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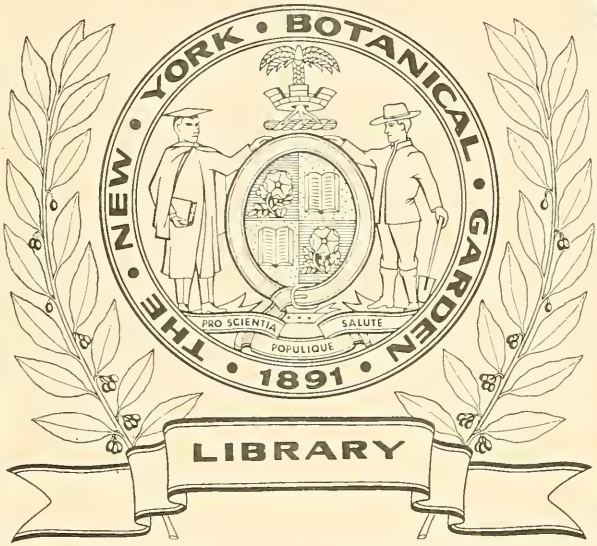

TRANSACTIONS

OF THE

Edinburgh Naturalists' Field Club

SOFT shadows flit across the wintry sky,
  And dawn is breaking thro' the mists of night,
  As Spring returns, robed in immortal light,
To bid the darkness and the tempest fly.
Sweet, o'er the meadows and the valleys, lie
  A thousand smiles, to charm our longing sight,
  As Hawthorn buds appear in virgin white,
And fields are clad in Primrose panoply.
  Oh, woodlands fair! oh, valleys decked with gold!
We fain would linger 'mong the blooming flowers,
  Where myriad songsters on the branches sing,
And all their music, with its joy untold,
  Now thrills impassioned thro' the vernal bowers,
To welcome thee, oh, fair eternal Spring!

—MINNIE M'KEAN.

TRANSACTIONS

OF THE

Edinburgh Naturalists' Field Club

SESSIONS 1881-86

VOLUME I.

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TRANSACTIONS.

INTRODUCTORY NOTE.

THE Edinburgh Naturalists' Field Club was instituted in 1869 for the practical study of Natural History in all its branches. For a number of years the work of the Club was carried on by a series of field-meetings only—held principally during the months of May, June, and July. It was then thought that it would be for the interests of the Club to hold a series of evening meetings during the winter months, at which papers bearing on the work of the Club in the field and otherwise might be read and discussed. At the annual meeting of the Club in November 1879, it was agreed to hold such evening meetings, which were at once arranged for, and met with a large measure of success. The resolution to publish Transactions not having been adopted till November 1881, it has been thought desirable to put on record a list of the papers read, and objects in Natural History exhibited, at the meetings during the two previous Sessions.

SESSION 1879-80.

"Colonsay." By Mr Symington Grieve.

"Recollections of Sutherlandshire." By Mr Arch. Craig, jun.

"A collection of British Mosses" made by Mr Grieve during 1879.

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"A small collection of British Birds and their Eggs." By Mr Craig, jun.

"A collection of British Butterflies." By Mr Moffat, Secretary.

"Duddingston and Trinity College Church plates, and a series of old Communion Tokens." By Mr W. Ivison Macadam.

"Notes on the rarer plants of the Lomonds and Pentlands, with specimens." By Mr P. B. Gibb.

"On Mosses: illustrated with diagrams." By Mr Moffat, Secretary.

"Note on the breeding of the Siskin in Scotland." By Mr Arch. Craig, jun.

"The Cliffs and Caves of Colonsay, and some things they teach regarding Britain, past, present, and future." By Mr Symington Grieve.

"The first decade of the Club, and how to render its work more profitable." By Mr John Walcot, President.

"The Natural History of Islay." By Mr R. Scott Skirving.

SESSION 1880-81.

"Dumfries and Criffel." By Mr John Walcot, President.

"The Scenery and Bird-life of Glen Urquhart, Inverness-shire: with specimens." By Mr Arch. Craig, jun.

"Notes on a Botanical Trip to Ben Lawers in August 1880; illustrated with specimens of the plants gathered." By Mr George Bird.

"Insects." By Mr Moffat, Secretary.

"Remarks on a Floral Plan of Ben Lawers." By Mr John Sadler.

"Craigmillar: a Reminiscence—Historical and Descriptive." By Mr T. A. Douglas Wood.

"British Ferns: their Structure and Classification. Illustrated by a collection of British Ferns and by microscopic preparations." By Mr John Lindsay.

"The use of the Spindle and Whorl by the fishing classes of Scotland." By Mr W. Ivison Macadam.

"Glen Lyon: its Scenery and Antiquities—embracing notices of its curious circular forts." By Mr Arch. Craig, jun.

"Some characteristics of the study of Natural Science." By Mr John Walcot, President.

The interest of the meetings during 1880-81 was much enhanced by the admirable series of preparations shown under the microscope by Mr James Simpson.

I.—*HOW WE SPENT THE 30th JULY 1879 IN THE WILDS OF KILMONIVAIG AND NORTH-WEST BADENOCH.*

By Mr SYMINGTON GRIEVE.

(*Read Oct.* 20, 1881.)

IF you can do with climbing and plenty hard walking, and wish to spend a pleasant holiday among the mountains, our advice is—visit Moy Farm. You reach it by taking the train to Kingussie on the Highland railway, and thence the Fort William coach, which passes Moy, and always waits a few minutes to change horses and let the passengers have some refreshment. We have made this place our headquarters more than once when away for a holiday. But we shall only write of one memorable day's outing, when the writer had with him two companions.

We took the coach as it was going from Fort William to Kingussie, and about nine o'clock in the morning were set down at the entrance to Aberairder Glen. The weather was magnificent; the scenery almost unequalled for beauty. The hum of insects and the song of birds, the sound of the rippling waters breaking against the shores of Loch Laggan, and the tumultuous roar of mountain torrents, betokened that all nature was revelling in the sunshine of another day. No wonder that we felt able for any amount of fatigue when we had such surroundings—especially when braced by the exhilarating mountain air of Badenoch. The rugged path took us up past Aberairder Farm, and into the glen among woods of Birch, Oak, and Hazel. The branches of the trees hung with festoons of beautiful Mosses, one of the most attractive being *Antitrichia curtipendula*, Brid., which was in fine fructification; while under foot were dense cushions of *Racomitrium heterostichum* and *R. lanuginosum*, Brid., variegated here and there with patches of Iceland and Reindeer Moss (*Cetraria islandica* and *Cladonia rangiferina*). And occasionally we came across the cone-shaped heaps of dried and broken twigs that marked the formicarias of the wood ant (*Formica rufa*). These little insects, always busy, may sometimes prove of use to the naturalist if he wishes to prepare the skeleton of a bird, fish, or any small animal. He has only to leave the dead body on one of these ant-hills, and he will find his

object very soon attained, and the work done as well as if the specimen had been placed in the hands of the most skilful taxidermist.

Emerging from the wood, we enter upon a stretch of moorland and morass, and here find the Cloudberry (*Rubus Chamæmorus*, L.); and after a hard walk at last reach Loch Cor Arder, which nestles in a deep dark corrie with tremendous cliffs at its upper end, which vary in height from 1400 to 1600 feet. The whole scene was impressive,—the silent grandeur of the mountains that towered above us to such a height, and yet seemed so near; the dark waters of the loch, the one moment calm, the next furrowed by a sudden gust of wind; while the breeze wailed as it passed along the face of the cliffs, seeming to betray the presence of some great unseen spirit. The wild flowers that dotted the beach bordering upon the shores of the loch attracted our attention, and the beautiful white blooms of the hairy Alpine Mouse-ear Chickweed (*Cerastium alpinum*, L.) and the cream-coloured corollas of the Mossy Saxifrage (*Saxifraga hypnoides*, L.), blending with the darker background of moss and rock, lit up to some extent the sombre picture.

The time had now arrived for lunch, and appetised by the exertions we had undergone, combined with the pure air that acted as the best of tonics, we sat down upon a knoll, the grass on which was interlaced with the trailing stems of the common Club-moss (*Lycopodium clavatum*, L.); and as we rested we watched the wary but voracious Trout rising on the surface of the loch, as they pursued the unsuspecting flies that either glided along close to the water or rested upon the transparent element, from whose bosom they had so shortly before sprung into life. Our repast ended, we got up our fishing-rod and soon captured some dozens of nice Trout, —very lively on the line, but small in size, most of them averaging about ten to the pound. The best flies, we found, were those with Teal Drake wings and orange worsted bodies, with a spiral band of gold tinsel—hooks ordinary loch size. When we started upon our excursion, it was our intention, after reaching Loch Cor Arder, to return the way we had come, and get the coach back to Moy as it went westwards in the afternoon; but tempted by the weather, we determined to ascend through a gully named Aberairder Window to the summit of Creag Meaghaidh (pronounced Craig Meggy), a mountain 3700 feet in height. To climb this gully—which presents the appearance of its having been the place where two mountains were rent asunder, and the intervening chasm partially filled in with their *débris*—was rather difficult and dangerous. The ascent is very steep, and over loose rocks that are poised against each other in such a way that to move one caused a sympathetic movement among others; and one false step might mean broken limbs, or something even worse. But we made the ascent of 1500 feet without mishap—the only unpleasant experience met with being the

effluvia that emanated from the carcasses of sheep that had fallen from the ledges of the cliffs, and testified, by their shattered appearance, to the dreadful fall to which they had been subjected. Near the summit we came upon a patch of Moss Campion (*Silene acaulis*, L.), but only got a few specimens in flower; and a little higher up the Parsley Fern (*Allosorus crispus*, Bernh.) is met with in great abundance—some of the plants growing up through the half-melted snow. At last we reach the ledge, and find that the sides of the Window are formed by the opposite cliffs of the upper part of the chasm. The lintel is awanting, but the ledge is composed of masses of rock that have here fallen in a kind of ridge across the gully; and behind this there is a deep basin, which is always filled with snow. To cross its immaculate surface seemed rather hazardous, as a descent into its depths would have cooled our ardour; so it did not astonish us that our companions were inclined to hold back. But having had an opportunity of testing its bearing powers the previous day, we were able to assure them there was no danger, and at length the advance was begun. We at once discovered that the snow was only soft on the top, while underneath was quite hard; and all fears were so soon forgotten that we indulged in the delightful but unusual pastime of a snowball fight on the 30th July. It was in Loch Cor Roy, which lies at the foot of a great cliff about the third of a mile to the north-west of this, that we caught some specimens of the *Salmo alpinus*, or Alpine Char, on a previous occasion. This rare fish is found in very few other lochs in Britain, and the specimens now in the British Museum are from Loch Cor Roy.

Having crossed the snow-basin, we continued a short distance westwards, then turning abruptly to the left began to ascend the shoulder of the mountain to the south-east, with the object of reaching the top of the cliffs that rise out of the corrie in which lies Loch Cor Arder. But when we approached the brink, intending to look over, the abyss seemed so dreadful that we shrank back from the attempt. We had been at this spot at various times, but had never seen it so clearly in all its loneliness. The contrast only served to impress upon us the impossibility of conveying an adequate idea of the change that comes over the scene in time of storm, when the mountain is wrapped in a thin mist that gathers more densely in the hollows, and the white vapour that fills Cor Arder is wrought into weird and fantastic forms by the wind, which hisses like a myriad of vipers as it dashes over the cliff, causing the mist to seethe as if it were the steam rising from a caldron; while from far down in the hidden depths of the corrie rise the sounds of the dashing waters of miniature cascades, like the cry of a multitude in distress, that conjure up within the mind a purgatorial picture well worthy of a place in Dante's Inferno.

It was now nearly four o'clock in the afternoon, and as we are to

ascend to the top of the mountain we must be on our way; so turning our backs upon the corrie we face westwards, and proceed for about half a mile over ground that gradually ascends, leading towards the Sappers' Cairn, that crowns the highest elevation. The whole heath was blackened by the frosts, while the snow that had lain all winter was still to be found in patches; and to the north side of the ridge was a great drift that rested on the upper part of a small glacier, whose face, exposed to the sun, had been melted out into small grottos that might have been the vestibules to a fairy palace. But we had no time for examining those strange sights, worthy of hyperborean regions; the cry is, "First to the top!" and we push panting on, and, notwithstanding our effort, fail to make up on one of our companions, who had got a considerable start; but, with a final rush, we touch the cairn, and out of breath gladly sink down upon one of the large stones that compose its base. It took us a few moments to recover from our exertion; but when we were able to look around us, the view that met our gaze from the position, 3700 feet above sea-level, was magnificent and impressive. The sun, sinking towards the west, was casting across the glens the dark shadows of the mountain outlines, that ever seemed to be ascending as the orb of day went lower in the firmament. But at various points the oblique rays struck the waters of some Highland loch or small mountain tarn, transforming its dark surface into the appearance of a sheet of burnished gold; while the lower hills were irradiated with the beautiful hue of blue that told of the bursting bloom of the Heather (*Calluna vulgaris*). In every direction the mountains rose up from glens in all the glory of their ruggedness, displaying upon their sides variegated colours that were the shadow of the corrie or the tints of Heath, Moss, or Heather; while here and there the white streak that looked like a line of white quartz-rock defined the course, and marked the cascades, of the foaming torrent. Away to the south, from east to west, could be seen the mountains of the southern Highlands, with Ben Cruachan raising its mighty peak like a hoary sentinel. To the north, almost beneath our feet, under the precipitous cliff crowned by the summit of Creag Meaghaidh, lay the Lochan Uaine; and beyond were the wilds of Kilmonivaig and bleak Corryarrick, where Prince Charlie and the clans fortified themselves in 1745. The background to this view was the snow-crowned head of Mealfourvounie; and in the far distance we thought we could distinguish the top of Ben Wyvis. To east or west we could almost see across Scotland. In the one direction were the mountains that line either side of Strathdee, while in the opposite was the massive brow of Ben Nevis, and far down in the hollow at its foot the glittering waters of Loch Eil—the bold outlines of the mountains of Ardnamurchan and Ardgour, standing

out against the sky, completing the picture. But while gazing in admiration on this scene we forget that time goes on, and that we have a long walk ere we arrive at our destination. We have hardly started before our attention is attracted by a very dark patch of ground, which we find studded over with dwarf plants of the Starry Saxifrage (*Saxifraga stellaris*, L.) without any flowering stems, the flowers being imbricated among the leaves; while alongside grows the *Dicranum Starkii*, W. & M., with its hoary diaphanous foliage. We now turn to the south along the shoulder of the mountain, and go almost in a straight line for about three-quarters of a mile, when we come upon a tract where the soil was composed of finely broken quartz; and here we found perhaps the rarest plant of this district —the Alpine Stitchwort (*Stellaria cerastoides*, L.), which, with its trailing stems and white flowers, was in striking contrast with the ground we had just come over. The descent from this point, which is about 3000 feet above sea-level, was very rapid, and we proceeded down along the right bank of a burn that falls into Moy Water until we arrive at the junction of the two streams at about an altitude of 2000 feet. This part of our journey we found the best for botanising, for here we got the mountain form of the Scurvy-Grass (*Cochlearia officinalis*, L.), the Alpine Meadow-Rue (*Thalictrum alpinum*, L.), the Least Willow (*Salix herbacea*, L.)—the smallest native shrub found in Britain. The Yellow Mountain Saxifrage (*Saxifraga aizoides*, L.) was growing on the wet rocks of the burn, while on the banks that rose on either side grew large plants of the usual form of the Starry Saxifrage (*Saxifraga stellaris*, L.); and here also among the rocks grew the Dwarf Cud-weed (*Gnaphalium supinum*, L.), and the largest plants we have ever seen of the Fir Club-moss (*Lycopodium Selago*, L.) From the junction of the two streams the descent was more gradual for about half a mile, but over very rough and boggy ground, that greatly taxed our exhausted energies. The only plants of special interest that we met with were the rather rare Moss, *Oligotrichum hercynicum*, DC.), the Alpine Club-moss (*Lycopodium alpinum*, L.), and the Alpine Lady's Mantle (*Alchemilla alpina*, L.) which grows in the crevices between the granite boulders all the way down, along the edges of the bed of Moy Water, until it joins the river Spean. In the bog at one place there is a patch of thick peat from which large tree-stumps project, and mark the site of part of the old Caledonian Forest; but it does not appear that more than clumps of these trees existed, as most of the hillsides are devoid of peat, and very bare. We had gone nearly two miles farther on our way before we found any other plants worth noting, but in a boggy part of the moor we got the two rarer varieties of Sundew (*Drosera intermedia*, L., and *D. anglica*, Huds.) These plants are most interesting from their carnivorous powers, and have been the subject of

most careful study by the late Dr Charles Darwin. They are easily grown in a saucer filled with wet Moss, if it is placed in a situation where the air is humid. The hairy appendages with which the leaves are furnished have a minute globule of mucilage at the point of each, and the unwary fly or other insect that comes in contact with these at once adheres, and gradually is absorbed by the plant.

The setting sun was gilding the mountain-tops, and the shades of night were falling upon the lower ground, when at last we arrived in sight of our destination. A few minutes more and we were receiving a kindly welcome from those who thought some accident had befallen us, or that we had lost ourselves.[1] A refreshing wash, and a cosy tea, soon made us forget our fatigues, and then we all joined in recalling to each other the incidents and adventures of a memorable day in the Wilds of Kilmonivaig and North-West Badenoch.[2]

II.—NOTE ON THE HABITS OF THE SPOTTED FLYCATCHER (MUSCICAPA GRISOLA).

By Mr A. B. HERBERT.

(*Read Oct.* 20, 1881.)

This bird was evidently a great favourite with Gilbert White of Selborne, who aptly designates it "that most mute and most familiar bird;" for though it is said to occasionally utter a faint warble, it has no claim to being a song-bird, and its usual note is a sharp call-note, or perhaps, more properly, cry of alarm, which is generally accompanied by a quick opening and closing of the wings as it sits on some post or dead branch on the look-out for flies and other insects; and as regards its familiarity, the nest is most commonly placed in a tree trained against our dwellings or garden walls, and I know scarcely any bird which has less fear of mankind. Flycatchers come to us early in May, and leave in August or early

[1] Some years ago an English gentleman was lost in this district among the mountains for several days, and at last found his way into Glen Roy, where he received the necessary aid.

[2] In addition to the Mosses mentioned, we also got the following: *Webera nutans*, Schreb., two varieties; *W. Ludwigii*, Spreng., *var. elata*, Schpr., growing at spring on north side of the summit; *Bryum alpinum*, L., lax form; *Grimmia Hartmanni*, Schpr., abnormal, and dwarf leaf-points distorted; *Dicranum falcatum*, Hedw.; *Philonotis fontana*, L.

in September. They are so very local in their habits that they are seldom seen more than about 200 yards from their nesting-place. An instance of this peculiar habit may be observed in the Dean Cemetery, where they breed regularly. You may go to the eastern part of the cemetery again and again and never see them; but within a hundred yards of the western entrance they are always to be found in the summer months, and their sharp staccato note greets you there at once. As far back as my memory extends, I have been a close observer of the habits of these interesting summer migrants; for when I was a child, a pair of Flycatchers had their nest year after year in the same branch of a Banksian Rose trained round my bedroom window, and I am quite convinced that the same birds or their young return annually to the same spot for nidification, and somehow there is always associated in my mind with these favourite birds the rich perfume from the clusters of white bloom of the Banksian Rose.

My principal object in writing these remarks on the Flycatcher is to contradict in the most emphatic manner an editorial note to a popular edition of White's 'Selborne,' where this very useful bird is most unjustly libelled as a destroyer of Bees; and I much fear the erroneous impression conveyed by this note has been the death of many a poor innocent Flycatcher. I had frequently observed the birds follow a Bee, seize it, and then settle on the gravel walk and beat it to death; but I felt sure the bird with its short beak dare not do this to a *worker* Bee on account of its sting, and that it must be feeding on the stingless drones—and I determined to ascertain this fact beyond the possibility of doubt. So the next time I saw the bird thus occupied, immediately it settled on the walk I threw a clod of earth and made it relinquish its prey. This I did at various times, and always with the same result—viz., that, as I expected, the insect was invariably a drone, and not a worker Bee. Now the time when the Flycatchers require these fat drones for their young is after the swarming season is over, and then the workers themselves are turning out and destroying the drones, which are no longer necessary in the economy of the hive; and therefore the birds are assisting the workers instead of destroying them, and are consequently friends, and not enemies, to the bee-keeper. I need scarcely mention that now, 20th October, there are no drones in our bee-hives.

Men should hesitate before publishing as facts in Natural History the results of superficial and careless observation. If the writer above referred to had reasoned on the improbability of a short-billed bird catching stinging Bees with impunity, and followed up his investigations, he would not have promulgated this erroneous statement, which, I have no doubt, has been copied into other works. I once saw a Sparrow take a drone from the landing-board

of a hive; but Sparrows are not enemies to Bees, and I venture to suggest that the Mantuan swain was in error when, in the 4th Georgic, he mentions the Swallow as a destroyer of Bees. Virgil's remark may be literally translated thus—"The bloody-breasted Swallow bears away in her beak the Bees while on the wing, sweet morsels for her merciless young." And I am confirmed in my view by the following remark from a correspondent in the last number of the 'British Bee-Keeper's Journal.' He says: "I saw a Swallow fly up to another which was sitting on a telegraph wire, and put something into its mouth, and then go away; the other almost immediately dropped what it had received. Noticing that it looked large, I went and examined it, and found it to be a large drone." A writer in the 'Field Naturalists' Magazine' for 1834 also states that, having observed some Swallows seize Bees in passing his hives, he shot them, and on opening them found that although they were literally crammed with drones, there was not a vestige of a working Bee. The Blue Tit (*Parus cæruleus*) has also been accused of killing worker Bees, but I very much doubt whether any of our short-billed birds dare attack a stinging Bee. Having mentioned the subject of Bees, it may be interesting to many of our members to know that a new Bee to this country has recently been introduced from Cyprus, and called the Cypriote Bee. I saw lately a hive of these near London, and they are extremely pretty insects, and very industrious—much smaller and lighter in colour than the Ligurian or Italian Bees, now so common in our apiaries. The owner of these Cypriotes had them in a bar-framed hive, and kindly took out several frames with the insects clustering on them for my inspection; but I am sorry to say he gave them a bad character for irritability, and for using their stings at the slightest provocation, being almost as bad in this respect as the little vicious Egyptian Bees. But to return to the subject of my note. The Flycatcher is most useful in destroying many insects which are injurious to vegetation, and I will mention one species in particular. We often see a white Cabbage Butterfly flitting about, apparently in a most innocuous manner, over a bed of Cauliflowers or other plants of the Brassica tribe. But watch the insect closely, and if a female, you will observe her settle first on one plant, and then on another, at short intervals. Examine at once the spots where she settled, and you will find small white eggs deposited on the leaves. These soon become green grubs, which injure and disfigure the plants—in many instances, where the grubs are numerous, rendering the plants unfit for human food. Now, if you have our friend the Flycatcher in the garden, the Butterfly's career is usually cut short before it has time to do much mischief. Her eye is upon it as it comes "over the garden wall," and it is soon seized, its wings bitten off and carried away by the wind, and the

body swallowed or taken to the nest. Entomologists may say the insects should be allowed to live; but many of us will be of opinion that they should at any rate be kept within reasonable bounds, as nature intended, by the birds, and that we prefer the vegetables *minus* the grubs.

Much as I like and value the Flycatchers, truth compels me to admit that they will occasionally give their young a few Red Currants; but considering the great service they render to the gardener, I never grudged them these, and it is only very rarely that they deviate from their habit of being purely insectivorous.

A pair of Flycatchers had their nest for many years in the same fork of a Pear-tree in my garden. There was another nest in an Apricot-tree against the wall, too near the ground to be safe from cats, so in the winter I cut out half a brick higher up to make a suitable nesting-place for my feathered friends on their arrival in the spring. But to my surprise, before the migrants arrived a Robin took possession of the hole, and had young nearly fledged when the Flycatchers appeared. As soon, however, as the Robins flew, I cleared out the nest, and had the satisfaction of seeing the Flycatchers rear their young in the same hole that summer, and for many consecutive summers afterwards. Many curious places have been chosen by these birds for nidification—for instance, one in the ornamental crown top of a lamp in the office of the Woods and Forests, Whitehall, London; another in the stove of the late President of the Horticultural Society, who noticed that during incubation, when the thermometer indicated a higher temperature than 72°, the bird often left the nest for a considerable interval; and I once saw a nest on the top of a Cactus in our vicar's conservatory in England. This Cactus was of very irregular growth, and there was a cavity just under the Flycatcher's nest, in which a Wren built her nest, and the two birds reared their respective young ones in close contiguity in perfect amity.

In conclusion, I will merely remark that if these rough notes should in some degree prevent the destruction of birds so useful to both gardeners and farmers, and so interesting in their habits to ornithologists, my object will be attained; and I trust many will hesitate before they give credence to an accusation so unjustly made against our "most mute and most familiar" little friend, the Spotted Flycatcher.

III.—BONES AND SHELLS TAKEN FROM A KITCHEN-MIDDEN ON INCHKEITH DURING 1881.

EXHIBITED BY MR T. B. SPRAGUE.

