This resemblance is not merely superficial. On the contrary, I am aware of no essential characteristics of the natural cups that are not shared—though of course in a more or less conventional way—by the great mass of the artificial ones. These characteristics I take to be three. First; originally and essentially they are cups, distributed singly or in groups. Secondly; in a later stage, the lip of the cup becomes grooved by a duct, leading the waste water away: and thirdly; this duct descends the slope of the stone.

Before following out the resemblance I must anticipate an objection. I have no intention to assert that all the varieties of circles and enclosures found in the artificial sculptures have their counterparts in nature. But there are suggestive indications, it appears to me, that the cup, as it is the simplest, is also the original expression of the symbols. It occurs in greatest abundance, and oftenest alone. The *circle* is sometimes represented by a mere unsymmetrical enclosure with cups grouped inside. There are symptoms too that the circle is subordinate also to the channel, for it is constantly to be remarked that, even when regular and concentric, the circles stop short where the channel should be, as if tacitly implying and respecting its position even when absent.

* G 6 in the Edinburgh Antiq. Museum.

The assumption that the cup is the primal type of the sculptures is at least perfectly warrantable.* Upon that assumption the three above-named characteristics are paralleled thus. Firstly, the cup, as in nature, occurs either singly or set in groups; secondly, a "radial groove" or duct represents the natural channel, and thirdly, this duct is placed "very generally down the slope of the rock."†

Thus far there is a fundamental similarity. But it displays itself in a parallelism much more extended. The natural cups are frequently confluent; so are sometimes the artificial. Ducts from several pot-holes sometimes unite stream-like, into a single main channel, which might be conventionally figured as "a rude resemblance to a plant;" so also do the artificial, from a description of which, by the late George Tate of Alnwick, I quote the simile. Cuts or hollows in the stone sometimes *accidentally* intercept channels passing from natural pot-holes, as also do other pot-holes lying in their way; and so again *designedly* in the case of the artificial. In fact, except the circles and what they have imported with them, the resemblance seems thorough. The tendency to lengthen out upon a slope is a feature which the artificial figures seldom display, and do not, so far as I am aware, carry out to the full extent, but cups separately elongated or passing into their channels as if by elongation are not uncommon.‡

I may be allowed to suggest that such detailed resemblances may not be accidental. They seem to me strongly to countenance the supposition, that in this case, as in most others, man has imitated nature, and that the natural rock-sculptures are the originals of these conventional and variously-figured cups and channels. But it will be asked—Why should these pot-holes attract the eyes of the ancient Britons, and wherefore should they deem them sacred?

* I have since learned from my friend the Rev. G. R. Hall, F.S.A., that we have the authority of Sir James Simpson's classification for this.

† George Tate, "Ancient Sculptured Rocks," p. 7.

‡ See Dr. Bruce's "Incised Markings on Stone," for figures of these, apparently of the natural size.

It is almost unnecessary to remind the reader that natural impressions upon rocks and stones have, all over the world, become invested with sanctity as the imprints of supernatural beings. It remains a belief among the Bedawin and others to this day, that holy personages have the power of leaving their prints on rock;* and the former prevalence of similar beliefs nearer home is shown by the well-known fact that there are few Druid monuments or curious stones in the country that do not bear upon them the sign-manual of giant, devil, or witch.

Traditions of this sort appear to be connected with that former practice of stone-worship, which was so "earnestly forbid," (to quote from Canute's decree on the subject,) by the ordinances of the early church in Britain, and which has not yet even died out in the world. Stone-worship has been explained as arising from the respect paid to boundary-or memorial-stones. Sir John Lubbock prefers to describe it as "merely a form of that indiscriminate nature-worship which characterises the human mind in a particular phase,"† which would leave it still to be asked, how the worship first began. It seems to me impossible to separate between the stones and the supernatural markings upon them, and it might well be that the former were consecrated simply because the latter were revered. What more natural than the worship of objects bearing upon them as it were the very handwriting of deities.

That pot-holes were not less the objects of supernaturalism than any other markings on stones may be inferred from the number of legends attaching to them. In Scandinavia the gigantic kettles that so puzzle the geologist, still bear the name of the legendary giants; the smaller pot-holes are explained as the prints of Troll's fingers made "when the rock was soft." In the bed of the Nerbudda pot-hole-like cavities are still venerated by the pilgrim as footprints of Indra's celestial elephant,—relics of the time when the great rain-god cleft open the marble gorge. Here in Northumberland they are the hoof-marks of a

* Palmer's Desert of the Exodus.

† Origin of Civilization, p. 221.

devil as at Birtley, or basins formed by Queen Mab and her train for bathing in, as tradition pleasingly narrates, at Rothley. The soul has almost gone out of such legends now, but time was when they were of earnest import to mankind.*

It is perhaps to the well-known group of pot-holes which on Shaftoe Crags is associated with "the Devil's Punchbowl," that we must look for the strongest suggestion of the former sacredness of these cavities. The cap of rock bearing them, which borders a plot of ground upon the crag "defended by a double ditch and dyke," and resembling in character the numberless ancient British enclosures of this district, projects almost over the entrance of a rude cavern, still retaining, according to Hodgson, the marks of tools and wedges in its interior. The suggestiveness of the combination did not escape the historian. "Is it not very probable," he asks, "that we have here a cave and a rock-altar of that primitive heathen worship which prevailed all over the world from India to Britain; that the rock basins on the top of the altar were once dedicated to the mysteries of the Druidical Hu?" As to the cave I venture no opinion, but the rock-altar, with its one large round artificial basin, and its many scooped and guttered natural excavations, seems wonderfully like a relic of primitive worship.†

* The Rev. G. R. Hall, F.S.A., has told the Birtley legend in a former Volume of these Transactions. A wandering demon, once upon a time, was unwary enough to drink at the Holy Well. But the sacred water disagreed with him like molten lead, and dashing his hoofs upon the stone he leaped a full mile from the spot. He alighted upon the rock beside the Leap Crag Pool in the North Tyne; in which deep black hole "tradition averreth he was drowned." At the Holy Well the tracks are about the size of a small donkey's, if I dare use the comparison, and consist of several pairs as if the miserable being had waxed fidgetty; beside the pool they swell to the size of an elephant's.

† Has the able historian ignored the following passage in Sykes' Local Records,—under date September 20th, 1825? Upon the occasion of the marriage of the Sir Wm. Blackett of that time, it is stated that "Shaftoe Vaughan, Esq., a gentleman of the neighbourhood of Wallington, ordered Shaftoe Craggs to be illuminated by a great number of large fires, which were placed on the most conspicuous parts of the Craggs. A large punch-bowl was cut in the most elevated rock, which was filled with such plenty of liquor as was more than sufficient for the vast crowds of neighbouring inhabitants who flocked thither at so uncommon an appearance." This passage may seem to render all theorizing superfluous. But need it take much to make one distrust the phrasing of a statement which must have run the gauntlet of surroundings so very unfavourable to accuracy?—this roystering crowd, and such "plenty of liquor?" It seems very improbable that so capacious a basin should have been laboriously hewn out of the solid rock for a mere freak, when the large

If, then, pot-holes were deemed supernatural by the ancient Britons, or were made so by their priests, there seems no reason that human veneration and desire to possess the likeness of the thing venerated should not have acted, as they have so often acted since, in impelling the exercise of the imitative powers. These rude figures,—of which all that is with certainty known is that they were religious symbols,—may owe their existence to a dark kind of the same religious devotion that inspired a Rafaelle. That the incised cup with its "radial groove" was the most natural form for the imitations to take needs no proof. In making use of cups to catch water, and channels to lead it away, underneath waste-pipes and at wells, we now-a-days conventionalize the pot-hole and duct exactly as the ancient Britons did.

How the great departures from the simple idea of the cup and channel—the superadded circles, irregular enclosures, spirals, etc., came about, is a question I am not qualified to discuss. They may have introduced some other symbolism,* or they may have been imaginary additions like those ordinary developments of art which have elaborated the plain Doric into the ornate Corinthian with the multiplex scrolls and leaf-curves

bowls of nature's providing, already on the same stone, (see p. 345) were there to serve the night's use. Moreover, the Devil's name (however appropriate to the occasion the tectotaller may think it), is generally, if not always, associated with objects of real antiquity. Is it not probable that the jovial Mr. Vaughan, tickled by the punch bowl's designation, simply adapted it to his purpose (its rim shews signs of ineffectual tampering), and that the writer of the record had no interest in ascertaining the exact colour of the truth? In this belief, which may have been Hodgson's, I allow the text and the following note to stand as they are.

I cannot claim any acquaintance with "the mysteries of the Druidical Hu," but the following passage so nearly describes the use I can imagine for this possible rock altar at Shaftoe Crags, with an allowance for difference of climate, that I quote it. "The Sonthals of Central Hindustan worship a conspicuous hill called 'Marang Baroo.' In times of drought they go to the top of this sacred mountain and offer their sacrifices on a large flat stone, playing their drum and beseeching their god for rain." Colonel Dalton, quoted in Lubbock's "Origin of Civilization," p. 224. To Indra, the rain god, belonged all libations; and what place could be more suited for invocations to him or any other than where he might be thought to shed his own libations into his own sacred rock-bowls. What scenes may this stone have witnessed! Libations of milk were until lately poured in honour of the sun on the gruaich stones of Skye. But did the Britons limit themselves to milk?

* "Doing things in circles, sunwise, is almost universal in the north." J. F. Campbell, West Highland Tales.

of its capital; or possibly, they may have been taken from the rings of fine stratification that often surround the pot-holes themselves, as the leaves of a book would surround a hole gouged in it. On any supposition it is perfectly explicable that the circles should have come to be *identified* with the cups; the accessory, as in the history of emblems generally, becoming blended with the original. It would not be unparalleled in the history of art, for instance, that the caprice of the inscribers should have carried them so far beyond the simple cup from which they started, as to omit it altogether, which has sometimes been done. I have already remarked that the concentric lines round a cup often stop short where the duct should be, even in its absence, as if tacitly respecting its position; in like manner the circle without the cup may be taken as implying its presence.

But it will probably be granted that even admitting full significance for the resemblance I have traced between incised cups and natural pot-holes, it would be as vain to attempt separate explanations of all the varieties as to try to predict or explain the vagaries of a savage's imagination.*

6. *Snail-Borings in Limestone.*—In the early days of controversy as to a possibly marine origin for escarpments, we hear of the presence upon rock-surfaces of the borings of lithodomous shells. The late Dr. Buckland had before then described short sac-like perforations in limestone, which he often found tenanted

* My friend Mr. Howse, the valued Secretary of this Club, has recently broached the ingenious view that these encircled cups, etc., of the rock surfaces of Northumberland are not artificial at all, but the work of a concentrically-growing lichen, when the climate was moister. ("Newcastle Daily Journal," July 26th, 1879.) The disintegrating power of lichens is well known; but it still remains to be pointed out that any lichens of the present day make even faint impressions of these particular designs. I have not examined the originals of the drawings given by the late George Tate and by Dr. Bruce, but I have carefully gone through a fine series of similar sculptures in the Museum of Antiquities at Edinburgh. That these, at least, are artificial, I am quite satisfied; and in the miniature cups and circles upon combs of bone, etc., preserved in this Museum, I think there is conclusive evidence that the larger cups, circles, and spirals, found, like them, in the "Picts' houses," are what antiquaries have taken them to be. See the Catalogue, under the head of "Sculptured Stones," and "Collections from 'Pictish Towers,'" etc., in the illustrations of which I think any one interested in the matter will find sufficient to satisfy him. This Catalogue is the best sixpenny worth of archæology he is likely to get. See Miscellanea, infra.

by land-snails, and believed to have been produced by a process of boring, in effect like that of the marine stone-boring molluscs. Dr. S. P. Woodward, also a great authority, considered these honey-combings to be purely atmospheric,—like the aerial pot-holes just described. In opposition to Dr. Buckland's observation that they occur mainly on the lower or sheltered surfaces of ledges, he remarked them "always on the windward side." The snails, according to Woodward, were only in temporary possession.*

Without pretending to enter authoritatively into the niceties of this question, I may be allowed to give the results of observations among Northumbrian limestones. The surface of weathered joints is apt to have a smoothly dimpled and dotted appearance, rather like dough marked with the tips of the fingers, and then somewhat drawn out in one direction,—that of stratification in the stone. This is unquestionably due to weathering—chiefly to solvent action. The deepening of the dimples into sacs might seem to be simply a continuation of the same process. This in many cases, however, it does not seem to be. If largely produced by solvent weathering, the deepening would proceed so as to allow water to fill the cups, or at least to keep them moister than the adjacent stone. In two excellent groups of perforations I have examined, one on the north bank of the stream bounding the lower end of the enclosure in which the Swinburne stone stands, the other in Gunnerton Nick, it is an almost invariable rule that the cavities *ascend* from their entrance in a way fitted to keep the interior dry. In the Swinburne group several of the holes—smooth and bulbous as usual, are entered as the bowl of a pipe is entered from its stalk, their entrance being no more than half their interior width, and the bowl ascending vertically for some three inches. In both places they abound much more on faces of limestone to leeward of the prevalent westerly winds; and I may remark, that among the exposed uplands, where the aerial pot-holes are most abundant, I have sought in vain for "borings."

* H. B. Woodward on Geology of Wells. Proc. of Somerset Arch. and Nat. Hist. Soc. 1873. See also his Geol. of England and Wales.

No mere weathering, it seems to me, could form such holes, which, I may say, were not associated with the rusty cores to be occasionally remarked in limestone. On the other hand, so complete a shelter might well be sought as such. Slugs and snails, even without doing any active boring, would concentrate moisture at the inner end of the cavities, and so promote their elongation by solvent action. If this be the proper view, the first beginnings of the holes were due to weathering: the deepest dimples were then selected as resting places or shelter by some wet-bodied animal, and there was thus brought to bear on their elongation the moisture otherwise excluded.

Conclusion.—In one of the limestone quarries you may find a coralline,—an exquisite piece of filagee, with the stone dissected away from it as no human hand, or finest instruments have delicacy to dissect,—every mesh perfectly opened, every thread pure white. The same power of waste, carving that stone lace-work into its minute tracery of threads and meshes, has cut out this Tynedale region into most of its diversity of heights and hollows,—from its pot-holes and swallow-holes up to its ribs of escarpment. A varied sculpture is the inseparable accompaniment of the gradual working down of drainage basins into the body of the country. There is a sort of evolution in the process. The river, its larger and lesser branches, and its minute capillary feeders, although constituting one great eroding machine, have neither equal powers, nor simultaneous opportunities, for excavation; and long after the main stream in its lower reaches has worked its bed down so close to the level at which it enters the sea, that gradients have become low, and action sluggish, and the processes of carving are more and more retarded, and the features, which are the monuments of active erosion, grow worn and vague, like the mouldings on any old bit of sculpture,—the golden age of force, activity, and opportunity has passed to the higher regions.

In this paper we have seen only one side of Nature's geological balance—that side which persistently lowers towards the

sea level. It is possible, that the omnipresence of denudation tends to induce those who only know at a distance of upheaval, violence, and fracture, to make too little of their original effect upon surfaces which give no internal evidence of recent disturbance. I have abstained from speculating upon the condition in which denudation may have first found this part of the country. For the probabilities in such cases I cannot do better than refer the student to Prof. Green's "Manual for Students;"* but it is impossible to deny that the up-arching movement that raises countries above the sea may have been attended, in many cases, by fracture and fissure. But of these I yet know of no evidence in Tynedale.

There is a beauty in these escarpments, point beyond point, step below step, jetty beyond jetty. See them sometimes, blackened by the shadows of evening, but with their outlines overlaid and melted by the molten gold of the setting sun; and when, as I have sometimes seen the clouds are of that clustered kind that are penetrated to the zenith by shafts of golden haze from the effulgent sphere at the horizon, there are few more suggestive moments in which to recall the sublime words of the old Hebrew prophet;—He that sitteth on the circle of the heaven—that fainteth not, neither is weary—"hath comprehended the dust of the earth in a measure and weighed the mountains in scales."

* p. 421 of 1st Edition.

APPENDIX.—To help any one who may investigate the subject, I add a notice of two points which at first struck me as difficulties in the way of the atmospheric origin of these escarpments.

1. The great spread of dipslope covered by a limestone at Great Bavington only three feet and a half to four feet thick. No less than half a mile's breadth of this limestone's outcrop is exposed, and it may seem that on the atmospheric theory it must have melted away. But is the preservation of this thin sheet any whit more easily accounted for upon any other theory? Could the glaciers have more easily ploughed out large bodies of strata in the neighbourhood and left *it*? Could the sea? It is rather surprising on any theory, but the following considerations may help to an explanation. 1st—The strata between this and the next overlying limestone—some forty feet thick—are almost entirely shale and have easily been worked back from it. 2nd—It overlies the whinsill, with only about a foot of shale between, and, if I recollect aright, has a finely crystalline structure; crystallised carbonate of lime is less liable to solution than ordinary limestone. The feature of this limestone has a curved front—the only case I have noticed. (see p. 321.)

2. Some sandstone crags—Queen's Crag in particular, have wasted at a rate that instead of raising them into prominence above their line of escarpment, ought to have made them bury themselves in the ground. The main part of Queen's Crag has worked itself back into a recess, and its debris, consisting of slices the whole depth of the seamless bed, cannot cover up its front, and check denudation as smaller materials might. If this were the usual mode of action, crags, on the atmospheric theory, could only get their head above the surface to the height of the *slicing* bed. I believe this difficulty disappears when the variable bedding of the sandstones is considered. Massive beds are of no great extent, quickly losing their massive character when traced out. It is possible therefore that denudation has brought the Queen's, and certain other, crags to a "measure" of rock that will soon be worked out, and give place to a kind less open to wholesale destruction.

XVII.—*Miscellanea.*

Effect of the severe Winter (1878) *on Birds at Dunston Hill.*—I fear we have lost nearly every individual save one or two of the Common Wren, *Troglodytes*. Up to the great frost and snowfall in November last, its song might be heard uttered with great energy and glee in every shrubbery and thicket here. Even this winter I have heard but one bird.

Doubtless the little creatures perished in numbers in their cavities during the past winter, and their hearty, musical carol may be nearly lost from our woodlands for several years.

The little bird which was present in more than ordinary number with us in November last, before the first hard weather, and in full song, was very late in re-appearing at all in the spring, so that I thought all the individuals that haunt our thickets at Dunston Hill had perished.

But at last the call-note and the song were heard again, though but very rarely, as if only a small remnant of the little creatures had lived through their hibernation.

The Wren never appears with the Redbreast, the Hedgey or Hedge-Warbler, and the Blackbird to claim a pittance at our windows. It never seeks human help, but is sometimes found lying dead in our outhouses whither it has gone in search of spiders and hibernating flies.

When a boy, and capturing Sparrows, by means of a sieve, under the eaves of stacks during the Christmas holidays, I once caught five Wrens from one hole in a haystack, and at once released them. They evidently were roosting together for mutual warmth.

I am still of opinion that they become torpid in very severe weather, occupying cavities under the roots of old and partially decayed trees, where also the Long-tailed Field-mouse often retires.

Evergreens.—That noble Evergreen, the *Quercus ilex*, of which fine specimens for the north, and not favoured by being near the sea, existed at the seat of the Rev. R. H. Williamson at Whickham, and at the Rectory there, have been killed to the ground,

though in one instance the trunk is as thick as a man's waist, and cannot be of less age than seventy or eighty years. It was in perfect health in November last. The few Ilices which I had in my own grounds have likewise perished to the very ground.

It is to be hoped that some fine trees of the species at Fallowden and at Howick may have survived as being on the coast-land, where winter's cold is somewhat mitigated by the vast unfrozen sea, retaining a temperature of perhaps 45° Fahr.

The Portugal Laurel has shown itself hardy as usual in the north, though in some of the Midland Counties it occasionally suffers injury.

That beautiful new introduction, *Laurocerasus Azorica*, though decidedly less hardy than *Lusitania*, its near relative, has held its own very fairly, losing only a few terminal shoots.

Araucaria imbricata has come through unscathed both at Whickham and with me. Above all, we have to rejoice in the perfect hardihood of *Cryptomeria Japonica*.

Berberis Darwinii is killed to the ground, a sad loss; but as it throws up suckers habitually it will soon re-establish itself.