(*Oct.* 20, 1881.)

MR T. B. SPRAGUE exhibited a number of bones and shells he had collected from a kitchen-midden on Inchkeith. The midden is situated on the high ground at the back of Battery No. 2, recently erected on the island, and a good section of it is exposed by the trench which surrounds the battery. The midden is composed principally of shells of the common Limpet (*Patella vulgata*) and Periwinkle (*Littorina littorea*), exactly similar to those which are at present found in great quantities upon the rocks of the island. There were also some shells of *Purpura lapillus*, and two fragments of Crabs' claws (*Cancer Pagurus*). The bones collected by Mr Sprague are chiefly those of the grey Seal and of various sea-birds, such as the Solan Goose. There are 148 bones (or portions of bones) of the grey Seal—including 6 rami (no two of which are a pair), 10 humeri, 23 vertebræ (one only of which belonged to an adult animal), 15 fragments of skull, and 22 ribs; and there are 117 bones (or fragments of bones) of birds. There is one rib of Sheep, 16 fragments of marrow-bones of ruminants—all of which had been broken, apparently for the purpose of extracting the marrow—and one fragment of a large bone of some large animal (Horse?). One of the bones, a fragment of a Seal's rib, bore a mark which may possibly have been caused by a dog's tooth; and one of the bones evidently belonged to an individual that was wounded by a flint-headed arrow, but escaped and lived for a considerable time afterwards, before it was actually captured. Professor Turner, who has seen the bones, points out that the ten humeri of Seal belonged to at least six different individuals, of which only one was mature, and suggests that Inchkeith was probably a favourite breeding-place of the Seal at the time the bones accumulated. Mr Sprague stated that in the centre of the midden he found the remains of a fireplace or hearth formed of fragments of rock; and he exhibited two fragments of the bones of some ruminant animal, which were rounded at the ends, and appeared to have been used as some kind of rude implement. He did not find any arrowheads or stone implements; but the midden, of which he only explored a small portion, appeared to cover a considerable extent of ground, and probably would reward the labours of other investigators.

In the 'Proceedings of the Society of Antiquaries of Scotland' for

11th March 1872, there is an account by Mr David Grieve of a kitchen-midden on Inchkeith examined by him in the year 1870. He says: "The locality is within a gunshot of the landing-pier on the east side, and in the slope or *talus* inclining from the cliffs to the beach." The bones obtained by him were portions of skull and a cervical vertebra of grey Seal; eleven bones of Sheep; one bone of Pig; seven bones of Ox (*Bos*); cannon-bones, parts of jaw, and several teeth of Horse; jaw-bones and other bones of Rabbit; also many portions of bones, chiefly of Sheep and Ox (some split). The shells found were—*Littorina littorea*, *Patella vulgata*, *Buccinum undatum*, *Ostrea edulis*, *Tapes pullastra*, *Purpura lapillus*, *Pecten varius*, and *Pecten maximus*. Mr Grieve states that the Rabbit burrows and is in a wild state on the island at present. On Mr Sprague's visit to the island no traces of the Rabbit were to be seen, and it was stated that it had been exterminated by the workmen engaged in building the fortifications upon the island. On comparing the lists of bones and shells found by Mr Grieve with those found by Mr Sprague, a very marked difference is observed. Almost all the bones found by the former were those of domestic animals, whereas in those found by the latter a very small number of bones belonged to domestic animals, and the great majority to the grey Seal. Mr Grieve does not appear to have found any bones of birds, whereas Mr Sprague found a large number of bones of sea-fowl of different kinds. It seems to be a fair inference that the kitchen-midden examined by the former is of a much later date than that examined by the latter—or, at all events, that it was accumulated by men further advanced in civilisation, and whose animal food was furnished more by their own domestic animals than by sea-birds and beasts. This conclusion is supported by the shells. Mr Grieve found shells of the Oyster and Scallop, whereas the shells found by Mr Sprague consisted entirely of Limpet and Periwinkle, and other shells which can be obtained in great abundance upon the rocks at low water. Some kind of dredging apparatus is essential to procure the former; and it seems a fair inference that the men who accumulated the kitchen-midden examined by Mr Sprague had no dredging apparatus such as must have been possessed by those who accumulated Mr Grieve's kitchen-midden, and to that extent they were in a lower stage of civilisation.

IV.—THE PROBABLE EFFECTS OF A CHANGE OF ELEVATION ON THE FLORA OF A COUNTRY.

By Mr W. TAIT KINNEAR.

(*Read* 22*d Dec.* 1881.)

The object of the present paper is to throw out a few suggestions as to the results which upheaval or depression might produce on the flora of the district where these operations take place. It must not be forgotten, however, that there are other powerful agencies at work. Man has cut down enormous spaces of forest-land, and has drained huge swamps, thus hastening the work of extermination and introducing new plants. Seeds from distant countries are deposited in ballast-heaps, and often spread far and near, to the injury of native plants. But most effectual of all, we notice that every plant seems tied down more or less strictly to certain conditions of existence, which in most cases it cannot go beyond. When these conditions change slowly or quickly, it is evident that if the same flora is to remain at that locality, it must adapt itself to the altered conditions: if not, then it must be exterminated by those better fitted to exist there.

The processes of upheaval and depression entail so many changes with them, that it is reasonable to think that in past time they have had some effect in modifying our present flora. Any process that changes the habitats of plants must affect the plants themselves. Upheaval changes the marsh into the plain, and the plain into more or less hilly ground. The effects of upheaval are different in different parts of the world. Thus a few hundred feet added to some of the mountains of this country would develop conditions suitable to the growth of an alpine flora. A depression of two thousand feet without a decrease of temperature would exterminate the greater part of an alpine flora from Britain. If, however, a decrease of temperature accompanied the process of depression, no material effect would take place, for the alpine flora would descend towards the coast.

High mountains in the tropics present an epitome of the different zones of vegetation to be found as the traveller moves northwards from the tropics. Agassiz has the following remarks on this point: "The climatic effects of different levels of altitude upon the growth of animals and plants is the same as that of different degrees of latitude; and the slope of a high mountain in the tropics from base to summit presents in a condensed form an epitome, as it were, of the same kind of gradation in vegetable growth that may be

observed from the tropics to the arctics." Nature affords several effective means for the distribution of seeds,—either by currents of air or water, birds, or furred animals; so that if elevation should go on in the tropics, the means are at hand to furnish a flora which shall succeed a tropical flora that cannot ascend beyond a certain limit. To this sub-tropical flora would succeed one characteristic of temperate regions, should circumstances permit. Depression going on to a sufficient extent would produce in a country possessing different degrees of elevation a series of islands; so that if we find a series of islands possessing a similar flora, it is reasonable to think that they may at some previous time have been united. A converse process of upheaval going on in an archipelago would convert a number of islands into a continuous belt of land, so that in this case the conditions are favourable for the appearance of a uniform flora.

We find at the present day that the means which nature employs for scattering seeds over a large extent of the earth's surface produce effective results. A high wind will scatter the seeds of plants that have lived on hilly ground over the marsh, meadow, and sea-shore. The seeds of maritime plants must often be carried far inland; while it is needless to speak of the effects which sea-currents produce in conveying seeds from one part of the globe to the other. Thus there is every chance given for an intermixture of plants belonging to different habitats. But in reality, do we, as a general rule, find the marsh plant growing alongside the agrarian weed, or the littoral plant with that of the wood? Speaking broadly, we do not. If, then, the plants characteristic of lowland districts will not grow in the sea-marsh, what will happen should a tract of level country be turned into a sea-swamp? If the change be sudden, then there is no doubt but that maritime plants will speedily exterminate all the others. But if the change be very gradual, then there is great reason to think that some, if not all, of the plants which grew on the open level ground may gradually adapt themselves to the new conditions of life. In this way varieties may arise. Some plants would seem to be able to defy extermination. There are several cosmopolitan genera which no change of climate would cause to become extinct. Polygonum amphibium grows in ponds and on dry land. Some plants in this country range from the sea-shore to alpine limits, while others would seem to take a leap from the sea-shore to the mountain, or *vice versa*. It follows, then, that should the marsh be suddenly elevated and drained, those plants which can grow both on moist ground and on dry would not become extinct. Again, the maritime plants which in this country are found at alpine limits would still continue to exist, even though the sea-line were rapidly elevated. To account for the fact of Cochlearia officinalis, Armeria

maritima, and Plantago maritima growing at the sea-shore, and then, after an interval, on bleak mountain-tops, is not an easy task. It cannot be said that the conditions of existence at alpine limits are those next favourable for these plants to those conditions in which they live at the sea-shore. Nor do we think the hypothesis that these plants were once universally distributed between the two spots is correct, for it does not seem to us consistent to think that a plant about to be run down in the struggle for existence could retreat to two habitats so entirely distinct.

A large number of instances could be given in which we find that the species belonging to a single genus occupy different habitats. Thus in the genus Carex we have species living on the sea-shore, the marsh, and dry ground. The genus Veronica has species to be found in marshy, semi-marshy, dry, and mountainous ground. Other instances will occur to every one. How is it that two plants, the differences between which the botanist only can determine, occupy two habitats so entirely distinct from each other? Should not two species so similar to each other be able to live one in the habitat of the other? Take two common plants, Veronica Beccabunga and V. hederæfolia: will the difference between them in the matter of leaf-form, or minute difference in the flower, account for the one growing in the marsh and the other on the wayside? We are inclined to think that it will not. It is a fact that it is a difficult matter to acclimatise alpine plants in gardens; and it has been proved that the best means of doing so successfully is to save seeds from those alpines which have previously managed to thrive. It is found that the plants which spring from these seeds are better fitted to grow well than the plants from which they were derived. A similar process may go on in nature. Suppose we have two marshes where one plant grows. Suppose also that the one spot very gradually becomes dry land, either through the gradually filling up of the marsh by its own decayed vegetation, or by the drainage, owing to some upheaval, being altered. As we have supposed the change to proceed slowly, there is every reason to think that the plant in question will be able to thrive until the character of its former habitat is entirely changed. Differences in the flower may come about by the unconscious selection by means of insects which have not before visited it. During all this time the same plant may be growing in the marsh which was not in a process of transition into dry land. There is no doubt but that the large number of species belonging to one genus that live under identical conditions may be owing to the variation of one or two original species, through the influence of the struggle for existence. But it seems to us that when we find two species nearly identical with each other inhabiting spots entirely different in character, the cause of this must be owing to some such process as that just

mentioned. Besides, the researches of Bendant and Plateau have proved that it is possible to accustom fresh-water species to live in the sea, and marine species to live in fresh water. The experiments of Schmawkewitch show that "by greatly increasing the saltness of the water, the crustacean Artemia salina became transformed in the course of a few generations into the totally dissimilar species Artemia Mulhauseni; while by the converse process he succeeded in transmitting the latter back again into the former. A still more extraordinary circumstance followed the dilution until it was perfectly fresh of the salt water in which Artemia salina lives, for in the course of a few generations the character of that species became so changed that they finally assumed those of a different genus, Branchipus." Can we draw an analogy? Any two of these crustaceans may have been derived from the other by the medium in which they lived being altered by natural means, and not by artificial methods as in the experiments. Similarly, one species existing in a habitat in a gradual state of conversion into another may become eventually specifically different from the same plant, which may still exist in some remote part in its original state.

Upheaval of the sea-bottom in the direction of currents flowing from continents will tend to extend the flora of that continent—at least, of the parts opposite the spot where upheaval has taken place. Thus the Bermudas, lying 800 miles east of the coast of Virginia, and placed in the track of the Gulf Stream, have not a single indigenous plant. They are all similar to those found on the opposite coast of America. A contrary case is that of the Mauritius, lying off the east coast of Africa, which has not a single plant similar to those on the opposite African shore, owing to the fact that no currents are said to run between the two spots. One tropical plant, at least, is known to have been found in a germinating condition on the southern shores of England; and two American plants, the Anacharis and Mimulus, have lately taken a strong hold in this island. The time during which man has studied nature in an intelligible manner has been so short, that there is no wonder we have not learned whence many of our native plants have come, and what links in the chain of life have been broken. The direction of sea-currents must be dependent in some measure on the distribution of the land. The present distribution of land and water has not always existed; and to cite one case only, the depression of the land-surface of Britain before the deposition of the Chalk must have been very great. Equally as great is the height to which the secondary rocks of the Alps have been upheaved. If the theory of the Weald be correct, then we once had a river running through Britain as large as the Ganges, and therefore draining a large part of land now covered by the Atlantic Ocean. As islands lying off the coast of a continent generally possess a

flora similar to the latter, especially if currents run between the two, a cessation of the currents may lead in time to the flora becoming specifically, though not generically, distinct.

As the work of upheaval or depression cannot be going on everywhere at the same time, it follows that if we find the character of one habitat changing, the plants which grew on it may retire to others which are not changing, provided that means are present for the effectual transmission of seeds. This migration would be most effectually accomplished among seeds with a pappus, while pond-weeds whose seeds sink to the bottom might have some difficulty in spreading. The principle of migration, if the word is suitable for plants, finds a fitting analogy in palæontology. Between the Chalk and the Eocene there is an enormous break both in geological time and fossil contents. This is correctly explained by supposing that the mammals living at the time of the Weald migrated elsewhere, upon the great depression of land-surface previous to the deposition of the cretaceous rocks, and returned during Eocene times, previous to which a great process of upheaval took place. Australia at the present day has several forms akin to those of Mesozoic times, as the bivalve Trigonia, the Port Jackson Shark, and the Burramunda (*Ceratodus Fosteri*), all of them generically akin to species long extinct in our islands, which must have betaken themselves thither when they could no longer keep up the struggle for existence here.

It is a fact well known to botanists that some alpines are not restricted as to their range of altitude. On the west coast of Scotland they descend to sea-level. In mountainous districts they are also found almost on a level with the sea-shore, especially if streams running down from higher grounds are present. This fact may either be owing to the excessive rainfall of the west coast, or from the fact that the soil at the sea-shore is the same as that within alpine limits, as all the rocks of the Highlands are metamorphosed Lower Silurians, except the patches of Cambrian rocks in the extreme north. From which it is evident that a very considerable depression would not cause some of our alpines to become extinct in certain parts of Scotland, where the moisture and soil are the same as that on mountain-summits. We do not, however, find alpines growing on the sea-coast in the east of Scotland, although the seeds must be carried to sea-levels in some places; and it would be a curious matter to inquire into, and to ascertain whether, if we had a rainfall on the west coast equivalent to that on the east, and a soil resulting from the disintegration of carboniferous rocks instead of Lower Silurians, we should still find alpines descending to the sea-shore. Very probably they would not.

V.—NOTES OF A BOTANICAL RAMBLE IN THE SAENTIS DISTRICT, SWITZERLAND, AUGUST 1881.

By Mr GEORGE BIRD.

(*Read Dec.* 22, 1881.)

It is proposed in this paper to give a few notes of a recent trip to Switzerland, with special reference to a botanical ramble in the Saentis district. I was accompanied by our friend and fellow-member, Mr J. C. Keller,[1] who, while spending his vacation in his Swiss home, kindly undertook to make me acquainted with some of the interesting features of his native mountains. Our headquarters during our stay were at Rheineck, in the canton of Appenzell. This flourishing and important village is prettily situated on the banks of the Rhine, which forms at this point the boundary between Switzerland and Austria. The buildings of which Rheineck is composed are substantial edifices, forming several handsome streets, with remarkably pretty suburbs stretching on either side. The industries of curtain and embroidery manufactures are carried on extensively, and the sound of busy shuttles may be heard issuing from many of the larger structures as one passes along. To the rear the ground rises at a considerable incline; farmhouses and mansions are scattered thickly on every available space, and the banks which slope towards the river are occupied by orchards, where immense quantities of fruit are raised, and where the Vine is cultivated to a great extent. The views from the higher grounds command comprehensive stretches of exquisite mountain scenery; the Lake Constance—a splendid sheet of water fifty miles in length—lying to the left, while the intervening valley was richly cultivated with Maize and other products. We botanised in this neighbourhood, examining all the plants that were in flower; and though we were rather late in the season for the flora generally, what were got were interesting and abundant, none, however, being considered rare, nor differing much from our own flora. The weather was exceedingly warm, and a very noticeable feature was the number of insects to be seen. The Crickets especially were very active, and filled the air with a continual chirping; while Butterflies of beautiful hues flitted about in greater numbers than one is accustomed to see them with us. A very conspicuous plant everywhere on the roadsides was the Chicory (*Cichorium Intybus*),

[1] We are sorry to have to record that Mr Keller died on the 10th January 1882.

its blue composite flowers rendering it quite an object of beauty. It seemed generally diffused over Switzerland, at least on the lower levels. In the marshy spots, where reeds were growing very high and rank, the White Water-Lily (*Nymphæa alba*) was uncommonly plentiful.

Having become familiarised with the plants of the district, we completed our arrangements for a ramble on the Saentis, which is the principal mountain-range in the canton of Appenzell. The altitude is from four to eight thousand feet; the highest point—the Saentis itself—being 8215 feet, or about twice the elevation of our highest mountain in Scotland,—Ben Nevis. As a convenient starting-point we made our way to the town of Appenzell, and on a bright and sunny morning at six we commenced our excursion. Our road followed for some miles the side of a stream which wound down the valley, the rich grassy verdure being clothed with numbers of our prettiest meadow plants, and bordered by a good deal of small wood, such as Alder, Willow, Ash, and Plane. As we advanced, the valley gradually narrowed,—the mountains towering up on our left, while on our right a beetling crag, rising steep and high, closed in the river, now a much smaller though still impetuous stream. Far up on the mountain-slopes nestled many a solitary cottage, with its cattle and goats grazing in the adjacent ground. As yet the plants we had met with differed but little from those of a lower level. We had passed large quantities of Aconites, and had picked up Alchemilla alpina (the Mountain Lady's Mantle), one of our favourite Highland plants. Steadily pursuing the path which carried us to the more open pastoral mountain-tops, our plant examination became more interesting. Among the first good "finds" was the Swiss Rhododendron, a purely alpine species. It grows in the form of a bush, and its richly tinted blossoms render it highly attractive. In many parts it is found in great abundance. Thus, in the case of one mountain which we afterwards explored, it literally clothed the rocks, just in the same way our Whin does with us. The Swiss themselves are particularly partial to this plant, and regard it as typical of the alpine region. One of their charming songs commemorates its virtues.

The prevailing character of the rocks in the Saentis district is limestone, which, being peculiarly liable to weathering, the mountains assume very various conformations, according to the action of the elements upon them. In some cases they presented rounded tops and smooth slopes, while in others there were jagged ridges with abrupt precipices extending for long distances. In many parts frowning chasms, terrible almost to approach or look down, separated one mountain from another; and as you picked your steps along the face of the ridge, an immense depth below inspired a feeling of sublimity and grandeur. It required very careful

work searching for plants in such circumstances; but when any good thing was found, one felt rewarded for the trouble. Towards the afternoon we reached Meglis-alp (altitude 4800 feet), a halting-place where pedestrians find tolerably good accommodation at a reasonable rate. This inn or tavern is surrounded by a few other humble huts, principally inhabited by herds who tend the goats and cattle, or are occupied in making cheese. It is the custom to send the cattle to graze in the higher grounds during the summer, and Meglis-alp is one of those pasture-spots where ample herbage and good shelter can be found. The cattle have generally a deep-sounding bell attached to their neck, so that the tinkling of these bells falls not unpleasantly on the ear at every motion of the animal. The mountains in the vicinity of Meglis-alp are very lofty, and almost inaccessible unless to practised climbers. Without, therefore, attempting anything hazardous, we penetrated far up the valley lying between the hills, where vegetation often lingers when the ordinary season is past. In this way we had the gratification of meeting with Soldanella montana, Primula farinosa, &c. It was also interesting to observe in abundance, where some snow had recently melted, strong and vigorous patches of our common marsh-plants, Caltha palustris and Veronica Beccabunga.

The following morning we rose at one o'clock to continue our ramble to the summit of the Saentis. It was still dark, and by the aid of a lantern we filed out of the valley, up the face of the hill, following a zigzag path, and round the ridges. The road was steep and difficult for some distance, and rendered still more so owing to the uncertain light; but it was pleasant to feel the cool air, instead of the beating sun we usually experienced during the day.

The configuration of the rocks was very wild and grand, with great depths below, and snow-fields in the distance. Very frequently there were immense fissures and cracks—unmistakable evidence of what atmospheric influences and water can do in breaking up, disintegrating, and altering even the "everlasting hills." This was one of the most distinct features of these alpine solitudes. The top of the mountain was composed of a huge cone, the actual surface being rather limited. On all sides it was steep. We were curious to know what flora we should find at these altitudes. There were certainly more plants than one meets with on the top of any of our Highland mountains, most of them species which were gathered at a lower level, though the higher ones were much stunted in growth. A very pretty Cerastium (*C. latifolium*) whitened the rocks with its snowy petals, having a habitat much like our Ben Lawers variety. The turquoise-blue Myosotis alpestris was very conspicuous, though only an inch high. On the ledges Saxifraga Aizoon secured an existence by clinging to the inter-

stices of the rock; and Silene acaulis (Moss Campion), with its pink cup-shaped florets, flourished on a grassy slope, giving it a distinct colouring, and, together with a bright yellow Cinquefoil (*Potentilla aurea*), enlivened these lofty retreats.

A good inn afforded shelter and refreshment on the summit, and was largely taken advantage of, both by visitors who had ascended overnight and by those arriving at all times during the day.

On commencing our descent, it was still early, so we devoted the day to a leisurely return to Meglis-alp, examining anything of geological interest, picking up many good plants, and enjoying the magnificent alpine views which were every now and again disclosing themselves. Leaving the ordinary track, we took what looked a much more direct way of getting down, but in so doing we brought upon ourselves an amount of hard work we did not quite expect. We were not long in finding that in this case appearances were certainly deceptive; and as it seemed a formidable task even to regain the road again, it was resolved to persevere in the direction we had chosen. I can scarcely give a clearer idea of the kind of footing we had, than by suggesting that one of the mountains had but recently been broken up into fragments, and the pieces, varying from some tons' weight each to a few pounds, had been tumbled down the sides of the valley, and allowed to sort themselves. This extended for some miles, so that it was a continual scramble from one rock to another, the edges of the stone affording a difficult footing. When we did reach the bottom, however, it was not without a thrill of satisfaction, and, looking back, we could in a greater degree realise the power of the physical forces at work whereby these rocks were arranged as we now find them. We had evidently been following what was the bed of an alpine torrent, which in the spring carried the ice and melted snow from the higher elevations, and it was stupendous in all its bearings.

On the following days the weather still kept very favourable, enabling us to continue our excursion to neighbouring mountains, but the altitude of these being considerably lower, the alpine flora was not so characteristic. The subjoined list contains the rarer plants collected, omitting the commoner species, which were identical with those of our own flora; and I am indebted to Mr Robert Lindsay, of the Royal Botanic Garden, for his kind assistance in determining several of the plants in this list:—

Achillea atrata.
Alchemilla alpina.
Allium lanceolatum.
" pedemontanum.
Allosorus crispus.
Anemone alpina.
" trifoliata.
Asplenium viride.
Aster alpinus.
Astrantia minor.
Campanula barbata.
" alpina.
" Trachelium.
" rapunculoides.
Cerastium latifolium.
Chrysanthemum alpinum.

Cystopteris fragilis.
Dianthus superbus.
Dryas octopetala.
Epipactis latifolia.
Erigeron alpinum.
Gentiana acaulis.
" asclepiadea.
" bavarica.
" campestris.
" excisa.
" Pneumonanthe.
" Saponaria.
Globularia cordifolia.
Gymnadenia conopsea.
Gypsophila prostrata.
Hutchinsia alpina.
Myosotis alpestris.
Nigritella angustifolia.
Paris quadrifolia.
Parnassia palustris.
Pedicularis verticillata.
Poa alpina.
Polygonum viviparum.
Polystichum Lonchitis.
Potentilla maculata.
" aurea.
Primula farinosa.
Ranunculus alpestris.
" " var. Bertolonii.
" montanus.
Rhododendron hirsutum.
Rumex scutatus.
Saxifraga Aizoon.
" aizoides.
" " var. aurantiaca.
" cæsia.
" diapensioides.
" muscoides.
" rotundifolia.
" stellaris.
Scutellaria alpina.
Serratula tinctoria.
Soldanella montana.
Thlaspi rotundifolium.
Vaccinium Vitis-Idæa.
Veronica urticæfolia.

At the meeting of the 22d December 1881, the following series of animal parasites was shown under the microscope by Mr James Simpson :—

Pediculus capitis (from the Australian savage).
Braula cæca (from the Queen Bee).
Colpocephalum sub-æquale (from the Crow).
Docophorus ocellatus (from the Crow).
" aquilinus (from the Golden Eagle).
Trichodectes subrostratus (from the Cat — first specimen recorded in Britain).
" scalaris (from the Ox).
" Equi (from the Horse).
Hæmatopinus sp. (from the Mouse).
" sp. (from the Buffalo, India).
" Suis (from the Pig).
" spinulosus (from the Rat).
Nirmus cameratus ♂♀ (from the Capercaillie).
Lipeurus sp. ♂♀ (from the Capercaillie).
" pelagicus (from the Fulmar Petrel).
Nycteribia sp. ♂ (from the Flying Fox).