Rhododendron Ponticum is probably unharmed. It is the great acquisition of this country to our evergreen shrubberies. Many very beautiful Hybrid Rhododendrons have shown themselves little or nothing the worse for their severe trial; but others have succumbed. *Thuyia borealis* quite unhurt.

Laurus Daphne, the Sweet Bay, and *Arbutus unedo* both cut down here, as indeed they are by every sharp winter. Our soil is unfavourable to them. They do much better even near the Cheviots; but the coast-line is their proper locality.

Ilex Aquifolium Balearica, the Majorca Holly, has stood admirably, like the common British species; but some of the golden varieties of the British Holly are sorely pinched.—*Ralph Carr Ellison, Dunston Hill, May 2nd*, 1879.

Letter from Sir John Trevelyan, Bart., to Thomas Bewick.

Mr. Bewick,—I have heard that you propose re-publishing your work; in which case I desire a set to be sent for me to the care

of Mr. Edwards, Linen Draper, High Street, Bristol; and Joe Black of Cambo will pay you.*

Of the Water-Hen, you say, "It is not yet ascertained whether they ever migrate. I can only say that they are in an island-pond of mine, near the house, all the year round; and in the winter season, always more than twenty; and I have counted thirty-three at one time: in the spring they go to the brooks to breed, except two pairs, supposed to be master birds, and from whom are as many broods. In November they return and remain the rest of the winter; and if hard weather they are fed with oats, and become very familiar.

The Water-Ouzel is well described in your History of Birds; but a few peculiar habits are omitted by you and Pennant, which ought to be noticed as they differ from every other species of the feathered tribe. The Water-Ouzel always flies very quick, and does not appear to me to be able to moderate his flight; for which reason, when he intends pitching on a point of rock, or stone, above the surface of the water, he avails himself of hitting his breast deeper, or shallower, dashing the water around him; and, partaking of the rebound, is at the instant on the spot, firm on his feet. In flying up the stream, he checks himself in like manner, nearer the object he intends to pitch on; and down, at a greater distance from; allowing for the rapidity of the water either way, so as to answer his purpose. I have seen the bird swim from a stone to a shelving bank, but never from a bank to a stone.

In your account of the Long-tailed Field Mouse, you conclude with Pennant's account of the Hampshire Mouse, which is also correct; but as they are tolerably plenty here, and which we call the Harvest Mouse, I have kept two or three of them in a Dormouse Cage, to observe their habits, and find they have a very flexible tail, towards the end, with which they frequently lay hold of a wire, twisting it twice round, close to the wire, as if to prevent their falling, should they slip; and sometimes they will suspend themselves from one of the upper wires, hanging wholly by the tail, perhaps a minute or more, but do not drop to

[* Land-agent to Sir John Trevelyan.]

the bottom of the cage, but, by a jerk, throw themselves up, and walk about the wires as before. The weight of a mouse is as near as possible to that of a half-penny. A gentleman now with me says, that he observed one of them in his garden, with the end of his tail twisted round a slender branch of a peach tree, partaking of the fruit.

You may recollect that I gave you, a few years ago, a list of the names of men taken from birds: I shall now add a few more, and if you find duplicates of some of them before given, it is with a view of strengthening the proofs:—

Eagle—Captain of Volunteers, Suffolk.

Falcon—late Consul at Algiers.

Hobby—of Herefordshire, Inn holder: Gazette, 1805.

Hen—Durham, near the Green Dragon, and two others of the name elsewhere.

Fowls—Married at St. James's Church, 1806.

Bustard—An officer in the Army: Gazette.

Goose (Mr.) Married to Miss Flock: Morning Post, 1807.

Gray-goose (Mrs.)—Court of King's Bench, Nov. 14, 1806.

Wildgoose—in the Army: Star, January 1805.

Eaglefinch—Queen Anne Street East: Gazette.

Oriole, Mr.—Clifton near Bristol: 1807. (*See Pennant.*)

Pheasant, Edward: Southwark Gazette, Jany. 17, 1807.

Curlew: Star, Jany. 1805 (Taylor) Gazette.

I hope you will excuse the trouble I give, should you think my observations trivial. Let me hear from you, and

I am, Your most humble Servant,

(Signed) JOHN TREVELYAN,

Mr. Bewick, Engraver, *Nettlecombe Court, near Taunton,*
St. Nicholas Church Yard, Newcastle on Tyne. *August 12th*, 1807.

Notes on the breeding of the Stock Dove, Columba ænas, Linn., *in the County of Durham, within a few miles of Newcastle.*—When on a visit to a friend on the 8th, 9th, and 10th of this month, my attention was drawn by my friend to a Ring Dove, as he called it, which had its nest on the top of an old summer house in the garden. On looking at the young which were fledged and lying

on the bare ground in a hole under an old Lilac tree, it struck me very forcibly, that the young were those of the Stock Dove, and not of the Ring Dove, as my friend supposed. On our way back to the house he pointed out an old Elm, with a hole at the top of a large branch, saying, "that another nest must be there, for he had seen a Dove fly out of the hole the other day." This settled the question that it really was the Stock Dove. However, to make it more certain, I wished to see the bird come out of the hole myself, upon which he replied, "your bed room looks upon the tree, and by getting up early in the morning you will see one of the birds sitting on the tree close by." I followed his advice, and, rising early, I saw the bird leave the hole and fly to a tree near, and after pausing awhile it flew right away: in about half an hour it returned and went into the hole. The Stock Dove is considered by naturalists to be a very shy bird, and I can bear testimony to this fact, for the bird made many movements from tree to tree before it reached the branch in which the nest was. I felt sure that the bird saw me through the window, although I kept very quiet and made no movement. After breakfast my friend got a ladder to get up to the hole to make certain that the nest was there. As soon as the ladder was placed against the tree, three birds flew out; one fell to the ground and the others flew away. The bird that fell to the ground was a young bird, with its right wing injured probably by some Jackdaw wanting a dinner, and thinking the young Dove would be a nice tender bit.

I may mention that a fourth bird flew from the same Elm tree but from another hole a little lower down the stem, which was about one foot six inches deep, and at the bottom of which lay two white eggs, undoubtedly those of another Stock Dove, making three nests in the same locality.

I had never seen this species in the first plumage before; a short description therefore will not be out of place:—Bill dusky, the upper mandible tipped with white; feet, toes, and claws the same colour as the bill: *these parts in the mature birds are red.* All the plumage is of a blue-grey, rump a little paler, bastard

wing, primaries and tail-feathers dark blue, upper tail coverts grey, a few dark-blue spots on the tertiaries, eye dark hazel.

This is the fifth locality I have to record of this interesting species making its appearance in our two northern counties. For a particular account of these reference may be made to The Birds of Northumberland and Durham, Vol. VI., p. 84, of our Transactions.—*John Hancock, May 15th*, 1880.

Preliminary Note on the Discovery of Old Sea-caves and a Raised Sea-beach at Whitburn Lizards.—In the spring of 1878, Mr. John Daglish kindly forwarded to the Museum of the Natural History Society a box of bones, discovered in an old Sea-cave by the workmen employed in quarrying limestone on the eastern escarpment of the Cleadon Hills, known on the Ordnance Map as the Whitburn Lizards; and he also granted, in the kindest manner possible, liberty to some of the members of this Society to excavate in the Cave, and examine any other part of the works now being carried on by the Whitburn Coal Company. This was the first intimation we had of the existence of seaworn caves on the escarp of the Cleadon Hills, and the occurrence of the remains of an extinct bird, the Great Auk, which, together with the bones of the Red Deer and Roe, formed part of the first instalment sent to the Museum, as well as numerous skulls of the Common Badger and Fox, made the discovery of the greatest interest. Systematic search was carried on constantly in the Caves, and amongst the materials first thrown out; and a very interesting list of Mammalia and Birds has been made out. Numerous others still await identification.

In the first Cave, only a few remains of man were secured, two lower jaws and some limb-bones, and these were found immediately at the entrance to the Cave. In a Cave adjoining, discovered during this year, the skulls of five persons were found, and other portions of the human skeleton. These were all removed by the workmen before anyone could have an opportunity of examining the position in which they were arranged. No artificial implements of any kind have, so far as we know, been found, but through the cave-earth remains of charred wood or

charcoal were frequent. The most numerous bones found are those of the Water-vole, which appears to have been the favourite food of the larger carnivora, Badger and Fox, as well as numerous bones of birds.

The Cave examined by us is situated about one hundred and forty feet above the present sea-level on the north-east escarp of the hill, and about fifteen feet from the top. It was entirely concealed by *debris*, which was overgrown by the regular herbage of the cliff, so that no outward signs of it were visible, and it was not till the workmen had removed a large quantity of loose rubble fallen from the cliff that the entrances of the caves were seen.

The general appearance presented by the first-discovered Cave much resembles caves cut by the sea in similar rock at its present level. The height of the principal entrance was rather more than six feet when the earth had been removed from the marly floor. It ran nearly west into the hill side, bifurcating at the far end into two branches. Near the entrance on the north side, another Cave branched off in a north-westerly direction from the main Cave, and a low outlet to this portion existed in the front. This branch was on a slightly higher level than the main Cave, and behind the pillar separating the two in front the most numerous remains of the small carnivora, birds, and fish bones, were found.

The second Cave, in which most of the human remains were discovered, was not seen by us, unfortunately. It was separated by about five feet from the first Cave to the south, and at the time of our first visit was concealed from view by a mass of *debris* from the weathering of the rocks above. The Caves had been worked out by the sea from softer material than the surrounding beds, and the bottom of both Caves was of soft, marly, yellow limestone. There was no accumulation of water-worn pebbles in the bed of the Cave; but the thick deposit of cave-earth, rather more than two feet, rested upon the marly limestone. It was of a reddish appearance, and rather fatty to look at, but when dried readily left the specimen.

Some of the larger bones were scattered in a very irregular

manner through the mass, but others were congregated and rather closely packed together. The larger bones had generally been broken and gnawed, and nearly all the bird bones, excepting the hollow limb bones, had been more or less fractured. Large masses of very small bones occurred together, which had been only partially digested, having formed the food of Badgers or Foxes. There was no appearance of stalagmite or stalactite, and only a very small deposit of calc-sinter was observed. Decomposed fragments of limestone which had fallen from the roof occurred here and there in the Cave-earth. The Cave-earth had an irregular surface, and was grooved more or less with water that had accumulated on and drained over its surface.

The following species of animals, some of which appear to have been more or less domestic, have been carefully identified by Mr. John Hancock: Horse, Cow, Sheep, Dog, Pig or Wild-Boar, Red-Deer, Roe, Badger, Fox, Yellow-breasted Marten, Weasel, Hedgehog, Mole, Water-Vole. Numerous bones of birds were also identified; among others the Kestrel or Merlin, Gannet, Great-Auk, Razor-Bill, etc. Shells of the Oyster, Periwinkle, Limpet, and several species of Snails were likewise distributed through the Cave-earth.

The occurrence of the remains of the Great-Auk, determined by Mr. John Hancock, would of itself give great importance to the contents of this Cave, as this bird has only once been recorded as occurring on the Northumberland coast, and has not been observed for the last fifty years in any part of the British Islands, and its former existence in the North Atlantic is now matter of history on both sides of this ocean. The Yellow-breasted Marten is now restricted to the northern part of Scotland, and the Badger, formerly abundant in the Northern Counties of England, as the names derived from its haunts show, has now disappeared from our locality, and is only found in the more wooded and secluded parts of the South of England.

No great antiquity need be claimed for the contents of these Caves. That they must have been raised to their present level long before they were the habitation of the creatures whose remains have been concealed in them admits of little doubt; but

the absence of any artificial instrument, and of the remains of those former denizens of England, the Hyæna and Cave-bear, found in the Yorkshire and Devonshire Caves, and its occupation by those still existing, or existing within the century in some part of the British islands, would seem to imply that a long period back is not required to explain all the appearances existing in these Caves.

Raised Sea-Beach.—In the railway cutting about forty feet below the level of the Cave, a most interesting section of the Raised Beach is exposed. The railway runs nearly along the one hundred feet contour line above the present sea-level. The section shews about nine inches of cultivated or formerly cultivated soil resting upon a reddish clay in which occur pieces of angular chalk-flints and rounded pebbles of pure white quartz. For want of a better name, "Scandinavian Drift" has been applied to this deposit, which is much newer than the true Boulder-clay, and has been deposited under somewhat different physical circumstances. In this locality, as at the Trow Rocks near Shields, it rests upon sea-formed gravel or the rock-head, and is as a consequence newer than the gravel it rests on. In some parts of the cutting the gravel was of considerable thickness and shews partial bedding of the materials, which are chiefly composed of limestone from the neighbouring cliff intermixed with a few pebbles derived from the older Boulder-clay which had, as must be inferred from the numerous remains of Trap and Carboniferous-limestone boulders resting on the rock-head, formerly covered the whole surface.

The gravel rests on sea-worn rocks either loose or *in situ*, which present much the same appearance as those on the sea-shore of the present coast-line. Further to the south along the line of railway, washings of sand and clay take the place of the gravel. No shells or traces of organisms have yet been observed in the gravel at Marsden, but in a corresponding deposit of gravel at the Trow Rocks near Shields, broken fragments of *Cyprina Islandica, Tellina proxima*, etc., were collected several years ago.

It has long been well known that the village of Cleadon, at a

slightly lower level than this raised beach, is built on a very extensive spread of marine gravel. No geologist can look at the Northern, Western, and Southern Escarpments of the Cleadon Hills, with its lines of projecting cliffs, without being convinced of the former insular character of this mass of limestone during long portions of the glacial period. The inferences to be drawn respecting the former depression and elevation of this part of England during the glacial period must be left for a future occasion. Our best thanks are due to our fellow-member, Mr. John Daglish, for the liberal manner in which he has placed the materials for this notice at our disposal and presented the specimens found in the Caves to the Museum.—*Richard Howse. Read at Marsden, October 3rd*, 1879.

On the so-called Sculptured Rocks of North Northumberland.—More than fifty years ago the late J. C. Langlands, Esq., first observed and reported to the members of the Berwickshire Naturalists' Field Club the existence of curious concentric circles on the sandstone rocks near the ancient semi-circular encampments on the brow of the hill above his residence at Old Bewick. From time to time since that date attention has been called to these and to other similar circles found in the neighbourhood of Wooler and Ford by members of the Berwickshire Club. Among those who have more particularly described them are Dr. Johnston in Botany of the Eastern Border, Vol. I., the Rev. William Greenwell, in the Tyneside Field Club Transactions, Vol. VI., p. 20; and the late George Tate, who took up the subject with his usual zeal, and has furnished an elaborate paper, illustrated with lithographs by our fellow-member Mr. John Storey, of nearly all the examples known to exist in this district, and advanced theories more or less accepted as to their origin and signification. Berwickshire Naturalists' Field Club, Vol. V.

In 1853 Dr. Johnston, Nat. Hist. Eastern Borders, Vol. I., p. 256, says, "I think that the circles we lie upon were made by the soldiers of that camp (Bruneburh) in relief of idleness, etc." This conjecture seems not to have gained many advocates, for, in his Presidential Address to the members of this Class

(Trans. Tyneside Nat. Field Club, 1863, Vol. VI., p. 21), the Rev. W. Greenwell expresses the opinion "that their import is religious; their connection with burial, always a most sacred rite, and closely joined to the religion of all races, points most distinctly to a sacred purpose, but what the mystery is which they dimly shadow may remain for ever unknown, at present it is completely hidden from all enquiry."

Mr. Tate had in his Presidential Address to the Berwickshire Club, September, 1853, Vol. III., pp. 129, 130, combated the idea that these circles were plans of ancient camps, and proposed a different view. "I cannot," says Mr. Tate, "regard them as the amusements of an idle soldiery, nor as plans of camps, nor as exercises of incipient engineers; for their wide distribution, and, notwithstanding differences in detail, their family resemblance prove that they had a common origin, and indicate a symbolic meaning representing some popular thought; and though I cannot spell the rude lettering, I fancy, since they are associated with the last remains of Celtic heroes and sages, they tell of the faith and hope of the aboriginal inhabitants of Britain." This view, which as far as I am able to ascertain, has been accepted by most writers on the subject is more fully expressed in the following carefully-selected extracts, which will give a correct idea of the theories which have been hitherto proposed to account for the origin of these so-called inscribed rocks under the headings: (1) Who formed them? (2) By what kind of tool were the inscriptions made? (3) What mean these sculptures? The answers to these three questions are given in the words of the late Mr. George Tate, of Alnwick.

(1.) "The opinion has been maintained that these sculptures were the work of Roman soldiers, who, after driving the native population out of their camps, occupied them, and caused the emblems of their own religion, relating to Mithraic rites, to be carved on the rocks in the district around. But such rude inscriptions possess none of the characters of Roman workmanship. The invariable association of these inscriptions with ancient British forts, oppida, villages, and sepulchres, is evidence of all having been the work of the people who dwelt in these villages,

and were buried in these tombs. They may have been earlier than the interments, as they might have been quarried from a sacred inscribed stone in the neighbourhood and placed over or in the cist to give a sanctity to the resting-place of the dead. These inscriptions, therefore, are pre-Roman, and may date backwards not less than two thousand years or more; because the relics of the period indicate a low degree of civilisation, and would carry us back to the early immigration of Celts into Britain."

(2.) "We may now inquire by what kind of tool the inscriptions were made—whether by stone or metal. The markings have been chipped or picked out, and not made by rubbing; the best preserved figures show that the tool was bluntly pointed. All our sculptures are in sandstone, which could have been incised by such a tool as was used, in far-distant pre-historic times, made of basalt, flint, hornstone, trap, or jasper. Metals, however, were known in the district when the sculptures were incised. It is, therefore, probable, that metallic tools had been also used to inscribe the Northumberland rocks."

(3.) "What then mean these sculptures? Are they merely ornamental? or are they symbolical? When the earliest public notices were given of the Northumbrian inscriptions, they were supposed to be plans of camps. In 1853 I proposed a different view, and advocated the notion that they were symbolical figures representing religious thoughts. The numerous additional facts observed, confirm, I think, the conclusions—first, that these inscriptions have been made by the Celtic race occupying Britain many centuries before the Christian era; and, second, that the figures are symbolical—most probably of religious ideas."

"The Rev. William Proctor, of Doddington, says, 'I am decidedly of opinion that they are all monumental inscriptions in memory of departed friends, whose remains had been deposited near them.'"*

Since Mr. Tate's paper was published our respected fellow-member and Vice-President, the Rev. Dr. Bruce, has, in an

* See "The Ancient British Sculptured Rocks of Northumberland and the Eastern Borders." Berwickshire Transactions, Vol. V., p. 106.

exhaustive summary prefixed to the magnificent folio plates, published under the liberal auspices of the late, and present Duke of Northumberland, reviewed the whole subject and adopted the opinion that these markings are artificial, and "it is possible that they have some religious significancy." (See Incised Markings on Stone, pp. 1–12, 1869.)

It may be remarked on the above quotations that the occurrence of slabs covered with concentric circles in the old burial places may be only accidental. A barbarous people with few powerful tools would be almost certain to search the outcrop of the rock-head for loose slabs, such as might be easily wedged off, and even the farmers of the present day, and in the very same places, employ their servants to do the very same thing, preferring to wedge off loose stones to the more expensive way of quarrying. Large pieces of the Routing Linn sculptured stone have been recently quarried, not for burial purposes certainly, but for "walling" and other agricultural requirements.

That these circles are associated with "the last remains of Celtic heroes and sages," even admitting the latter were proved to be such, is no proof at all that the circles are of Celtic origin. "The invariable association of these inscriptions with ancient British forts, oppida, villages, and sepulchres," is no evidence of all having been the work of the people who dwelt in these villages and were buried in these tombs, for how many thousand camps, etc., are there in other parts of the country belonging to the same race where no trace of concentric circles has ever been found? how many a tomb has been opened and district explored without finding a trace of these circles? we must therefore attribute the proximity of the camps to them on the wild moors of Northumberland, Yorkshire, and Scotland, to be merely accidental.

In Northumberland, even within the historic period, the physical appearance and condition of the country where these camps occur must have been widely different from what it is at present. The primitive, natural woods as they are called in this district, covered the tops of all but the very highest hills, and dense forests the lower ground. Proofs of this still remain in many

peat-bogs at great elevations that have been examined. The general appearance of the country would be much the same as sung by the poet in other lands.

> "Fluminibus salices, crassisque paludibus alni
> Nascuntur, steriles saxosis montibus orni."

Barren birks spread themselves over the rocky fells, allers covered the dense swamps, and sallows fringed the streams, with here and there in suitable places groves of gnarled oak and plots of lofty Scotch Fir. Along the glades of the dense swamps roamed the fierce Urus and the Wild-Boar, in the quietudes of the more lofty forest the Elk and the Red-Deer with Roe on the hill-sides, and here and there packs of bloodthirsty wolves. Excepting the last both plants and animals have left their remains in deposits of peat indubitable witness of their former presence in these counties.

And how different is the appearance of these British towns now from those described centuries ago by Cæsar. "Oppida autem Britanni vocant, cum silvas impeditas, vallo atque fossa munierunt, quo incursionis hostium vitandæ causa convenire consuerint." From this one must conclude that all these old camps in Northumberland, bare and exposed as they are at the present day, were concealed and protected by a dense vegetation, as well as by walls of earth and rubble, each family required, the race being very quarrelsome, to be protected against its neighbours, tribe against tribe as strictly as against the Roman or any other foe. All the rocks among these dense woods would then be covered over with a rich garment of lichens and other plants, no bare stones being left uncovered, and in such a state no doubt had these concentric circles being buried long before Celt or Neolith, or Palæolith, or any other form of man, *terra edita* or not, had sprung up to trouble the surface of the country with ruthless wars.

And with regard to the meaning of these circles, if the theory proposed in this paper be correct, these markings, instead of being symbolical of a future, may be only direct evidence of a past life of plants which flourished and faded, which grew upon the first bare upheaved surfaces of the rock-head when it was

first lifted up from the surface of the glacial sea during the uprising of the land at the end of the last glacial period, which helped to prepare a soil, by covering up the surface which they had grown upon and inscribed during long years with concentric rings, for the present flora of the temperate zone; and instead of being, as has been suggested, two or three thousand years old, they may be of such remote antiquity as to be beyond the reach entirely of our present method of computing time.

For many years past I have sought for opportunities to examine for myself the curious markings on the surface of these sandstone rocks on the lofty moors, which extend northwards from Old Bewick to Ford Moss, and probably further in a north-easterly and south-westerly direction. The first opportunity I had was in the neighbourhood of Wooler, in 1872, where, under the accomplished guidance of Mr. James Hardy, I was led without any trouble to examine the fine examples of the so-called sculptured or incised stones which are found on the large flattened exposed masses of sandstone spread over a portion of Weetwood Moor. The surfaces we first examined were very flat, and had to me the appearance of having been formerly glaciated, (see Incised Markings on Stone, Pl. XVIII.,) and this opinion was strongly supported when by stripping off the heather from some heather-covered rock close by we found the surface smoothed, and striated with strong grooves and delicate scratches, proofs not to be doubted of former glaciation. Such a surface exposed to the action of the weather would soon lose the sharp markings, and would in the situation named become soon covered with lichens. It would, in fact, become like the general surface we had examined close by, which was covered with supposed-sculptured concentric circles. It struck me at the time that these circular grooves with central cups were not artificial but natural, and caused by vegetable growth assisted by natural weathering, and that the curious concentric ring-like depressions were in reality due only to the periodical growth of a large species of lichen similar to many specimens still growing close by the place we were examining. It struck me as remarkable that when the markings were on a slope there was a straight furrow or gutter

leading down in the direction of the slope of the surface from the cup-like centre; when the markings were on a perfectly flat or hollowed surface such a groove or gutter was not present. I am not certain whether I expressed my doubts about the artificial nature of these appearances to my friend Mr. Hardy or not; but I am certain that I showed him the glaciated surface of the adjoining rock-surface, and did not believe in the artificial theory of these concentric markings.

It was not till July, 1877, that I had another, the second opportunity of seeing and examining more of these circles on the summit of the hill at Old Bewick, the place where they were first observed by J. C. Langlands, Esq. Meantime having made myself acquainted with Mr. George Tate's and Dr. Bruce's elaborately illustrated works on this subject, I was fully prepared and expected to be able to examine what the illustrations had given me the hope of seeing. Instead, we found the surface of the sandstone rock much weathered away, the sharp markings of the grooves, as figured, gone, and some of the figures scarcely to be traced at all. It was evident that exposure to the atmosphere for a few years, for some of them had not been very long uncovered, had almost obliterated the circles, and the destruction of the ridges was gradually forming the whole into one large basin-like hollow when the surface was flat, and levelling the ridges and flattening the surface on the slopes. How, then, if these appearances are artificial, did they become preserved to the present time? When found, most of them, if not all, were covered with vegetable mould, formed in the first instance by lichens growing on sandstone for a long series of years, until by the decomposition of the lichens a soil was formed for the growth of moss and then heather, bleaberry, etc. Were these rocks incised or sculptured before exposed to the growth of lichens? Or were the incisions or sculptures, or whatever they are, covered carefully up by those who made them, to protect them from the weather?

The theory which I then proposed, and still propose, is this—that when the rock-surfaces at an early period were bare, after the last glacial period, they were exposed to the growth of

lichens. The spores of some lichens are known to bore into the rock on which they select to grow, and by so doing loosen the particles of sand of which the sandstone is composed. Many lichens grow in a circular form, and radiate, or rather send out, rings of growth periodically, the central part dying and decomposing, very nearly in the same way as the *mycelium* of some Fungi form the rings which are commonly called Fairy-rings. Shakspeare embodies the once popular opinion in *The Tempest*.

> "You demi-puppets, that
> By moonshine do the green-sour ringlets make,
> Whereof the ewe not bites; and you whose pastime
> Is to make midnight mushrooms."

Indeed, if the periodical Fairy-rings could be made permanent from the centre outwards, we should have on a very large scale precisely the same shape and appearance in a grass field which we now see on these supposed incised or sculptured surfaces of the sandstone of the North-Northumberland moors. But the lichen is limited in its growth; it cannot attain beyond a certain diameter, and consequently we find these markings not more than about eighteen inches in diameter, generally much less. Also the lichen does not cut uniformly through hard and soft material, as an iron or even a stone tool would do, but leaves ridges of the harder parts it meets with, and this is precisely one of the appearances presented by these circles. Whenever the circles are traversed by a narrow vein of iron-hardened sandstone, the furrows are not continuous, but the vein remains permanent and disfigures the symmetry of the pattern. Fine examples of this are figured by Mr. Tate, Sculptured Rocks, Pl. V., X., XI., and Dr. Bruce, Incised Markings on Stone, Pl. VI., VII., X., XI., XIII., XXI., XXIII., XXV., XXVIII.–XXX.; but this fact is most intelligible and convincing when you have the actual specimen before you. Would any workman disfigure his pattern because he had a little harder material to cut through? It is no disgrace to a cryptogamic plant, or the wind, or the rain, that they cannot always cut an exact circle; but a sun-worshipper who could not outline the shape of his god perfectly, ought to sink in our estimation below the visible horizon, and a symbol-maker who could

not perfect his design would expose himself to contempt. This simple fact, that hard veins do cross these furrows intact, ought to be of insuperable difficulty with those who contend for the artificial origin of these circular markings. But there is another appearance shown by these circles which militates just as strongly against their artificial origin. It often happens that two sets of concentric circles impinge or come into contact with each other. In such instances the outer circles of one or the other or both are incomplete. (For examples see Tate's Illustrations, Berwickshire Trans., Pl. I., V., VIII.; and Dr. Bruce's Incised Markings, Pl. III., V., XX., XXII., XXIII., XXVIII., XXX.) This impingement or contact of the circles is easily explained by supposing two lichens growing nearer to each other than their fully-developed size allowed. When the outer circle of one had extended to or reached beyond the periphery of the other a stoppage of the growth of one of them would happen, the more vigorous overpowering the other occasionally, and frequently both would suffer. The small size and irregular shape of some of these markings is also more easily accounted for by the natural than by any artificial theory yet proposed. That some lichens do grow, radiating from the centre and forming periodical circles extending in some instances more than twelve inches from the centre, the following extracts will show.

Lichen centrifugus, Linn. Sp. pl. 1609:

Flora Lapponica (1792), tab. XI., f. 2, pp. 357–8.

"In lichene hoc adolescente, pereunt antiqua folia et flores centro proximi reliquentes lapidem, cui insedebant, fere nudum vel furfure obductum, ut videas quasi *latum circulum* ruditer a pictore in lapide depictum."

Flora Succica, pp. 409, 410.

"Progrediam a centro ad periphæriam, sensim in medio deliquescendum, primo intuitu dignoscitur."

Lichen centrifugus, Linn. Lightfoot, Flora Scot. p. 814.

"The centre of the circle often consists only of minute furfuraceous leaves, which decay first, while those in the circumference still remain and constitute a broad circular band." The *L. centrifugus*, Lightfoot, is now separated from *L. centrifugus*,

Linnæus, and in most recent works is referred to as *Parmelia conspersa*, Hooker, Scot. II., p. 55.

In the periodical growth of both these lichens we have, if it were recorded on the rock surface, exactly the pattern of the concentric rings, and that some lichens do bore into the rock is well known. "They act," says Dr. Balfour, "by degrees upon the hard rocks, and cause disintegration of their stony particles, and thus form a stratum of mould in which the seeds of higher plants can find a nidus when wafted thither by winds or other causes."

"They make a way
For bolder foliage nursed by their decay."

"Many of them no doubt take up into their substance the materials of the rock on which they grow, and when analyzed are found to contain phosphate and oxalate of lime and other inorganic substances." *Lecidea geographica* is so called from the peculiar marking it produces on the rocks.

These quotations prove that lichens do grow in concentric circles, and that some of them, if not all, leave peculiar impressions upon the rock where they have grown.

In 1879, in company with a few of our members, we had another opportunity of examining numerous specimens of these circular markings at Routing Linn and Ford Moss. The wind and the rain are playing havoc with these old markings, and it is very evident that they cannot have been exposed many years or they would have been entirely obliterated before this. They are always on the laminated surface, and most frequently on a sloping surface, and they face the north and west more than the south and east, which is the situation in which many lichens are found. I could find no trace of these circles on the upright or perpendicular fracture of the rock. In a few years more any one going with Mr. Tate's book in his hand to examine these rocks will be very much disappointed, as they will very soon be entirely effaced by weathering of the stone and other causes.

The Routing Linn stone is a conspicuous object at present even from a distance. It is a veritable *roche moutonnée* of large size for our district, and appears to have been covered or nearly

so with a growth of heather over its whole surface. Formerly, before the destruction of the natural wood, it must have been more or less concealed from view, and when the young plantation now surrounding it has grown up it probably will be so again, that is, if the farmers and others do not quarry it entirely away first, and portions of it have already in this way disappeared. We felt much disappointed in an attempt to trace the circles on this now celebrated stone. It has been figured so often, and by good authorities, that we expected to find what we were not able to see. It was somewhat difficult to trace out even a few of the circles, and such as we saw were not comparable with those on Weetwood Moor, and in a few years these will have vanished. This proves that their preservation to the present time is due to their having been covered with peat and heather, the removal of which, as at Old Bewick and other localities, has led rapidly to their effacement. On Ford Moss we saw better examples on some parts of the exposed rock-head affording what we wished to see, distinct evidence that some of the circles are crossed by elevated ridges of harder veins.

In concluding these remarks it may be stated that the only evidence adduced in support of the artificial origin and symbolical meaning of these circles is the circumstance of their being frequently found in the neighbourhood of Celtic encampments, and the fact that they have been found on stones employed in sepulchre for covering cists and urns, but surely both these circumstances may be as purely accidental as of their having been found on old walls at Black Heddon. It is suggested that they may have been formed by the use of blunt implements. If on carefully removing the peat which has covered all of them originally, tool marks of unquestionable character could be found, then their artificial origin would be at once established. I am not aware that such evidence has been found, but I have seen some circles on Weetwood Moor tampered with recently by some modern idler.

The chief evidence for their natural origin is that they occur generally on the rock-head and laminated surfaces of sandstone. I am aware of, and have seen one stone, found by the late Mr

Wightman of Wooler, which has recently been figured in the Berwick Transactions, but the surfaces were so weathered that it was impossible to determine without breaking a piece off what rock it was, but it had much the appearance of porphyry. Many also have been found on the Mica-Schist of Argyle, and these occur chiefly, as I think they also do in Northumberland and near Ilkley, on glaciated surfaces, and if this observation can be verified, it goes far to prove their natural origin and remote antiquity. The fact that the pattern of these circles is often crossed by hard veins which interfere with the continuity of the grooves and sometimes render a circle imperfect is perhaps the strongest proof that can be offered of their natural origin, and the figures referred to above, especially those from the neighbourhood of Loch Gilphead, occurring as they do on glaciated Mica-Schist and crossed as they are by ridges of quartz, bear incontestable evidence of their natural formation. The contact of two or more circles destroying the shape of one or both, and the irregularity of many of the figures, can be best explained by the natural theory of lichen-formed rings, and that some lichens do cut or erode the stone over which they spread is not to be questioned.

I conclude these remarks nearly in the words of our former President, the Rev. William Greenwell, who first directed the attention of the members of this Club to these mysterious concentric rings in his Anniversary Address, 1863, and who more than all others has investigated the remains of the first inhabitants of this part of the British Isles. "I record this theory (of the natural origin) of these circles (at present) merely as a tentative view, because, in a question of mystery like this, anything that strikes an independent observer is worthy of consideration," but I hope the time is not far distant when further discoveries may either substantiate the view proposed in this paper or prove it to be wholly untenable.—*Richard Howse, Newcastle-on-Tyne, July 25th*, 1879.

Note on the Priority of Discovery of Archanodon (*Anodon*) *Jukesii*, Forbes, *in the Lower Carboniferous Rocks of North Northumberland.*—As stated on page 173 of this volume I had the

pleasure, through the kindness of Mr. Wightman, of Wooler, of ascertaining that the fresh-water Unio, *Anodon Jukesii*, had been found in a stratum of thick sandstone by Mr. James Waldie, of Doddington. A notice of the discovery of this important fossil was read at our Field-Club Meeting at Newbiggin-by-the-Sea, and was published in full in the Newcastle Journal, August 7th, 1877.

I think I am strictly correct in stating that before the 28th July, 1877, the day on which I first saw this species in Northumberland, no geologist, professional or amateur, had any knowledge of the existence of this shell in the rocks of Northumberland, but on the evening of that day I did both mention that I had obtained it and shewed a specimen to a geological friend at Alnwick. After, but not before my paper was announced to be read at the Field-Meeting, it was soon whispered about that this species had been previously found in the Northumberland rocks; and in the early part of the year 1878 a formal claim was made, not only for priority of discovery of the species, but for acquaintance also with Mr. Wightman's specimens, in a "Preparation" by Mr. G. A. Lebour, of the Hutton Collection of Fossil Plants. His words are, "In 1873 the writer (Mr. now Prof. Lebour) found broken fragments of this shell in a bed of grit near the base of the Lower Bernician (or Carboniferous Limestone) series, near Holystone, in Northumberland. In June, 1876, more perfect specimens were obtained by Mr. Ralph (*sic*) Waldie, of Doddington, an intelligent quarryman, in sandstone occupying somewhat similar position to the above, near Chillingham. The writer saw these specimens in the late Mr. Wightman's collection at Wooler a day or two after their discovery. The Holystone specimens are in the Jermyn Street Museum."

This extract was published rather more than six months after my paper was read and published in the Newcastle Journal. Before this time no printed record or public announcement had been made of the Holystone fragments, and we are left somewhat in the dark as to whether the fragments were found by Prof. Lebour himself when he was on the Geological Survey, or by the Survey Collector who visited that (Coquet) district to collect

fossils in the Lower beds about the time mentioned, as the specimens are said to be in the Jermyn Street Museum. At the time mentioned above (1873) and for a year or more after, in fact, until he had left the Survey sometime, I corresponded with him, and had frequent conversations about the fossils which the Survey Collector had found in the Lower Carboniferous rocks of the Upper Coquet district, and during all this time he neither mentioned this discovery to me nor to any of his associates on the Survey. It is very difficult, indeed, quite impossible to think that he kept so important a palæontological discovery entirely to himself until July, 1877. But it follows that if Prof. Lebour can point out any written testimony that he identified the Holystone "fragments" with *Anodon Jukesii* at the time he mentions (1873) no one will presume to dispute his claim; but if he did not know what the fragments were till after July 28th, 1877, then I should take his claim of discovery to be an afterthought, and I suppose many other persons will hold the same opinion.

The other part of Prof. Lebour's statement is of a graver nature. He distinctly says that "The writer saw these specimens in the late Mr. Wightman's collection in June, 1876, a day or two after their discovery." Now for the correctness or not of this apparently plain statement I have the assertion and written statement of Mr. James Waldie, the discoverer of these fossils, that he did not find them till 1877. Though I have the exact date when they were found, there is no necessity at present to inform the Professor too exactly. Mr. Waldie, who was here a few months ago, and to whom I mentioned Prof. Lebour's statement said, that it was impossible that any one could have seen the shells a year before they were found, and that witnesses could be brought to prove the correctness of his own date. Therefore it now remains with the Prof. to verify his date and to substantiate his other statement regarding the discovery of this rather important fossil in the Holystone Grits; for, admitting that fragments had been found, no one knew or claimed to know to what shell the fragments belonged till after July 28*th*, 1877. —*Richard Howse, Newcastle-on-Tyne, August* 24*th*, 1880.

TYNESIDE NATURALISTS' FIELD CLUB.

LIST OF MEMBERS, AUGUST, 1880.

Elected.		
1863	Abbs, Henry	Cleadon House, Sunderland.
1861	Abraham, John	Bold Street, Liverpool.
O.M.	Adamson, C. M.	Clayton Street West, Newcastle.
O.M.	Adamson, Wm.	Clayton Street West, Newcastle.
1858	Adamson, Horatio	99, Howard Street, North Shields.
1859	Adamson, H. E. P.	Tyne Street, North Shields.
1877	Adams, W. E.	32, Holly St., W. Jesmond, Newcastle.
1875	Addison, John Geo.	17, North Bridge Street, Sunderland.
1876	Alcock, John T.	Percy Terrace, Jesmond, Newcastle.
1861	Alcock, Samuel ..	Frederic Lodge, Sunderland.
1861	Anderson, Joseph	16, Ellison Place, Newcastle.
1869	Angas, C. H.	184, High Street, Sunderland.
1876	Angus, J. G.	Fell House, Gateshead.
1865	Appleton, J. R.	Western Hill, Durham.
1880	Archer, H. T.	34, Lovaine Place, Newcastle.
1849	Armstrong, George	Royal Arcade, Newcastle.
1878	Armstrong, James	The Hills, Bardon Mill.
1876	Armstrong, J. F., M.D.	23, Victoria Terrace, South Shields.
1875	Armstrong, J. L.	4, Northumberland Pl., North Shields.
1860	Armstrong, Luke, M.D.	26, Clayton Street, Newcastle.
1876	Armstrong, T. J.	Hawthorn Terrace, Newcastle.
1877	Arnison, W. C., M.D.	Northumberland Street, Newcastle.
1861	Atkin, David	2, Somerset Place, Newcastle.
1872	Atkinson, Amos	68, Grey Street, Newcastle.
1874	Atkinson, J. B.	Ridley Mill House, Stocksfield.
1878	Atkinson, Robert	2, Leazes Crescent, Newcastle.
1877	Atkinson, W. N.	Shincliffe Hall, Durham.
1870	Atkinson, W. H.	Bedford Street, North Shields.
1866	Backhouse, T. W.	West Hendon House, B'pwearmouth.
1877	Bailes, Thomas	Lovaine Place, Newcastle.
1876	Bainbridge, Miss	Cliff House, Cullercoats.
1861	Bainbridge, Wm.	2, Howard Street, North Shields.
1876	Balfour, Andrew	Northumberland Street, Newcastle.