Mites.

Dermaleichus chelopus ♀ (from the Blue Titmouse).
" bifidus ♂♀ (from the Blue Titmouse).
Glyciphagus plumiger ♂♀ (very rare).
" sp. ♀ (probably a new species).

VI.—THE HAUNTS AND HABITS OF THE CROSSBILL (LOXIA CURVIROSTRA).

By Mr ARCHIBALD CRAIG, Jun.

(*Read Jan.* 26, 1882.)

This very curious bird is of much commoner occurrence in various parts of Scotland than is generally supposed, which may be accounted for in part by its chiefly inhabiting the dense Fir forests of the north,—its general quiet habits also rendering it at times a matter of some difficulty to discover its whereabouts. The district where the species most abounds is Strathspey, particularly in the plantations around Castle Grant, where, by the way, they used to be denominated the "American Bird" by the youth of the neighbourhood. But besides that locality, numbers have occurred at different periods of the year in the woods of Dulsie, near Elgin, in the Fir forests of Ross-shire, Sutherlandshire, Dumfriesshire, Peeblesshire, and also in Glen Urquhart, Inverness-shire. Judging from accounts contained in works on ornithology, its numbers must have vastly increased in Scotland of late years; but there can be little difficulty in accounting for that circumstance, when we take into consideration the great extent of country now planted with Firs, which in the early part of the present century was barren muirland or rough hillside; so consequently the birds, finding a sufficient supply of food, remain all the year round, in place of migrating to foreign lands. Numerous instances are on record of their sudden appearance in various parts of England, where they were quite unknown previously—as far back even as the year 1254, also during the reign of Queen Elizabeth, and at various other periods,—for information as to which, reference may be made to Yarrell's or Morris's 'British Birds.' In the former work will be found a quaint description in old English of a flock which visited Kent in 1593, but which it is unnecessary to quote here. A still older mention of the Crossbill is contained in a fanciful superstition from the German, translated and versified by the poet Longfellow, and appearing in his poems under the title of "Legend of the Crossbill." The conception is a strange one, savouring slightly of absurdity; yet, however fantastic and unreal the idea may appear to the reader, the subject is hardly one to be commented upon in a paper like this, and certainly of too solemn a nature to be turned into ridicule. Other instances might be quoted to show that its presence in many parts of Great Britain has been noticed from time

to time during several centuries; but as they may all be gathered from the standard works on natural history now in use, with these few introductory remarks we may turn more particularly to the habits and outward appearance of the bird itself.

With the exception of the short season of incubation, Crossbills are almost invariably observed in flocks, especially during autumn and winter, although at times solitary individuals are met with in most unlikely places. The numbers composing the flocks vary very much, ranging from little bands of five or six up to large companies of sixty or seventy, the latter including both the old birds and the young of the year, whereas the smaller lots are most likely to be the parents with their own offspring alone. A good deal of uncertainty exists as to the times of breeding. In mild seasons many nest in February, which is just about a month earlier than the earliest of our native birds, such as the Raven and Rook. But again, many seem to postpone operations until May or June. The reasons for this variation are not easy of solution. An open winter and early spring may no doubt induce them to pair a little sooner than they would feel inclined to do in a cold backward season, when the stock of food wherewith to feed the young would naturally be scarcer; but, on the other hand, it is confidently asserted by those who have studied their habits that the birds found in May and June are second broods, which is probable enough, as many species rear two and even three successive families in a season. Without further opportunities for closer observation, it would be premature to offer an opinion as to which suggestion is the correct one. They are very affectionate to each other, and not much addicted to quarrelling, their principles being usually those commended in the psalm regarding brethren dwelling in unity. Yet, notwithstanding their general love of peace, a few overstep the bounds of discretion now and again, more particularly a short time prior to the pairing season. They may be seen occasionally fighting furiously in the air, screaming harshly the while—whether animated by jealousy or the mere fondness for testing their strength would be difficult to decide. As a rule, however, they may be said to agree admirably, and do not seem to attack other birds, although frequently accompanied by parties of Siskins, Redpolls, Tits, &c. In the late autumn the former birds more frequently join the Crossbills than at any other time of the year, probably "with an eye to the main chance"—it being very evident that they take advantage of the Crossbill's superior facilities for breaking open the cones to pick out the seeds from the half-opened ones left by the larger birds, without which assistance it would be rather an arduous task for them to extract any, especially when the cones are firm and unburst.

While on the subject of food, it would be as well to explain

shortly the interesting process by which the Crossbill contrives to pick up a living out of such apparently dry substances as Fir cones. In the case of the Larch cones, the bird usually cuts them off with its powerful bill much in the same way that a pair of scissors is used, then transfers the cone to its feet as you may have seen a Parrot hold a stick in its cage. But as the mode of procuring the seed can be better explained on the larger Spruce cone, I shall take it as an example. If the cone is not too big, the bird snips it off also, holding it against the branch with its claws; but should it prove too heavy, it hangs on back downwards after the manner of a Tit or Siskin. In either case the mode of procedure is similar. The under mandible has a sidelong motion as well as the up-and-down action possessed by all birds, so that being the case, it has an extra purchase over the cone, as will be seen presently. It inserts its bill underneath the scale of the cone, and moves the lower jaw to the side, at the same time opening its mouth, which double action has the desired effect of raising up the sheath. That done, it pushes out its long worm-like tongue and pulls the seed into its mouth, letting drop the thin papery-looking substance on the end of which the seed is placed. This operation is performed in far less time than it takes to tell, and it is marvellous how soon a strong old bird can finish a cone. The end of the tongue is furnished with a sharp bony appliance somewhat resembling a "scoop" in structure, which materially assists the bird in extracting the seed. From this slight description can be understood the use of the twisted mandibles, which, in place of being a deformity or malformation, as the old naturalists maintained, is a wise provision of nature to enable the bird to procure its food easily. In fact, an ordinarily constituted bill would be next to useless; and as it has hard work to do, Providence has endowed it with an extra-powerful organ to accomplish its purpose. The upper mandible crosses sometimes to the right and sometimes to the left; but it is quite a mistake to suppose that the manner of crossing is a distinguishing mark of the sex, each sex having the bill twisted in both directions. Some have the mandibles more crossed than others—not necessarily old birds, be it remarked, as young ones frequently show the twist to an extraordinary degree. Taken on the average, the bills of the greater proportion show the crossing to much the same extent, although there are exceptions to this as to every other rule. In connection with this peculiarity, Dr Bechstein, in his interesting volume on 'Cage Birds,' relates a foolish superstition prevalent in some parts of Germany, such as the Black Forest and Thuringia. He states that the country people hold the Crossbills in great regard, and often keep them in cages, not so much for the purposes of pleasure as from the idea that the poor birds attract diseases from the human frame to their own bodies, and in that

way are supposed to be unfailing specifics in the cases of epilepsy and apoplexy, both of which afflictions are common among birds deprived of their liberty. The insane idea is carried still further, as they firmly believe that the specimens which have the upper mandible crossed to the right side attract only the diseases peculiar to men, and those whose bill crosses to the left are kind enough to transfer to themselves the complaints of the opposite sex. Foolish ideas with reference to the habits and faculties of birds are not confined to Germany, however, the more illiterate of our own countrymen retaining beliefs whose extreme silliness would be ludicrous, were it not lamentable to think that such could exist in an enlightened age like the present.

As previously stated, Crossbills usually travel about the woods in flocks; and so fearless and apparently careless of danger are they on many occasions, that a person may climb up the same tree on which the birds are feeding, and by exercising a little caution may approach within a few feet of them, thus obtaining opportunities of a closer observation than can be had of most other species. It would appear from this that the presence of man has not the same terrorising effect on this species that it has on most other birds, but this must not be taken as an invariable rule by any means, as at times they are unusually restive and difficult to approach. To speculate on the cause of this vigilance would almost be useless. The most probable explanation appears to be that on these occasions the birds are about to shift their quarters, and consequently, like other species previous to migrating, do not seem inclined to settle down for any length of time in one place. Other and simpler causes may be at work to account for their restlessness, such as fear caused by being shot at, the close proximity of Hawks or Owls, &c. But the effects of these do not last long, as, after being fired at, they often return in a few minutes to the vicinity of the spot just vacated.

When feeding, they speak to each other in a low chuckling sort of note almost without cessation, but when on the wing they utter a clear ringing sound quite unmistakable to any one acquainted with the notes of birds. The song of the male is peculiar, and rather low in the tone, but at the same time audible a long way off in calm weather, from the fact of his taking up a prominent position on the top of a tree when vocally inclined, and in that way the sound is not intercepted by the thick branches. His musical abilities do not rank very high, but notwithstanding are not unpleasant to the ear, and, what is of more importance to the songster, are evidently appreciated by his feminine friends. The females are said to sing also, which is not unlikely, as in a number of species the song is not confined entirely to the male,—the Bullfinch, for instance, being an example in point. One peculiarity

which I have noticed in the Crossbill while in confinement is his warbling with his mouth shut, the only indication of his being so employed (saving the sound) being the puffing out at the throat, accompanied with a tremulous motion of the body, and a more apparent movement of the tail. In this case the sound ekes out at the sides of his bill; but when uttering the sharp call-note, or singing loudly, the mouth is opened in the usual manner.

Where trees are high, Crossbills seldom come low down except in winter, but at that time of year they often sit on the ground and pick out the seeds from the fallen cones, besides alighting on dykes or fences, should there happen to be any near at hand. It is, indeed, a pleasant sight, and one possessing especial charms for the naturalist, to observe a flock alight on the snow-covered ground; the bright red plumage of the males, and the scarcely less beautiful green hues of the females, standing out in fine contrast to the pure and dazzling whiteness of the surroundings. On these occasions they are apt to fall an easy prey to predatory boys, whose propensities for stone-throwing and other acts of cruelty to dumb creatures are matters of sufficient notoriety to need no comment. The Crossbill is an eminently foolish bird, so far as ideas of self-preservation are concerned, and when engaged dissecting a cone will sustain a running fire of missiles with equanimity, until a well-directed stone arouses it to a sense of its danger, when, alas! it is too late to escape. Although it would hardly be imagined to be the case, they live admirably in confinement, and with a little care and attention can be readily tamed, so as to come out of their cage when called, sit upon and feed out of the hand, and so on. In fact, few wild birds (not even the Siskin or Bullfinch) make themselves so quickly at home when in captivity. Some have powers of imitation, and can copy the songs of other birds, such as Canaries and Goldfinches, kept within their hearing; but that remark is only applicable to very young birds, old birds not being so apt when their natural note has been confirmed. This faculty, however, is no great rarity, being possessed in a greater or less degree by many birds, notably Starlings, Blackbirds, Chaffinches, and particularly Bullfinches. It is a curious circumstance, and one which must strike every one who has taken the trouble to look into the matter, that many species whose own songs are the reverse of melodious make the best imitators; and again, those whose natural melody is very sweet seem unable to acquire the notes of any other bird to anything like the same extent. This is amply illustrated in the case of the Starling and Bullfinch, and others might be instanced.

The plumage of the Crossbill is rather perplexing, as at different seasons of the year, and at different ages, the birds show a variety

of colours, causing a great disparity even in one flock The young of both sexes are alike at first, speckled, and look like an exaggerated specimen of a hen Siskin; but after moulting some turn green, and others red or carmine-coloured. Females apparently do not vary so much as males, being of a uniform greenish-grey tint, varying in intensity according to the season; but the latter are found donning a great variety of shades. Some are very bright red, and others have the red subdued with an admixture of yellow and green. The age of the bird and the time of year in which it was born, no doubt, influence the plumage considerably. For instance, one born in February ought to be better plumaged in autumn than one born in May: perhaps, also, the weather may have some effect. Birds in a cold, wet, and backward season can hardly be so brightly plumaged as in a warm and genial year; so in judging of the plumage of the Crossbill, we must take all these little items into consideration. Notwithstanding the variations exhibited, none are of so marked a nature as to lead an ornithologist to mistake a Crossbill for any other species, the shape of the head and formation of the mandibles being sufficient for identification. The common Linnet (*Linota cannabina*) is another example of a bird assuming a variety of garbs, giving rise in this case to a varied nomenclature slightly puzzling to the young student of ornithology. Country people, in spite of their opportunities, are in the great majority of cases very ignorant concerning bird-life, and are convinced in their own minds that the grey, brown, rose, and whin Linnet are different species, whereas they are identical. Young naturalists should be very chary of accepting as fact the opinions of country people, as their notions are generally crude, and very often erroneous.

The only other point now to be touched on is the construction of the nest. Being usually well hid in a thick Spruce, it is not so often found as would be imagined, considering the great numbers of birds hatched every season. It is composed of small twigs of the Larch, and lined with grass, moss, and fibrous matter, and on the average is rather large, and inartistically constructed. One which I had the good fortune to discover possessed the unusual peculiarity of a semi-roof made of lichen-covered twigs, probably added with an idea of sheltering the young. This formation would seem, however, to be quite exceptional. While wandering through the thick Fir plantations, such as exist in many parts of the Highlands, one often comes quite unexpectedly upon an open space surrounded on all sides by trees, probably in former times the site of an old sawmill or forester's cottage long since decayed, and leaving no trace behind save the grass-grown outlines of its foundations. In such a spot the Crossbills love to congregate on a warm sunshiny day, flying at intervals across the open space,—

their constant chirping betokening a sense of supreme happiness and want of care to which human beings are entire strangers.

So far as a short paper is concerned, the more important features of the species have been mentioned; and as time would not permit of further description, I shall only beg leave to say in conclusion, that among the many examples of the feathered race to be found in Great Britain, few are more curious or interesting than the Crossbill; and I feel certain that, should opportunity occur, any one who spent an hour or two in watching their quaint habits or in listening to their peculiar song, would not consider the time devoted to such a purpose as wasted.

VII.—NOTE ON THE WALL-CREEPER (TICHODROMA PHŒNICOPTERA) AND A FEW OTHER BIRDS OBSERVED ON A VISIT TO SWITZERLAND.

By Mr A. B. HERBERT.

(*Read Jan.* 26, 1882.)

If tourists are asked on their return from Switzerland whether they noticed any rare birds there, the usual reply is that they scarcely saw a bird in the country. I do not know how it may be in the spring and early part of summer, but in the autumn, when the country is most frequently visited by British tourists, there is undoubtedly a paucity of bird life. I had the pleasure of spending about a month in that charming and interesting country in August and September last, and in crossing France by rail, the only rare birds noticed *en route* were Buzzards (*Buteo vulgaris*), and these, though now extremely rare in Britain, are by no means uncommon in France. You see them soaring about on buoyant wings, or stationed on posts and other prominent places near the railway. They feed on small mammalia and reptiles; and not being themselves fit for human food, seem to be left unmolested. By a Frenchman, however, with gun in hand, birds of almost all kinds, great or small, flying or sitting, are slaughtered indiscriminately, and eaten. One of my friends called on a Frenchman who had a small quadrangular courtyard, in which were a few evergreens, and on two opposite sides of the enclosed space were nets so arranged that, by pulling strings, the whole court could be made a bird-trap. My friend was shown the catch of the day,

put aside for cooking, and among many Sparrows, Greenfinches, and Chaffinches, he observed two Wrens, a Titmouse, and a Robin. This is the kind of slaughter not uncommon in France, and we cannot therefore wonder that the country is as a whole so uninteresting to ornithologists. When, however, we reflect that our Hurlingham is still an aristocratic and fashionable resort, and that a dish of Dunstable Larks forms a dainty *entré* at our epicurean civic and other feasts, we must not be too severe in condemnation of the cruel practices of our Gallic neighbours.

A rather curious incident occurred on my railway journey across France. A Hawk, about the size of our Sparrow-hawk, but with plumage much the colour of a Woodcock, kept up parallel with the train, and about fifty yards distant, for many miles. When we passed through plantations or in cuttings, we temporarily lost sight of him, but on emerging, there he was still continuing his flight near the train; and I have a strong impression that he had found by experience that the train disturbed small birds, which, in their flight, became to him an easy prey. I am convinced that this long-continued flight near the train was not accidental and without an object. The only other bird at all rare seen by us in France was a beautiful male Golden Oriole, and these birds, we know, are occasional visitants to Britain, and would breed here if left unmolested. They are sometimes seen near Paris.

The birds noticed by us in Switzerland which are rare in England were the Black Redstart (*Phœnicura Tithys*), the Nutcracker (*Nucifraga caryotactes*), and the Snow-Bunting (*Emberiza nivalis*). The Black Redstart in habits much resembles his congener, our common Redstart. The Snow-Bunting we saw in large flocks near the top of Pizz Langard, in the Engadine, at about 9000 feet elevation. The Nutcracker is a large bird, with a flight much like our Jay, and is common in many of the Pine woods, but close observation of it is difficult amongst the dense Fir trees. In the Upper Engadine, at an elevation of 6000 feet, this bird is frequently met with among the Cembra Pines near the glaciers of the district, and it is known at once, as it flies from tree to tree, by the conspicuous white tip to its tail. The plumage is brown, spotted with white. It is a migratory species, feeding on worms, insects, fruits, nuts, and seeds of Pines, and raps the trees to alarm the insects, after the manner of our Woodpeckers. We were unfortunate in not meeting with the alpine Accentor, a bird by no means uncommon in Switzerland, and much like our Hedge-Sparrow, except that its plumage is lighter and prettier; and instead of building in hedges, it forms its nest and lays its bright blue eggs in holes and fissures of the rocks.

The bird, however, which most riveted our attention, and which is quite unknown here, was the beautiful Wall-Creeper (*Tichodroma*

Phœnicoptera). I first saw this bird at Chur, in the Grisons canton. I was standing at the hotel door on the 28th August, when a bird flitted by me which at once aroused my attention and curiosity, as it was clearly one I had never before seen. Its peculiar jerking flight in the bright sun and clear Swiss atmosphere displayed its delicate grey body and brilliant crimson wings to the greatest advantage. The wings have white spots on them, and the tail is black tipped with white. It settled against the hotel, and, clinging with its claws to the perpendicular wall, traversed the whole length of the building with a creeping lateral motion, which reminded me of our Nuthatch, and probed with its sharp-pointed bill all the interstices between the stones in its search for spiders and their eggs, to which it is particularly partial, spreading out very frequently its pretty and unique crimson wings. So intent was the bird on its occupation that it allowed us to approach close, and watch and admire it for some time. I could not find any one there to tell me the name of the bird, beyond that it was called the "Specht," which I thought might be synonymous with our word "spectre," from the light colour of the bird; but it appears the word "Specht" is used in Germany to denote both the Wall-Creeper and also the Woodpecker. Afterwards, on visiting the museum at Lucerne, I saw many stuffed specimens of this interesting subject of our observation, and ascertained the correct specific name. A few days afterwards, while walking from Airolo on our return from the Italian lakes over the St Gothard Pass, and at a very high elevation—indeed just as we were entering the clouds—another of these pretty birds flew over my head, and settled in a fissure in a rock, where I feel sure it had a nest, but the precipitous nature of the rock forbade my great desire to examine the spot. The Wall-Creeper is, I find, strictly European, and is found in mountainous districts in all the middle and southern portions of the Continent, and frequents the naked and precipitous parts of the most elevated mountains, among which it is seen flitting from crevice to crevice in search of food. It does not use the tail as a support, as our common Creeper and Woodpeckers do, but clings with its tenacious claws unaided to the rough rocks, in the same manner as our Nuthatch does to the rough bark of trees. It moults twice in the year, in spring and autumn. The two sexes are much alike in markings, except that after the spring moult the male assumes a black patch on the throat. Crimson, I need scarcely remark, is a very uncommon colour in the plumage of our indigenous birds. I can call to mind only three which have this shade, and it is solely on their heads—viz., the Redpoll, the Goldfinch, and the Woodpecker. With the Wall-Creeper, however, crimson is the predominant colour; and its habit of so frequently expanding its beautiful wings as it creeps along the walls and rocks renders it a most attractive object, even

to those who are not ornithologists. I strongly advise any member of our Club who may have the pleasure of travelling in Switzerland to keep a sharp look-out for these brilliant birds. I cannot think they are very rare, as during our short tour I saw two alive, and many stuffed specimens in the Lucerne museum.

VIII.—NOTE ON THE MOUTH-ORGANS OF INSECTS.

By Mr ANDREW MOFFAT, *Secretary.*

(*Read Jan.* 26, 1882.)

The object of this note being solely explanatory of a series of microscopical preparations which was exhibited in illustration of the various forms of the mouth-organs of insects, it is not thought desirable to reproduce it here.

The mouth-organs of the following insects, among others, were shown—viz. :

Telephorus dispar, Blatta orientalis, Forficula auricularia, Acheta domestica, Apis mellifica, Bombus terrestris, Vespes vulgaris, Musca vomitoria, Eristalis tenax, Rhingia campestris, Pieris Brassicæ.

IX.—MIMETIC PLANTS.

By Mr JOHN LINDSAY.

(*Read Feb.* 23, 1882.)

There is no more interesting chapter in Natural History than that which treats of the outward resemblances found to subsist between genera or species far removed from each other in natural relationship. The term popularly adopted to describe this curious phenomenon is not entirely satisfactory, but it is the simplest which has as yet been suggested. Mimicry, or the power of imitation, is, in the general acceptation of the word, a voluntary act, with no serviceable end, as a rule, in view, and which, being voluntary, can be assumed or laid aside at pleasure. But when applied, as in this instance, to plants or animals, the term "mimicry" must be taken in a metaphorical sense to express an external appear-

ance unlike that belonging to its own class, and like that of another class,—such resemblance, further, being ostensibly adapted to subserve some useful purpose, whatever that purpose may be. This phenomenon has hitherto been investigated to a much greater extent in the Animal Kingdom than amongst plants. Mr H. W. Bates, who first introduced the subject to public notice, and subsequently Mr Alfred R. Wallace, have both been diligent workers in this interesting field, and many curious facts have already been brought to light. It may perhaps tend to a clearer understanding of the subject in hand—viz., mimetic resemblances in plants—if a glance is taken at some of the analogous conditions which obtain in the Animal Kingdom.

Among the many ways by which quadrupeds, birds, and insects are believed to maintain their existence is that of concealment by obscure or imitative tints or colours. On this theory an explanation is given of wild Rabbits always having grey or brown tints; of arctic animals possessing white fur; of desert animals being desert-coloured; and of the desert birds of Asia and Northern Africa—such as the Stonechats, Larks, and Quails—being tinted and mottled to resemble the soil of the districts where they are found. Taking an example or two from the birds of our own country, we at once call to mind the Ptarmigan, with its white plumage in winter and its pearly-grey summer dress, harmonising with the lichen-covered stones where it is generally found. The Woodcock is a still better example of imitative tints, in the browns and yellows of fallen leaves being reproduced in its plumage, and rendering its resting-place under trees such a safe one. But these resemblances are perhaps found to their greatest extent in the insect world. Mr Wallace, in his 'Contributions to the Theory of Natural Selection,' tells us that "in the tropics there are thousands of species of insects which rest during the day, clinging to the bark of dead or fallen trees; and the greater portion of these are delicately mottled with grey and brown tints, which, though symmetrically disposed and infinitely varied, yet blend so completely with the usual colours of the bark, that at two or three feet distance they are quite undistinguishable." And he remarks further, that these tints of the bark or leaf are not only reproduced in the wings of many insects, but that "the form and veining of the leaf, or the exact rugosity of the bark," are also imitated. The examples of the so-called "Walking-leaf" and "Walking-stick" insects are so familiar, that a passing reference to them will be sufficient.

Such resemblances, however, though undoubtedly something more than mere curious coincidences, are not the only phenomena claiming our attention here. The mimicry of animals which has its fittest counterpart in that of plants is not so much a likeness

in colour or tint—though that also is found—as in outward appearance. It is at once a *resemblance* to an entirely different group, and a *want of resemblance* to closely allied groups; so that it has been well remarked that such imitators "appear like actors or masqueraders dressed up and painted for amusement, or like swindlers endeavouring to pass themselves off for well-known and respectable members of society." Examples of this kind of imitation exist particularly amongst the Lepidoptera, where we find that they not only mimic each other, but also other insects, as Bees and Wasps; and at least one tropical Moth is said to resemble closely a Humming-bird. There are fourteen or fifteen species of the Sesiidæ or "Clear-wings" in this country, and each is named after some other insect whose uniform it wears. Exactly the same kind of simulation is found to exist amongst Beetles; and Mr Bates further mentions a Caterpillar which at first sight startled him, and deceived even his practised eye, by its close resemblance to a poisonous Viper. Were this paper treating of the mimicry of animals, and not that of plants, much might have been added on this fascinating subject; but any wishing to pursue it further will find much to interest in Mr Wallace's book already mentioned. Having thus prepared the way, we will now pass on to observe some instances of this same law of mimicry amongst plants.