Elected.		
1872	Balfour, Prof. F. M.	Trinity College, Cambridge.
1878	Bald, John Heath	Heathfield, Hebburn.
1859	Barkas, T. P., F.G.S.	Art Gallery, Newcastle.
1879	Barker, Thos. B.	Westoe, South Shields.
1876	Barkus, Benjamin, M.D.	West Street, Gateshead.
1859	Barnes, J. W.	Messrs. Backhouse and Co., Durham.
1861	Barron, James	27, John Street, Bishopwearmouth.
1877	Bartram, Robt. A.	Hylton, Sunderland.
1874	Barwick, John S.	7, Grange Crescent, Sunderland.
1878	Bagshawe, Washington	27, Westgate Road, Newcastle.
1877	Beckingham, J. H.	Percy Park, Tynemouth.
1879	Beer, Wm.	2, Crossley Terrace, Newcastle.
1860	Bell, I. L., F.R.S.	Rownton Grange, Northallerton.
1880	Bell, John	28, Burdon Terrace, Newcastle.
1860	Bell, John Thos.	Iron Works, Monkwearmouth.
1876	Benson, J. G.	139, Westgate Road, Newcastle.
1860	Benson, Wm.	Allerwash, Hexham.
1849	Bethune, Rev. Angus	The Vicarage, Seaham.
1851	Bewick, T. J.	Haydon Bridge.
1878	Bewick, Robert	Whalton, Newcastle.
1877	Bertram, Charles J.	Sheriff's Mount, Gateshead.
O.M.	Bigge, Rev. J. F., M.A.	Stamfordham Vicarage.
1867	Bird, Rev. C.	Chollerton, Hexham.
1879	Bird, Henry Soden	15, Grey Street, Newcastle.
O.M.	Blacklock, Joseph	Summerhill Terrace, Newcastle.
1872	Blair, Robt.	Winchester Street, South Shields.
1873	Bolam, Charles	Stella, Blaydon-on-Tyne,
1858	Bolton, Andrew, M.D.	New Bridge Street, Newcastle.
1875	Bolton, George	8, Park Terrace, Sunderland.
1880	Bone, William J.	61, Linskill Terrace, North Shields.
1858	Booth, George R.	50, West Sunniside, Sunderland.
1858	Bourne, Wm., M.D.	104, Howard Street, North Shields.
1876	Bowdon, Thos.	Sheriff Mount, Gateshead.
1874	Bowlker, Rev. Chas.	Heddon-on-the-Wall, Wylam.
1859	Bowman, R. B.	Windsor Terrace, Newcastle.
1853	Boyd, Edward F.	Moor House, Durham.
1877	Boyd, Wm.	2, South Parade, Newcastle.
1871	Bradford, George	Etherley, Bishop Auckland.
1871	Bradford, James	Bunker's Hill, Fence Houses.
1849	Brady, Prof. G. S., M.D.	Fawcett Street, Sunderland.
1858	Brady, Henry B., F.R.S.	Hillfield, Gateshead.
1865	Branford, W. E.	90, Grey Street, Newcastle.
1878	Branford, Mrs.	90, Grey Street, Newcastle.

Elected.		
1875	Brice, Rev. C. E.	Wark-on-Tyne.
1860	Briggs, R. S.	21, Fawcett Street, Sunderland.
1867	Brooks, J. C.	Wallsend.
1850	Browell, E. J. J.	East Boldon, Newcastle.
1876	Brown, Arthur	122, High Park Road, Newcastle.
1872	Brown, Rev. Dixon	Unthank Hall, Haltwhistle.
1871	Brown, Rev. J. J.	Silksworth, Sunderland.
1860	Brown, John	69, Blenheim Street, Newcastle.
1876	Brown, John	269, Westgate Road, Newcastle.
1879	Brown, John H.	19, Collingwood Street, Newcastle.
1877	Brown, M. Walton	7, Elswick Park, Newcastle.
1854	Bruce, Gainsford	2, Harcourt B'ldings, Temple, London
O.M.	Bruce, Rev. J. C., LL.D.	Framlington Place, Newcastle.
1878	Buchanan, John	14, Windsor Crescent, Newcastle.
1861	Buck, Robt.	17, Fawcett Street, Sunderland.
1878	Bulman, Geo. W.	Corbridge House, Corbridge-on-Tyne.
1872	Bulman, Thos.	5, Leazes Crescent, Newcastle.
1878	Bulman, Wm. E.	Corbridge House, Corbridge-on-Tyne.
1871	Bunning, T. W.	Mining Institute, Newcastle.
1861	Burnett, Rev. W. R., M.A.	Bishopwearmouth.
1874	Burns, David	Haltwhistle, by Carlisle.
1872	Burnup, Edwin	66, Rye Hill, Newcastle.
1860	Burnup, John, Jun.	27, Eldon Street, Newcastle.
1880	Burrell, John	Lower Condercum, Newcastle.
1867	Burrell, R. A.	Durham.
1866	Cadogan, C. H.	Brinkburn Priory, Morpeth.
1876	Cameron, Robt.	10, The Green, Sunderland.
1875	Campbell, Chas.	Oakside, Guildford, Surrey.
1879	Calvert, Rev. Thos.	92, Lansdowne Place, Brighton.
1872	Capper, C. J.	Quayside, Newcastle.
1874	Carins, W. A.	64B, South Street, Leominster.
1874	Carr, Edmund	Dunston Hill, Gateshead.
1865	Carr, John	21, Norfolk Street, North Shields.
1878	Carr, Wm. Cochrane	Fenham Hall, Newcastle.
1878	Carr, Mrs.	Fenham Hall, Newcastle.
1874	Cave, H. A.	Herald Office, Sunderland.
1860	Challoner, J. S.	56, Dean Street, Newcastle.
1880	Charlton, George	Chester Street, Newcastle.
1974	Charlton, Francis	Moot Hall, Newcastle.
1888	Charlton, Richard	20, Claremont Place, Newcastle.
1861	Charlton, W. H.	Causey House, Gosforth, Newcastle.
1860	Chartres, Wm.	Ayton, Berwickshire, N.B.

Elected.		
1868	Clapham, Henry	North Ashfield, Newcastle.
1860	Clapham, R. C.	Earsdon, Newcastle.
1876	Clark, Frederick	Oak Lea, Sunderland.
1880	Clark, George	22, Belgrave Terrace, Newcastle.
1876	Clark, Harry	Oak Lea, Sunderland.
1871	Clark, Isaac	Blaydon-on-Tyne.
1872	Clark, John	Haltwhistle, by Carlisle.
1867	Clark, William	Mount Greenwich, Gateshead.
1873	Clark, Rev. W. A., B.A.	Belford Hall, Belford.
1870	Clarke, H	24, Dockwray Square, North Shields.
1868	Clarke, T. T.	Post Office Buildings, North Shields.
1865	Clay, William	19, Claremont Place, Newcastle.
1854	Clayton, John	Fenkle Street, Newcastle.
1858	Clephan, James	9, Picton Place, Newcastle.
1860	Clephan, R. C.	14, Side, Newcastle.
1869	Cobb, Joseph	149, High Street, Sunderland.
1880	Cole, James	Walker-on-Tyne.
1876	Cooke, Miss	124, Rye Hill, Newcastle.
1851	Coppin, John	Bingfield House, Corbridge-on-Tyne.
1869	Corder, Alexander	1, Carlton Terrace, Sunderland.
1868	Corder, Francis	Princes Street, Sunderland.
1862	Cowen, J. A.	Blaydon Burn, Blaydon-on-Tyne.
1865	Cowen, Joseph, M.P.	Stella House, Blaydon-on-Tyne.
1858	Cox, J. H.	33, Fawcett Street, Sunderland.
1876	Coxon, Joseph	139, Westgate Road, Newcastle.
1849	Crawshay, Edmund	Bensham Hall, Gateshead.
1875	Crease, J. R., M.D.	49, King Street, South Shields.
1877	Crisp, Joseph	Salisbury Place, South Shields.
1863	Crossling, Thomas	81, Clayton Street, Newcastle.
1862	Culley, Matthew T.	Coupland Castle, Wooler.
1876	Cutter, John	2, Portland Terrace, Newcastle.
1858	Daggett, Wm.	3, Dean Street, Newcastle.
1860	Daglish John	Marsden, South Shields.
1875	Daglish, William	Usworth Office, Quayside, Newcastle.
1877	Dalton, Henry	Stella Brewery, Blaydon-on-Tyne.
1864	Dance, J. W.	Shipcote Villa, Gateshead.
1870	Davis, John, M.R.C.S.	North Bridge House, Sunderland.
1867	Davison, Edwin C.	23, Park Place, Sunderland.
1867	Davison, Joseph	Cheviot View, Benton.
1879	Davison, Thomas H.	5, Hotspur Street, Tynemouth.
O.M.	Dees, R. R.	Pilgrim Street, Newcastle.
1849	De Mey, W. F., M.D.	Eldon Square, Newcastle.

Elected.		
1860	Denham, J. S., M.D.	Chapter Row, South Shields.
1865	Dickinson, I. G.	Mosley Street, Newcastle.
1858	Dinning, Wm.	41, Eldon Street, Newcastle.
1867	Dixon, Robert	52, Bewick Road, Gateshead.
1865	Dickinson, Robert.....	The Arcade, Newcastle.
1878	Dixon, Matthew Thos.....	2, Jesmond Road, Newcastle.
1863	Dixon, W. H., M.D.....	35, Frederic Street, Sunderland.
1879	Dobson, James.....	17, Frederic Steeet, Sunderland.
1879	Dobson, John T.	Windsor Place, Newcastle.
1865	Dodds, Edwin	Low Fell, Gateshead.
1867	Dodds, M. S.....	34, Quayside, Newcastle.
1849	Dodsworth, Frederick	Collingwood Street, Newcastle.
1869	Dodsworth, W. V.....	Collingwood Street, Newcastle.
1864	Douglas, James	Winlaton, Blaydon-on-Tyne.
1867	Douglas, John	Montague Cottage, Gateshead.
1875	Douglas, Morley, L.R.C.P. ...	19, John Street, Sunderland.
1865	Downie, Henry.....	12, South Parade, Newcastle.
1876	Dresser, Henry E.....	6, Tenterden Street, London.
1860	Drewett, D. O.	Riding Mill.
1878	Drummond, Charles J....	9, Spring Terrace, North Shields.
1860	Dunn, A. M.	72, Jesmond Road, Newcastle.
1868	Dunn, Henry.....	22, Pilgrim Street, Newcastle.
1880	Duppuy, Rev. Charles	58, Maple Street, Newcastle.
1859	Dwarris, Rev. Brereton	Bywell.
1879	Eccles, Edward.....	South Close, Gateshead.
1879	Eccles, Thomas.....	Blyth.
1875	Edwards, R. D.....	Nat. Prov. Bank, Gateshead.
O.M.	Ellison, Ralph Carr	Dunston Hill, Gateshead.
1870	Elsdon, W. B.	4, Royal Arcade, Newcastle.
O.M.	Embleton, Dennis, M.D.	Eldon Square, Newcastle.
1879	Eyton, Thomas.....	76, Grey Street, Newcastle.
1873	Favell, T. M.....	14, Saville Street, North Shields.
1879	Farrer, S. H.	The Grove, Gosforth, Newcastle.
1861	Featherstonhaugh, Edward...	Roker, Sunderland.
1877	Fedden, G. H.	Queen Street, Newcastle.
1880	Fell, Alfred	Hebburn-on-Tyne.
1861	Fenwick, George	34, Dockwray Square, North Shields.
1865	Fenwick, G. W.	158, Rye Hill, Newcastle.
1860	Fenwick, John	18, Saville Street, North Shields.
1874	Fenwick, John G.....	Moorlands, Gosforth.
1858	Fenwick, J. W.....	Saville Street, North Shields.

Elected.		
1854	Finch, Rev. Thomas	Morpeth.
1876	Fletcher, James	4, Higham Place, Newcastle.
1878	Fletcher, James R.	4, Higham Place, Newcastle.
1876	Fletcher, John W.	20, Argyle Square, Sunderland.
1858	Forster, G. B., M.A.	Backworth Hall, near Newcastle.
1850	Forster, J. S.	Plawsworth, Durham.
1860	Foster, Robert	The Quarries, Clifton Rd., Newcastle.
1868	Fothergill, J. M.	W. B. Lead Office, Northumberland St.
1880	Fowler, A. M.	Tankerville Terrace, Newcastle.
1872	France, George T.	Ford House, Felling.
1860	Francis, Mattw., M.R.C.S.	Frederic Street, Sunderland.
1865	Fraser, Donald	Forth Goods Station, Newcastle.
1873	French, J. H.	South Benwell, Newcastle.
1876	Gardner, Matthew B.	10, East Parade, Newcastle.
1876	Garland, James	Jesmond Road, Newcastle.
1860	Garrett, John	Bigg Market, Newcastle.
1851	Gibb, C. J., M.D.	Westgate Road, Newcastle.
1855	Gibson, Charles, M.D.	Eldon Square, Newcastle.
1870	Gibson, Charles	Alma Place, North Shields.
1871	Gibson, W. C.	4, Side, Newcastle.
1873	Gilchrist, Charles	Primrose Hill, Fence Houses.
1880	Gilchrist, Thomas	Ovington Cottage, Ovington-on-Tyne.
1872	Gillie, John	Westoe, South Shields.
1867	Gillies, Alexander	9, Ravensworth Terrace, Gateshead.
1872	Gillies, W.	5, Walker Terrace, Gateshead.
1876	Glen, D. C.	14, Anfield Place, Glasgow.
1878	Glendenning, William	Grainger Street, Newcastle.
1864	Glover, John	Walker, by Newcastle.
1876	Glover, William	Kell's Lane, Low Fell, Gateshead.
1866	Gooch, T. L.	Saltwell, Gateshead.
1865	Gourlay, Rev. G. M.	Blanchland, Riding Mill.
1861	Gowland, G. H.	178, High Street, Sunderland.
1874	Grace, W. Percy	Scotswood-on-Tyne.
1867	Graham, John	1, John Street, Sunderland.
1880	Graham, William	Lovaine Terrace, North Shields.
1865	Greaves, John	17, Nun Street, Newcastle.
1862	Green, Edward	Beverley Terrace, Cullercoats.
O.M.	Green, R. Y.	86, Pilgrim Street, Newcastle.
1875	Green, Thomas	Garden House, Monkseaton.
1854	Green, William	Thornley House, Blaydon-on-Tyne.
1872	Greene, C. R.	Rodsley House, Gateshead.
1858	Greener, Martin	Fawcett Street, Sunderland.

Elected.		
1877	Greenwell, G. C.	8, Prior's Terrace, Tynemouth.
1858	Greenwell, Robert	Derwent Iron Co., Grey Street.
1877	Hadaway, George	21, Washington Terrace, No. Shields.
1867	Hall, F. W.	2, St. Thomas' Street.
1865	Hall, Rev. G. Rome	Birtley, Wark-on-Tyne.
1858	Hall, James	Palmer, Hall & Co., Quayside, N'castle.
1862	Hall, John	Princes Buildings, Newcastle.
1875	Hall, Matthew	16, Winterbottom Street, So. Shields.
1866	Hall, Thomas	Winlaton, Blaydon-on-Tyne.
O.M.	Hancock, John	St. Mary's Terrace, Newcastle.
1880	Hardie, William	Osborne Road, West Jesmond.
1849	Hare, John	Grey Street, Newcastle.
1878	Harrison, Cuthbert	11, Gloucester Terrace, Newcastle.
1864	Harrison, J. A.	3, Albert Drive, Low Fell, Gateshead.
1859	Haswell, F. R.	12, Howard Street, North Shields.
1859	Havelock, Michael	14, Sandhill, Newcastle.
1872	Hawdon, William	South Docks, Sunderland.
1880	Hazelwood, Rev. Thomas	St. Edmund's Vicarage, Gateshead.
1877	Heath, Thomas	3, Lambert Terrace, Newcastle.
1879	Hedley, Edward A.	3, Saville Place, Newcastle.
1878	Hedley, George R.	Elswick Grange, Newcastle.
1864	Hedley, T. F.	John Street, Sunderland.
1876	Hedworth, T. H.	Dunston, Gateshead.
1876	Henderson, M.	All Saints Cemetery, Newcastle.
1865	Henzell, W. M.	Belgrave Terrace, Newcastle.
1878	Henning, H. B.	Hardwick Terrace, Gateshead.
1876	Herbert, George H.	Oxford Terrace, Gateshead.
1877	Heslop, George, Jun.	St. George's Square, Sunderland.
1871	Heslop, Joseph	Newcastle-on-Tyne.
1868	Heslop, R. Oliver	West End Terrace, Corbridge-on-Tyne.
1877	Hetherington, David	Coxlodge Colliery, Gosforth.
1874	Hick, Rev. J. M.	Staindrop.
1880	Higginbottom, A. H.	4, Percy Terrace, Newcastle.
1867	Hill, Alfred H.	Union Street, North Shields.
1860	Hinde, Rev. J. S., D.C.L.	Cramlington.
1875	Hinde, John	Westoe, South Shields.
1865	Hobkirk, William	Farm Cottage, Cramlington.
1859	Hodgkin, Thomas	St. Nicholas' Square, Newcastle.
1870	Hodgson, S. S.	Belle Vue, Gray Road, Sunderland.
1864	Hodgson, W.	Pierremont Crescent, Darlington.
1864	Holmes, W. H.	Wellburn, Jesmond, Newcastle.

Elected.		
1863	Hooppell, Rev. R. E., M.A., LL.D., F.R.A.S.	Byers Green.
1874	Hopgood, J. F.	Vine Place, Sunderland.
1872	Howchin, Rev. Walter	9, Frank Place, North Shields.
O.M.	Howse, Richard	17, Saville Row, Newcastle.
1865	Hudson, R. M.	Exchange Buildings, Sunderland.
1875	Hudson, Thomas	Thrift Street, South Shields.
1871	Humble, Charlton	38, Jesmond Road, Newcastle.
1871	Humble, S. J.	West Street, Gateshead.
	Humble, Mrs.	Osborne Avenue, Jesmond, Newcastle.
1876	Hunting, C. S.	2, Hutton Terrace, Newcastle.
1866	Huntley, D. P.	Ward Terrace, Sunderland.
1874	Huntley, F. C.	East Sunniside, Sunderland.
1867	Hutchinson, Cuthbert	Whitburn, Sunderland.
1875	Hutchinson, G. C.	Westmorland Road, Newcastle.
1876	Hutchinson, Henry	Elswick Ordnance Works.
1867	Hutchinson, Joseph	The College, Durham.
1880	Hutchinson, Wm.	Roseworth Villas, Gosforth.
1878	Hutton, George	17, Claremont Place, Newcastle.
1872	Hutton, John	Mosley Street, Newcastle.
1878	Hutton, J. B.	19, Leazes Terrace, Newcastle.
1876	Hutton, T. G.	South Moor, Sunderland.
1878	I'Anson, William A.	230, Westgate Road, Newcastle.
1861	Irving, George	Central Station, Newcastle.
1878	Jackson, Joseph	National Provincial Bank, Newcastle.
1860	Jackson, Thomas, Jun.	Camden Street, North Shields.
1865	Jackson, Thomas	Camden Street, North Shields.
1876	Joel, J. E.	1, Newgate Street, Newcastle.
1871	Johnson, Rev. A.	Healey, Riding Mill-on-Tyne.
1867	Johnson, A. W.	19, Claremont Place, Gateshead.
1875	Johnson, Rev. John	Hutton Rudby, Yarm.
1875	Johnson, W.	South Preston Terrace, North Shields.
1876	Johnson, W. J.	Pod's Bank, Allendale.
1878	Johnson, Rev. William	9, Meadow View, Whitehaven.
1867	Johnston, R. J.	New Bridge Street, Newcastle.
1871	Johnston, William	Mosley Street, Newcastle.
1877	Joicey, James	4, Walker Terrace, Gateshead.
1873	Joicey, John, M.P.	Newton Hall, Stocksfield.
1877	Jones, Major E. R.	United States Consulate, Grey Street.
1867	Jordon, Joseph	Side, Newcastle.

Elected.

1876 Kaye, W. S., L.R.C.P. ..... 5, Catherine Terrace, Gateshead.
1846 Kaye, William ..... Lovaine Terrace, Newcastle.
1867 Kell, John..... 14, North Terrace, Newcastle.
1867 Kelman, William ..... 13, Queen Street, Glasgow.
1878 Keiffenheim, Alfred ..... Fernwood Road, Newcastle.
1879 Kidd, George ..... 2, Cloth Market, Newcastle.
1867 Kidson, John ..... 66, John Street, Sunderland.
1869 Kirkby, James W. ..... Ashgrove, Windygates, Fife.
1865 Knothe, Rudolph ..... 35, Close, Newcastle.

1869 Laidler, G. G. ..... Northumberland Street, Newcastle.
1876 Lambert, Thomas..... Whickham.
1870 Lawson, Professor, M.A..... The Botanic Garden, Oxford.
1863 Lawson, Rev. Edward..... Longhirst Hall, Morpeth.
1873 Leather, J. Towlerton ..... Middleton Hall, Belford.
1871 Lebour, Professor G. A. ..... 2, Woodhouse Terrace, Gateshead.
1849 Leefe, Rev. J. E. ..... Cresswell, Morpeth.
1868 Legge, Alfred ..... 72, Grey Street, Newcastle.
1873 Lilburn, Charles ..... Murton Street, Bishopwearmouth.
1875 Lincoln, J..... South Shields.
1866 Lincoln, Thomas ..... 5, Church Row, South Shields.
1869 Livesey, Frank..... Littleton House, East Dulwich, London.
1859 Lowrey, Edward ..... Lombard Street, Newcastle.
1865 Lowrey, Richard ..... Lea Villa, Riding Mill.
1851 Luckley, George ..... Exchange Buildings, Newcastle.
1859 Lyall, George, F.G.S. ..... 48, East Winchester St., So. Shields.

1852 Maling, C. T. .... Ellison Place, Newcastle.
1880 Maling, John Ford ..... 14, Ellison Place, Newcastle.
1863 Maling, E. A. ..... John Street, Sunderland.
1865 Maling, William ..... Granville Road, Newcastle.
1878 Marley, J. E..... Hebburn-on-Tyne.
1858 Marreco, Professor A. F..... College Physical Science, Newcastle.
1846 Mather, Edward ..... Mosley Street, Newcastle.
1861 Matthew, George ..... West Sunniside, Sunderland.
1871 Maughan, Rev. J. A. C. ..... Mickley Vicarage, Stocksfield.
1877 Maughan, William ..... 2, Elswick Park, Newcastle.
1880 Maw, Thomas .... Wallace Terrace, Ryton-on-Tyne.
1876 Mawson, Miss L. L..... ..... Ashfield, Gateshead.
1879 McAuliffe, C. K. ..... 78, Shaw Street, Liverpool.
1867 McLean, Hugh, M.D. ..... Corbridge-on-Tyne.
1877 Mearns, Dr. .... High West Street, Gateshead.

Elected.		
1860	Messent, Philip, C.E.	Tynemouth.
1870	Metcalfe, J. S.	60, Percy Park, Tynemouth.
1867	Meynall, E. J.	Durham.
1875	Middleton, R. M., Jun.	Castle Eden, Co. Durham.
1871	Millard, Joseph	Morpeth.
1876	Miller, Hugh, F.G.S.	Otterburn.
1869	Milling, John	14, Framlington Place, Newcastle.
1878	Milburn, Edward	Staward Hall, Langley, Hexham.
1879	Moor, J. C.	Newcastle Journal Office, Sunderland.
1858	Moor, William	59, John Street, Sunderland.
1873	Moore, William	Winchester Terrace, Newcastle.
1846	Moore, John	Beckenham, Kent.
1862	Moore, J. M.	Market Place, South Shields.
1866	Morgan, G. B.	Villiers Street, Bishopwearmouth.
1859	Morison, D. P.	Collingwood Street, Newcastle.
1860	Morton, Rev. Henry	St. Stephen's Rectory, South Shields.
1879	Morton, R. L.	Percy Park, Tynemouth.
1880	Motum, Hill	Helensville, Grainger Park Road, Newcastle.
1879	Murray, A. D.	14, Belgrave Terrace, Newcastle.
1860	Murray, William, M.D.	Clayton Street, Newcastle.
1877	Neill, William	Deaf & Dumb Institution, Newcastle.
1879	Nelson, James	Wentworth Place, Newcastle.
1876	Nelson, R. C.	Roker, Sunderland.
1862	Nesham, T. C.	Northumberland Street, Newcastle.
1871	Nicholson, James	King Street, South Shields.
1860	Noble, Captain A., F.R.S.	Jesmond Dene House, Newcastle.
1860	Norman, Rev. A. M.	Burnmoor Rectory, Fence Houses.
1874	Oliver, Edward	Forest Lodge, Benton.
1879	Oliver, John	10, Gloucester Terrace, Newcastle.
1879	Oliver, Thomas, M.B.	6, Eldon Square, Newcastle.
1876	Ormston, Miss M.	Musgrave, Gateshead.
1877	Osbeck, Peter	Tynemouth.
1879	Oswald, Septimus	St. Nicholas' Buildings. Newcastle.
1877	Oubridge, Dinsdale	40, Campbell Street, Newcastle.
1871	Owen, G. O.	Percy Park, Tynemouth.
1877	Page, John	4, Alexandra Crescent, Newcastle.
1867	Park, A. D.	Bigg Market, Newcastle.
1872	Park, John	34, Westmorland Terrace, Newcastle.
1858	Pattinson, John	The Side, Newcastle.

Elected.

1846 Peacock, Reginald ..... East Sunniside, Sunderland.
1853 Peacock, Septimus ..... East Sunniside, Sunderland.
1872 Pearman, George W. ..... Prince Street, Sunderland.
1860 Peart, R. S., M.D. ..... 22, Dockwray Square, North Shields.
1865 Peckett, G. C. ..... 2, Park Place, East, Sunderland.
1967 Peele, Richardson..... Durham.
1874 Peile, George ..... Shotley Bridge.
1876 Penney, J. H. ..... Gas Co.'s Office, South Shields.
1877 Peverley, R. B..... Challoner Terrace, South Shields.
1862 Philipson, G. H., M.A., M.D. Eldon Square, Newcastle.
1854 Philipson, John ..... 9, Victoria Square, Newcastle.
1866 Philipson, Joseph A. ..... 15, Pilgrim Street, Newcastle.
1877 Pickering, George ..... 1, Dean Street, Newcastle.
1861 Pilkington, Edward..... Frederic Street, Sunderland.
1875 Pinkney, William ..... John Street, Sunderland.
1868 Porrett, J. C. ..... Thornhill Park, Sunderland.
1862 Potts, George Calder ..... Central Buildings, Gateshead.
1871 Powell, Rev. R. P. ..... The Rectory, Bellingham.
1865 Proctor, Matthew..... Osborne Terrace, Newcastle.
1860 Proctor, B. S. ..... Fern Avenue, Jesmond, Newcastle.
1861 Proctor, W. W..... 33, Side, Newcastle.
1876 Pumphrey, Thomas ..... Summerhill Grove, Newcastle.
1861 Punshon, N. ..... Dean Street, Newcastle.
1877 Pybus, M. W. ..... 40, Dean Street, Newcastle.

1879 Radbourne, Rev. H. E. ..... 37, Grove Street, Newcastle.
1871 Raine, F. ..... Durham.
1874 Rea, James S. ..... Beverley Terrace, Cullercoats.
1861 Reay, John ..... Park Place, East Sunderland.
1862 Redmayne, J. M. ..... H. L. Pattinson & Co., Grey Street.
1862 Redmayne, R. R. ..... 27, Grey Street, Newcastle.
1879 Redpath, Robert ..... Linden Terrace, Newcastle.
1866 Reed, J. R. ..... 15, Park Place, West Sunderland.
1865 Reid, David ..... Grey Street, Newcastle.
1877 Reid, Edwin O..... 4, North Terrace, Newcastle.
1877 Relton, Henry ..... Holly Avenue, Newcastle.
1879 Renwick, W. H. ..... 62, Bewick Road, Gateshead.
1879 Rhagg, Adamson ..... Haldane Terrace, Newcastle.
1876 Rich, F. W. ..... Union Chambers, Grainger Street West, Newcastle.
1876 Richardson, E. H. ..... Cotfield House, Gateshead.
1877 Richardson, James ..... South Ashfield, Newcastle.

Elected.		
1876	Richardson, Thomas	Harle Street, Mount Pleasant, Gateshead.
1874	Ridsdale, John	4, Bigg Market, Newcastle.
1868	Ritson, F. F.....	15, Foyle Street, Sunderland.
1868	Robertson, David, F.G.S. ...	42, Kelvin Grove Street, Glasgow.
1864	Robertson, W. L.	Durham.
1876	Robinson, T. Walton	6, Gladstone Terrace, Gateshead.
1861	Robinson, W. S.	68, John Street, Sunderland.
1880	Robson, A. H.	2, Esplande, Sunderland.
1849	Robson, E. Capper	45, Queen Street, Sunderland.
1864	Robson, Fred.	45, Dean Street, Newcastle.
1872	Robson, James	7, Chapter Row, South Shields.
1872	Robson, John E.	Sea View, Hartlepool.
1871	Robson, M. H.	18, Albion Place, Newcastle.
1863	Robson, S. S.	Hendon Ropery, Sunderland.
1873	Robson, Shafto.....	Bewick Road, Gateshead.
1874	Robson, Stephen E.	2, Esplande, Sunderland.
1865	Robson, W. C.	29, Blackett Street, Newcastle.
1875	Rogers, Rev. Percy, M.A. ...	Simonburn, Humshaugh.
1879	Routledge, Edward	Consett.
1878	Routledge, R.	Orchard Place, Hexham.
1876	Ryott, W. H.....	Saltwell Grove, Gateshead.
1860	Sample, Thomas	Bothal Castle, Morpeth.
1878	Sanderson, William	3, St. Thomas' Crescent, Newcastle.
1870	Scorfield, E. S.	Quayside, Newcastle.
1873	Scott, Christopher	18, Lovaine Place, North Shields.
1872	Scott, George	Westoe Terrace, South Shields.
1862	Scott, Stephen	42, Jesmond Road, Newcastle.
1877	Scott, Walter.....	Holly House, Durham Rd., Sunderland.
1879	Scott, W. J. S.	White House Buildings, Pilgrim Street, Newcastle.
1874	Shaw, Benjamin	Northumberland Street, Newcastle.
1867	Shaw, Frederick	35, Close, Newcastle.
1876	Shevill, W. H.	5, Norfolk Street, Sunderland.
1880	Shewbrook, Edward.....	49, West Street, Gateshead.
1864	Shiel, George	Fawcett Street, Sunderland.
1867	Shiel, G. R.	The Cottage, Stockton Rd., Sunderland
1873	Shiel, John	Framwellgate Colliery, Durham.
1854	Shield, G. R.....	Grey Street, Newcastle.
1861	Shields, John	Durham.
1866	Short, John	1, Camden Street, North Shields.

Elected.		
1858	Shotton, Edward	53, Tyne Street, North Shields.
1870	Sibun, James	1, Nelson Street, Sunderland.
1869	Siddle, Robert	Vine Place, Sunderland.
1879	Simpson, Edward	Chirton, North Shields.
1855	Simpson, J. B.	Hedgefield House, Ryton.
1859	Simey, Ralph	1, John Street, Sunderland.
1878	Slee, Henry B.	Gateshead.
1876	Smart, Collin	18, John Street, Sunderland.
1877	Smith, George	Collingwood Ter., Jesmond, N'Castle.
1879	Sopwith, H. J.	Tankerville Terrace, Newcastle.
1873	Southwell, Charles	Gurry Lodge, Kilburn, London.
1867	Spence, C. J.	North Shields.
1871	Spence, Faraday	Grey Street, Newcastle.
1861	Spence, Joseph	110, Howard Street, North Shields.
1858	Spence, J. F.	110, Howard Street, North Shields.
1860	Spence, J. F., junr.	110, Howard Street, North Shields.
1858	Spence, Robert	107, Howard Street, North Shields.
1874	Spencer, G. R.	Victoria Street, Newcastle.
1870	Spencer, J. P.	Town Hall, North Shields.
1856	Spencer, Michael	Millfield, Newburn.
1861	Spencer, Thomas	The Grove, Ryton.
1877	Stainton, Matthew	Westoe, South Shields.
1880	Stark, James Fleming	Hebburn-on-Tyne.
1865	Steele, Thomas	Bank Buildings, Sunderland.
1850	Stephens, Thomas, M.R.C.S.	21, Dockwray Square, North Shields.
1875	Stephenson, James	42, Rendel Street, Newcastle.
1869	Stephenson, Thomas	Quayside, Newcastle.
1851	Stevenson, A. S.	Tynemouth.
1879	Stewart, W. A.	Dean Street, Newcastle.
1870	Storey, Samuel	John Street, Sunderland.
1877	Storey, John	7, Pilgrim Street, Newcastle.
1867	Stout, G.	82, King Street, South Shields.
1880	Strachan, Henry	3, Villa Place, Union Lane, Gateshead.
1854	Straker, John	Stagshaw House, Corbridge.
1868	Straker, Joseph H.	Willington House, Durham.
1873	Stuart, James	42, Side, Newcastle.
1880	Stuart, Thomas Wilson	Hebburn-on-Tyne.
1865	Sutherland, B. J.	Sandhill, Newcastle.
1860	Sutherland, Robert	50, Howard Street, North Shields.
1859	Swan, J. W.	Mosley Street, Newcastle.
1867	Swan, Robert	New Square, Lincoln's Inn, London.
1876	Swanwick, E. M., L.R.C.P.	Church Street, West Hartlepool.
1862	Swithinbank, G. E.	Ormleigh, Anerley, London, S.E.

Elected.

1858 Tate, R. M. ..... 20, Camden Street, North Shields.
1867 Taylor, Hugh ..... Chipchase Castle, Wark-on-Tyne.
1867 Taylor, Rev. Hugh ..... Humshaugh, Wark-on-Tyne.
O.M. Taylor, John..... ..... 2, Lovaine Place, Newcastle.
1860 Temperley, N. .... Clavering Place, Newcastle.
1855 Temperley, W. A..... Hencotes Street, Hexham
1867 Thackeray, William, Jun. ... 7, The Avenue, Sunderland.
1869 Thirkell, W. T. ..... Roker, Sunderland.
1850 Thompson, Cuthbert..... Winlaton.
1851 Thompson, George ..... Winlaton.
1878 Thompson, George ..... 18, Victoria Street, Newcastle.
1860 Thompson, J. T. ..... Winlaton.
1873 Thompson, Joseph ..... 10, Bewick Road, Gateshead.
1858 Thompson, Thomas ..... Messrs. Lambton & Co., Grey Street, Newcastle.
1875 Thubron, Robert ..... East Boldon.
1865 Tidswell, W..... 67, Westmorland Road, Newcastle.
1861 Tone, W. ..... 58, Villiers Street, Sunderland.
1877 Topley, W., F.G.S. ..... H. M. Geol. Surv., Northumberland.
1850 Tristram, Rev. Canon, F.R.S. Durham.
1878 Turner, Archibald..... Summerhill, Blaydon.
1879 Tweddell, George..... 188, Westgate Road, Newcastle.

1873 Vann, S. R. ..... Durham.
1880 Veitch, Wm. Young, L.R.C.P. 37, Grange Road, Middlesbrough.
1850 Vint, Robert..... The Cedars, Sunderland.

1865 Waddington, Thomas ..... North Eslington Villa, Saltwell, Gateshead.
O.M. Wailes, George..... Gateshead.
1866 Waite, James ..... 23, Northumberland Square, North Shields.
1866 Wait, John ..... Ayton House, North Shields.
1860 Wake, W. M..... John Street, Sunderland.
1878 Walker, J. H. ..... 19, Collingwood Street, Newcastle.
1879 Walker, J. D. ..... 21, Holly Avenue, Jesmond, Newcastle.
1877 Ward, George ..... West Parade, Newcastle.
1872 Warden, G. C., Jun..... 54, Percy Park, Tynemouth.
1872 Warden, Walter H. ..... 54, Percy Park, Tynemouth.
1853 Warwick, John..... 108, Rye Hill, Newcastle.
1871 Wasserman, J. C..... .. 50, Beverley Terrace, Cullercoats.
1866 Watson, Henry..... Millfield House, Eldon St., Newcastle.

Elected.		
1877	Watson, James S.....	Elysium Lane, Gateshead.
1864	Watson, Mason.....	Prudhoe Street, Newcastle.
1869	Watson, Robert	Grey Street, Newcastle.
1861	Watson, R. S.	101, Pilgrim Street, Newcastle.
1865	Watson, T. C.	21, Blackett Street, Newcastle.
1879	Watts, Rev. Arthur	Training College, Durham.
1863	Wayman, J. W.	47, Villiers Street, Sunderland.
1860	Welford, George, M.R C.S....	29, John Street, Sunderland.
1860	West, Tuffen.....	Frensham, Farnham, Surrey.
1868	Westmacott, Percy	Benwell Villa, Newcastle.
1867	Wheeler, Rev. R. F.....	The Vicarage, Whitley.
1867	Wheldon, John.....	Paternoster Row, London.
1876	White, Chas. Fred., F.L.S. ...	42, Windsor Road, Ealing, W.
1876	White, W. H.	Killingworth House, Newcastle.
1868	Wiener, Martin.....	Exchange Buildings, Sunderland.
1863	Williamson, Sir H., Bart. ...	Whitburn Hall, Sunderland.
1852	Williamson, John.....	Westoe, South Shields.
1855	Wilson, Charles	High Street, Sunderland.
1864	Wilson, Henry	Westoe, South Shields.
1869	Wilson, Henry W.....	Winchester Terrace, Newcastle.
1874	Wilson, James	Villiers Street, Sunderland.
1878	Wilson, Edward	St. Thomas' Street, Newcastle.
1851	Wilson, Thomas	Angus & Wilson, Grainger Street West
1872	Winter, J. M.	Market Street, Newcastle.
1861	Wood, Lindsay.....	South-hill, Chester-le-Street.
1879	Wood, John	20, Gladstone St., Shieldfield, N'Castle.
1870	Wood, Peter	South Boldon.
1874	Worswick, R. A.	Local Board Office, Whitley.
1880	Wright, Rev. W. J.	Hendon, Sunderland.
1875	Yeld, H. J., M.D.....	Claremont Terrace, Sunderland.
1878	Yeld, Rev. Reginald	Albion Place, Sunderland.
1879	Yellowley, William	Catherine Street, South Shields.
1865	Youll, J. G.	Grainger Street West, Newcastle.
1866	Young, C. H.	Goldspink Hall, Jesmond, Newcastle.
1874	Young, J. R.....	2, Windsor Terrace, Newcastle.
1864	Young, Oliver	Sandhill, Newcastle.

Any corrections of the above list of Members will be thankfully received. Members are particularly requested to send notice of any change of residence immediately to the Secretaries.

HONORARY MEMBERS.

Elected.		
1854	Airey, Sir G. B., M.A., F.R.S.	Greenwich Observatory.
1868	Baker, J. G.	Kew Gardens, London.
1861	Bate, C. Spence	Plymouth.
1861	Glaisher, James, F.R.S.	13, Dartmouth Terrace, Lewisham.
1861	Jones, Prof. T. Rupert, F.G.S.	Farnborough, Hants.
1863	Mennell, H. T., F.L.S.....	20, Fenchurch Street, London.
1861	Oliver, Prof. D., F.L.S.	Kew Gardens, London.
1863	Perkins, V. R.	Wotton-under-Edge, Gloucester.

NATURAL HISTORY SOCIETY
OF
NORTHUMBERLAND, DURHAM, AND NEWCASTLE-UPON-TYNE.

REPORT OF THE SUB-COMMITTEE APPOINTED AT A MEETING OF THE COMMITTEE HELD ON THE 4TH OCTOBER, 1875.

Your Sub-committee beg leave to report as follows:—

The Rules of the Society, adopted at its formation in 1830, and embodied in the Trust-deed, dated 1st September, 1834, provide as follows:—"An Annual Meeting shall be held on such day of the Newcastle Summer Assize week as the Committee shall appoint, which shall have power to elect the annual members of the Committee for the ensuing year, to enact new, and alter and repeal existing laws; but no such enactment, alteration, or repeal shall take place, unless a specific notice thereof shall have been given at a previous General Meeting."

A meeting called the Anniversary Meeting was held in 1866, not in the Summer Assize week, but on the 26th April.

The Committee then presented a report, in which they stated that the Rules provided that the Anniversary Meeting should be held in the Assize week in the August of each year, and that as the time for holding the Assize Courts had been changed, this was no longer practicable. The statement thus made was inaccurate. The Rules provided for holding the Annual Meeting, not in the Assize week in August, but in the Summer Assize week; and the change from August to July in the time of holding the Assizes did not involve the consequence supposed. The Committee further stated that a schedule of amended Rules would be submitted to the meeting; and if the proposed amendments should meet with approval from the Society, it would be the

duty of the incoming committee to take the necessary steps for insuring their legality.