Mimicry in plants may be divided into two kinds: it may either be *general*—that is, of the whole habit or mode of growth; or it may be *special*, consisting in the development of some particular organ or part, as the leaf, the flower, the seed or fruit, and even the odour. Examples of the first kind—viz., of resemblances in habit—and of foliage resemblances in the second, are perhaps the most numerous, and may be treated of together, leaving out of sight, for the present occasion at all events, flower, fruit, or other resemblances. It is well known that there are plants in every Natural Order which might easily be taken as belonging to some other Order. The late Mr W. Wilson Saunders of Reigate repeatedly exhibited at the *soirées* of the Linnæan Society paired specimens of mimetic plants belonging to entirely different Natural Orders, yet resembling one another in their habit and general appearance to so extraordinary a degree, that even a good botanist, it is affirmed, might well have been excused for passing them over as identical. It is a fact familiar to many, that Sir William Hooker once figured and described a New Zealand Veronica (*V. tetragona*), without fruit or flower, as a Conifer. Dr Hooker, in his 'Flora Antarctica,' draws and describes a most singular species of Caltha (*C. Dionæfolia*), the leaves of which are almost an exact reproduction of those of the well-known "Venus's Fly-trap." Again, such an authority as Kunze pronounced a Cycad (*Stangeria paradoxa*), after an ex-

amination of the nature and venation of the leaf, to be a Fern. On comparing some of the weird-looking American Cacti with the African Euphorbias, they are found to be wonderfully alike. The curious thing here is, that both the columnar or branched and the globular forms of Cacti have their representatives in the Euphorbiaceæ. But let us take a few illustrations from plants nearer home. One example is the rare Menziesia cærulea, which is so like the Crowberry (*Empetrum nigrum*) that the one may easily be mistaken for the other. The Equiseta, or Horse-tails, it has been remarked, find their echoes in the Hippuris, which is a flowering-plant. Dr M. C. Cooke, in his 'Freaks and Marvels of Plant-Life,' figures a composite plant (*Azorella Selago*) which is extremely like a Lycopod. A similar example is Thujopsis lætevirens, a Conifer, compared with such a Lycopod as Selaginella Lyallii. Two Rosaceous plants—Alchemilla alpina and Potentilla alchemilloides—have their foliage identical; as have also Rumex sanguisorbæfolia, belonging to the Polygoneæ, and Sanguisorba officinalis, one of the Rosaceæ. Many familiar names, suggesting like similarities, will readily recur to memory—as Polygonum Convolvulus, Solanum jasminoides, Arenaria serpyllifolia, and so on. A curious Veronica (*V. salicornioides*) has lately been introduced from New Zealand by Isaac Anderson Henry, Esq. of Woodend. The plant—of which there are several specimens in the Royal Botanic Garden—has never yet flowered in this country, and therefore doubts have been entertained as to its really being a Veronica, though on that point competent judges are quite satisfied. Its striking similarity to a Conifer may be easily seen on comparing it with Cupressus Lambertiana or Dacrydium Franklinii, both belonging to the Coniferæ. Again, we saw above two forms of Cacti reproduced in two Euphorbias; but a still more striking example of mimetism is furnished by *three* shrubs, two of them possessing a variegated form, and all three, in the normal type, nearly identical, though presumably with no genetic relationship. One is Osmanthus illicifolius, a member of the Oleaceæ or Olive family; the second is Desfontainea spinosa, belonging to the Loganiaceæ; and the third is the Common Holly (*Ilex aquifolius*)—N. O. Ilicineæ. To give but one illustration more: there are two plants which are so like dwarf Palms, that in nearly every nurseryman's catalogue—and indeed in some works of much greater pretensions—they are classed under that heading. Yet neither is connected with the Palmæ. One is Carludovica palmata, belonging to the Pandanaceæ or Screw Pines; and the other is Curculigo sumatrana, a Hypoxidaceous plant, allied to the Amaryllids. Let us place each of these plants alongside of a Palm leaf. Carludovica palmata may be paired with Livistona chinensis, the one seeming to be a variety of the other, and each as decidedly Palm-like in habit as its neighbour. Curculigo sumatrana

may have for partner Cocos flexuosa, in its juvenile stage. This form the Palm preserves for about the first three years of its growth, when the more mature leaf assumes a pinnate character. The two plants are so identical, that one may readily be led astray regarding them. These illustrations may suffice as evidence in proof of the statement, that there are to be found amongst plants, as well as in the Animal Kingdom, similarities of outward appearance between groups naturally far removed in many instances from one another. Such abnormal departures from the ordinary type ought to be kept in view by geologists when naming fragmentary specimens of fossil plants.

What, then, we may now ask, is the reason for one plant thus assuming the appearance of another?—and how is the resemblance brought about? It cannot all happen by mere chance, for nature never works in that haphazard fashion. As a partial answer to the latter question, such resemblances among quadrupeds, birds, and insects—whether to other living creatures or to inanimate objects—have been accounted for by the theory of natural selection and the "survival of the fittest." But, of course, a deeper cause must exist in some occult law of their being, which we may never be able to comprehend. Then as to *why* such resemblances exist,—by a large induction the conclusion has been arrived at, that in the Animal Kingdom, at all events, such mimetism, whether of form or colour, or both, seems to afford protection from enemies, either where the habits of the "mimic" expose it to special danger, or where it is not sufficiently endowed with more effective means of escape. We hesitate before applying a similar reason for the existence of mimicry in plants. For what, it may naturally be asked, does the plant gain in the way of protection?—or what does it require protection from? The only instance where this reason for the phenomenon has been hazarded is in the case of the Menziesia cærulea already mentioned—a plant as yet found in Scotland only on the Sow of Athole, in Perthshire, and but sparingly there. As the Crowberry grows very abundantly beside it, the remark has been made that the *rare* plant is thus protected "from the rapacity of botanists"! Passing over the problem, then, as to why these resemblances exist in the Vegetable Kingdom, by simply saying that these forms are the best suited for the requirements of the plant, and asking next *how* they have come about, the following theories have been advanced. As one explanation, we have the law of consanguinity or heredity put forward,—though, remembering the widely separated families in which the resemblances have been found, this plainly cannot meet all the requirements of the case. Again, similarity of conditions has met with some favour as an operating cause. Resemblances in habit are, no doubt, often due to similar

conditions of soil and climate. And when long generations are conceded in order to adapt a plant to its environment, one can easily understand how the change from the normal type might be great indeed. This explanation is, however, at best a partial one, and does not at all account, besides, for resemblances in special organs, as in fruit or flower. Hybridisation has been adduced as probably a concurrent cause; but this theory is naturally beset with so many difficulties, that it has not met with much favour. The last resource has been to take refuge in the pre-Darwinian doctrine of Design as an answer to the whole difficulty, and to suppose, with Mr A. W. Bennett, that there is in all this some purpose "not in every case for the immediate advantage of the individual species, but in furtherance of some plan of general harmony which it may take centuries of unwearied and laborious toil before we discover the key by which we may be able to unlock it." This idea seems at first blush a very plausible one; but a little reflection soon shows that it is most unsatisfactory as an explanation, for it simply defers any attempt at a solution to a very indefinite period. We cannot expect that the conclusion here arrived at will receive general acceptance; and it is to be hoped that some other interpretation of the mystery which will meet all the necessities of the case will by-and-by be forthcoming.

By the kindness of Mr Sadler, *Curator, Royal Botanic Garden, Edinburgh, the following plants were exhibited in illustration of the above paper:—*

Menziesia cærulea,	Ericaceæ.
Empetrum nigrum,	Empetraceæ.
Thujopsis lætevirens,	Coniferæ.
Selaginella Lyallii,	Lycopodiaceæ.
Potentilla alchemilloides,	Rosaceæ.
Alchemilla alpina,	Rosaceæ.
Veronica salicornioides,	Scrophulariaceæ.
Dacrydium Franklinii,	Coniferæ.
Osmanthus illicifolius,	Oleaceæ.
Ilex aquifolius,	Ilicineæ.

(*Green and variegated forms of both shrubs.*)

Curculigo sumatrana,	Hypoxidaceæ.
Cocos flexuosa,	Palmæ.
Carludovica palmata,	Pandanaceæ.
Livistona chinensis,	Palmæ.

Cereus niger, ...	Cactaceæ.
Euphorbia sp., ...	Euphorbiaceæ.

(*Columnar form.*)

Mammillaria Dolichocentra, . .	Cactaceæ.
Euphorbia melliformis, . . .	Euphorbiaceæ.

(*Globular form.*)

X.—ACOTYLEDONS, MONOCOTYLEDONS, AND DICOTYLEDONS: THEIR MORPHOLOGY AND PHYSIOLOGY.

By Mr WILLIAM LUNDIE.

(*Read Feb.* 23, 1882.)

The two questions discussed were—

(*a*) What are the distinctive characters by which these three groups are recognised?

(*b*) On what grounds did Jussieu claim for this classification the title *Natural?*

Q. I. The distinctions are of two kinds,—morphological, *i.e.* such as have reference only to form; and physiological, *i.e.* such as have reference to function. The morphological distinctions become quite apparent when we contrast the Fern, the Lily or Palm, and the Rose, as representatives of the three groups. The absence of what would represent the aerial stem of the Rose, the peculiar form of the frond, and the total want of anything resembling a flower, are characters which strike us as peculiarly characteristic of a Fern. Again, the branching of the stem in the Rose, its woody character, the number of floral envelopes (two—calyx and corolla), the number of parts (five) in each, and the character of the embryo, clearly separate it from the Lily or Palm, which have an unbranched stem (caudex), a single floral envelope of six parts (Lily), and a single cotyledonary embryo; while none of these characters are possessed by the Fern. The physiological characters are equally marked, and are connected with the functions of nutrition and reproduction. The nutritive organs are those by which the life of the plant is maintained, and consist, in the lower forms of vegetable existence, of a thallus, and, in the higher forms, of root, stem, and leaf. The reproductive organs, on the other hand, are those by which the species is perpetuated, and consist of spores in the lower forms, and of a flower and fruit in the higher. The greatest diversity in those

nutritive organs is to be found among Acotyledons. This class includes such organisms as the Algæ, Fungi, and Lichens, whose nutritive organs consist of a single cell, or of an expansion of cellular tissue—the thallus; but in the higher forms of Acotyledons, such as Mosses, Ferns, Club-mosses, &c., structures resembling in general form and function the root, stem, and leaf, are distinctly marked, which thus approach the Monocotyledon and Dicotyledon type. The greatest differences are seen when the structure of the stem and leaf of each of these three classes is compared. The structures themselves are composed of the same elements, but differ in the mode of their arrangement. Roughly, we distinguish in the stem of a Dicotyledon, such as a Maple or Pine, three portions,—an outer bark portion, an inner wood, and a central pith portion. More strictly, however, the bark consists only of the outer layer of cells, which have become corky, within which lies a green cellular rind. Between this green cellular rind and the pith lie what are termed the Fibro-Vascular Bundles, consisting for the most part of wood and bast, the latter lying exterior to the wood. A transverse section of the rhizome of a Fern exhibits an arrangement of these bundles in the form of an irregular circle, while in that of a Cane or Palm they are scattered irregularly in the abundant pith; and in the Maple, Pine, or Rose they arrange themselves in collateral wedges, so that the wood forms a circular band, which broadens each year, enclosing a central pith, and coated externally by the peripheral bark. As a rule, bark is only present in Dicotyledons. Its absence is a characteristic mark of Monocotyledons. The venation of the frond of the Fern is forked; in the Monocotyledon, parallel; and in the Dicotyledon it is reticulated. Two other points of distinction need only be mentioned, as they give rise to terms of no uncommon occurrence. The first is that of the growing point (*punctum vegetationis*), and the consequent development of the stem; and the other is derived from the character of the root. In certain Acotyledons (not, however, universally) the growing point consists of a single apical cell, from the repeated subdivisions of which stem, roots, &c., originate, and hence they are spoken of as Acrogens; while Monocotyledons and Dicotyledons are distinguished as Endogens and Exogens respectively. From the character of the root, these three were again distinguished as Heterorhizal, Endorhizal, and Exorhizal respectively.

But the chief peculiarities of these three groups lie in their reproductive organs. In Monocotyledons and Dicotyledons reproduction is effected by what are termed Flowers, hence the name Phanerogams applied to these two classes. In contradistinction to this, Acotyledons, which have no such conspicuous flowers, have been termed Cryptogams, a term which refers to its hidden or secret method of fertilisation. Dicotyledons are generally distinguished by

the possession of two outer floral envelopes, the calyx and corolla, of four or five parts each, marked generally by a difference in colour, the calyx as a rule being green. These surround the essential organs of the flower, the stamen and pistil or pistils, which are generally correlated in number to the parts of the calyx and corolla. In Monocotyledons, as a rule, there is no difference between calyx and corolla—at least, as regards colour. There is one floral envelope of six parts, in two alternating whorls, of which the three outer may be taken to represent the calyx, while the three inner represent the corolla. The various parts of the flower represent a ternary arrangement, quite distinct from the quinary or quaternary arrangement of Dicotyledons. These two may be contrasted by setting side by side their typical floral formulas, thus—

Dicotyledons, . .	5 S.	5 P.	5 A.	5 G.
Monocotyledons, . .	3 + 3 P.		3 + 3 A.	3 G.

It is, however, in the character of the embryo that the essential distinction in the reproductive organs lies. Within the coat of the seed, such as the Pea or Bean, representing Dicotyledons, are two hemispheroid masses placed face to face with each other. These are the cotyledons or seed-leaves, the primary nutritive organs, being in fact storehouses of nourishment for the young embryo. Dicotyledons, as the name implies, possess two of those seed-leaves, while Monocotyledons possess only one. Acotyledons is a questionable term, inasmuch as it indicates a negative character. It denotes the absence of cotyledons—reproduction, as already stated, being effected by spores. In its higher forms it presents the peculiar reproductive phenomenon of an "Alternation of Generations." This is well seen in a Fern, from the spore of which a prothallium is produced which leads an independent life. From this prothallium the reproductive organs, antheridia and archegonia, are developed, which, by a true process of fertilisation, in turn give rise to the spore-bearing Fern.

Q. II. These three groups, founded on the primitive nutritive organs in the seeds, represent the natural classification of Jussieu; and it is not a little interesting to trace the various steps by which he arrived at such a classification, and its claim to the title "Natural." The honour of distinctly defining what a true classification of the Vegetable Kingdom should be, is due to an Englishman, John Ray (1703). He maintained that a true classification of the vegetable forms of life is one which exhibits a gradation from the lower forms to the higher, and thus becomes the expression of the plan observed in nature in the creation of living things. From this, it would appear, arose the term "natural," contrasting with other classifications which were termed "artificial." Ray, how-

ever, left it to be more fully developed by a Frenchman, Antoine Laurent de Jussieu. Born at Lyons in 1748, and educated at Paris under his uncle Bernard de Jussieu, he was, when comparatively young, appointed to the office of Demonstrator in the Jardin des Plantes. In attempting to classify the plants of the garden according to the artificial classification then in use, he became thoroughly dissatisfied with it, and was led to consider what a true classification ought to be. When he discovered Ray's definition of a classification, he entirely adopted it, and worked it out to greater perfection than Ray himself had done. He found that, though the true aim of a classification had been reached, there was considerable diversity of opinion as to the means of arriving at such a classification. The aim of this classification being to arrange the vegetable forms in allied species, their principle was, "That species which are dissimilar should not be brought close together, nor should species that are similar be kept apart." This gave rise to the question, "What is to determine similarity or dissimilarity?" The advocates of the artificial classification selected each a certain organ arbitrarily, and classified according to the similarity or dissimilarity of that organ. They differed greatly as to the organ which they selected. Andreas Cæsalpinus (1583) chose the character of the fruit; Dr Morrison of Aberdeen (1670), the character of flower and fruit; Tournefort (1684-1700), the character of the corolla; and last of all, Linnæus (1778), the character of stamens and pistils. Jussieu held that it should be determined by natural distinctions alone, and was the first to lay down the principle that affinity could only be determined by correspondence in structure. This is a natural deduction from the axiomatic truth, "If any two plants be alike in every point in their structure, then these two are identical." Hence he defined a species to be, "Individuals which are very much alike in all their parts, retaining their resemblances from generation to generation." "Those species," he said, "are to be associated which correspond in the greater number of their characters; but one constant is of more importance than several inconstant characters." For example, the stamens and pistils are more constant characters than either the calyx or corolla, either or both of which may be absent, and hence of greater value as a basis of classification. It was this fact that made the classification of Linnæus of more permanent worth than any other artificial classification.

But Jussieu, in order to establish a gradation, had to discuss the relative values of the constant structures,—"the determination of which," Lindley says, "is the pivot on which the operation of any systematist must turn." He pointed out that the relative value of any structure must depend upon the function which that structure performs; and that as the existence of a plant depends on its

vegetative or nutritive organs, these must possess the highest relative value, and will afford characters of a primary distinction. Next in importance he placed the organs with which the plant cannot dispense if its race is to be preserved—viz., those of reproduction, since nutrition is antecedent to and finds its ultimate end in reproduction or the perpetuation of its species. In this way Jussieu was led to adopt the primary nutritive organs—the cotyledons—as the structures which present the highest relative value, and whose structural differences, being of primary importance, afford the first and best characters on which to base a classification. Acotyledons, Monocotyledons, and Dicotyledons are thus founded on those characters of the embryo which are of the widest distinction, and yet exhibit a gradation from the lower forms to the higher, conforming to the principle of a natural classification enunciated by Ray. The simplest and lowest types of structure in the vegetative organs is to be seen among the Cryptogams or Acotyledons, where, in many cases, a single cell carries on both the functions of nutrition and reproduction; while, a stage higher, we have cells combined to form a tissue—the Thallus. The highest differentiation of cells, and the most complex nutritive process in the embryo, is observed among Dicotyledons; while in Monocotyledons it represents an intermediate stage.

In illustration of the above paper, the following preparations were shown under the microscope—viz.:

1. Transverse section of Acer of the first, second, and third year's growth, and one or two abnormal forms,—all representing Dicotyledons.
2. Transverse section of Sugar-Cane, Ruscus, and Dracæna, representing Monocotyledons.
3. Transverse section of Pteris (Fern); apical longitudinal section of Chara, showing growth; Prothallium of a Fern with antheridia and archegonia,—all representing Acotyledons.

Besides these, there were hand-specimens to show their morphological characters.

XI.—NOTE ON THE ROOSTING OF THE PEREGRINE FALCON ON THE SPIRE OF ST MARY'S CATHEDRAL, EDINBURGH.

By Mr ROBERT STEWART.

(*Read Feb.* 23, 1882.)

I think it may be interesting to the members of the Club to learn that for some time past a Peregrine Falcon has regularly taken up its night quarters on one of the small ornaments near the top of the spire of St Mary's Cathedral. I first noticed the bird as it came along Melville Street, and on this, as on all subsequent occasions, it flew on a level with the tops of the houses until it reached the Cathedral, when a few steady strokes of its wings enabled it to occupy its high perch. The ornament referred to is not protected in any way, and it is as astonishing to consider how it managed to retain its footing during the recent storms, as it is to find it there at all.

I.—NOTES ON THE NOMENCLATURE OF BRITISH MOSSES.

By Mr JOHN WALCOT, President.

(*Read Oct.* 27, 1882.)

The Moss plant, in its perfect state, consists of roots, stem, leaves, fruit-stalk, and seed-vessel. These parts vary more or less in size, colour, shape, and condition; and the earnest student must make himself familiar with all these varieties, if he would make any real progress in the knowledge of Moss life. Several distinct peculiarities mark off the Moss plant from other parts of the vegetable kingdom. Its *leaves* have no footstalk, and are attached at their lower edge to the stem; some of them are serrated at the margin, but none of them are divided and compound, as those of many other plants are. Their *surface* is free from everything like hairiness; they do not decay and fall off from the stem, and, as a result of this enduring character, do not remind us of our frailty and destiny as do the falling leaves of other plants, for they may be kept for months, and even years, and retain the power of reviving when placed in water.

In the early stage of his studies, the student's attention will be sure to be arrested by the singular fact that the slender stem, called the *seta*, on the summit of which the seed-vessel rests, in some Mosses projects from the summit of the plant, and in others from the side of it. This distinct peculiarity has very properly been fixed upon as the first means of division. All Mosses are classed under the terms Acrocarpi and Pleurocarpi,—the one accurately describing fruit from the summit, the other fruit from the side. In later synopses a third term, Cladocarpi, has been adopted to describe some plants whose fruit-stalk, being on short lateral branches, appears to be lateral, though in reality it is terminal.

The capsule, or seed-vessel, of the Moss plant, as a rule, possesses a small lid called the *operculum*, a beautiful fringe about the mouth called the *peristome*, and a thin covering or veil over the upper part of it which is called the *calyptra*. In Moss life, as well as in other things, this general rule has its exceptions. A few Mosses have no operculum; a few others have no peristome, while of those which have it, in some the circle of fringe is single, in others it is double. These exceptions have been made the bases of other divisions which are as accurately expressed as those which are based upon the position of the seta. Hence in the progress of nomenclature we have the following:

Astomi, without a mouth; Gymnostomi, naked at the mouth; and Peristomi, with a fringe at the mouth. Under this last division there are two others—Aploperistomi, with a single circle of fringe; and Diploperistomi, with a double circle. From such facts as these, it is obvious that in the early stages of study it will be a comparatively easy thing to assign Moss plants their proper position in the system of nomenclature. With so many easily recognised characteristics and clearly defined distinctions, the student may arrange his treasures, and store them away in safety till he can secure the time necessary for more minute examination, and for endeavouring to discover the grounds of their generic and specific names.

In considering the origin of family and generic names, we soon find out that they cannot be traced to any one part of the plant exclusively. The generally accepted nomenclature can be traced up to many sources. Some parts of the plant, as, for instance, the organs of fructification, supply a greater number of names than others; but this honour does not belong to them alone. Modern authors of distinction have done a great deal to change and modify the names. They have designated some in a more scientific manner, and have distributed one or two of the largest families under other titles, but they have not abandoned the older titles altogether: these are retained as the general designations, under which those newly invented are arranged. Considerable differences exist in the modern synopses, and at present it is impossible to say whether any one of them will supersede the older arrangements and names. The object aimed at in the present paper requires that we should mainly refer to those names which have become familiar to us through standard authors. This nomenclature proceeds along two general lines, distinct from and unlike each other.

I. One proceeds upon the acknowledged existence of some peculiarity in the plant itself,—either in its habit, or nature, or organs of fructification. Hypnaceæ, the largest family, derives its name from a supposed natural property to induce sleep. It is probable that this property consists rather in their soft and feathery character than in any chemical virtue. If so, there are other Mosses that might claim the same title with equal right. Why the one class has been chosen and the other not, we cannot say; but let no one complain of this. The feathery Mosses afford an elysium of delight to the eye and to the touch. On their down-like bed the most skeleton forms of human life may rest in ease and comfort. The names of some genera are taken from their habit of growth—as those called Fontinalis, which grow in streams, and probably those called Splachnum, which chiefly grow on the fæces of animals. Others derive their names from a peculiarity of the fruit-bearing stalk

(*seta*), as Funaria hygrometrica, which in dry weather becomes so twisted that it resembles a piece of rope. Many others derive their names from some peculiarity in the veil (*calyptra*), as Polytrichum, many-haired, hairs lying flat on the calyptra as if it were thatched. Also Orthotrichum, straight-haired, the upper part of the calyptra being covered with hairs all projecting upwards. This same principle of designation is freely adopted in later synopses, where you find the names Atrichum, Antitrichum, and Oligotrichum. Another name, Glyphomitrium, describes a calyptra furrowed or sculptured; and the name Encalypta describes the seed-vessel as within the calyptra, and hidden by it, and hence is known by the name Extinguisher-moss. Other Mosses derive their names from *differences existing in the peristome*, and include a greater number than any other family does. We need not wonder at this, for the peristome exerts an important influence in the propagation of the plant. It not only affords protection to the spores when the lid falls off, but disperses them when they are matured. This delicate and sensitive part of the plant is wonderfully fascinating. When once the beauties of the peristome open to the mind, the desire to investigate them becomes wellnigh irresistible. The segments of which this fringe is composed conform to a singular law of numbers, the number being either four or a multiple of four, —never less than four, never more than sixty-four, and never including any intermediate numbers excepting sixteen and thirty-two. Of the plants which derive their names from this source, we mention Dicranum (forked teeth), Cinclidotus (teeth with lattice-work at base), Tortula (twisted teeth), and all those which in the older and in the more recent nomenclature end in some form of the Greek word *odous*, a tooth—as Amblyodon, Ceratodon, Cyrtodon, Didymodon, Orthodontium, Leucodon, Leptodon, and Zygodon. These examples suffice to show that all muscologists have regarded the peristome as possessing a strong claim to furnish names for the plants.