The set of Rules thus brought up by the Committee was approved by the meeting; but it is to be observed that as no notice thereof had been given at a previous General Meeting, the meeting had no power in the matter.

On the 19th June, 1866, a Special General Meeting was held, when the proposed set of Rules, approved at the meeting of 26th April, was expressed to be adopted with amendments; but this resolution was equally without authority, inasmuch as the Rules could only be altered at an *Annual* Meeting, which the Special Meeting was not, and did not assume to be.

One of the provisions of the proposed new Rules was, that the Annual Meeting should be held in the first week in February; but this suggested regulation has been totally disregarded, the Annual Meetings since 1866 having been held as follows:—

1868..... July 9th.
1870..... May 10th.
1872..... April 22nd.
1874..... July 16th.
1875..... July 15th.

No Annual Meeting was held in 1867, 1869, 1871, or 1873.

It appears, then, that no valid repeal or alteration of the Rules was made in 1866, and that the Society is still governed by the Rules set forth in the Trust-deed, subject to an alteration made in 1835, as to the election of Honorary Members.

It does not seem that the interests of the Society are affected by the circumstances stated. The appointment of officers was regularly made at the last Annual Meeting; which was held in the Summer Assize week in accordance with the original Rules still in force.

It is, indeed, fortunate, that the original Rules were not superseded by those proposed in 1866, inasmuch as the latter exhibit defects in material points. But it is doubtless desirable that steps should now be taken for revising the code, and re-enacting it in a form suitable to present requirements.

THOMAS BELL, Chairman.

ABSTRACT OF ANNUAL MEETING, JULY 2ND, 1877.

The minutes of the last Annual Meeting were read and confirmed.

The Treasurer's Report was read and adopted. See page 399.

On the motion of Mr. Thomas Bell, seconded by Rev. J. F. Bigge, It was resolved that the proposed new Rules, of which notice was given at the General Meeting held May 21st, 1877, with some verbal alterations, be henceforth the Rules of the Society. See page 403.

The following gentlemen were elected officers for the ensuing year.

PATRON.

His Grace the Duke of Northumberland.

PRESIDENT.

The Lord Bishop of Durham.

VICE-PRESIDENTS.

Sir Walter C. Trevelyan, Bart.
The Rt. Hon. the Earl Ravensworth.
The Rt. Hon. the Earl of Tankerville.
Sir W. G. Armstrong, C.B., F.R.S.
A. J. B. Cresswell, Esq.
John Clayton, Esq.
Lieut.-Col. Addison Potter.
The Mayor of Newcastle.
Ralph Carr Ellison, Esq.
Rev. John F. Bigge.
I. L. Bell, Esq., M.P., F.R.S.
R. S. Newall, Esq., F.R.S.
D. Embleton, Esq., M.D.
John Hancock, Esq.
R. B. Bowman, Esq.
Col. Joicey.
Edward Joicey, Esq.

TREASURER.

Joseph Blacklock, Esq.

SECRETARIES

Andrew Noble, F.R.S. | William Dinning.

COMMITTEE.

Mr. Thomas Bell.
Mr. E. F. Boyd.
Mr. E. J. J. Browell.
Mr. John Daglish.
Mr. D. O. Drewitt.
Mr. R. R. Dees.
Mr. John Glover.
Mr. William Maling.
Mr. John Pattinson.
Mr. James Richardson.
Mr. A. S. Stevenson.
Mr. Joseph W. Swan.
Mr. Cuthbert Thompson.
Mr. Thomas Thompson.
Mr. Henry Watson.

HONORARY CURATORS,

1877.

ZOOLOGY.

VERTEBRATA.

D. Embleton, M.D. | J. Hancock.

ARTICULATA.

W. Dinning.
J. Hancock. | Rev. A. M. Norman.

MOLLUSCA.

Rev. A. M. Norman. |

RADIATA.

D. O. Drewett.
J. Coppin. | Rev. A. M. Norman.

BOTANY.

Rev. J. F. Bigge. | R. B. Bowman.

GEOLOGY.

E. Boyd.
E. J. J. Browell.
J. Daglish. | W. Dinning.
J. W. Kirkby.

GENERAL CURATOR.

Richard Howse.

KEEPER OF THE MUSEUM.

Joseph Wright.

THE TREASURER IN ACCOUNT WITH THE NATURAL HISTORY SOCIETY.

CURRENT ACCOUNT FROM 7TH JULY, 1876, TO 2ND JULY, 1877.

1876.	Dr.	£	s.	d.
July 7.	To Balance brought forward	274	13	6
	,, Subscriptions from Members	145	14	0
	,, ,, from Associates	1	10	0
	,, Literary and Philosophical Society	40	0	0
	,, Fine Arts Society (One Year's Rent, due 1st August, 1876)	34	12	0
	,, College of Physical Science, One Year's Acknowledgment for Use of Specimens from the Museum	5	0	0
	,, Admissions	111	7	0
	,, W. T. Moor, One Year's Rent for *Chronicle* Signboard	2	0	0
	,, Donation from the Entomological Society	6	9	5
		£621	5	11

1877.	Cr.	£	s.	d.
July 2.	By One Year's Salary to Keeper of Museum	90	0	0
	,, John Clayton, Esq., One Year's Interest for £2000 Mortgage, less Income Tax	79	0	0
	,, One Year's Fire Insurance	15	0	0
	,, W. T. Moor, Cabinet Maker's Account	100	15	7
	,, J. Richardson & Co., for Painting and Glazing	11	1	1
	,, Treasurer of Tyneside Naturalists Field Club, Share of Cost of Printing Transactions, Vol. V., Parts 2 and 3	25	17	0
	,, Richard Howse, Curatorship Account	19	12	0
	,, Thomas Atthey, for Collection of Fossil Plants	30	0	0
	,, Richard Howse, for Fossil Fishes	16	0	0
	,, John Bell, for Printing	6	14	3
	,, Sundry Accounts	35	19	9
	,, Balance in Bank	191	6	3
		£621	5	11

LIST OF DONATIONS TO THE MUSEUM

OF

THE NATURAL HISTORY SOCIETY,

FROM JUNE, 1876, TO JUNE, 1877.

BOOKS.

A Set of the Transactions of the Physikalisch-Okonomischen Gesellschaft of Königsberg. *The Society.*

Memoirs of the Boston Society of Natural History. Vol. II., Part 4. Nos. 2, 3, 4. Occasioual Papers, No. 2. Proceedings, Vol. XVII, Nos. 3, 4. Vol. XVIII., Nos. 1, 2. *The Society.*

Proceedings of the Academy of Natural Sciences, Philadelphia. Parts 1, 2, 3, 1875. *The Academy.*

A Volume of Original Drawings of Marine Animals by the late Joshua Alder, Esq. *Miss Alder.*

Proceedings of the American Academy of Arts and Sciences, Boston. Vol. III. New Series. *The Academy.*

Memoirs, Vol. II. and Supplement, etc., of the Royal Swedish Academy, Stockholm. *The Academy.*

Publications of the United States Geological Survey. Vols. IX. and X. of the Survey of the Territories. Bulletin, Vol. II., Nos. 3 and 4. Descriptive Note and Map of the Grotto Geyser of the Yellow-stone Park, *Dr. F. V. Hayden; U. S. Geological Survey.*

Memoirs of the Museum of Comparative Zoology at Harvard College. Vol. II., No. 9; Vol. IV., No. 10. Bulletin, Vol. III., Nos. 11—16. Annual Report, 1876. *Prof. Alex. Agassiz, Harvard College.*

Proceedings of the Zoological Society of London. Parts 2, 3, 4, 1876. Part 1, 1877. *The Society.*

Transactions of the Plymouth Institution. Vol. V., Part 3. *The Institution.*

Memoirs of the Literary and Philosophical Society of Manchester. Vol. V., Third Series. Proceedings, Vol. XV., 1875—6. Catalogue of the Library. *The Society.*

Proceedings of the American Philosophical Society, Philadelphia. Vol. XVI., No. 97. *The Society.*

Transactions of the Academy of Science, St. Louis. Vol. III., No. 3. *The Academy.*

Proceedings of the Literary and Philosophical Society of Liverpool. No. 30, 1875-6. *The Society.*

A Set of the Handbooks prepared for the British Association Meeting at Glasgow, 1876.
The Fauna and Flora of the West of Scotland.
Catalogue of Western Scottish Fossils.
On some of the leading Industries of Glasgow and the Clyde Valley.
The Local Committee.

Proceedings of the American Association for the Advancement of Science. Vol. XXIV., 1875. *The Association.*

Package of Books from the Royal Norske University, Christiania.
The University.

Report and Proceedings of the Manchester Field Naturalists' and Archæologists' Society, 1876. *The Society.*

Twenty Packages of Pamphlets on Natural History Subjects, from the Library of the late Mr. Albany Hancock.
Mr. John and the Misses Hancock.

Papers on the Tineina and Entomostraca of Colorado, by W. T. Chambers.
The Author.

Annual Report of the Smithsonian Institution for 1875. *The Institution.*

Proceedings of the Davenport Academy of Natural Sciences. Vol. I.
The Academy, Davenport, Iowa.

ZOOLOGY.

Head of an Egyptian Mummy. *Miss Knothe, Eldon Street.*

Portion of an Antler of the *Rein-deer*, found on the shore at Holy Island.
Rev. J. F. Bigge.

A Specimen of the Wild Cat, taken in Brae-More Deer Forest, Ben Duig, Ross-shire. *Mr. A. Bookless.*

A Specimen of the Ringed Plover (*Charadrius hiaticula*). Immature. Shot at Whitley. *Mr. E. Bold, Long Benton.*

Two Specimens of the Short-eared Owl *(Stryx brachyotus)*.
C. M. Palmer, Esq., M.P.

A Specimen of the Mountain Finch (*Fringilla montifringilla).*
Mr. W. P. Grace.

A Specimen of the Hornbill *(Buceros)*. *Mr. Gibson.*

Specimens, in the Immature State, of the Carrion Crow, Ring Ouzel, and Water Hen. *Mr. F. Hutchinson.*

Nine Bottles containing Snakes, etc., from Ceylon.
Mr Knightly H. Coxe, Ceylon Civil Service.

The Skull, Pelvis, and Carapace of a large Turtle.
Lieut. Greenhow, R.N., H.M.S. Orontes.

A Specimen of the Armed Bull-head *(Cottus cataphractus)*.
Mr. Thos. Dobson, M.A.

A Specimen of American Trout *(Salmo fontinalis)*, bred at Dissington.
Mr. E. M. Bainbridge, Dissington.

Two Specimens of *Mya arenaria*, from W. Loch Tarbert, Argyleshire.
Mr. John Hancock.

Two Specimens of *Testacellus Haliotoideus*, taken at Bensham, in the garden of E. Crawshay, Esq. *Mr. R. Y. Green.*

FOSSILS AND MINERALS.

Specimens of *Holoptychius* (Scales) from the Old Red Sandstone, near Melrose. *Mr. T. P. Barkas, F.G.S.*

Specimens of Conglomerate, from a Cave at Oran, Africa.
Mr. Chas. E. Boutland.

Specimen of Copper, from Heckla and Calumet Mine, Lake Superior.
I. L. Bell, Esq., M.P., F.R.S.

Specimen of Limestone, from a heap by the roadside near the village of Hersham, in the Black Forest. *Rev. J. F. Bigge.*

Specimens of Hair Pyrites, from Risca New Colliery, Monmouth.
Mr. Sheriton Holmes.

NEW RULES.

At the Annual Meeting of the Natural History Society of the Counties of Northumberland, Durham, and Newcastle-upon-Tyne, held in the Museum of the Society in Newcastle-upon-Tyne on Monday, the 2nd day of July, 1877, at 12 o'clock at noon, being the day and hour during the Summer Assizes appointed for that purpose.

In pursuance of a notice given at a General Meeting of the Society, held on the 21st day of May, 1877. On the motion of Thomas Bell, Esq., seconded by the Rev. John Frederic Bigge, It is resolved, That so much and so many of the laws of the said Society, expressed or contained in the first schedule subjoined to the Deed of Settlement of the said Society, bearing date the 1st day of September, 1834, as are in the said schedule numbered from No. 1 to No. 20, both inclusive, and are placed under the heads Nos. I., II., III., and IV. in such schedule, and all other laws, rules, and regulations which have since been made shall be and the same are hereby repealed; and that the laws, rules, and regulations hereafter set forth, together with the unrepealed laws, which in the said first schedule are numbered from No. 21 to No. 25, both inclusive, be henceforth the laws, rules, and regulations of the said Society.

I.—The Natural History Society of the Counties of Northumberland, Durham, and Newcastle-upon-Tyne, shall consist of members who shall be called for distinction ordinary members, who shall alone be entitled to vote in all matters relating to the Society, and who shall alone be entitled to the benefit of the trusts of the deed of settlement of the 1st day of September, 1834, and such member shall have the power of electing honorary members and associates, who shall have no voice, power, or interest as members of the said Society.

II.—The persons named in the first schedule to these rules are declared to be the present ordinary members, and the persons named in the second schedule the present honorary members, and the persons named in the third schedule the present associates.

MEETINGS.

III.—The Annual Meeting of the Society shall be held in the Society's rooms on the first Tuesday in July, at two o'clock in the afternoon, or on such other day and at such other hour as shall at any time be appointed by the committee, and at such meeting a report of the proceedings and an abstract of the accounts of the past financial year shall be presented by the committee.

IV.—Ordinary meetings shall be held at such times as shall be appointed by the committee, and at such meetings members shall have the power of introducing visitors.

V.—Special meetings shall be held at such times as shall be appointed by the committee, either at their discretion or at the request in writing of five ordinary members, addressed to the secretaries fourteen days previously; and such business only shall be transacted at the special meetings as shall have been specially announced.

VI.—No motions, save such as relate to the ordinary routine business of the meeting, shall be adopted at any meeting, unless notice in writing of such motion has been given at a previous meeting.

VII.—No alteration shall be made in the laws of the Society except at an annual meeting, and every alteration to be then proposed shall be announced by notice in writing at a previous ordinary or special meeting and inserted in its minutes, or notified in any other manner the committee may think proper.

VIII.—Every question which shall come before any meeting of the Society shall be decided by the votes of the majority of the ordinary members then present and voting. In case a meeting shall be equally divided on any question, the chairman of such meeting shall have a second or casting vote.

ELECTION OF MEMBERS.

IX.—Every person desirous of becoming an ordinary member of the Society must be recommended in writing by three ordinary members. On being so recommended he shall be declared to be elected by the votes of the majority of the ordinary members present either at a committee meeting, an ordinary meeting, or the annual meeting of the Society.

X.—Honorary members shall be proposed by three ordinary members, and voted for at the next ordinary or annual meeting.

XI.—Members of the Tyneside Naturalists' Field Club may become associates of this Society so long as the present arrangement between this Society and the Tyneside Naturalists' Field Club exists, upon the payment of the subscriptions hereinafter mentioned.

XII.—Any member proposing to resign shall notify the same in writing to the secretaries previous to the day on which the yearly subscription becomes due.

XIII.—Every ordinary member shall pay to the treasurer the sum of not less than one guinea annually, such subscription to be paid in advance, and to be due on the first day of August in each year.

XIV.—Every associate shall pay to the treasurer a sum of five shillings annually in advance, due on the first day of August in each year.

XV.—An ordinary member may compound for his future annual subscriptions by a payment of fifteen guineas, and having so compounded he shall be entitled to all the privileges of an ordinary member.

XVI.—If any member do not pay his subscription for one year after its becoming due, and further neglect to pay it for three

months after notice shall have been sent him of this rule, he shall cease to be a member.

OFFICERS.

XVII.—At each annual meeting a president, four or more vice-presidents, a treasurer, and two secretaries, shall be elected, and with twelve ordinary members to be elected at the same meeting, shall form the committee for the year ensuing.

XVIII.—In case the treasurer, the secretaries, or four of the twelve shall, during his or their year of office die or resign, or become incapable to act, the vacancy so occasioned may be filled up by the committee, or not, at their option.

XIX.—The secretaries shall regularly record the proceedings of all meetings of the Society and of the committee, and they shall, under the committee's direction, conduct the Society's correspondence and prepare the annual report, and shall also superintend the printing of such reports and the other papers of the Society.

XX.—The funds of the Society shall be deposited in the hands of the treasurer, and shall be disbursed by him according to the direction of the committee.

XXI.—The expenditure of the funds of the Society, the enforcing of its laws, and the general management and conduct of its affairs, shall be confided to the committee; they shall have the appointment of all necessary paid officers and servants; and they shall have power to make regulations, from time to time, for the guidance of such officers and servants.

XXII.—Meetings of the committee shall be convened by the secretaries whenever they shall deem it requisite, or shall receive a requisition of three members of the committee for that purpose. At all meetings of the committee three shall be a quorum.

XXIII.—The record of the committee's proceedings shall, at all times, be open to the inspection of the ordinary members of the Society.

XXIV.—The committee for each year, at their first meeting, and from time to time afterwards, when a further appointment may seem to them requisite, may appoint curators, to whom shall be entrusted the making of the minor arrangements of the museum and building, the care of the specimens, and the examination of accounts. Their proceedings shall be subject to the revision and control of the committee.

XXV.—Auditors shall be appointed at the annual meeting each year; and their examination of the accounts shall be completed, and a statement thereof, as audited, shall be printed and distributed with the notice of the annual meeting, one week at least before such meeting.

XXVI.—The Society shall not make any dividend, gift, division, or bonus, in money, unto or between any of its membrrs.

PROPERTY OF THE SOCIETY.

XXVII.—The property of the Society, both real and personal, shall be vested in fifteen trustees, to be chosen out of the ordinary members, and the said Ralph Henry Brandling, Charles William Bigge, Charles John Bigge, John Clayton, Henry Hewitson, Robert Ormston, the younger, John Spedding, John Adamson, George Clayton Atkinson, William Chapman Hewitson, William Hutton, Robert Plummer, Thomas Swinburne, George Wailes, and Matthew Wheatley, the younger, shall be such trustees.

XXVIII.—When the trustees so chosen, or any of them, or any future trustees to be appointed as after mentioned, shall happen to die, or shall be desirous of being discharged of and from, or shall refuse or decline to act in the trusts in them reposed, then, and in such case, and so often as it shall happen that by such means such trustees shall be reduced under the number of five, it shall and may be lawful to and for the ordinary members of the Society, from time to time at a meeting to be called for that purpose, of which a month's notice shall be

given at a previous general meeting, to elect, nominate, substitute, or appoint any other persons to be trustees, in the stead or place of the trustees so dying or desiring to be discharged or refusing or declining to act; and when so often as any new trustee shall be nominated and appointed, all the trust property, as well real as personal, shall be thereupon, with all convenient speed, conveyed and assured, assigned and transferred, in such sort and manner, and so as that the same shall and may be legally and effectually vested in the surviving or continuing trustees or trustee of the same trust estates and such new trustees, jointly, or if there shall be no such continuing trustee, then wholly in such new trustees, in trust for the said Natural History Society, and to be held and applied according to the rules or regulations and laws for the time being of the said Society, and the recital in the deed or deeds of conveyance or assignment of the trust property, of the appointment of new trustees by the Society, shall, in all respects, and to all intents and purposes, be considered as evidence of the resolution and appointment, and of the same having been regularly made.

XXIX.—It shall and may be lawful to and for the trustees for the time being, at any time or times hereafter, by the direction of a majority of the members of the Society then present, at a meeting to be held for the purpose of considering of the expediency of any sale, exchange, or mortgage, (of which notice shall be given at a previous general meeting,) to sell, exchange, mortgage, or otherwise dispose of any part of the real property now belonging or hereafter to belong to the Society, in such manner as by a resolution of the Society for that purpose shall be ordered and entered in their minutes, and a recital of such resolution in the conveyance of such property shall be evidence of its having been regularly and properly made, and the receipts or receipt of the trustees for the time being for the money, for which any part of such property may be sold or mortgaged, or for any money to be received for equality of change or otherwise, shall be sufficient discharges to the person or persons paying the same respectively for the money for which the same shall be so given, or for so

much thereof as in such receipts or receipt shall be acknowledged to be received, and the person or persons paying the same respectively, and taking such receipts or receipt as aforesaid, shall not afterwards be answerable or accountable for the loss, misapplication, or non-application, or be in anywise obliged to see to the application thereof, or of any part thereof respectively, and such person or persons shall be free from all obligation of ascertaining the existence of the resolution, or of its having been duly made.

XXX.—It shall not be in the power of any member or members of the Society to dissolve the same, or to sell, give, assign, change, or dispose of his or their share or respective shares or interest therein, or the property belonging thereto. And on the decease or secession of any member, or on the erasure of his name from the list of members in the books of the treasurer of the Society, agreeably to the established laws thereof, his share or interest in the Society, and of and in the property belonging thereto, shall immediately thenceforth cease and determine.

XXXI.—The committee shall have the power of exchanging specimens with other institutions or individuals, in such manner as they may judge conducive to the interests of the Society and of science; such specimens excepted as shall have been presented under express stipulation to the contrary.

SCHEDULE I.

LIST OF ORDINARY MEMBERS OF THE NATURAL HISTORY SOCIETY.

Adamson, C. M.	Crag Hall, Jesmond.
Alder, Miss	15, Summerhill Terrace.
Armstrong, Sir W. G., C.B., F.R.S.	Jesmond.
Armstrong, Lady	Jesmond.
Armstrong, W., jun.	Wingate, Durham.
Atkin, David	Somerset Place.
Atkinson, Thomas	Saltwell.
Bell, I. L., M.P., F.R.S.	Rounton Grange, Northallerton.
Bell, Mrs. I. L.	Rounton Grange, Northallerton.

Bell, Thomas ..... Crosby Court, Northallerton.
Bell, T. Hugh ..... Redcar.
Benson, T. W., jun. ..... Allerwash.
Berkerley, Cuthbert..... Marley Hill.
Bewick, William ..... Haydon Bridge.
Bigge, Rev. J. F. ..... Stamfordham.
Blackett, Sir Edward, Bart. ..... Matfen.
Blacklock, Joseph ..... Grey Street.
Bowman, Henry ..... Windsor Terrace.
Bowman, R. B. ..... Windsor Terrace.
Brown, Ralph ..... Grey Street.
Browne, B. C. ..... Newcastle.
Browne, E. G. ..... Newcastle.
Bunning, T. W. ..... Mining Institute.
Burdon, George ..... Heddon House.
Burnett, Jacob..... Tynemouth.
Browell, E. I. J. ..... East Boldon.

Charlton, W. H. ..... Hesleyside, Bellingham.
Clark, Rev. W. Atkinson ..... Belford Hall.
Clayton, John ..... Fenkle Street.
Coppin, John ..... North Shields.
Cookson, N. C. ..... Oakwood, Wylam.
Coxon, Samuel ..... Usworth.
Craig, James ..... Tynemouth.
Crawhall, Joseph..... Eldon Square.
Cresswell, A. J. B. ..... Creswell.
Cruddas, W. D. ..... Elswick.
Cuthbert, William ..... Beaufront.

Daglish, John ..... Tynemouth.
Deacon, Thomas F. ..... West Parade.
Dees, R. R. ..... Pilgrim Street.
Dinning, William ..... Percy Street.
Dickinson, I. G. ..... Portland House, Jesmond Road.
Dodds, Edwin ..... Low Fell.
Drewett, D. O..... Riding Mill.
Drewett, Mrs. ..... Redworth House, Darlington.
Durham, Bishop of ..... Auckland Castle.

Ellison, Ralph Carr..... Dunston Hill.
Embleton, D., M.D. ..... Eldon Square.
Embleton, T. W. ..... The Cedars, Methley, Leeds.

Foster, Robert ..... Rye Hill.
Forster, J. S. ..... Plawsworth.
Forster, G. B. ..... Backworth Hall.
Freeman, George..... Claremont Place.
French, J. H. ..... South Benwell.

Gibb, C. J., M.D. ..... Westgate Road.
Gibson, William ..... Gladstone Terrace, Gateshead.
Glover, John ..... Heaton.
Glover, William ..... Low Fell.
Greenwell, Robert ..... 9, Grey Street.
Green, R. Y..... Newcastle-on-Tyne.

Hall, T. W. ..... St. Thomas' Street.
Hancock, John ..... St. Mary's Terrace.
Harrison, T. E. ..... Whitburn.
Hedley, Thomas ..... Coxlodge.
Hewitson, William C..... Oatlands.
Hunter, William ..... Sandhoe.
Howse, Richard ..... Saville Row.

James, Sir Walter Charles, Bart. ..... Whitehall Gardens, London.
Johnson, Col. ..... The Deanery, Chester-le-Street.
Johnson, John..... Osborne Road.
Joicey, Col. ..... Newton Hall.
Joicey, Edward ..... Whinney House, Low Fell.

Laycock, Joseph ..... Low Gosforth.
Leathart, James ..... Bracken Dene, Gateshead.
Liddell, Mrs. E. ..... Benton Park.
Liddell, Matthew..... Prudhoe Hall.

Maling, C. T. ..... Ellison Place.
Maling, William ..... Granville Road.
Mawson, Mrs. ..... Ashfield, Gateshead.
Mennell, H. T..... London.
Mitchell, Charles..... Jesmond Towers.
Moor, W. T..... Library Place.

Newall, R. S., F.R.S..... Ferne Dene, Gateshead.
Newall, Mrs..... Ferne Dene, Gateshead.
Noble, Captain, R.A., F.R.S ..... Jesmond.
Noble, George ..... Jesmond.
Northumberland, Duke of ..... Alnwick Castle.

Ord, Mrs. Blackett ..... Whitfield Hall.
Ormston, Robert ..... Saville Place.

Palmer, C. M., M.P. ..... Grinkle Park.
Pattinson, John ..... Bensham Lodge.
Pattinson, W. W..... Felling.
Pattinson, John ..... Scot's House.
Pattinson, Henry..... Scot's House.
Pease, J. W..... Benwell.
Philipson, G. H., M.D. ..... Eldon Square.
Potter, Lieut.-Col. ..... Heaton Hall.
Pumphrey, Thomas..... Summerhill Grove.
Proctor, B. S. ..... Jesmond Gardens.

Ravensworth, The Earl of ..... Ravensworth Castle.
Reed, E. B. ..... Highfield House.
Rendell, G. W..... Benwell.
Richardson, James ..... South Ashfield.
Ridley, Sir Matthew White, Bart..... Blagdon.
Rogerson, John ..... Croxdale Park.

Scholefield, Henry ..... Windsor Crescent.
Simpson, J. B..... Hedgefield House.
Smith, T. E., M.P. ..... Gosforth House.
Smith, Mrs. ..... Gosforth House.
Smith, Henry ..... Gosforth House.
Spence, Robert..... Tynemouth.
Stevenson, A. S. ..... Tynemouth.
Swan, J. W..... Low Fell.
Swan, J. G. ..... Upsal Hall, Middlesbro'.
Swinburne, Sir John, Bart. ..... Capheaton.

Taylor, John ..... Earsdon.
Taylor, John ..... Lovaine Place.
Taylor, W. J. ..... 174, Bye Hill.
Thompson, Cuthbert ..... Winlaton.
Thompson, Thomas..... Winlaton.
Trevelyan, Sir W. C., Bart. ..... Wallington.

Walker, E. J. ..... Low Elswick.
Watson, Henry ..... Millfield House.
Watson, Robert S. ..... Bensham.
Wilson, Thomas ..... Riding Mill.
Wood, Lindsay ..... South Hill.
Woods, W. G. ..... Windsor Terrace.
Woods, Major ..... Hollyn Hall.

SCHEDULE II.

LIST OF HONORARY MEMBERS.

Atthey, Thomas, F.L.S. ..... Gosforth.

Balfour, Prof. J. H., F.R.S., F.R.S.E. Edinburgh.

Collinson, Captain, R.E. .....

Dawson, Charles H., Esq. .... Boyd's Hall, Yorkshire.
Duff, Joseph, Esq. ..... Bishop Auckland.

Emmett, Lieut.-Col., R.E. .....
Enniskillen, Right-Hon. The Earl of, Florence Court.

Henslow, Rev. George, M.A ..... London.
Hincks, Rev. Thomas, B.A. .....
Home, David Milne, Esq., F.R.S.E. ... Milne Graden.
Hooker, Dr. J. D., F.R.S., F.L.S..... Kew, London.

Jeffreys, J. Gwyn, Esq., F.R.S. .. ... The Priory, Ware.
Jones, Prof. Rymer..... ..... King's College, London.
Jones, Prof. T. Rupert, F.G.S. ... . Sandhurst.

Kirk, William, Esq. ..... Bishopwearmouth.

Mead, Thomas, Esq. ..... Chateley, near Bath.

Oliver, Prof. F.R.S., F.L.S. ..... Kew, London.

Pryor, M. R., Esq. ..... Weston Stevenage.

Reeves, John Russell, F.R.S., etc..... Clapham.

Swinhoe, R., F.Z.S., H.B.M., Consul.. Formosa.
Sykes, Lieut.-Col. Wm. H., F.R.S. ... London.

SCHEDULE III.

LIST OF ASSOCIATES.

Armstrong, George .... Arcade.

Barkas, T. P. ..... Grainger Street.
Barkus, Dr. ..... Gateshead.
Bell, Henry ..... Tynemouth.
Brooks, J. C. ..... Wallsend.
Brown, John ..... Blenheim Street.
Bruce, Rev. Dr. ..... Framlington Place.
Burnup, John, jun..... East Parade.
Burnup, M. M. D. ..... Derwent Place.

Challoner, J. S. ..... Dean Street.
Chartres, William ..... Grainger Street West.
Clephan, James .... 11, Saville Row.
Cowen, John A. .... Blaydon Burn.
Crossling, T. C. ..... Clayton Street.

Dodsworth, Frederick..... Collingwood Street.
Downie, Henry ..... South Parade.

Frazer, D..... Regent Terrace.

Gillies, Alexander ..... Gateshead.

Mather, Edward ..... Mosley Street.

Norman, Rev. A. M. .... Burnmoor Rectory.

Philipson, John .... Victoria Square.

Redmayne, J. M... ..... Saltwell, Gateshead.
Robson, E. C. ..... Sunderland.
Robson, Frederick ..... Dean Street.

Shield, G. R. ..... Mosley Street.
Smiles, Henry ..... Central Station.
Spencer, M. ..... Millfield, Newburn.
Spencer, Thomas ..... The Grove, Ryton.
Stanger, John ..... Chronicle Office.
Straker, Joseph ..... West House, Tynemouth.

Temperley, Nicholas ..... Hanover Square.
Thompson, I. T. ..... Winlaton House.

Watson, Mason .... Lawson Street.
Watson, Thomas C..... Blackett Street.

REPORT FOR 1878.

In submitting their Annual Report your Committee beg to say, that the new Rules adopted at the last Annual Meeting have been found to work satisfactorily.

In making the revision and necessary alterations, the Committee were much indebted to Mr. John Clayton and Mr. Thos. Bell for the active part they took therein.

The Trustees of the Society, having by death and resignation been reduced below the requisite number, as specified in the Rules, it became necessary to appoint new Trustees.

At a General Meeting, convened for that purpose, held on the 4th day of June last, fourteen new Trustees were elected, viz.:

The Earl of Ravensworth,
Earl Percy, M.P.,
Sir M. W. Ridley, Bart., M.P.,
Sir W. G. Armstrong, C.B., F.R.S.,
Col. Joicey,
Captain Noble, R.A., F.R.S.,
Rev. J. F. Bigge,
I. Lowthian Bell, M.P., F.R.S.,
E. J. J. Browell,
Norman C. Cookson,
N. G. Clayton,
Edward Joicey,
Charles Mitchell, and
Thomas Wilson,

who, with Mr. John Clayton, make up the full number of fifteen, in conformity with the Rules.

A new Trust Deed has been drawn up and signed by all the Trustees, also by Mr. George Wailes and Mr. Robert Ormston, who have resigned.

The list of members stands about the same as it was at the last Annual Meeting, and your Committee cannot but look upon this as a matter for regret, that in a district like this the number of subscribers should be so limited.

Efforts have been made at various times to increase the number, but these efforts have not been rewarded with permanent success. We would earnestly urge upon each member to do what they can in bringing before their friends the claims of the

Society, for surely in these days, when elementary and scientific education receive so much attention, the advantage of having a well ordered Museum open to the general public almost free should not be overlooked.

During the past year the Society has had to deplore the loss of one of its oldest members, Mr. W. C. Hewitson, whose death took place at Oatlands, Surrey, on May 28th, 1878.

The deceased gentleman was a member of this Society from its commencement; he was a member of the first Committee, and for two years he held the office of Honorary Secretary: he was also one of the original Trustees.

During his official connection with the Society he took an active part in furthering its objects, and when he removed from the neighbourhood still took a warm interest in its welfare, so much so, that some years before his death he increased his annual subscription from one to five guineas.

As a fitting memoir of Mr. Hewitson will appear in the Transactions of the Society, your Committee will not enter into any detail of his works other than to say, that his published works have won for him a world-wide reputation, and that he occupies a foremost place in the roll of eminent naturalists who have made the name of Newcastle famous in all Natural History circles.

In distributing his fortune, Mr. Hewitson has amply shown his warm interest in the welfare of the Society, and by his will has left to it the munificent bequest of £3000 free of legacy duty. In addition to this he has also bequeathed to the Society his valuable Natural History Library, consisting of upwards of four hundred volumes, chiefly upon his favourite subject, the Lepidoptera, and which we understand is one of the most complete in that branch of Natural History in Europe.

Mr. Hewitson's bequest of £3000 has been invested in North Eastern four per cent. debenture stock at 103⅞.

The valuable collection of fossils collected by Mr. Thomas Atthey, A.L.S., of Gosforth, illustrative of the Fauna of the Northumberland Coal-Measures, has been presented to the Society through the liberality of one who takes a warm interest in the welfare of the Institution, but who for the present wishes

the name to be withheld. Of the value and interest of this collection your Committee can only say that it is such, that it is not equalled in any Museum in the kingdom, and the Society is to be congratulated in possessing such a collection.

As an indication of the value of Mr. Atthey's collection, it has been consulted by Dr. Traquair, of Edinburgh, who is engaged on a work on Fossil Fishes.

During the past year many interesting additions have been made to the collections, some of which may be specially mentioned.

Through the exertions of Mr. John Hancock, a fine and very large specimen of the great Japanese Crab, *Inachus Kæmpferi*, was procured for the Society by Captain St. John, R.N. This specimen has been prepared by Mr. Hancock to whom the thanks of the Society are due.

Through the instrumentality of Mr. W. J. Barkas, late of this town, a specimen of the peculiar Australian fish, *Ceratodus Forsteri*, has been procured for the Museum. This is a most interesting addition to our collection, as it closely resembles the Coal-Measure fish, Ctenodus.

Mr. T. P. Barkas, F.G.S., has presented a large cranium of *Loxomma Allmani*, from the Northumberland Coal-Measures.

Two skins of the Kakapo (*Strigops habropilus*), from New Zealand, have been kindly presented by Mr. William Nesham, and six specimens of the beautiful Glass-rope Sponge (*Hyalonema mirabilis*), from Japan, have been presented by Mr. J. Blechynden, Essex Street, Newcastle.

Mr. Blake of London has also examined the Fossil Cephalopods in the Museum for a work on which he is engaged under the auspices of the Royal Society.

Before closing this Report your Committee have much pleasure in stating that there is a prospect of the Society being placed in a position to provide a new building for the accommodation of your collections, a few gentlemen having come forward most generously to support the project with a large portion of the funds.

Your Committee hope shortly to place the matter in a more tangible form before the Society.

OFFICERS OF THE NATURAL HISTORY SOCIETY,

1877–8.

PATRON.

His Grace the Duke of Northumberland.

PRESIDENT.

The Lord Bishop of Durham.

VICE-PRESIDENTS.

Sir Walter C. Trevelyan, Bart.
The Rt. Hon. the Earl Ravensworth.
The Rt. Hon. the Earl of Tankerville.
Sir W. G. Armstrong, C.B., F.R.S.
A. J. B. Cresswell, Esq.
John Clayton, Esq.
Lieut.-Col. Addison Potter.
The Worshipful the Mayor of Newcastle.
Ralph Carr-Ellison, Esq.
Rev. John F. Bigge.
I. Lowthian Bell, Esq., M.P., F.R.S.
D. Embleton, Esq., M.D.
John Hancock, Esq.
R. B. Bowman, Esq.
Col. Joicey.
Edward Joicey, Esq.

TREASURER.

Joseph Blacklock, Esq.

SECRETARIES.

Andrew Noble, F.R.S. | William Dinning.

COMMITTEE.

Mr. Thomas Bell.
Mr. E. J. J. Browell.
Mr. D. O. Drewett.
Mr. R. R. Dees.
Mr. John Glover.
Mr. Wm. Maling.
Mr. John Pattinson.
Mr. James Richardson.
Mr. A. S. Stevenson.
Mr. Jos. W. Swan.
Mr. Cuthbert Thompson.
Mr. Thos. Thompson.
Mr. Henry Watson.
Mr. John Daglish.
Mr. E. F. Boyd.

HONORARY CURATORS,

1878.

ZOOLOGY.

VERTEBRATA.

D. Embleton, M.D. | J. Hancock.

ARTICULATA.

W. Dinning.
J. Hancock. | Rev. A. M. Norman.

MOLLUSCA.

Rev. A. M. Norman. |

RADIATA.

D. O. Drewett.
J. Coppin. | Rev. A. Norman.

BOTANY.

Rev. J. F. Bigge. | R. B. Bowman.

GEOLOGY.

E. F. Boyd.
E. J. J. Browell.
J. Daglish. | W. Dinning.
J. W. Kirkby.

GENERAL CURATOR.

Richard Howse.

KEEPER OF THE MUSEUM.

Joseph Wright.

THE TREASURER IN ACCOUNT WITH THE NATURAL HISTORY SOCIETY.

CURRENT ACCOUNT FROM 2ND JULY, 1877, TO 3RD DECEMBER, 1878.

1877.	Dr.	£	s.	d.
	To Balance brought forward	191	6	3
	,, Subscriptions from Members	197	19	0
	,, ,, Associates	1	5	0
	,, ,, Literary and Philosophical Society	40	0	0
	,, Fine Arts Society, One Year's Rent, due August, 1877	34	12	0
	,, Admissions	164	15	11
	,, North of England Institute of Mining Engineers, Two Years' Subscription to October, 1877	40	0	0
	,, W. T. Moor, Two Years' Rent for Permission to place Joists in Walls of Museum	1	0	0
	,, W. T. Moor, Two Years' Rent for *Chronicle* Signboard	7	0	0
	,, Carver & Co., One Year's Rent in advance for Sign to be placed on Museum Wall	5	0	0
	,, Bank Interest on £3000	31	13	8
		£714	11	10

1878.	Cr.	£	s.	d.
July 7.	By Salary to Keeper of Museum	127	10	0
	,, John Clayton, Interest for One Year and a Half on £2000 Mortgage, less Income Tax	118	3	4
	,, One Year's Fire Insurance	15	0	0
	,, W. T. Moor, Cabinet Maker's Accounts	77	3	9
	,, John Bell & Co., for Printing	5	12	9
	,, Spencer G. Percival, for Cost of Sections of Fossil Corals	1	12	0
	,, William Langhrin Polperro, Liskeard, for Collection of Fish and Crustacea	50	5	6
	,, Richard Howse, Curatorship Account	37	9	6
	,, Sundry Accounts	26	14	8
	,, R. Y. Green, Tyneside Naturalists' Field Club, Share of Transactions Part I. Vol. 7, and *Journal* Office Account	58	9	4
	,, Balance in Bank	196	10	0
	,, Error	0	1	0
		£714	11	10

LIST OF DONATIONS TO THE MUSEUM

OF

THE NATURAL HISTORY SOCIETY,

FROM JUNE, 1877, TO JUNE, 1878.

BOOKS.