II. The second general principle which has been observed in designating Mosses is altogether different from that we have considered. That described something about the plant itself; this has its origin in the human element as it is related to the plant,—either identifying the plant with the person who was fortunate enough to discover it, or acknowledging eminent service in the study of muscology, or doing honour to those who have expressed generous sympathy with those who have pursued this branch of science under difficulties. Hence some of the choicest Moss plants, in the names they bear, perpetuate the memory and service of distinguished men. There are at least ten of this class. Three of these represent Britain, one America, one Flanders, and five Germany. The

three Britons are George III., the Rev. Joseph Dalton, and Sir William Hooker. The Mosses known by the name Georgia boast of a name derived from a monarch whose reign is conspicuous in British history. The main facts of George III.'s character and reign may not be estimated alike by us all; but all will rejoice that the cares of his anxious life were relieved by botanical studies, and that his royal influence was sometimes exerted to encourage those who, under difficulties, were devoting their energies to the study of botanical science. The knowledge of these facts is adapted to quicken our sympathies with the monarch, and to deepen our interest in the history of his life. The Rev. Joseph Dalton is the only clergyman who had the honour of having his name embalmed in the older nomenclature of British Mosses. Not a little that is favourable may be inferred about him from the fact that this honour was conferred upon him by Hooker and Taylor, and that Sir William Hooker named his son Joseph Dalton Hooker. This honoured man, we may hope, was not less efficient as a minister of the Gospel, because he was a distinguished botanist. The study of plant life is not incongruous with the study of the Scriptures, or with faithful service in the kingdom of Christ. He who knows most of the great works of God in nature, possesses an unfailing fund of illustration by which he may impressively enforce the highest duties and privileges of men. Side studies relieve the pressure of professional toil, and strengthen for its patient endurance.

If we linger over the third British name, Sir W. J. Hooker, we shall be excused by the eminence he attained, and by the value of his contributions to botanical literature and research. It was a fortunate circumstance that this Norwich-born lad possessed such a love of nature, that the energies intended for trade were diverted from it and consecrated to the study of plants. He was persuaded to do this by Sir J. E. Smith, to whom he applied for the name of a rare Moss. One circumstance occurred very early in his history which gave promise of a great life, because it revealed the existence of greatness in youth. When about twenty-four years of age, he was returning from Iceland, laden with specimens of its plants which he had collected there, and with many drawings and notes respecting them which he had made. In a storm all these treasures were lost, and his life was placed in great jeopardy. The great sorrow which Sir Isaac Newton experienced was tasted by him, though from a different cause and under different circumstances. But by a toil which knew no fatigue, by a memory such as few possess, and by an elasticity of spirit which rose above every discouragement, he succeeded in reproducing all that part of his work which was of special value to botanical science. Can we be surprised to learn that, shortly after accomplishing this great eat, he began to collect a herbarium which became celebrated as

the finest in Europe? or to find him associated in special work with such men as Taylor and Greville and Berkeley, who at that time were in the zenith of their fame? Hooker's power of work was something altogether unique, and extended over a long period. Monuments of his toil still have a conspicuous and enduring character: they are the pyramids of botanical literature, and having them before our minds, we are not surprised at the honours which were heaped upon him in his professional life. From the Chair of Botany in Glasgow, he rose to the directorship of the celebrated gardens of Kew, and afterwards was decked with the garland of knighthood, which he wore with modesty and grace, amidst a large circle of congratulating friends. The plant selected to bear his distinguished name is worthy of it: Hookeria lucens is well known to every muscologist, and is a special favourite, as under the microscope it is exquisitely beautiful.

The American continent is represented in the subject we are now considering by only one name, but that name is a "tower of strength." John Bartram flourished from the beginning of the eighteenth century, nearly to the time of Hooker's birth in 1785. He belonged to the good old-fashioned, drab-suited, broad-brimmed Quakers. He had a passion for plants from his youth, which manifested itself not only in searching for them and examining them, but in planting and nursing them. It was said of him by a friend that he would ride fifty or a hundred miles to get a new plant. This fact shows what metal he was made of. He who does not cheerfully endure fatigue, and hunger, and self-denial, if needs be risk, in this work, is not worthy the name of a botanist. It was on the banks of a river near Philadelphia that Bartram founded his garden, which really was the first botanical garden in America. He planned it, laid it out, and filled it with plants chiefly collected by himself. This self-taught man literally made the world wonder at his success. The great Linnæus said of him that he was the greatest natural botanist in the world—a testimony which we may readily accept, coming as it does from such an authority. George III. appointed him as "American Botanist" to himself—an appointment which conferred as much honour on the monarch in giving it as it did on the man who received it. This man, Bartram, has fallen asleep, but his spirit and energy have been perpetuated in others. He goes marching on through the wide world. The tastes he gratified, the pleasure he imparted, the knowledge he diffused, and the successes he achieved, were all as so much choice seed cast into the soil of national life, and which to after generations have yielded a golden harvest.

I cannot now give particulars respecting the six continental names already mentioned: they are the names of men whose memories will be cherished by muscologists to the end of time. Some

one has said of J. G. Hedwig that he was the prince of muscologists; but this might be said also of Necker and of Weissius, of Timm, of Grimm, and of Buxbaum,—they were princely in their gifts, in their workings, and in their successes. Dr Buxbaum's passion for work led him to spend months at a time in the forests, and on the mountains of Jena, and resulted in his being entrusted with the care of the Royal Gardens of St Petersburg by the Czar of Russia. Opportunity was thus secured for prosecuting that careful work in Russia, in Turkey, in Siberia, and Astrakhan, with which his name is inseparably connected. It was Linnæus who consecrated to his memory that singular little Moss, Buxbaumia aphylla.

II.—ON A SPECIMEN OF GYRACANTHUS OBTAINED FROM THE CARBONIFEROUS LIMESTONE SERIES AT BURGH LEE.

By Mr T. STOCK.

(*Communicated Oct.* 27, 1882.)

I have much pleasure in giving, at your Secretary's request, a short account of the *Gyracanthus*, obtained during our pleasant excursion to Straiton.

Large and well-preserved fragments of the skeleton of sharks are exceedingly rare in carboniferous rocks. Nevertheless, we know from the spines and teeth that the waters of that age were tenanted by an abundant selachian fauna, of which perhaps the most formidable genus, both from its numbers and its size, was *Gyracanthus*. The late Messrs Hancock and Atthey, the eminent Northumbrian ichthyologists, have contributed some of the most important observations yet made on that fish, and the Burgh Lee specimen is confirmatory of their conclusions. From the scattered though abundant material at their disposal they sought to establish the following points: 1, That certain *Gyracanthus* spines are paired, and most probably pectoral spines. They grounded this on the fact that the apical extremity in many specimens had lost its point, and was worn down smoothly at an angle, and that this wear was always on the side opposite to the point of attachment. Further, they observed that in these specimens there was some lateral as well as antero-posterior curvature—that there were right and left spines. Moreover, they found "large flat triangular bones frequently associated with the spines, measuring sometimes $8\frac{1}{2}$ inches $\times$ $6\frac{1}{2}$ inches wide at the widest part," which they re-

ferred as carpal bones to the shoulder girdle. 2, They referred to the skin certain patches of minute tubercles.

Turning now to the large fragments from Burgh Lee, we find that there are the remains of two spines, one of them measuring 16 inches in length, the other a mere fragment of 4 inches. They lie with very little *post-mortem* disturbance. The apices nearly touch in the same plane, the bases are widely divergent, and between them are the remains of the carpal bone, so-called, of Messrs Hancock and Atthey. This bone is triangular; its longest measurement is 6½ inches, its broadest probably 4½ inches: a little bit is broken off from one edge, but it is very nearly perfect. It presents the same appearance of loose texture as seen in the Northumberland specimens, and is undoubtedly the same bone. One or two detached bones have likewise occurred to me in the Wardie Shales. It is therefore satisfactory to find this bone so intimately associated with the spines (in a specimen which has undergone scarcely any disturbance), that any doubt lingering in one's mind, caused by the presence of such an extensive ossification in a usually cartilaginous skeleton, has no excuse for being any longer entertained.

The larger and nearly perfect spine has a short base of attachment, and the area of attachment at the back of the spine is not symmetrically divided, but has a greater development on one side than on the other, giving the spine the appearance of being *twisted.* This, the lateral curvature, I suppose, of Messrs Hancock and Atthey, is evidently due to its being a paired spine. The same specimen, too, is much worn at the apex. The wearing begins 3½ inches downwards from the broken-off point, passes gradually into a deeply excavated groove, which again passes into a smooth terminating area, from which all traces of ridges and tubercles have disappeared. This wear is, as in the Northumbrian specimens, on the anterior aspect of the spine.

The evidence is therefore cumulative, that we have here the remains of the pectoral region of a large shark. The two spines are of the species known as *Gyracanthus tuberculatus*, Ag., and they do not differ from each other in the slightest degree in size or ornament. They are, however, right and left, as was to be expected. A glance at any part of the specimen (in the proper plane) behind the spines, reveals the presence of the dermal tubercles. They are a good deal scattered. Whether they were found on other parts of the animal than the fin is uncertain, though probable. One finds patches of them occasionally with no spines near. They certainly, however, formed a dense coating on the surface of the fins, as a beautiful specimen in my Wardie collection shows.

At this meeting a series of fossil sections, including transverse

and longitudinal sections of the spine of Gyracanthus, were shown under the microscope by Mr James Simpson. Mr G. M. Brotherston also exhibited a number of British Butterflies, and made some remarks as to their localities.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Club was held on the evening of the 23d November 1882. The Secretary and Treasurer's Statements were submitted to the meeting, and office-bearers were elected for the Session. After the election of President, Vice-President, Secretary and Treasurer, and four Councillors, in room of those retiring, the office-bearers for Session 1882-83 will stand as under, viz. :—

President.—A. B. Herbert. **Vice-President.**—P. B. Gibb.

Council.

Arch. Craig.	T. B. Sprague.	Robert Thomson.
James Simpson.	John Heggie.	George Bird.
John Lindsay.	Chas. F. Robertson.	Robert Stewart.
Hugh H. Pillans.	W. Tait Kinnear.	Dr L. Dobbin.

Auditors.—Alex. Matheson; J. A. Brodie.
Secretary and Treasurer.—Andrew Moffat.

The financial statement showed an income, including balance from previous year, of £47, 3s. 2½d., an expenditure of £23, 10s. 4½d., leaving a balance in favour of the Club of £23, 12s. 10d. At this and the previous evening meeting in October, the Secretary read extended reports of the meetings held during 1881-82; but owing to the available space being required for other communications, it has been deemed advisable only to reproduce the introductory paragraph here :—

The following meetings have been held during 1881-82, viz.: *Evening Meetings*—20th Oct. 1881, First Evening Meeting; 23d Nov., Annual and Second Evening Meeting; 22d Dec., Third Evening Meeting; 26th Jan. 1882, Fourth Evening Meeting; 23d Feb., Fifth Evening Meeting; 7th April, Conversazione. *Field Meetings*, viz.: 18th Feb., Arniston (1st excursion); 25th Feb., Arniston (2d excursion); 29th April, Straiton; 6th May, Currie; 13th May, Auchendinny; 20th May, Borthwick Castle; 27th May, St David's; 3d June, Pressmennan; 7th June, Craigmillar; 10th June, West Linton; 17th June, Caribber Wood; 21st June, Liberton; 24th June, Leslie; 28th June, Royal Botanic Garden; 1st July, Peebles; 8th July, Balerno; 19th July, Blackhall; 22d July,

Gullane; 9th Sept., Colinton; 16th Sept., Musselburgh,—in all 26 meetings, with an aggregate attendance of 848, or an average of over 32 at each meeting. As compared with Session 1880-81 with the same number of meetings, the Session just closed shows an increase in the aggregate attendance of 225. During the past year, 11 members have withdrawn their names from the roll, and one has died; 34 new members have been added to the roll, making a net increase of 22 members. As showing the progress of the Club, it may be well to state that in 1873 the published list showed a membership of 69; in 1878 the number had fallen to 60; in 1879 it was 64; in 1880, 69; in 1881, 88; and in 1882, 110.

At this meeting a rule was adopted by which Corresponding Members would be admitted to the Club.

In connection with the Secretary's Reports, Miss Craigie prepared a series of notes on the geological features of some of the localities visited, which were read at the March meeting, and which will be found in their place.

III.—RESTALRIG CHURCH—A MONOGRAPH.

By Mr THOMAS A. DOUGLAS WOOD.

(*Read Nov.* 23, 1882.)

The village of Restalrig is very ancient: its date is uncertain. The Parsonage is known to have existed as far back as the death of Alexander III., which took place in 1286. Its former names were Lestalrig, Listalrike, and Lochsterrock. The owner of the barony used to take the same name. It would seem that at an early period it was an independent parish lying between Duddingston and Leith, and the hamlet was at the same time the seat of a not inconsiderable establishment, being in the honourable position of kirk-town of South Leith. From early records we find that in 1296 Adam of St Edmunds, the parson of the parish, swore fealty to King Edward of England; and during the siege of Leith in 1560, Holinshed states that "the Lord Gracie, lieutenant of the Inglis armie, ludged in the town of Lestalrike, in the dean's house, and the most pairt of their demilances and horsemen lay in the saym towne." The church itself is believed to be also of ancient origin, as it was celebrated for the tomb of St Triduana, a noble virgin who came from Achaia in the fourth century along with St Rule, and died here. It used to be resorted to by many pilgrims, and numbers of miracles were believed to be accomplished by its aid, especially in the healing of the eyesight.

As already referred to, the lands belonged to a family bearing the same name in the early period of its existence. They passed, however, about the fourteenth century, to the Logans, through marriage, in the reign of Robert I., whose descendants held them till 1604, when they were sold to Lord Balmerino, secretary to James VI., whose descendants in turn possessed them till the Stuart rebellion, when they were confiscated, and handed over to the Bute family in 1746. These Logans seem to have figured somewhat conspicuously in the annals of history, and to one of the earliest of their branches does Edinburgh owe its large share in the management of the Leith Docks—indeed the superiority over Leith itself. It might, therefore, be not uninteresting to refer shortly to some of the principal events in their history. The name Logan appears first in the documents of the realm about the twelfth year of Alexander II.'s reign. The principal family of the name was given of Lastelrig, commonly called Lasterrick. Sir Robert married a daughter of Robert II., and he granted in May 1398 a charter to the city of Edinburgh while he was Admiral of Scotland, allowing it the exclusive right to certain waste places in the vicinity of the harbour of Leith for the erection of quays, wharves, shops, and granaries. In 1413 he made another one, this time restricting the Leith folks from carrying on any trade, or keeping inns for strangers, thereby giving to the city the whole monopoly of trade. In 1421 he acted as one of the hostages for James I. In 1441 we find that one John Logan, a son or grandson of the former, was made High Sheriff of Edinburgh by James II. The superiority of Restalrig was sold to Mary of Lorraine in 1555. The last to whom Restalrig belonged seems to have been a scapegoat. In some of the early traditions he is described as a "profligate and debaussit man." In 1580, by marriage to a daughter of Sir P. Home of Fast Castle, he became its proprietor. On account of outlawry for participation in a highway robbery, he hid himself here in 1596. In the same year he sold his estate of Nether Gogar to Logan of Coatfield, and, as we have seen, the barony of Restalrig to Lord Balmerino in 1604. It seems he was in a way implicated in the famous Gowrie conspiracy, although his complicity was not found out till after his death, which took place in 1606. Two years thereafter, a man, George Sprott by name, was tried, found guilty, and executed for his share in the conspiracy, and the evidence on which the conviction stood was merely a letter found in his possession written by Gowrie to Logan. Although now dead, the authorities, according to an old law, gave orders for the exhumation of his bones, which were duly brought into Court to receive sentence of confiscation and outlawry. Many people of the name of Logan changed it, although they were unconnected with the family, so great was the ignominy attached to it. A younger son fled to France, where he joined the

army. Having a quarrel with Garson, a favourite of the king's, they fought it out, resulting in the death of the Frenchman. Having to quit the country immediately thereafter, in case he should suffer death for his deed, young Logan once more arrives in Scotland. He was obliged to live a quiet, obscure, and retired life, on account of the stain on his name. Few could be found willing to associate themselves with him. Tradition asserts that it was he who, while so living, became acquainted with Tibbie Fowler of the Glen, immortalised in Scottish song, and, in spite of her father's objections, succeeded in carrying her off as his prize. It seems a house stood in the Shirra Brae, opposite the Coalhill, up to 1840, but was then removed, that was pointed out as the one in which they afterwards lived.

James III. seems to have taken a great fancy for this retired nook, for he established a collegiate apart from the old parsonage, and endowed it along with Lasswade. The establishment consisted of, besides the church, a "ludging" for the dean, and "chambers or manses with yardis and lands" for his prebendaries. James IV. augmented it by the addition to the foundation of eight prebendaries, who were endowed with the rights of titles in various parts of the country. James V. finished what was left uncompleted by the father, when he appointed a dean, nine prebendaries, and two singing-boys, the whole being dedicated to the Virgin and Trinity. In the year 1661 the following was the rental of the parish, as given in a return sent to Government: "The Fruits of the Deanery of Restalrig as it pays presentlie and commonlie their divers yiers bygane, with the parochin of Lesswaide and Glencorss—25 chalders, 8 bolls, 2 firlots oats; 8 chalders, 6 bolls, 2 firlots bear; 2 chalders, 13 bolls, 1 firlot wheat; 1 chalder, 3 bolls, 2 firlots rye; along with £43, 6s. 8d. Scots." The manse and glebe were feued for the yearly sum of £47, 6s. 8d. Scots.

Somewhere near the year 1490, if not in it, the church of South Leith was built, and through time many of the inhabitants of the village began to go there; but it was not till the year 1560, when the first General Assembly met after the Reformation, that an Act was passed condemning the church at Restalrig, and prohibiting service therein. The words of the Act read as follows: "Finds that the ministrie of the Word and Sacrament of God, and the assembly of people of the haill parochin of Restalrig, be within the Kirk of Leith, and that the Kirk of Restalrig, as a monument of idolitrie, be razed and utterly casten doun and destroyit." The name of John Knox is the first adhibited to this Act, and those of David Lindsay, minister, Andrew Lamb, and Patrick Boyman, are appended as representatives of Leith. It would seem that the wishes of the Assembly were soon to be gratified, for we find the following notice in the "Diurnal Occurrents" of 1571: "The Lords

and Captain of the Castle causit big ane new port at the Nether Bow, within the auld port of the samyne, of aisler wark in the maist strengthene maisoner: and tuik to big the sayme with all the aisler stanis that Alexander Clark had gaderit of the Kirk of Restalrig to big his hous with." The Legislature themselves passed a statute in 1609, the 25th chapter of which runs thus: "Understanding that the Kirk of Restalrig is ruinous, and that the Kirk of Leith has been the place of the convening of the parochines of Restalrig the space of fyftie ziers past, as alswa that it is most commodious, pairt in respect that the toun of Leith is the greatest pairt of the said parochin, whilk kirk notwithstanding has never yet been erected in ane paroch kirk." Further on the Act proceeds to declare "that the said Kirk of Leith be ane paroch kirk, and ordains to be repute, and called heirafter the paroch kirk of Leith, and all the inhabitants of Restalrig to resort thairto as unto thair paroch kirk as they have dune in tymes past; and that the beneface parsonage thairof, gleib and manse pertaining thairto, shall be always desponit to the minister serving the cure at the said Kirk of Leith in all tyme coming: and that the said Kirk of Restalrig be suppressed and extinct from henceforth and for ever."

The choir only now remains of this once famous and important edifice. It is of the Early English Gothic description, and, though small, is very neat and clean. It can scarcely date further than the fourteenth century. Its roof is high, and very beautifully decorated. On its walls are monuments to Dr Andrew Wood, and Louis Cauvin, the founder of the hospital at Duddingstone, whose remains lie just outside the door. It was rebuilt and renovated in 1836, through the instrumentality of Dr Chalmers and the Church Extension Committee, according to plans executed by William Burns, Esq. It was arranged that the second minister of South Leith should always occupy the pulpit on the Sabbath at least once a-day. Since, however, Dr Mitchell has been appointed, and the dual charge ceased, he has contrived to make the villagers assist in maintaining, if not altogether maintain, a minister of their own. In 1557 John Knox wrote of Mr John Sinclair, then the Dean of Restalrig, afterwards Lord President of the Court and Bishop of Brechin, as possessing so impartial a bearing to others that some thought him "not far from the kingdom of God." For himself, he thought "that as he was blynd of ae e'e in his body, he had lost baith in his saul."

The burying-ground is very interesting. It is kept, as many of the old country churchyards are, in a fairly tidy manner,—the custom of having the graves kept level with the borders, however, not being yet introduced. The sexton and beadle—a man over eighty years—is intelligent, a hale old man for his years, and very communicative, relating stories regarding the families whose grounds

he kept. At the time Episcopacy was overthrown in Scotland, the burying-ground was extensively used as a place of sepulture for the families and deposed clergy of the order, on account of a prohibitory notice issued against the reading of a service in the city and suburban burial-grounds. For this cause Alexander Rose, the last Established Episcopal Bishop, was in 1720 interred here. The monument over his grave has recently been renewed, and he is represented in full size, wearing his mitre, and having his crosier in his hand. Here lie the remains of Lord Brougham's father and family, and, as previously mentioned, of Louis Cauvin, the founder of the Hospital at Duddingston; Lord Wood, a senator of the Court of Justice; and the recently deceased Dr Andrew Wood's ground is here.

I must not, before closing, forget to mention a curious mausoleum annexed to the church, and which may at one time have been part of the old edifice. According to our friend the beadle, this is called the Earl of Moray's vault, who succeeded to the possession of the lands. There is at this time nothing to be seen inside save a stone, bearing to be in commemoration of the Lady Mary of Restalrig. It is half broken, and owing to the darkness of the place the whole inscription cannot be followed. From a description of this curious place I have been privileged to read, belonging to the Architectural Association of Edinburgh, it would seem that the building of it is ascribed to Sir Robert Logan, who died in 1441; and the opinion is expressed there, that from its antique form it might date much further back, and was perhaps a private chapel of St Triduana herself. The roof is ornamental in character, the same as the church, and is supported by a very massive carved pillar.

There once stood somewhere near the site of St Margaret's Station, at the junction of a cross-road leading to Holyrood, a well dedicated to St Margaret. It was protected by a handsome arch, supported by two columns. From this pure spring the monks were supplied with water. In course of time, however, the building was demolished and the well almost covered up, to enable the station there to be erected. A few years ago, through the exertions of the late Dr David Laing and the Society of Antiquaries, the well was removed and the water conducted to the Queen's Park, and now stands enclosed by a gate a little south of the Palace, on the road to St Anthony.

Having long had a desire to visit Restalrig, that desire has not till very lately been gratified. My visit over, curiosity which had previously been aroused was whetted, and I felt that I must for myself dip into its history. What information I obtained I jotted down as notes for my own use, and I have now ventured to give them to you, in the hope that I may be imparting to some such an interest in a church so close to their own dwellings as may induce them to pay a visit, however short, to that village.

IV.—SOME NOTES ON REMAINS OF THE GREAT AUK OR GAREFOWL (ALCA IMPENNIS, L.), FOUND IN EXCAVATING AN ANCIENT SHELL-MOUND IN ORONSAY.

By Mr SYMINGTON GRIEVE.

(*Read Nov.* 23, 1882.)

It may be perhaps rather difficult for some of you to understand that any special interest can attach to what appear to be such uninteresting objects as the few bones now before you. But they are worthy of notice because they belong to a bird whose history, if carefully written, would read like a romance; and the pen of the ready writer could put down in black and white the story of some scenes in the life of the race that, told with pathos, might bring tears of sympathy from hearts of stone.

The last of the Great Auks has, we believe, lived and died, ending its existence at the hands of its ruthless and oftentimes cruel enemy, mankind; and now the remains of this bird are prized because so rare, especially those that have been found in Britain. What are now before you we obtained from an ancient shell-mound on the island of Oronsay, one of the Southern Hebrides, during the month of June 1881; and as this is only the second place where such remains have yet been found in Scotland, they have excited some interest, and having been brought under the notice of the Fellows of the Linnæan Society, London, they have had them figured, along with a woodcut of the shell-mound.[1]

I have also to submit a woodcut[2] of the Great Auk, which I have carefully compared with the stuffed skins of the bird in the British Museum, London, as also with those in York Museum, and it is a most accurate picture, and decidedly superior to any other figure of the Great Auk that I know of.

It may be as well to mention that it is stated that some remains of this bird were found in a cave near the sea-coast of county Durham[3] a few years since; and through the kindness of Mr John Hancock, Newcastle-on-Tyne, who examined all the remains from this cave, we have ascertained that only one bone of the Great Auk was found, and that was an upper mandible.

[1] "Notice of the Discovery of Remains of the Great Auk or Garefowl (Alca impennis, L.), on the island of Oronsay, Argyllshire," by Symington Grieve. 'Linnæan Society's Journal'—Zoology, vol. xvi. pp. 479-487, and Plate IX.

[2] Woodcut which appeared in 'The Century,' August 1882.

[3] 'Natural History Transactions of Northumberland and Durham,' vol. vii., Pt. 2 (1880), pp. 361-364.

This is the first instance of the occurrence of any remains of this bird in England that we have heard of. But it is to be hoped that further search in both England and Scotland may yet recover from the shell-mounds, kitchen-middens, and cave-dwellings of the ancient inhabitants of our country more bones that belonged to this interesting and extinct bird. We can hardly expect to find anything like a complete skeleton in the European region that it inhabited, though such have been obtained from mummy Great Auks found in the frozen deposits of guano on Funk island, off the coast of Newfoundland;[1] but it is worthy of note that almost all the remains of this bird that have been found in the European shell-mounds are duplicates of the same bones of its body, which were those that were thickest and hardest, such as the larger bones of the wings and legs. It is probably to this that we owe their preservation, as they were best able to resist the ravages of time and exposure.

The habits of the Great Auk appear to have led it to frequent those isolated situations where, under ordinary circumstances, it would be free from molestation by man, as its want of the power of flight made it so helpless when on land. It is unfortunate that, perhaps owing to this instinctive retirement from places of human existence,[2] we know really so little regarding it. One of the best descriptions that we have is that by Martin, who, writing of St Kilda, says: "The sea-fowl are first the Gairfowl, being the stateliest as well as the largest sort, and above the size of a Solan Goose, of a black colour, red about the eyes, a large white spot under each, a long broad bill; it stands stately, its whole body erected, its wings short, flies not at all; lays its egg upon the bare rock, which, if taken away, she lays no more for that year. She is whole-footed [web-footed], and has the hatching spot upon her breast—*i.e.*, a bare spot from which the feathers have fallen off with the heat in hatching; its egg is twice as big as that of a Solan Goose, and is variously spotted—black, green, and dark. It comes without regard to any wind, appears the first of May, and goes away about the middle of June."

The Great Auk appears to be first mentioned as occurring in the American region by Sebastian Cabot[3] in 1497 or 1498, and it was soon greatly valued as food by the early voyagers to those waters, as it could scarcely fly, and was so stupid or fearless, when on shore, that it allowed itself to be driven on board the vessels in immense numbers, by merely stretching sails or planks of wood

[1] 'Annals of Natural History,' third series, Pt. 14. 'Proceedings of Zoological Society, London,' 10th November 1863.

[2] 'A Voyage to St Kilda, May 29, 1697,' by M. Martin, Gent. Published in London, 1753, p. 27.

[3] 'Hakluyt's Voyages,' vol. iii., 1810 (Sebastian Cabot).

from the ships to the shore; and we need not wonder that it has been exterminated, especially when we remember that the female birds only laid one egg each year.

For a long period the Great Auks, or Penguins as they were called in the American locality, were so numerous that mariners frequenting those seas depended upon them as the principal source of provision for their ships; and it is probably not much more than a century since the merchants of Bonavista used to sell these birds to the poor people by the hundred-weight instead of pork.

Our knowledge of what were its breeding-places may be defective; but it seems the following are historically well attested,—viz., St Kilda, Faroe, and the three Garefowl Rocks off the coast of Iceland. Then we have to go west to the east coast of North America, where, in the neighbourhood of Newfoundland, it was met with on Funk and many other islands, also on some of the islands in the Bay of St Lawrence, and at Cape Breton; while another station on the same coast at which it probably occurred was Cape Cod—and this seems to have been near the southern limit of the region in which the bird lived. We find it gradually diminished in numbers at all the American breeding-places, until, finally, early in the present century, it altogether disappeared; and although we have one or two notices of its being observed in American waters between the years 1830 and 1852, when the last notice occurs, it does not appear that any of these occurrences are fully authenticated by those who report them. In the European region it lingered a few years longer; and it is not difficult to recount its recorded occurrences during the present century, but we shall only refer to a few of these. Its last authenticated occurrences in British waters are as follows: Two specimens, a male and a female, were killed at Papa-Westray, one of the Orkney islands, during the year 1812. The skin of the female bird was so destroyed that it was unfit for stuffing; but that of the male bird is now in the British Museum, and is the finest skin they possess. Early in the summer of 1821 a specimen was caught alive at St Kilda; and coming into the hands of Mr Maclellan, a tacksman of Glass or Scalpa, one of the Northern Hebrides, it was by him given to the Rev. John Fleming, D.D., minister of Flisk, afterwards Professor Fleming of the New College, Edinburgh, on the eve of his leaving Glass in the yacht of the Commissioners of Northern Lighthouses, 18th August of that year.[1] This bird was fed on fresh fish, and allowed occasionally to sport in the water, with a cord fastened to its leg to prevent escape. Unfortunately it got away when the yacht was near the entrance to the Firth of Clyde, as it was being allowed to take its usual bath.[2] There appears to be some evidence that this bird afterwards

[1] 'Proceedings of the Society of Antiquaries of Scotland,' vol. ii., N. S., p. 441.
[2] 'Edinburgh Philosophical Journal,' vol. x., 1824.

died, and that its body was cast ashore at Gourock.[1] Of all the specimens, perhaps more has been written about this one than any other, but we have no space for a longer notice. In May 1834, two Great Auks were captured near the entrance to Waterford harbour, and one of these is now preserved in the Museum of Trinity College, Dublin, but the other was unfortunately destroyed, through the ignorance of its captors.[2] This is probably the last authentic recorded occurrence of this bird on the British coasts; but it is stated that two were seen in Belfast Bay during 1845,[3]—and this is worthy of note, as, if it is correct, it is a year later than the date at which the last Great Auks were killed on Eldey, off the coast of Iceland.[4]

It is recorded that several Great Auks were, from time to time, seen or caught on the French side of the English Channel; but they were all observed early in the century.[5] A dead bird is said to have been found near Fredericksstad, in Norway, during the winter of 1838.[6]

The station, however, at which Great Auks lingered longest was Iceland, where they had several rocky skerries on which to breed that were difficult of access from the stormy sea with which they were surrounded. But by a volcanic subsidence that occurred in 1830, their principal breeding-station, named the Geirfuglasker, situated off Reykjavik, disappeared beneath the waves, and immediately afterwards a colony of these birds appeared at Eldey, a skerry which lies much nearer the main island; and it was here that a number of specimens were got, until what is believed to have been the last pair of living Great Auks were killed at the beginning of June 1844,[7] and their intestines and other internal organs are now preserved in the Royal Museum, Copenhagen.[8] But what became of their skins, bones, and other remains, appears to be unknown.[9]

As far as we have been able to ascertain, the known remains of the Great Auk may be totalled as follows: skins, 72 (or 74?); skeletons, 9; number of birds represented by detached bones, 90 (or

[1] 'Birds of the West of Scotland,' R. Gray (1871), pp. 441-453.

[2] Thomson: 'Birds of Ireland,' vol. iii. p. 238.

[3] Ibid., p. 239.

[4] "The Garefowl and its Historians," in 'Natural History Review,' 1865 (Prof. Newton).

[5] 'Degland Ornithologie Eur.,' vol. ii. p. 529. Also M. Hardy's 'Catalogue des Oiseaux de la Seine-Inferieure.'

[6] "The Garefowl and its Historians," in 'Natural History Review,' 1865, p. 469 (Prof. Newton).

[7] Mr J. Wolley's Researches. 'Ibis,' vol. iii. (1861) p. 392.

[8] 'Proceedings of Royal Society, Edinburgh,' 1879-80, p. 679 (Robt. Gray, Esq.).

[9] Videnskabdige Meddeleser, 1855, Nos. iii.-vii. Prof. Steenstrup's Paper, p. 78.

93?), calculating the remains obtained from Funk island by Professor Milne as representing 50 birds; eggs, 67.

We hope these few notes may have proved interesting; and if within any of you there has been aroused an interest in this extinct bird, we shall have ample excuse for having extended them rather beyond what we intended.

V.—ON A SPECIMEN OF THE POISONOUS LIZARD OF MEXICO (HELODERMA HORRIDUM, WEIGMANN).

Exhibited, with Remarks, by Mr R. J. HARVEY GIBSON, M.A., *November* 23, 1882.

The Heloderm is a native of the hottest part of Mexico, bordering the Gulf of Tehuantepec. It is further limited in its distribution to the dry parts of that region, being entirely unknown on the Mexican Gulf side. It is nocturnal and terrestrial. Its saliva, which is copious and of gluey consistence, is poisonous to small animals. The teeth, like those of poisonous serpents, are perforated by a canal distinct from the pulp cavity, but no special poison-gland has been discovered in connection with the teeth. Its hide is of extreme beauty, being of a creamy buff, with dark brown markings arranged in a definite pattern. The fact of its possessing poisonous powers, taken along with its known preference for eggs as food, gives rise to the question, What use is the poison to the animal? It has been long known that human saliva, if concentrated, possesses poisonous properties; and the recent researches of M. Gautier of Paris have demonstrated the existence of sulpho-cyanide of potassium in saliva, of the young especially. It is of considerable interest to find that man is not alone in this peculiarity, while, in addition, it suggests a possible explanation of the origin of poison-glands generally. The specimen will shortly be mounted in the Science and Art Museum, to which it has been presented by Mr Patrick Geddes — by whose courtesy Mr Gibson was enabled to show the specimen to the club.

VI.—BEES AND BEE CULTURE.

By Mr A. B. HERBERT, President.

(*Read Dec.* 22, 1882.)

These insects, and their instincts and habits, have from remote ages engaged the thoughts and consideration of many eminent

naturalists, and volumes upon volumes have been written respecting them. I propose to treat the subject thus,—first, glancing at Bee literature, and the natural history of Bees; then their various species, both indigenous and introduced, and the habits of the insects; then to enumerate some of the flowers most frequented by them; afterwards to consider their enemies; and afterwards their natural and artificial habitations, combined with such general remarks as may occur to me.

Among the early writers on the subject we have Aristotle, born 381 years before the Christian era; Virgil, born seventy years before Christ; and Pliny the elder, who lived about the time of our Saviour; and afterwards a learned Spaniard, Columella, who wrote his 'De Re Rustica' in the first century.

Virgil wrote very fully on Bees, and I will give a few literal translations from the Fourth Georgic. He says: "First, a proper station must be sought for the Bees, to which winds have no access; and let lizards with speckled backs be kept far away from the rich hives; and woodpeckers, and other birds, and the swallow, whose breast is stained with blood,—for these birds create great havoc, and in their beaks bear away the Bees while on the wing, sweet morsels for their merciless young. But let clear springs and pools edged with green moss be near, and let green cassia, and far-smelling wild thyme, and strong-scented savory, and beds of violet, be near the spring." He also mentions, as favourable to the insects, "the glowing crocus, the gummy lime, and the purple hyacinth;" and he states that "the life of a Worker-Bee is not prolonged beyond the seventh summer." But if he had said the seventh month, he would have been far nearer the truth. Virgil also tells us that, while their king is safe, all live in perfect harmony; but on his death they dissolve their union: that he is their guardian,—they buzz around him, and in vast numbers protect him. He also states that Bees often take up little stones to steady them in their flight, as unsteady vessels do in a rough sea. This, no doubt, is in allusion to the balls of pollen carried by the insects in the peculiar cavities in their hind legs. It is pretty clear that Virgil knew but little of the true natural history of Bees, or the internal economy of the hive, and was not even aware that the principal Bee was a female, for he speaks of her throughout as a king: and as there were no glass hives in those times, his remarks were restricted to the results of external observations. But Virgil had observed that there were two species of Bees then, as now, in Italy,—namely, our common black Bee (*Apis mellifica*), and the Italian or Ligurian, or, as it is often designated, the Alp Bee (*Apis Ligustica*); and he very truthfully mentions the latter as the preferable species, where he says "there are two sorts of bees—one glowing with refulgent spots of gold, and conspicuous by its glittering scales;

and this is the better species." It is clear that these remarks apply to the bronze colour of the anterior folds of the abdomen in the Ligurian, which is the distinguishing characteristic of the species.

Coming down to a later period, we have Tusser,—old Tusser, as he is called,—who lived in the sixteenth century, and wrote 'The Five Hundred Points of Good Husbandry,' who has a curious couplet on the position of beehives. He says:—

> "Set hive on a plank, not too low, on the ground,
> Where herb with the flowers may compass it round;
> And boards to defend it from north and north-east,
> From showers and rubbish, from vermin and beast."

And again, we have Bees mentioned several times by Shakespeare. We all know Ariel's song in the "Tempest"; and also where he says, so graphically and concisely—

> "So work the honey-bees,—
> Creatures that by a rule of nature teach
> The art of order to a peopled kingdom."

Again, the Scottish poet of nature, Thomson, very pleasingly writes, in the 'Seasons':—

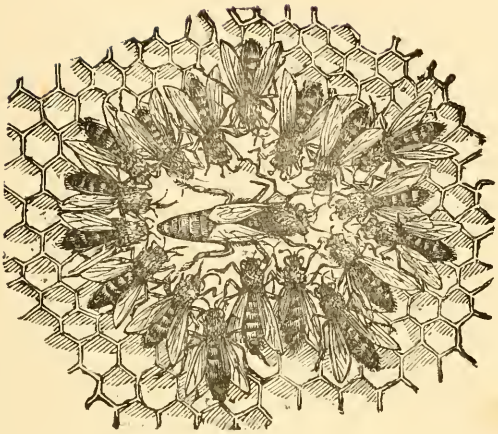
> "Here their delicious task the fervent Bees
> In swarming millions tend. Around, athwart,
> Through the soft air the busy nations fly,
> Cling to the bud, and with inserted tube
> Suck its pure essence, its ethereal soul;
> And oft, with bolder wing, they soaring dare
> The purple heath, or where the wild thyme grows,
> And yellow load them with the luscious spoil."

The oldest book I possess on the subject is dated 1721, and is entitled, 'The True Amazons; or, Monarchy of Bees,' by Joseph Warder; and in this are quotations from a book by a Mr Purchas, dated 1656, and bearing the curious title of 'The Theatre of Political Flying Insects.' Warder gives, with all seriousness, directions for bringing dead Bees to life, by holding them in your warm hands, or putting them in a perforated tin box in the trousers' pocket; but I need scarcely remark that the Bees so operated upon were simply cases of suspended animation through cold. I have revived hundreds, probably thousands, in the same manner, either by holding them in my hands or putting them in a small perforated zinc tea-infuser in my trousers' pocket, without knowing that Joseph Warder had adopted a precisely similar practice a century and a half ago. The first symptoms of returning animation in chilled Bees is a slight quivering of the antennæ; then a movement of the folds of the abdomen in breathing; then the insect gets on her legs, moves her head about to see where she is, and lastly, before taking flight, wipes her eyes and each of her antennæ with her fore-feet. It is interesting to watch this return to life and activity

in a few minutes from apparent death. I have observed that when the Bee's tongue or proboscis is protruded, the insect is dead beyond the power of Mr Warder or any one else to revive; but that so long as the tongue is retained between the mandibles, there is hope of recovery by warmth. The dedication of Warder's book to Queen Anne is quaint and amusing. He compares the devotion of the queen's subjects to that of the Worker-Bees for their queen, and reasons from analogy that the monarchical is the only proper form of government. The next writer I will mention is Wildman, the author of a treatise on the management of Bees, dated 1768. This work was published by subscription, and among the subscribers are several Edinburgh men—namely, Dr Black, George Clerk, Dr Ferguson, and others. Wildman also wrote a very excellent account of the natural history of Wasps. There are two cases on record of Bees swarming on human beings—one of them mentioned by Wildman. The particulars of these cases I will give when I come to speak of swarming. The works of recent date on our subject in this country, the Continent, and America, are so numerous, that I must content myself with merely mentioning some of the authors' names, such as Huber, Reaumur, Schirach, Dzierzon, Bevan, Nutt, Chesshire, Root, Langstroth, Tegetmeyer, Pettigrew, our townsman John Lowe, Sir John Lubbock, Cowan, and last, but by no means least in importance, Mr Abbott of Fairlawn, near London, the able and obliging editor of the 'British Bee Journal,' and the author of "Leaflets for Cottagers," and other very useful and inexpensive works. Mr Abbott's indefatigable exertions in inculcating humanity towards Bees, and giving valuable information, are fully appreciated by all who have the pleasure of his acquaintance. In the summer of 1881 I spent some hours with him amongst his beehives most enjoyably and profitably; and it was there that I saw for the first time the newly imported Bees from the island of Cyprus. In noticing Bee literature, it is extraordinary to think how much we owe to a blind man for our intimate knowledge of the natural history of the insect. I refer, of course, to that estimable man, Francis Huber, who lived to the venerable age of 81, and died in 1831. His work, written originally in French, but translated into English, is undoubtedly one of the most scientific and best treatises we possess. Huber was fortunate in having that greatest of earthly blessings, a devoted and affectionate wife, and when he became totally blind he used her eyes and reasoned upon what she saw; and most of his remarks have been repeatedly confirmed by subsequent writers. The account of his matrimonial engagement is romantic and interesting. When quite young, and attending a dancing academy, he formed an ardent attachment to a daughter of M. Lullin, a member of the syndic of the Swiss Republic; and during his engagement, which

was of seven years' duration, he on one occasion lost his way on a journey, and suffered so much from exposure to cold, &c., that his eyesight was seriously affected, and it became only too evident to himself and his immediate friends that ere long he would be entirely deprived of sight; and M. Lullin strongly opposed the marriage of his daughter to a man so afflicted. Huber, too, had some fear lest the object of his affection should coincide with her father's views, and endeavoured to conceal from her the extent of his calamity. Huber, in fact, had not sufficient faith in the affection and devotion of this noble-minded girl. When she found out he had tried to conceal from her how utterly blind he was becoming, she reproached him for his distrust of her—probably the only time she ever reproved him—telling him that there was now the greater reason why they should be united, as he would require that assistance and those innumerable attentions which a devoted wife alone could supply; that she should soon be of age, and would then be her own mistress, and they would be married. And most admirably did she prove her devotion. She became his right hand in everything, his amanuensis, entering heartily into all his scientific researches; and in order that, when she could not accompany him, he might not be deprived of his accustomed walks, she stretched strings for his guidance along the paths he usually frequented. She died many years before Huber; and he remarks that so long as she lived he never knew to the full extent how great a calamity it is to be blind. Such was this amiable and accomplished woman, Maria Aimée, the wife of Francis Huber. In concluding this part of my subject, I may mention that one of the best simple and practical books on Bees is Mr Cowan's 'Bee-keeper's Guide Book,' published at the moderate price of 1s. 6d., which has now run through several editions.

We will now proceed to the consideration of the natural history of the Hive-Bee; and this I will state as concisely as possible. An ordinary good stock of Bees in the summer consists of one queen or mature female, about 500 drones, and 20,000 workers. Swarms of Bees are now frequently advertised to be sold by weight; and I may mention that it takes about 5000 Worker-Bees to weigh a pound. The queen is the only Bee which lays eggs; and it is said she will lay as many as 2000 in twenty-four hours. My own opinion is that this is a slight exaggeration, for it is at the rate of 83 per hour; and though I have often seen the queen laying eggs much quicker than one a minute, I have observed that after laying a score or so she usually pauses for a time—and it is when she is resting in this manner that you see a group of workers round, with their heads all towards her, apparently caressing her by touches with their antennæ, and offering her food from their tongues (see Illustration). She also spends much time in walking over the combs



The Queen or Mother Bee surrounded by workers with their heads towards her, as she can be seen at any time in an Observatory Hive, and as exhibited in a glass Hive to the Royal Visitors at the British Bee-Keepers Association at Kilburn, by Messrs. Abbott Brothers, of Southall.

to find suitable cells which have not already brood or honey in them; and she invariably puts her head into a cell before laying in it. The queens are usually hatched in large cells placed vertically on the edge of the comb, and it takes 17 days from the laying of the egg till the queen emerges a perfect insect from the cell. A drone takes 24 days, and a worker 21 days. The queen is much longer in the body than the workers, has longer legs, and is provided with a sting, but which is seldom used except in a combat with a rival queen. I have had a queen in my hand several times, but never knew her attempt to sting. She never leaves the hive except on her hymeneal flight, which occurs a few days after leaving the cell, or when she leads out a swarm. The drones are the males, are much larger than the workers, and have no stings; and none of these survive the winter. They begin to hatch out in April or May, and are destroyed by the workers about August. The workers are females, but incapable of reproduction—in fact, immature queens; for it is now considered an established truth, that when a hive is by any accident deprived of its queen, a worker grub, a few days old, is selected, its cell enlarged, and by giving it a peculiar food it emerges a perfect queen. The workers are provided with what is called a honey-sack, into which the honey is drawn up from the nectary of the flowers, and ejected through the tongue or proboscis into the cells. The cells containing drone grubs are larger than those for worker grubs, and both kinds of cells are used as receptacles for honey; and it is clear the queen must know what kind of eggs she is laying, as she does not deposit a worker egg into a drone cell, or *vice versâ*. The workers are also provided with small sacks or cavities in their hind legs, which they fill with pollen. The use of the antennæ of Bees is a subject which has engaged the close attention and observation of many scientific Bee-keepers, and especially of Sir John Lubbock; and it seems, I think, highly probable, that they are delicate and highly sensitive organs of sense to which we have no strict analogy in our own constitution. That they are feelers, we can have no doubt. But are they not much more than this? May not the insect through them be made aware of atmospheric changes, or of vibrations in the air caused by sound, or possibly may they not convey to the insect a sensation resembling our sense of smell? These are questions we cannot solve; but we are quite certain they are most important organs, though their exact uses we cannot define. If you notice closely a worker leaving the hive, you will often see that before taking flight she wipes her antennæ with her fore-legs, as though it were of the first importance that these organs should be perfectly free from the smallest particle of dust or other extraneous matter. I have hundreds of times observed the workers do this, but have not seen it remarked in any publication.

We will now consider the various species of Bees, both indigenous and introduced. As a honey-gathering Bee for any useful purpose, we have really only one native species, the common black Bee, *Apis mellifica*. We have certainly many species of beautiful Humble Bees, such as *Bombus muscorum*, *Bombus lapidarius*, and *Bombus terrestris*, and others; but these only gather enough honey to feed their brood, and only a few of the females survive the winter, and emerge in the spring, to become the founders of nests, and in this respect their habits are very similar to those of Wasps.

Regarding Honey-Bees which have been introduced into this country in recent years we have now several species,—the Ligurian or Italian, or, as it is sometimes designated, the Alp Bee, the Egyptian Bee, the Cypriote Bee, and the Carniolan Bee. All these are so nearly allied to our own species that they will cross and produce hybrids, and these hybrids are fertile, so that cross-bred Bees are now by no means uncommon wherever Bees are kept. I have a strong opinion that neither the Egyptian nor the Cypriote Bee will eventually be favourites with Bee-keepers. They much resemble each other, being of a very light colour, and smaller than our Bees, very active, and, I believe, prolific breeders; but the disposition of both is far from amiable. My friend Mr Lowe had some years ago a hive of Egyptians near the Dean Bridge, but if you even walked in front of the hive there was some danger of being stung; and when I was at Fairlawn in 1881, Mr Abbott kindly opened a frame hive of Cypriote Bees to show me the queen and drones of the species, and though I had a Bee-veil on, I found I had to keep my hands very firmly in my pockets to keep free from stings. I look, however, on Ligurians, as evidently Virgil did, as an improvement on our own, and in these respects,—that they are prettier insects, having the anterior rings of the abdomen of a pale brown colour; they are more active, and unquestionably more prolific, and as honey-gatherers quite equal if not superior to our own Bees. It may probably be found that hybrids between our own and Ligurians are the best of all. With regard to the prolific nature of these hybrids, I will mention a fact which came under my notice this year. In May I had one straw hive of black Bees; a neighbour had a similar hive of hybrids,—both, I think, equally strong in numbers. My hive threw off one swarm only on the 15th June; my neighbour's, on the other hand, threw off one swarm on the 30th May, a second on the 10th June, and a third on the 16th of the same month: moreover, the first swarm of the 30th May sent off other three swarms, so that in July, while of black Bees there were only two stocks, of hybrids there were seven.

To me one of the most interesting sights connected with Bee-keeping is the process of swarming—that is, the queen leading out a swarm to form a new colony; and this always takes place when

there are young queens being reared, one of which will be able to take the place of the old queen who had left. As perhaps many of our members may have never witnessed the process of swarming, I will give a brief account of my own swarm last June,—for, though I have hived perhaps over 100 swarms, I had never before actually seen the queen leave the hive on these occasions, and I much wished to do so. I knew the Bees were ready to swarm. There are manifestations of this well known to Bee-keepers; and after several wet days, the morning of the 15th June opened with bright sunshine, so about 10 o'clock I posted myself close to the hive, and kept a sharp look-out, and happily had not been long there before I saw the queen walk out of the hive, pause for a few moments on the landing-board, and then take flight. To my surprise, a full minute or more elapsed before the rush of Bees to the mouth of the hive took place: then out they came, as they always do, with that helter-skelter speed, as one writer describes it, as though their lives depended on their expedition; and as you watch the living stream tumbling over each other in their haste to get out, you wonder how the hive could possibly hold so many. The air was then full of them, and they seemed to be long in finding their queen, and so tired with flying that they settled thickly over the grass, on the wall of the garden and house, and great numbers on myself, and it was impossible to move without treading on some. However I saw the queen not far from me walking up the wall, and soon there was the joyous hum, so well known to Bee-keepers, as the Bees all rose and congregated round her in a dense mass on the wall. I then placed my bar-framed hive above the cluster of Bees, with one edge resting on the wall, and the other supported on a stake from the ground, and successfully hived them.