Proceedings of the Academy of Natural Sciences, Philadelphia, U.S. America. Parts 1, 2, 3, 1876. Parts 1, 2, 3, 1877. *The Academy.*

Bulletin of the United States Geological and Geographical Survey. Vol. III., Nos. 1, 2, and 4. *Dr. F. V. Hayden, U. S. Geologist.*

Report of the United States Entomological Commission, Nos. 1, 2, and First Annual Report of the Entomological Commission on the Rocky Mountain Locust. *Dr. F. V. Hayden.*

Report of the United States Geological Survey of Wyoming, etc. *Dr. F. V. Hayden.*

Catalogue of the Publications of the U. S. Geological Survey.
Miscellaneous Publications of the U. S. Geological Survey, Nos. 1 and 6.
Publications of the U. S. Geological Survey.
Gannett's Lists of Elevations.
Matthew's Hidatsa Indians.
Geological Survey of Montana.
Bulletin of Geological and Geographical Survey.
Ninth Annual Report of the Geological and Geographical Survey of the United States, 1875.
Vol. XI. of the U. S. Geological Survey.
Coue's Fur-bearing Animals.
Illustrations of Cretaceous and Tertiary Plants of the Western Territories of the United States.
Atlas of the Geological Survey of Colorado, U. S. America.
Bibliography of North American Palæontology.
Dr. F. V. Hayden, U. S. Geologist.

Proceedings of the American Philosophical Society, Philadelphia. Vols. XV., 96; XVI., 98, 99; Vol. XVII., 100; XVIII., 101; and Catalogue of the Library, Part 3. *The Society.*

Memoirs of the Museum of Comparative Zoology, Harvard College, Cambridge, Mass., U. S. America.
Vol. V., 1, North American Starfishes.
,, ,, 2,
,, VI., 3,
Bulletin. Vol. IV.

Binney's Air-breathing Mollusca of the United States. Vol. V., with Plates. Bulletin, Vol. V., Nos. 1, 2, 3, 4, 5, 6. *Prof. Alex. Agassiz.*

Memoirs of the Boston Natural History Society. Vol. II., No. 5, Part 4, No. 6. Proceedings. Vol. XVIII., Parts 3, 4; Vol. XIX., Parts 1, 2. *The Society.*

Proceedings of the American Academy of Arts and Sciences, Boston. New Series. Vol. IV.; Vol. V., Part 1, 2, 3. *The Academy.*

Report of the Smithsonian Institution, 1876. *The Institution.*

Proceedings of the American Association for the Advancement of Science, Twenty-fifth Meeting, 1876. *The Association.*

Proceedings of the Devonport Academy of Natural Sciences, U. S. America. Vol. II., Part 1. *The Academy.*

Transactions of the Academy of Science, St. Louis, U. S. America. Vol. III., No. 4. *The Academy.*

Transactions of the Academy of Arts and Sciences, Connecticut, U. S. America. Vol. III., Part 2; Vol. IV., Part 1. *The Academy.*

Transactions of the Berwickshire Naturalists' Field Club. Vol. VIII., Parts 1 and 2. *The Club.*

Proceedings of the Zoological Society of London. Parts 2, 3, 4, 1877. Parts 1, 2, 3, 1878. *The Society.*

Annales de la Societie Malacologique de Belgique. Tome X., and Process Verbeaus, 1877. *The Society.*

Memoirs of the Royal Swedish Academy of Sciences. Vol. I., Nos. 13, 14. Supplement to Memoirs. Vol. II., No. 3. Bulletin. No. 33. *The Academy.*

Proceedings of the Literary and Philosophical Society of Liverpool. Vol. XXXI. *The Society.*

Two Drawings of the Common- and Bull-Trout. *Joseph Crawhall, Esq.*

Report of Manchester Field Naturalists' Society. 1877-8. *The Society.*

Der Isis. Dresden. Two Parts, 1877.

Proceedings of Newcastle Chemical Society. Vol. IV., Parts 1, 2. *The Society.*

Transactions of the Geological Society of Glasgow. Vol. V., Part 2. *The Society.*

Report and Transactions of the Plymouth Institution and Devon and Cornwall Natural History Society. Vol. VI., Part 2. 1877-8. *The Institution.*

Annual Report of Yorkshire Philosophical Society. 1877. *The Society.*
Two Parcels of Transactions of the Royal Irish Academy, Dublin.
The Academy.

ZOOLOGY.

A Skin of the Vampire Bat. *Mr. John Kell, Mosley Street.*
A Bat, a few Flint Arrow Heads, and a small Basket and Specimens of Cordage, from Terra del Fuego. *Mr Philip Hobbs, Ellison Place.*
A few Bones of the Apteryx, from New Zealand. *Miss S. Richardson.*
Specimen of the Glaucous Gull (*Larus glaucus*), in Winter Plumage, shot at Holy Island. *C. M. Adamson, Esq.*
A young Dipper, taken in Dipton Burn; one of a second brood from the same nest. *Mr. F. Hutchinson.*
A Specimen of the Spotted Flycatcher, taken at Ravenswood, near Benwell. *Master Thomas Clark, Ravenswood.*
A Specimen of the Hooded Crow, shot at Long Benton. *Mr. E Bold.*
Two Skins of the Kakapo, from New Zealand. *Mr. Wm. Nesham.*
A Model of the Egg of the Great Auk. *Mr. John Hancock.*
Two Specimens of the Common Viper (Male and Female) from Islay.
Mr. Thomas Hanning, Islay—per R.. Y. Green, Esq.
Three Specimens of the Common Ringed Snake, from Cambridgeshire.
Master Dickinson.
Specimens of the Common Frog, Smooth Newt, etc. *Mr. James Stephenson.*
A Specimen of the Burbolt, taken in the River Wiske.
I. L. Bell, Esq,, M.P., F.R.S.
A very large and fine Specimen of the great Japanese Crab (*Inachus Kœmpferi*), taken off the coast of Japan. *Capt. H. C. St. John, R.N.*
A few Specimens of *Lepas fascicularis*, found on the beach at Tynemouth.
Dr. W. B. Clarke.
Specimens of the Colorado Beetle, from Pennsylvania.
Presented by Dr. Embleton, from T. B. Grierson, Esq,, Thornhill, Dumfries.
A Specimen of the Colorado Beetle, from Hartford, Connecticut.
Geo. Angus, Esq., Beech Grove.
Models of the Eggs, Larva, and Imago of the Colorado Beetle.
Messrs. James Gibbs & Co., Mark Lane, London.
A Specimen of *Conus bandanus* and *Trochus Niloticus.* *Mr. R. Y. Green.*
A fine Specimen of *Helix aspersa*, from Islay. *Mr. R. Y. Green.*
Six Specimens of the Glass Rope Sponge (*Hyalonema mirabilis*), Two Corals (*Isis*), and Two Fish, from Japan. *Mr. John Blechynden.*
A Box of various Objects of Natural History from New Zealand, including Shells, Boar's Teeth, &c. *Mr. J. W. Swan.*

A Specimen of *Ceratodus Forsteri*, from Australia.

Exchange, per Mr. W. I. Barkas.

FOSSILS AND MINERALS.

The extensive Collection of Fossils, illustrative of the Fauna of the Coal Measures of Northumberland, formed by Mr. Thomas Atthey.

Presented by Lady Armstrong.

Specimen of Titaniferous Iron Sand and Crude Iron from the furnace, etc., from the West Coast of New Zealand.

The Proprietor of the Newcastle Chronicle.

Four Specimens of Fossil Corals, from near Blenkinsopp.

Edward Joicey, Esq.

A Specimen of *Lepidodendron*, in Sandstone, from Wideopen Quarry.

Mr. W. C. Robson.

A Collection of Bones of Mammalia, Birds, and Fishes, found in a cave near Marsden. *Mr. John Daglish.*

A few Specimens of Iron Pyrites, from Terra del Fuego.

Mr. Philip Hobbs.

NEW TRUST DEED.

(COPY.)

This Indenture made the 2nd day of December 1878 BETWEEN JOHN CLAYTON of Newcastle upon Tyne Esquire ROBERT ORMSTON of Newcastle upon Tyne Gentleman and GEORGE WAILES of Newcastle upon Tyne Gentleman of the first part the said JOHN CLAYTON and NATHANIEL GEORGE CLAYTON of Newcastle upon Tyne Esquire of the 2nd part and THE RIGHT HONORABLE HENRY GEORGE EARL OF RAVENSWORTH THE RIGHT HONORABLE HENRY GEORGE PERCY commonly called The Earl Percy SIR MATTHEW WHITE RIDLEY of Blagdon, in the County of Northumberland Baronet SIR WILLIAM GEORGE ARMSTRONG of Jesmond in the Borough of Newcastle upon Tyne Knight Companion of the Bath ISAAC LOWTHIAN BELL of Rounton Grange in the County of York Esquire THE REVEREND JOHN FREDERICK BIGGE of Stamfordham in the County of Northumberland Clerk in Holy Orders EDWARD JOHN JASPER BROWELL of East Boldon in the County of Durham Esquire the said JOHN CLAYTON the said NATHANIEL GEORGE CLAYTON NORMAN CHARLES COOKSON of Wylam Oakwood in the same County Esquire EDWARD JOICEY of Whinney House in the Borough of Gateshead Esquire JOHN JOICEY of Newton Hall in the County of Northumberland Esquire CHARLES MITCHELL of Jesmond Towers in the Borough of Newcastle upon Tyne Esquire ANDREW NOBLE of Jesmond in the same Borough Esquire and THOMAS WILSON of Riding Mill in the County of Northumberland Esquire (who are together hereinafter referred to as the Trustees) of the third part WHEREAS by an Indenture of Bargain and Sale duly enrolled dated the 25th day of April 1834 and made between John Barras and George Barras of the 1st part Susannah Airey of the 2nd part Ann Turner of the 3rd part Ralph Park

Philipson and George Airey of the 4th part Sir Matthew White Ridley Baronet Cuthbert Ellison and others of the 5th part and Ralph Henry Brandling Charles William Bigge Charles John Bigge the said John Clayton Henry Hewitson the said Robert Ormston (then called Robert Ormston the younger) John Spedding John Adamson George Clayton Atkinson the said William Chapman Hewitson William Hutton Robert Plummer Thomas Swinburne the said George Wailes and Matthew Wheatley the younger of the 6th part the piece or parcel of ground together with the erections and buildings then or then late standing thereon containing by admeasurement 530 square yards or thereabouts situate in the Town and County of Newcastle upon Tyne on the south side of a street there called Westgate Street Bounding partly on hereditaments belonging to the Members of the Literary and Philosophical Society of Newcastle upon Tyne and partly on the lane or open passage way there called Library Place on or towards the north on hereditaments then or then late belonging to John Anderson on or towards the east on the town walls of Newcastle upon Tyne on or towards the south and partly on hereditaments then or then late belonging to Robert Leadbitter and partly on hereditaments to the Members of the said Literary and Philosophical Society on or towards the west together with the right of way as therein mentioned over Library Place aforesaid and with the appurtenances were conveyed unto and to the use of the said several persons parties thereto of the 6th part their heirs and assigns for ever but nevertheless upon trust for the Members for the time being of the Natural History Society of the Counties of Northumberland and Durham and Newcastle upon Tyne and to be conveyed and disposed of as the majority of the said Members present at a General Meeting of the said Society should or might direct or appoint AND WHEREAS by an Indenture dated the 1st day of September 1834 and made between Dixon Dixon and George Townshend Fox and the several other persons whose names and seals were subscribed and affixed to the now reciting Indenture and mentioned or set forth in the 2nd Schedule thereunder written of the first part and the said Ralph Henry Brandling Charles William

Biggs Charles John Bigge John Clayton Henry Hewitson Robert Ormston John Spedding John Adamson George Clayton Atkinson William Chapman Hewitson William Hutton Robert Plummer Thomas Swinburne George Wailes and Matthew Wheatley of the 2nd part the said parties hereto agreed that the said Natural History Society should be governed by the several rules or regulations and laws particularly mentioned and set forth in the 1st Schedule thereunder written and by such other rules or regulations and laws as should from time to time be duly made and established pursuant thereto And also that the collection of curiosities goods chattels and effects which then belonged or thereafter should belong to the said Natural History Society should be held and possessed by and absolutely vested in the parties thereto of the 2nd part and it was thereby agreed and declared that the persons parties thereto of the 2nd part or other the trustees for the time being of the said Society should stand and be seised possessed of and interested in the piece or parcel of ground and hereditaments (subject to an agreement to grant a mortgage thereof to Matthew Clayton for securing £1000 and interest) and of and in the collection of curiosities goods chattels and effects of the said Natural History Society to be held enjoyed and applied according to the rules or regulations for the time being of the said Society And by the rules set forth in the said first Schedule it was provided that the property of the Society both real and personal should be vested in 15 trustees to be chosen out of the ordinary members and that the persons parties to the lastly hereinbefore mentioned Indenture of the 2nd part should be such trustees and that when the trustees so chosen or any of them or any future trustees to be appointed as therein mentioned should happen to die or should be desirous of being discharged of and from or should refuse or decline to act in the trusts in them reposed then and in such case and so often as it should happen that by such means such trustees should be reduced under the number of 5 it should and might be lawful to and for the ordinary members of the Society from time to time at a meeting to be called for that purpose of which a month's notice should be given at a previous general meeting to elect

nominate substitute or appoint any other persons to be trustees in the stead or place of the trustees so dying desiring to be discharged or refusing or declining to act and that when and so often as any new trustee should be nominated all the trust property should be thereupon conveyed and transferred in such sort and manner and so as that the same should and might be legally and effectually vested in the surviving or continuing trustees or trustee of the same trust estates and such new trustees jointly in trust for the said Natural History Society and to be held and applied according to the rules or regulations and laws for the time being of the said Society and the recital in the deed or deeds of conveyance or assignment of the trust property of the appointment of new trustees by the Society shall in all respects and to all intents and purposes be considered as evidence of the resolution and appointment and of the same having been regularly made And it was also declared that it should and might be lawful to and for the trustees for the time being at any time or times thereafter by the direction of a majority of the members of the Society then present at a meeting to be held for the purpose of considering of the expediency of any sale exchange or mortgage (of which notice should be given at a previous general meeting) to sell exchange mortgage or otherwise dispose of any part of the real property then belonging or thereafter to belong to the Society in such manner as by a resolution of the Society for that purpose should be ordered and entered in their minutes and a recital of such resolution in the conveyance of such property should be evidence of its having been regularly and properly made AND WHEREAS the agreement for a mortgage to the said Matthew Clayton referred to in the lastly hereinbefore recited Indenture was a mortgage for the sum of £1000 advanced by him under a resolution of a general meeting of the said Society held on the 20th day of January 1834 which resolution was to the effect that the trustees be directed to raise a sum not exceeding £1000 upon the property of the said Society AND WHEREAS at a general meeting of the said Society held on the 13th day of August 1835 (of which notice was given at the then next preceding general meeting) it was resolved that

administrators and assigns ALL and every the collection of curiosities goods chattels and effects now vested in them the said John Clayton Robert Ormston and George Wailes or any of them as trustees or as a trustee of the said Natural History Society AND ALL the estate right and interest of the same persons and each of them in and to the same premises TO HAVE HOLD RECEIVE AND TAKE the collection and premises hereinbefore expressed to be hereby assigned unto and by the trustees their executors administrators and assigns In trust for the said Natural History Society and to be held and applied according to the rules or regulations and laws for the time being of the same Society AND the persons parties hereto of the first part do hereby for themselves severally and respectively and for their respective heirs executors and administrators (but so far only as concerns their own respective acts deeds and defaults) covenant and declare with and to the trustees their heirs executors administrators and assigns that they the covenanting parties respectively have not heretofore made done or knowingly suffered or been privy to any act deed matter or thing whatsoever whereby or by reason or means whereof the hereditaments chattels and premises hereinbefore expressed to be hereby granted and assigned respectively or any part thereof respectively have or has been or are is can shall or may be conveyed assured impeached charged or in anywise incumbered IN WITNESS whereof the said parties to these presents have hereunto set their hands and seals the day and year first hereinbefore written

John (L.S) Clayton	W. G. (L.S.) Armstrong
Percy (L.S.)	I. Lowthian (L.S.) Bell
E. J. J. (L.S.) Browell	John F. (L.S.) Bigge
A. (L.S.) Noble	Norman C. (L.S.) Cookson
Robert (L.S.) Ormston	Edward (L.S.) Joicey
Geo. (L.S.) Wailes	John (L.S.) Joicey
N. G. (L.S.) Clayton	C. (L.S.) Mitchell
Ravensworth (L.S.)	Thos. (L.S.) Wilson
M. W. (S.L.) Ridley	

Signed sealed and delivered by the within named John Clayton

Robert Ormston George Wailes Nathaniel George Clayton The Earl Percy Sir William George Armstrong Isaac Lowthian Bell John Frederick Bigge Edmund John Jasper Browell Norman Charles Cookson Edward Joicey John Joicey Charles Mitchell Andrew Noble and Thomas Wilson in the presence of

JOSEPH WRIGHT, Keeper of the Museum
Newcastle upon Tyne

Signed sealed and delivered by the within named Earl of Ravensworth and Sir Matthew White Ridley in the presence of

JOSEPH WRIGHT, Keeper of the Museum
Newcastle upon Tyne

the trustees of the said Society should raise a further sum of £1000 upon the property of the said Society AND WHEREAS the said Matthew Clayton on the 1st day of October 1835 advanced and lent the said further sum of £1000 to the said trustees and to secure the repayment thereof with interest at £4 per centum per annum and also of the said further sum of £1000 with interest at the like rate the said trustees deposited the hereinbefore recited Indenture and other the muniments of title relating to the said hereditaments with the said Matthew Clayton AND WHEREAS the said Matthew Clayton died on the 21st day of April 1867 having made and duly executed his will dated the 23rd day of July 1866 and proved on the 6th day of May 1867 and thereof appointed the said John Clayton and Nathaniel George Clayton executors AND WHEREAS the said sums of £1000 and £1000 making together £2000 with interest thereon from the first day of October last still remain due and owing to the said John Clayton and Nathaniel George Clayton as such executors as aforesaid AND WHEREAS the said Ralph Henry Brandling Charles William Bigge Charles John Bigge Henry Hewitson John Spedding John Adamson George Clayton Atkinson William Chapman Hewitson William Hutton Robert Plummer Thomas Swinburne and Matthew Wheatley being dead and the said Robert Ormston and George Wailes being desirous of being discharged of and from the trusts in them reposed the said Earl of Ravensworth Earl Percy Matthew White Ridley William George Armstrong Isaac Lowthian Bell John Frederic Bigge Edward John Jasper Browell John Clayton Nathaniel George Clayton Norman Charles Cookson Edward Joicey John Joicey Charles Mitchell Andrew Noble and Thomas Wilson were at a general meeting of the said Society held on the 4th day of June last called for the purpose and of which a month's notice was given at a previous general meeting elected and appointed trustees in the stead or place of the said deceased trustees the said Robert Ormston and the said George Wailes NOW THIS INDENTURE WITNESSES that in consideration of the premises the said John Clayton Robert Ormston and George Wailes do and

each of them doth hereby grant unto the said Earl of Ravensworth and his heirs ALL that the said piece or parcel of ground with the Museum standing thereon and all other the premises comprised in the said Indenture of the 25th day of April 1834 AND ALL the estate right title interest claim and demand whatsoever of the said John Clayton Robert Ormston and George Wailes and every of them in to and out of the same hereditaments and premises and every part thereof TO HAVE AND TO HOLD the said piece or parcel of ground and all other the hereditaments and premises hereinbefore expressed to be hereby granted unto the said Earl of Ravensworth and his heirs TO THE USE of the said John Clayton and Nathaniel George Clayton their heirs and assigns for ever subject nevertheless to the proviso for redemption hereinafter contained that is to say PROVIDED always that if the trustees their heirs or assigns shall on the expiration of 6 calendar months from the day of the date of these presents pay unto the said John Clayton and Nathaniel George Clayton their executors administrators or assigns the sum of £2000 with interest after the rate of £4 per centum per annum computed from the first day of October last then the said John Clayton and Nathaniel George Clayton their heirs or assigns shall and will at the request and costs of the trustees their heirs or assigns convey and assure the said hereditaments hereby granted unto and to the use of the trustees their heirs and assigns for ever In trust for the said Natural History Society and to be held and applied according to the rules or regulations and laws for the time being of the same Society AND it is by way of confirmation hereby expressly declared that the power of sale and all other the powers and provisions contained in the 2nd part of the Act 23 and 24 Vic. chap. 145 shall be incorporated in these presents and be applicable to the mortgage hereby made AND THIS INDENTURE FURTHER WITNESSES that in further pursuance of the said appointment and in consideration of the premises the said John Clayton Robert Ormston and George Wailes DO and each of them DOTH hereby assign unto the trustees their executors

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