The custom of "ringing Bees" by beating the shovel with the poker when a swarm has issued was very general in my younger days, and is still practised in many rural districts in England, from an idea that the Bees would not settle unless this were done. Two reasons have been assigned for the custom,—one, that you gave your neighbours notice that you had a swarm on the wing, and so were at liberty to follow them; another, that it was an imitation of thunder, and that during an impending storm the Bees would be more ready to settle and get under shelter. It is generally considered lawful, both here and in England, to follow a swarm on to your neighbour's property to hive them, and such is the universal custom, but whether you are strictly within the law is somewhat doubtful. A circumstance occurred last summer in England which seemed likely to bring this point to an issue. A swarm belonging to a Mr Thomson settled in his neighbour's garden, such neighbour being one of the fair and gentle sex, though the latter quality was not very apparent in this instance, for seeing the clus-

ter on the tree, she procured a large tub of water, and drowned the entire swarm. Then came a very strong remonstrance from Mr Thomson, but the only reply he received was that "she neither wanted Mr Thomson nor his Bees in her garden, and what was more, she would not have them." This was followed by a lawyer's letter demanding compensation for destruction of property, and it ended in the lady paying what was considered an equivalent for the value of the swarm, to avoid litigation. So the law upon the point is still unsettled; but the British Bee-Keeper's Association have resolved, when another case arises, to obtain a legal decision on the point, entertaining scarcely a doubt that such decision will be in accordance with what is the universal custom.

There are two instances on record of swarms of Bees settling on human beings, and these may perhaps interest you. The first is mentioned by Mr Lombard; the second by an old English Bee-keeper named Thorley, in the year 1717, and recorded in Wildman's book. Lombard says:—

"A young girl of my acquaintance was greatly afraid of Bees, but was completely cured of her fear by the following incident. A swarm having left the hive, I observed the queen alight by herself at a little distance from the apiary. I immediately called my little friend that I might show her this important personage. She was anxious to have a nearer view of her majesty, and therefore, having first caused her to draw on her gloves, I gave the queen into her hand. Scarcely had I done so when we were surrounded by the whole Bees of the swarm. In this emergency I encouraged the trembling girl to be steady and to fear nothing, remaining myself close to her, and covering her head and shoulders with a thin handkerchief. I then made her stretch out her hand, which held the queen, and the Bees instantly alighted on it, and hung from her fingers as from the branch of a tree. The girl, experiencing no injury, was delighted above measure at the novel sight, and so entirely freed from fear that she bade me uncover her face. The spectators were charmed at the interesting spectacle. I at length brought a hive, and shaking the swarm from the child's hand, it was lodged in safety without inflicting a single sting."

This is Thorley's account of a somewhat similar occurrence:—

"In the year 1717 one of my swarms settled among the twisted branches of a Codlin tree, and not to be got into a hive without help, my maid-servant, being in the garden, offered her assistance to hold the hive while I dislodged the Bees. Having never been acquainted with Bees, she put a linen cloth over her head and shoulders, to secure her from their stings. A few of the Bees fell into the hive, and some on the ground, but the main body upon the cloth which covered her garments. I took the hive out of her hands when she cried out that the Bees were got under the covering, and were crowding up towards her breast and face, which put her into a trembling posture. When I perceived the veil was of no further service, she gave me leave to remove it. This done, a most affecting spectacle presented itself to the view of all the company, filling me with the deepest distress and concern, as I thought myself the unhappy instrument of drawing her into so imminent hazard of her life. Had she enraged them, all resistance would have been vain, and nothing less than her life would have atoned for the offence. I spared not to use all the arguments I could think of, and used the most

affectionate entreaties, begging her with all earnestness in my power to stand her ground, and keep her present posture; in order to which I gave her encouragement to hope for a full discharge from her disagreeable companions. I began to search amongst them for the queen, they having now got in a great body upon her breast, about her neck, and up to her chin. I immediately seized her from the crowd, with some of the commons in company with her, and put them together into the hive. Here I watched her for some time, and as I did not observe that she came out, I conceived an expectation of seeing the whole body quickly abandon their settlement: but instead of that, I soon observed them gathering closer together, without the least signal of departing. Then I immediately reflected that either there must be another sovereign, or that the same was returned. I directly commenced a second search, and in a short time, with a most agreeable surprise, found a second or the same. She strove by entering farther into the crowd to escape me, but I reconducted her with a great number of the populace into the hive. And now the melancholy scene began to change into one infinitely more agreeable and pleasant. The Bees, missing their queen, began to dislodge and repair to the hive, crowding into it in multitudes, and in the greatest hurry imaginable, and in the space of two or three minutes the maid had not a single Bee about her, neither had she so much as one sting."

Artificial swarms are now frequently made either by driving from straw skeps, or where frame-hives are used, by taking a few frames containing brood-comb from a full hive, and putting them into an empty one. These processes are fully explained in the cheap leaflets published by the British Bee-Keeper's Association. The titles of the leaflets published at a halfpenny each are as under, and they are most useful publications: "Making an Apiary," "Managing an Apiary," "Quieting Bees," "Bee Entomology," "Transferring," "Feeding," "Ligurianising," "Driving Bees," "Making Artificial Swarms," and "Fixing Comb Foundations."

Some years ago I assisted my friend Mr Lowe to drive a stock of Bees: it was a Ligurian colony which he wished to send to London. The process is simple. We reversed the straw hive, placed an empty hive on the top, put a cloth round the junction of the two hives, then drummed on the inverted hive to alarm the Bees, which hurried with their queen up into the empty hive, where they clustered. This we did in the evening, and the same night the Bees in the new hive were despatched to London, and the old hive, full of brood and a few workers, restored to its former place.

The practice of ligurianising stocks of black Bees is now carried on extensively—*i.e.*, substituting a Ligurian queen for a black one. These queens are bred here, and also imported for sale at 6s. or 8s. each. The old queen is removed, and the Ligurian, with a few of her subjects, confined in a perforated zinc cage placed in the hive. It would not do to put the new queen in without this precaution, as she would probably be at once destroyed. But when the workers miss their queen, and the scent from the hive has penetrated well into the cage, the workers, on the cage being opened, welcome the new queen, and treat her as they would their own. She then be-

gins of course to lay Ligurian eggs, and as the old black Bees die off, the hive becomes in a few months a pure Ligurian colony, and this practice has enabled us to form a very good idea of the duration of life of a worker Bee, the average of which is found not to exceed a few months.

It may be well to enumerate a few of the flowers most frequented by Bees. I will merely mention some of the most important. In the early spring the Crocus and Willow are perhaps the first, and much pollen is procured from these, and also from the blossoms of fruit-trees. Raspberry and Gooseberry blossoms seem great favourites with Bees, and Turnip flowers, and all the Brassica tribe; then Ribes, Lime, Arabis alpinus, Limnanthes Douglasii, Wallflower, Mignonette, White Clover, Melilotus leucantha; and in the autumn Heather, Ivy, Garden Balsam, &c. A full list of Bee flowers is given in a recent number of the 'British Bee Journal.' One fact may not be generally known, namely, that a Bee, when gathering honey, does not go promiscuously from one flower to another—for instance, from White Clover to Mignonette. If she begins on Mignonette, she goes to no other flower till she returns to the hive. You can notice this at any time, and I have no doubt your observations will confirm my statement.

We will now glance at some of the enemies of Bees. You are aware, from the paper I wrote last year on the Flycatcher, that I do not consider our small birds as enemies to Bees. That beautiful bird the Bee-eater (*Merops apiaster*) is always spoken of as a great destroyer of them, but it never visits Scotland, and is an extremely rare visitant to England, where unfortunately its attractive plumage soon renders it a specimen for our museums. It is possible its long bill may enable it to kill Worker-Bees with impunity. Wasps are great enemies to Bees. I have known weak colonies entirely destroyed by them. Mice will sometimes in winter, when the Bees are almost helpless, make sad havoc with the combs, but the entrance of the hive ought never to be sufficiently large to admit them. Snails in their shells sometimes crawl into a hive, and the Bees, not being able to eject them, with propolis fix the edges of the shell to the floor-board, and the mollusc is suffocated, and so hermetically sealed that its remains cannot be deleterious or offensive. The Wax Moth is an enemy, for the larvæ do great injury to the combs; and the Death's-Head Moth is also mentioned as doing much mischief in hives, but this splendid Moth is seldom seen in Scotland. By far the greatest enemies the Bees have are unquestionably human, or more properly inhuman, beings, who, not content with taking a portion of the honey the insects have stored, still dig holes in the garden, in which sulphur is burned, and the hive placed over the fumes, and the whole colony suffocated, and the dead and dying buried out of sight. We will

sincerely hope that this unmitigated and unnecessary barbarity will soon be an action of the past, for now wherever Bee-societies are established, there are always members who will willingly, on being allowed the insects for their trouble, drive them for the cottager, instead of destroying them, and even pay him some trifle for the Bees so driven.

The places selected by Bees in their wild state for habitations are hollow trees and holes in rocks; and I have known many instances where swarms have located themselves under the tiles or slates of houses, and remained there for years; and I once hived a swarm in Wiltshire, which issued from a disused chimney. Some cousins of mine, who settled in Illinois forty years ago, established their apiary in the following manner:—Having discovered a strong colony of Bees in a hollow tree, they in the evening plugged up the entrance, sawed off the top, and afterwards the root, and then shouldered the portion containing the Bees, and stuck it upright in their garden, and as swarms issued hived them in the usual way. How different is the state of things now in Illinois, for that state is quite in the van of Bee-culture, the only weekly publication on the subject in the world being published at Chicago.

Various materials have been, and still are, used in the construction of hives. Virgil mentions the bark of trees, and the slender Willow twigs twisted together. In Northern Africa hives in general use are made of earthenware, very like our drain-pipes, one end being blocked up, and a small hole left in the other: these are stacked one upon another, so that a number of hives would occupy a small space. Straw and wood are, however, the common materials used in all temperate climates, and it is still an open question which is preferable. Straw is a good non-conductor of heat, but not so durable as thick wood; and now, with all advanced Bee-keepers, wood seems to be preferred. I have often thought that cork, or wood with a cork lining, would be very suitable, cork being a good absorbent of moisture, and good as a non-conductor; and I see hives with a cork lining have very recently been advertised for sale. In a recent number of the Journal, mention is made of a hive of plaster of Paris, the invention of a Scotchman, a Mr Paterson of Struan, who says Bees winter well in it, and that it is a panacea for all winter troubles in this climate.

The forms in which hives have been constructed are almost endless, depending much on the system adopted—such as the collateral one of placing boxes beside each other, on a level, with communication from one to the other, or piling them vertically as supers or nadirs. Warder tells us that a Mr Gedde was the first man in this country who made hives of wood, and he was granted a patent for his invention by King Charles II.

Nutt's collateral bee-boxes were much used in England thirty

years ago, and were patented, but they were unnecessarily complicated, and very costly—their principal merit being, that with them honey could be taken on the depriving system without destroying the Bees, and this was a great advance on Bee-keeping at that time; but all modern hives now give facilities for this practice. Afterwards Stewarton brought out his octagonal boxes placed one upon another on the storifying principle, and these are still extensively used, but there is here also the objection of expense; and, moreover, when you have several stories in a hive, there must necessarily be much valuable time wasted by the insects in going up to deposit the honey. The Giotto hive, the invention of an Italian, is much used in that country, and has been introduced here. It consists of a number of frames, like sections of a square box placed longitudinally, and held together by iron pins and nuts; but it is too cold for this climate, and can never be so workable as a bar-framed hive. A writer in the 'Bee Journal' of Oct. last speaks of it thus: "I unhesitatingly say, from my experience of about a dozen Giotto hives, that they are unworkable, are virtually fixed,—and if you want to utterly disgust any one with Bee-keeping, recommend him a Giotto hive, for, to manage one, he would require to have the temper of an angel, the patience of Job, and the skin of a rhinoceros." Without mentioning the great variety of hives which have from time to time been invented, I will now direct your attention to the modern bar-framed hive—one of which, made by Mr Cockburn of Cairnie, by Keith, I exhibit for your inspection. This is the form now so generally used by Bee-keepers, and acknowledged to be the best for practicability and utility in Bee management. A standard size of frame has now been agreed upon and adopted by most makers: it is 13½ inches by 8 inches inside the top of the frame, being one inch wide, and spaces between the frames being half an inch. This hive combines many advantages. It can be reduced in size at pleasure, by taking out some of the frames and substituting padding, for keeping out winter cold. Honey can be taken at any moment without destroying the Bees; and by inserting a dividing zinc plate, which, while allowing workers to pass through, excludes the queen, we can ensure combs of honey free from brood; and by placing over the frames a crate of supers, we have the power of temporarily enlarging the hive to almost any extent. The entrance, by an ingenious and simple arrangement, can be enlarged or contracted at pleasure.

For purposes of observation of the internal economy of the hive, many forms of observatory hives are made, and prizes are given annually for these hives at the Kensington Exhibition, and the stipulations of the Association regarding these hives are, that they shall allow every Bee in the hive to be seen at any moment, so that the queen is always visible. They are, therefore, mostly uni-comb

hives. There is an excellent revolving one at the Alexandra Palace, near London, with Bees working in it all the summer. The great objection to uni-comb observatory hives is the difficulty of wintering Bees in them, as it is the habit of the insects in winter to cluster between the combs. But they afford excellent opportunities for observing all that goes on in the hive, and are extremely interesting.

One of the most useful inventions in Bee management is the slinger. This consists of a small metal box, in which a frame of honey is fixed, and by centrifugal force the honey is sent out of the comb, and the empty comb and frame placed again in the hive. This saves the Bees a large amount of trouble in comb-making.

I ought, perhaps, to have explained how combs are formed. The Bees hang together in a cluster, and very small, almost transparent laminæ of wax exude from between the folds of the abdomen. These scales are caught by the hind legs of the Bee, and passed along under the body to the mandibles, and by these worked into comb.

Honey is wholesome and palatable, and should be produced in this country in far larger quantities than it is, for there are many districts abounding with honey and other flowers where scarcely any Bees are kept: this is said to be especially the case in Derbyshire. It is generally considered that Bees do not go beyond a radius of two miles from their hives; but in contradiction to this, I have seen mention of them in the Isle of May, which is full four miles from the nearest point of the mainland: but this report of Bees on the May requires confirmation.

We are apt to suppose that the best way to get pure honey is to buy it in the comb, and, as a general rule, this is correct; but it is not without exception, for there are ingenious people on the other side the Atlantic, and there is a cheap substance produced there in the manufacture of sugar called "glucose." Now there is nothing deleterious in glucose: it resembles in appearance pale-coloured treacle, and is extensively used in confectionery both here and in America. Some Bee-keepers in the States ascertained that if Bees were supplied with glucose and water, they would take a large quantity, put it in their cells, and seal it up for winter use. Now glucose and water, sold at the price of honey, showed a very good margin of profit, and was indeed a good commercial speculation, and large quantities of this compound in the comb have been, and perhaps still are, imported into this country. As to the honesty of the transaction I need not speak.

Another subject of adulteration I will mention. This comb-foundation which I exhibit has, since the introduction of bar-framed hives, been extensively used, and is manufactured from Bee's-wax: one maker near Glasgow sold upwards of a ton of it last year. You are aware there are large oil springs in America, and our ingenious

friends across the water discovered that the yellow substance formed in the refinement of oil, mixed with some pure Bee's-wax to give the proper perfume, made very good-looking comb-foundation, and was far cheaper than genuine wax, and large quantities of this compound were last year exported from the States to this country. But besides Bee-keepers, there were the Bees themselves which had to be deceived, and when this impure material was fixed in the frames for them to work into comb, they turned up their noses at it—or, more properly perhaps, those highly sensitive organs, their antennæ — and positively refused to have anything to do with it. In these times of adulteration it is rather difficult to know when we get a genuine article. The last instance on record is the case of a man bent on self-destruction, who bought poison; but the poison was adulterated, and the man recovered!

Let us consider, in conclusion, what is the position of Bee-culture in different countries, as far as we know, at the present time. Bees are found all over Russia and Siberia—in southern Russia very extensively—because the peasants use honey instead of sugar; and wax-tapers, to the value of no less than £180,000, are required every year for the gorgeous ritual of the Greek Church. In Russian Poland some of the peasants are said to possess four hundred hives each; and in Spain, Bees are kept to a still larger extent, a single parish priest in that country being known to have as many as five thousand hives. Humboldt tells us that, in his time, from the island of Cuba, wax to the value of 650,000 dollars was exported annually. In Denmark, Bee-keeping is extensively carried on; while in Germany and Hungary large colonies are found. In 1873 the aggregate number of stocks in Germany was estimated at 1,450,000—Bavaria alone having 330,000. Bee-culture is largely encouraged by the German Government: teachers in the management of Bees are paid by the State, who travel through the rural districts. In the villages Bee-clubs are common, and as a result of all this care, Germany has produced many skilful apiarians, and contributed much to our knowledge of apiculture. It is in America, however, that the science has been most extensively carried on, and every scientific appliance brought into use. America is highly productive of honey-sucking flowers, and as a consequence, large honey harvests are obtained. In 1874, one Bee-farm alone—that of Mr Harbison, in San Diego county, California—furnished the enormous quantity of 67 tons of honey. In Egypt, as the plants blossom and fruit ripens about six weeks earlier in Upper Egypt than in Lower, the Bee-keepers in the latter, in the spring, move their hives in hundreds in boats, and convey them up the Nile. The Bees go foraging every day, returning at night to their hives. Then the boats are gradually moved along down the river, and thus advantage is taken of the succession of flowers that flourish so abundantly on

the banks of the Nile. Niebuhr states that he once saw near Cairo a convoy of four thousand hives on the Nile. This practice is also followed by the Italians; and in France, also, floating boat-houses for Bees are common.

Now let us look at home. Under the system of Bee-keeping adopted until within the last few years, hundreds of tons of honey must have been annually wasted. At a recent meeting of the Worcestershire Bee Association, it was stated that a calculation had been made that Scotland alone could have maintained on its Bee pastures enough Bees to have provided 4,000,000 lb. of honey and 1,000,000 lb. of wax. Scarcely a mile from Land's End to John-o'-Groats is properly stocked with Bees; and in Ireland the land flows with honey, yet for miles you travel without seeing a single Bee-hive. If these little insects were kept, all they would ask would be fair treatment—immunity from the brimstone pit, and a portion of the stores they gather. The science of Bee-keeping is not formidable. What a Russian, a German, or an American can do, surely we can; and moreover we are doing it, and making rapid progress—though not rapid enough—in Bee-culture. Bee societies are being established all over the kingdom. We have here the Caledonian Apiarian Society, of which I have been a member from its formation. There is scarcely a county in England now without its Bee Association, often with a nobleman or noble lady as president; and the clergy of all denominations, much to their credit, are generally in the van in the movement. I know one parish clergyman in England, a good carpenter, who makes frame hives and sells them, devoting the proceeds of his labour to the improvement of his schools, and he feels that he is thus doing good in more ways than one. Mr Cockburn of Keith, the maker of my hive, states, in a recent number of the Journal, that he knows a working man who this year made £20 by his Bees; and that the Rev. Robert Grant of the Free Manse, Botriphnie, had a hive which produced 98 lb. of splendid super honey,—and he adds, who will dare to say that Bees won't pay. But to my mind, to pay well there are three requisites—careful, not difficult, management; a fair locality for honey; and humane treatment.

The principal aim of Bee societies is to encourage Bee-keeping among artisans and cottagers, to abolish at once and for ever the cruel and unnecessary practice of destroying the Bees to obtain the honey, and to foster among this class habits of thrift and temperance, combined with an intellectual pursuit, to add to their home pleasures, and to make them thus better and more intelligent members of society. We must bear in mind that in Bee-keeping very small space is required. Bees are not deemed trespassers,—there is no Glen Tilt in their case; but as far as unrestricted range goes, the peasant is on an equality with the peer. Believe me, it

is in the power of all of us to do some little good in the world—we know not how much till we try: and if we can succeed in showing our cottagers and artisans that by keeping a few hives of Bees they can make them pay a considerable portion of their rent; that Bee-keeping will give them an additional interest in their homes; and that a chat with their neighbours on a summer's evening in the society of *Apis mellifica* is better for them in every way than the society of the Blue Dragon or the Golden Lion, we shall have really benefited our neighbours. And following up this train of thought, perhaps I cannot more appropriately close these remarks than by quoting from one of our poets the short tale of "Abou Ben Adhem and the Angel":—

"Abou Ben Adhem (may his tribe increase!)
Awoke one night from a deep dream of peace,
And saw, within the moonlight in his room,
Making it rich, and like a lily in bloom,
An angel, writing in a book of gold.
Exceeding peace had made Ben Adhem bold,
And to the presence in the room he said—
'What writest thou?' The vision raised its head,
And, with a look made of all sweet accord,
Answered, 'The names of those who love the Lord.'
'And is mine one?' said Abou. 'Nay, not so,'
Replied the angel. Abou spoke more low,
But cheerly still, and said—'I pray thee, then,
Write me as one who loves his fellow-men.'

The angel wrote, and vanished. The next night
It came again with a great wakening light,
And showed the names whom love of God had blessed,
And lo, Ben Adhem's name led all the rest!"

VII.—*LIST OF A FEW FERNS AND FERN-VARIETIES COLLECTED CHIEFLY IN THE PARISH OF KILMALCOLM, RENFREWSHIRE*, 1881-82.

By Mr STEWART ARCHIBALD.

(*Communicated Dec.* 22, 1882.)

I have now been a collector of plants in general for a good many years, and of Ferns in particular for a longer period still, and had come to think I knew these latter pretty well, having gathered the most of the species now to be found in Scotland. My books, of course, told me that there were several varieties of some of the Ferns, but I thought them too rare to be frequently met with, and

so made no special effort to find any of them. It was like a new revelation—it was in reality an introduction to a new (botanical) world of wonders—when last year there were placed in my hands two large volumes for perusal, being Lowe's 'Our Native Ferns,' in which he describes 50 species and nearly 1300 varieties, most of them being figured, and many beautifully printed in their natural colours. The first attempt at perusal of such a work causes a feeling of bewilderment, but in a short time the eye and mind get somewhat familiarised with the many very varied and very beautiful forms assumed by our old familiar friends, when growing under suitable circumstances as to soil, climate, &c. Only a small proportion (less than 10 per cent) of the varieties are mentioned as having been found in Scotland, most of the finer ones being apparently confined to the warmer regions in the south and west of our island. Lowe remarks that although a great deal had been done during a few years previous to the date of publication of his work (1865), in the way of searching for and finding Fern varieties, a wide field was still open in that direction. What has been done since 1865 I have no means of knowing, though doubtless a good deal has been accomplished. A diligent search in our northern and less favoured part of the island will no doubt be the means of finding already known varieties in many new localities, or even of discovering new varieties. But then, though every thing possible were known and recorded in books (and of course it is not), it remains for each of us to make the knowledge our own as far as we can by practical field work. So having made myself somewhat familiar with the appearance of the several varieties, and being in a fairly good locality, I went out to try what I could find. You have now the results of my labours within narrow limits both of time and place; and the collection is interesting, not so much on account of what it is, as showing what may be done.

And now a little as to the locality. An open pastoral glen, about 400 feet above sea-level, and about four miles inland from the Firth of Clyde at Port-Glasgow, surrounded by low hills, except on the east, towards which the streams in this part of the county flow. Through the glen runs a small stream, the Greenwater, joined by another small stream, the Blackwater. On the rocky peninsula between them stand the ruins of Duchal Castle. For some distance above and below the ruins the scenery on the streams is very fine and romantic, where they flow through deep rocky gorges, whose banks are shaded with bushes and trees. It was chiefly in these gorges that the Ferns in this collection were gathered. In these gorges, and all around, at ditch-sides, hedge-sides, road-sides, the commoner sorts of Ferns grow in great profusion, and very luxuriantly. Specially may be noted the Oak

Fern, which completely drapes the high banks near the old castle with its pretty fronds. A finer display, in its way, could scarcely be seen anywhere.

The species of Ferns which contain most varieties are Polypodium vulgare (37 varieties), Polystichum angulare (162), Lastrea filix-mas (69), L. dilatata (61), Athyrium filix-fœmina (over 200), Scolopendrium vulgare (over 400), and Blechnum spicant (68). Several Ferns, as Polypodium Dryopteris, the Woodsias, the Hymenophyllums, &c., are not known to produce any varieties.

The following is the list of Fern varieties which I have gathered in this locality:—

Polypodium vulgare, var. auritum.
" Phegopteris, var. multifidum.
Lastrea filix-mas, var. abbreviata.
" " Borreri.
" " incisa (with two sub-varieties).
" " producta (with sub-variety).
" " dentata.
" " pinnatifida.
" " furcans (with two sub-varieties).
" " variabilis.
" " depauperata.
" " multiformis.
Lastrea dilatata, var. Brownii.
Athyrium filix-fœmina, var. incisum.
" " decompositum.
" " denticulatum.
Scolopendrium vulgare, var. undulatum.
" " sublineatum.
" " reniforme.

The following Fern species have also been gathered by me in this district:—

Polypodium vulgare.
" Dryopteris.
" Phegopteris.
Polystichum aculeatum.
Lastrea filix-mas.
" dilatata.
" Oreopteris.
Athyrium filix-fœmina.
Asplenium Trichomanes.
Blechnum boreale.
Pteris aquilina.
Hymenophyllum Wilsonii.
Cystopteris fragilis.

Botrychium lunaria.

(All the above were gathered within a mile of the old castle.)

Asplenium Trichomanes.
" viride.
Cystopteris fragilis.
Scolopendrium vulgare.
Asplenium Adiantum-nigrum.

(The first three were gathered in Devol Glen, the last two at the side of the Clyde below Gourock. One or two plants of Allosorus crispus have also been got in the parish.)

VIII.—NOTE ON THE CONTINUED FLOWERING OF THE MALE FLOWERS OF ANACHARIS ALSINASTRUM.

By Mr W. TAIT KINNEAR.

(*Read Dec.* 22, 1882.)

Perhaps the members of the Field Club are aware that the male flowers of this common and noxious weed were only noticed for the first time in Great Britain in the autumn of 1880. They were found by a well-known Edinburgh botanist, Mr D. Douglas, on one of the ponds on the Braid Hills, frequently used for skating purposes in winter-time, and were figured in 'Science Gossip.' The object of this note is not to describe the flower, as that has been done already, but to state that I have noticed that the plants have produced male flowers ever since. When Mr Douglas was working up the subject, I frequently visited the spot with him, and gathered numerous specimens. Last year (1881) my friend could not go out, owing to extreme ill-health, in order to notice the flowering, so that I did it myself. I had a pressing request from Mr Bennet of Croydon to get specimens, but when I went to get them, rain had so increased the depth of the water that the plants themselves, let alone their flowers, were invisible. On Saturday, September 9, 1882, I again repaired to see if the flowers would again be found, and there they were, floating among Potamogetons and Bur-reeds, with their yellow pollen strewed over the water. The fact, then, is established, that this extremely rare flower, as yet only chronicled from the one spot in Britain, has flowered for three consecutive seasons, 1880-81-82; and there is no reason for thinking that when the male flower was found in 1880, that this was the first time they had flowered. It is, I think, very probable, from the fact that they have been noticed for three seasons running, that they must have been flowering a considerable time previously. Any enterprising young member of the Club could, I think, write a good paper on the variations of the pistil in the female flower, as numerous different forms occur.

At this meeting a series of Sponge-spicules were shown under the microscope by the Secretary.

IX.—THE HAINING, SELKIRK: WITH NOTICES OF ITS ANTIQUITIES, TOPOGRAPHY, AND NATURAL HISTORY.

By Mr JOHN LINDSAY.

(*Read Jan.* 25, 1883.)

Should any one, in search of quiet pastoral beauty, resolve to

"turn aside,
And see the Braes of Yarrow,"

he would do well to include the ancient town of Selkirk, the centre of numerous Border traditions, and the scene of many stirring events in the stormy days of Scotland's early history. As remote as 1124 there already existed at this place a castle, a village, and a church, and these seem to have arisen in the order named. The royal hunting-ground of The Forest necessitated a royal residence, while under its shadow quickly clustered a number of huts; and then, for purposes of devotion, a church was built in intimate connection with the Court, and named Selechirche, from two Celtic words meaning "the great church," or "the church of the king's Court." Such, at least, is what some authorities give as the origin and meaning of the name Selkirk. The little town seems to have been for a lengthened period a kind of "debatable land"—the arena of constant strife and the subject of varied possession. Thus we find Chalmers relating, in his 'Caledonia,' that "during the long conflicts for the succession to the crown, the town of Selkirk was often granted to the successive partisans of the rival kings."[1] Besides, it was ever and anon roughly treated by the English, who had probably learnt by bitter experience something of the fierce spirit of "the foresters." As has often been related, of the eighty burgesses of Selkirk who, under the leadership of their town-clerk, followed James IV. to Flodden, but four returned—for the little band had fought with desperate valour. Therefore that pathetic wail which has come down to us through the centuries, that "our braw foresters are a' wede awa'." In retaliation, the English, shortly after Flodden, burst across the Border, and, amongst other depredations, burnt the old town of Selkirk to the ground. James V., however, showered on the houseless inhabitants, in return, his kingly favours. Their lost charter, constituting the town a royal burgh, was renewed, and 1000 acres of forest-ground, with the trees for rebuilding their houses, were granted as a reward for their loyalty. But in about thirty years thereafter Selkirk was again burnt down, in that malicious and vandal-like progress of the Earl

[1] Chalmers, 'Caledonia,' vol. ii. p. 978.

of Hertford, when so much wanton mischief was done throughout the length and breadth of the Lowlands.

These introductory remarks regarding the ancient town of Selkirk have been given, partly on account of the interest attaching to the subject, but chiefly because of the intimate connection of the old town with our present theme. For Selkirk is said to have stood, when thus burnt down in the reign of Henry VIII., on what is now part of The Haining estate. On entering by the handsome gateway situated in what is yet called "The Green," though now a public thoroughfare leading to the market-place, the site of the old town is shown on the left hand. This place, known as the "Chicken Acre," is also traditionally said to be the burial-place of that noted freebooter Willie Armstrong and of nine of his followers, who were tried at Selkirk, and hanged on the Gallows Knowe, still pointed out. Seeing, therefore, that we are thus inside The Haining, it may not be out of place to say a few words concerning the history of the estate. As regards the name itself—"The Haining"—it simply means that part of Ettrick Forest which was *hained*—*i.e.*, set apart, preserved, or enclosed—for the king's use.[1] Anciently the whole county was termed Ettrick Forest, or briefly The Forest; and in this favourite hunting-place of our early kings there seems to have been no want of sport. One of the oldest of Scottish ballads, "The Song of the Outlaw Murray," describes it as containing

> "Baith dae and rae, and hart and hynd,
> And of all wild beasts great plentie."

The Scottish kings, in imitation of the Anglo-Norman monarchs, issued from time to time "Forest Laws," and amongst these are found very stringent enactments as to the privacy of The Haining. The castle was occupied as a royal residence during the hunting season for more than two hundred years—viz., from David I. to Alexander III.—and was a favourite abode of William the Lion. Its site is now known as Peel Hill, but no trace of any building is left above-ground—nothing except a large Yew-tree to mark the spot where the castle stood. In this castle, during the 12th and 13th centuries, the Scottish kings occasionally held "assizes," as they were termed, and issued thence—"In curia regis apud Selechirche"—Acts of Parliament. These old Acts have been preserved, and reprinted, with others of that time. They are hardly Acts of Parliament, however, as we now understand these, but rather quaint exhortations regarding the manners and morals of the king's subjects. The castle of Selkirk changed hands frequently after it ceased to be a royal residence—now being held by the English, and

[1] "It is defended and forbidden that anie man dwelling within the wood, or anie other, sall enter within the close or *hanit* parts of the wood with their beasts or cattell."—Forest Laws, c. i. s. 1.

anon by the Scots, until more peaceful times intervened, and law was re-established. Several members of the Scottish nobility then successively received tacks of the whole estate, including, amongst other honours and privileges, the sheriffdom of the county, the right to the burgh customs, and occasionally the office of provost. From about 1480 to 1630 The Haining was held by a branch of the Scotts of Buccleuch. The Scotts were followed by the ancient family of the Riddells, and these again by the Pringles—a descendant of the latter family being now in possession. The Pringle family has not been wanting in illustrious names, two at least being "men of mark" in Scotland—viz., John Pringle, Lord Haining, appointed a senator in 1729; and Andrew Pringle, Lord Alemoor, elevated to the bench in 1759.[1]

The Haining occupies a somewhat elevated position, the "bench-mark" at the main gateway being given in the Ordnance Survey map as 495 feet above the sea. Several portions of the estate are at a much higher elevation—for, as every one knows, Selkirk is pre-eminently "a city set on a hill," and the town clusters in great part round the slope of the estate. The grounds are thus beautifully diversified, from their undulating nature, and are thickly planted in many parts with trees and shrubs, which are in fine healthy condition. Some splendid avenues are thus formed of Lime, Birch, and Chestnut, from which glimpses of the lake and the family mansion can be obtained. From elevated knolls, also, one can look down on the haugh or valley of the Ettrick and Yarrow, and around on the encircling hills. Perched on such an outlook, the words of Dr John Brown, in 'Minchmoor,' may partly be realised in their truth and beauty. He says: "The great, round-backed, kindly, solemn hills of Tweed, Yarrow, and Ettrick lay all about like sleeping mastiffs,—too plain to be grand, too ample and beautiful to be commonplace." No one but the genial author of 'Rab and his Friends' could have penned such a sentence as that! The Haining thus holds out attractions both for the botanist and for the lover of nature,—in which latter category, indeed, every true botanist is included.

I was very fortunate, in my first visit to The Haining in August last, in having as cicerone the Rev. Mr Farquharson, President of the Berwickshire Naturalists' Field Club, whose picturesque manse is in the vicinity. This gentleman kindly gave me some interesting information as to the natural history of the estate and of the district. Probably owing to the humidity of the climate, and the absence of cold winds—the prevailing direction being S.W.—vegetation was most luxuriant. This was everywhere very noticeable: moreover, the fronts of several of the houses in and around the town were covered by the showy perennial Tropæolum speciosum,

[1] *Vide* Chalmers, 'Caledonia,' vol. ii. p. 991.

—a plant which refuses to grow to any perfection in what may be termed our Scottish midlands, though it is often seen well grown in Inverness-shire and Perthshire, and again appears in fine condition in the southern counties of Scotland. Another curious fact regarding this plant is, that "it does not prosper so well when transferred to the milder climate of England." Its bright scarlet blossoms, especially when mingled, as they at times were, with the purple flowers of Clematis Jackmanii, were truly a memorable sight. Particularly noteworthy, in this connection, was the lodge at the entrance to Bowhill Avenue, about three miles from Selkirk, the front of which has been covered annually, for a number of years, with this scarlet creeper. But to return to The Haining: one of its chief features is the sheet of water named The Haining Loch. The water of this loch at one time stood much higher than it now does, coming up close to the mansion-house. But on a child of the family falling from a window into the loch, and being drowned, an outlet was made which caused the water to fall considerably, and consequently to recede some distance from the house. The water is of a dark-brown colour, which hue it has assumed gradually, during a long course of years, from the increase of a cateniform conferva. In this loch are said to be many interesting objects for the microscopist; and, like many other waters, it swarms with the common Water-flea (*Cyclops quadricornis*). So early as 1661 the loch was the cause of litigation on the part of the mayor of Berwick, who brought a case into the Court of Session on the plea that foul water from it killed many of the Salmon in the Tweed. The mayor, however, lost his suit, as the learned judge gave his decision on the broad principle of physical law, that "rivers are the natural drainage-system of the country"![1] As already noticed, The Haining mansion-house stands near the margin of the loch, and at the lower end of it, thus commanding a view of its whole extent. The present house has been in great part rebuilt in a modern style, of whinstone and freestone, with handsome colonnaded porticos to the main front and water front. A number of valuable antique statues, in bronze and marble, surround the terrace.

As regards the plants to be found within the grounds, there are several of our familiar favourites, which need not be enumerated here. The following may be noticed, however. The Amphibious Buckwheat (*Polygonum amphibium*) grows very luxuriantly in and around the loch, forming a marked feature when in flower. The common Yellow Water-Lily (*Nuphar lutea*) is also very abundant; and the Great White Water-Lily (*Nymphæa alba*) is present in

[1] This (as well as a few other facts concerning The Haining) is given on the authority of T. Craig-Brown, Esq. of Woodburn—a gentleman who is well known for his intimate acquaintance with the antiquities of the ancient burgh.

lesser quantity, but very pretty when its large white floating blossoms unfold. The Great Reed-mace (*Typha latifolia*) has been introduced; and alongside it is the Common Reed (*Phragmites communis*). Strong, well developed plants of the Tway-blade (*Listera ovata*) are plentiful at the upper part of the lake. Turning to the pastures, there are to be found the Adder's-tongue Fern (*Ophioglossum vulgatum*) and the Moonwort (*Botrychium lunaria*)—both, but the latter especially, much "nibbled over" by sheep. The Great Butterfly Orchis (*Habenaria chlorantha*) and the Green Frog-Orchis (*H. viridis*) are also growing in the same situations. The marshy parts of the estate contain, besides other plants, numbers of Carices, among them being Carex teretiuscula, C. paniculata, C. pallescens, C. sylvatica, and C. paludosa.

But any description of The Haining would be quite incomplete without a reference to the numbers of wild and domesticated waterfowl which at once enliven and embellish the loch. By the kindness of the proprietor, I am enabled to give a list of these:—

List of Water-Fowl on The Haining Loch, *October* 1882.

White Swan.	White Call Ducks.
Black Swan.	Brown Call Ducks.
Swan Geese.	Shieldrakes.
White Chinese Geese.	Black Indian Drakes.
Brown Chinese Geese.	Tufted Pochard.
Canada Geese.	Red-headed Pochard.
Bean Geese.	
Laughing Geese.	Teal.
Egyptian Geese.	Grebe.
Brent Geese.	Bald-Coots.
American Runner Ducks.	Water-Hen.
Pekin Ducks.	Water-Rail.
Cayuga Ducks.	Herons.
Aylesbury Ducks.	Wild Ducks or Mallards.
Rouen Ducks.	&c. &c.

The Heron (*Ardea cinerea*) is a frequent visitant to The Haining; while the Black-headed or Laughing Gull (*Larus ridibundus*) breeds there, in what is called the Pic-maw Moss, making its presence very evident by the peculiar cry from which it derives its trivial name. The small birds are none of them particularly noteworthy, so far as I can learn. The modest little Tree-creeper (*Certhia familiaris*) is common; and the Starling (*Sturnus vulgaris*) abundant.

The walk round the margin of the loch is a very pleasant one. On the south-west side a line of Birches and Chestnuts, drooping over towards the water, forms a natural arcade; while the opposite side is thickly planted with Laurels, Berberis, Hollies, Dwarf Conifers, Rhododendrons, and other shrubs. Some very fine trees, also, are dotted over the grounds, particularly Horse-Chestnuts and Scotch Firs. One widespreading Chestnut, which might rival

Longfellow's celebrated tree under which stood the "village smithy," I found measured fifty feet through the lower branches; and several others, almost as large and as beautiful in their symmetry, were growing near. Beyond this point is the deer-park, stocked with Red Deer.

Such are the principal features of The Haining: and perhaps enough has been said regarding it to show that it will well repay a visit. Many beautiful and well-known spots, besides, are clustered near,—names round which the "Minstrel of the Border" has woven the magic of his verse, and the praises of which have been sung by the Ettrick Shepherd and the Cumberland Bard. Amid such scenes one would fain linger, while fancy peoples them with the forms of the past, and the mind is soothed and the eye enchanted by the beauty of the present.

(*In illustration of the above, a number of photographic views, by* Mr A. R. Edwards, *Photographer, Selkirk, were exhibited.*)

X.—PITLOCHRY AND ITS BIRD-LIFE.

By Mr ARCH. CRAIG, Jun.

(*Read Jan.* 25, 1883.)

It may seem a somewhat trite remark to observe in connection with Pitlochry, that the district is an eminently beautiful one, the great partiality shown for the neighbourhood by tourists and other summer visitors being of itself almost sufficient evidence, without dilating on its peculiar attractions, to warrant the assertion. Briefly stated, the scenery shows the same endless variety that is so characteristic a feature of our Northern Highlands, comprising all gradations, from the desolate muirland to the richly wooded and cultivated haughs, watered by the rivers Tummel and Garry,—these being swelled in turn by the numerous tributaries that have their origin in the muirs above, and to whose agency we are indebted for the many picturesque little glens that lend additional charm to the locality. The woods especially call for particular notice, from their extraordinary richness and diversity of character,—many of the trees, notably about Faskally, Killiecrankie, and surroundings, having attained to considerable age, and, from their large proportions and curious growth, offer great scope for the display of artistic and photographic talent.

In addition to the scenic effects, there is no lack of Ferns, Mosses, and other botanical treasures, to engage the attention of the botan-

ist, besides also the historic interest that attaches to the vicinity, embracing reminiscences of the old and savage clan feuds, as well as the more modern and—to us at anyrate—more interesting battlefield of Killiecrankie. And when to these are conjoined the still older relics of the past that exist in the standing-stones and ancient hill camps, enough has been said in support of the claim of Pitlochry to rank high among the many lovely summer retreats with which our Highlands abound. Were it not foreign to the purpose of the present paper, a great deal might be written concerning the scenery alone; but having regard to the largeness of such a subject as the "Bird-life" of any particular district, and the impossibility of doing the scantest justice even to it in a short sketch, nothing further need be said on that score.

It will readily be understood that a locality possessing so varied a landscape, and so well sheltered in the low grounds by the thick woods and luxuriant vegetation, is more than likely to contain a correspondingly large variety of birds, and, so far as Pitlochry is concerned, such is undoubtedly the case. In proof of this, a glance at the subjoined list of forty-eight birds, all of which were observed in four days, without, be it understood, any special effort being made to discover them, may go far to show that if all these species could be noted in so short a time, how large a number might it not be possible to add during a constant residence, with of course the requisite amount of trouble taken to identify and note the occurrence of every visitant. Undoubtedly the largest number and variety of the smaller birds frequent the woods which border the river Garry in the Pass of Killiecrankie, or the Tummel in its course from the loch of the same name. Prominent among them is the Redstart, one of our prettiest plumaged summer migrants, whose chastely contrasted garb (particularly that of the male) attracts notice at first sight, and fairly entitles it to be classed among the *élite* of small birds. On first arrival both sexes are rather wary and jealous of a near approach; but when actually settled down to the duties of incubation, a great deal of their natural timidity and shyness vanishes, so much so that intrusion on their nesting-ground causes them to fly excitedly near at hand, in a jerking, flirting sort of manner, observable at times in the Robin as well, uttering meanwhile a clear mellow whistle, which strikes the hearer as being singularly appealing and plaintive. In the Pass large numbers had built their nests in the walls at the road-side, the loose character of the masonry giving ample scope for that purpose; but others again appeared to prefer sites among the roots of trees and in broken banks. Although found in greatest abundance in the low grounds, as also in gardens, parks, and hedgerows close to human habitations, this species does not always court publicity, as amidst the dense and dark Pine-woods covering the

hills in many parts of the Highlands, and which are shunned as a general rule by most species, a pair of Redstarts may often be found, attention being called to their presence by the short though sweet song of the male, which in such situations falls on the ear with greater acceptance from the oppressive gloom and silence that pertains to these regions, as well as to the scarcity of any other melody to form a contrast. The Bullfinch also is a tenant of the Pass, although not so numerous as the last. Various causes combine to prevent its increase, or rather to hasten its decrease,—the demand for it as a cage pet being a fertile source of diminution. Severe winters also make havoc among its numbers. But perhaps a more potent cause than either is to be found in the wanton slaughter perpetrated by gardeners, many of whom wage continual war against the little birds in spring-time. The reason of this hostility is the damage presumably wrought on the young buds of fruit-trees. But although harm to a certain extent is without doubt committed, in the opinion of many competent to judge the injury is unnecessarily exaggerated. The question naturally arises to our minds, supposing it to be actually the case that fruit-trees are destroyed so considerably as horticulturists would have us believe, how does it happen that other trees in a wild state, such as Geans, Sloes, &c., do not seem to suffer? Yet it is notorious that the Bullfinch shows a similar *penchant* for the buds of these, which, notwithstanding, bear fruit in spite of his efforts. Even granting for the moment that gardeners' statements are absolutely true, surely few people possessed of any humane feeling would grudge the birds the little they would take, the pleasure to be derived from observing the handsome little creatures in the full enjoyment of life being to many sufficient compensation for the non-appearance of a few apples or sour plums. Prejudices of that kind are, however, always difficult to contend with, more especially when the mistaken notions have been believed in without any attempt to justify them by actual observation, as is the case with many who never think it worth their while to look at the question from any other standpoint save their own. But with the increasing educational influences of the present time more liberal and enlightened ideas may be looked for, and then perhaps better days and kindlier treatment will be in store for the pretty and interesting little Bullfinches.

Among the common species that haunt the locality, and which it is unnecessary to do more than name, are the Blackbird, Hedge-accentor, Robin, Greenfinch, and Chaffinch—the Latin synonym of the latter, which signifies a "bachelor," owing its origin to a habit that induces the sexes to separate and keep by themselves in winter,—a fact which seems now to be indubitably established. About the village and adjacent farm-steadings the well-known and

despised Sparrow propagates his species plentifully enough to call down on his head the execrations of the farming community, whose scanty crops are certainly not rendered more valuable by his predilection for grain diet. But, in common with all granivorous birds, he has his light as well as his dark side, being a considerable destroyer of grubs and insects during the nesting season, so that it is a moot-point whether his good qualities, if fairly weighed, would not counterbalance his bad. Another bird much vilified by agriculturists for the same and other reasons is the Rook, but in his case the redeeming qualities seem to preponderate. Endowed with a most accommodating appetite, to which no edible substance ever seems to come amiss, he plays the part of scavenger during spring and winter to perfection; and when we consider the extraordinary extent and variety of his *cuisine*, and the apparently equal relish with which he fluctuates from grubs and snails to eggs or grain, from fresh to rotten meat and other garbage, we cannot but think with wonder and admiration on his digestive powers, which are certainly of no ordinary kind. It is patent to all that the Rook is not what one with any regard to truth would term a songster, his usual cry being diametrically opposed to what we understand by melody. But, nevertheless, he at times solaces himself with a few notes widely different from the harsh and well-known "caw." This musical freak is perpetrated by a solitary bird who sits on some prominent place, and then gives birth to a gurgling sound; and judging from the quaint antics accompanying his efforts, he seems to derive intense satisfaction therefrom, although the same feelings of delight do not generally find a responsive echo in the breast of the human listener.

The only other specimen of the Corvidæ noticed was the Jackdaw,—the remainder, such as the Carrion and Hooded Crows, Magpies, &c., as well as the nobler Falconidæ and Strigidæ, being apparently in the fair way to become extinct—thanks to the perpetual persecution of gamekeepers and trappers, abetted by sportsmen, whose mania for game preservation is fast reducing the numbers to a minimum, and at the same time depriving the naturalist of the opportunity of studying the habits of birds of prey from life, a circumstance to be regretted by all practical ornithologists. The only Hawk observed was on the slope of Ben Vrackie, a high mountain immediately behind the village. The species, so far as could be determined from a distance, was that of the Sparrow-Hawk, most likely a female from its size, and its sudden appearance on the scene had the effect of silencing a Curlew or "Whaup," who had been making the air ring for some time with her quivering whistle of distress, engendered by the inadvertent intrusion on her nesting-ground. In the same locality, which was just at the limit where the few straggling thickets of Fir-trees ended and the bare

wide muir began, the Cuckoos had evidently found their proper element, as on all sides the familiar note—the reiteration of their own name—was to be heard. In fact, the whole country-side abounded with them; and by dint of hiding and exercising a little patience, a very fair view could be obtained of individual birds, who would remain seated on the same spot for a considerable time, so long as the presence of a stranger was undetected. While resting on a rock, our attention was attracted by a most curious noise, resembling the snarling of an ill-natured terrier dog. It was evident from the locality that the sound could not emanate from one of those disagreeable quadrupeds, but must be accounted for in some other way; yet with every effort to find out the cause, half an hour elapsed ere the authorship of it was traced to a female Grouse, whose plumage harmonised so admirably with the surrounding heather as to render detection wellnigh impossible. Further investigation led to the discovery that while accompanying a flock of lately fledged "cheepers," not much larger than Sparrows, she had been startled, and in the interests of self-preservation had taken flight, leaving, of course, the young ones behind. The peculiar growling sound was then either a call of distress, or intended as a signal to the small fry to indicate her whereabouts—the latter the more likely solution of the two. The Meadow Pipit, as usual, was abundant on the muir; and on the dry-stone dykes dividing the pasture-land from the hill, several pairs of Wheatears flitted about, showing a great amount of restless anxiety for the safety of their young, which, judging from the time of year, must have been nearly ready to fly. As is matter of notoriety, the click-clicking notes of this species have originated the lowland Scotch appellation of "Stane-chacker," and the Gaelic "Clacharan." Another specimen of the Saxicolinæ, which it is a pleasure to record as inhabiting the district, is the Whinchat, a most interesting little bird, all the more so from its local distribution in Scotland. In certain favoured localities this species, although nowhere very numerous, may be said to be not uncommon; whereas in others, which to the outward eye seem quite as well suited to its requirements, it is very rarely observed, and in some cases absolutely unknown. The Whinchat does not appear to live at such a high altitude as the Wheatear, the last named in that respect being more ubiquitous, as it is found in the valleys as well as on the mountain slopes. No fewer than three pairs had taken up their quarters close to the village and parish kirk of Moulin, and contiguous to an old ruin known as "Chaistel Dubh," in its palmy days reported to have been a stronghold of the Earls of Athole, but which at the present time is remarkable for nothing save its filth, and a total lack of interest to even the most enthusiastic archæologist. The Corn-Crake, although unseen, was not

unheard, as in all the hay and grain fields the grating sound was audible at intervals — not, however, with the same monotonous frequency as it would have been a month earlier, as, after the eggs are laid and the young hatched, the somewhat unlovable love-song of the male gradually decreases in intensity, until it finally dies away altogether. The absurd idea that Landrails cannot fly, which commends itself to so many people, is perhaps due to the fact that the birds in the first instance invariably endeavour to seek safety by running swiftly along the ground under cover of the long herbage, or skulk behind bushes, hedges, or in ditches; and it is only when hard pressed that they venture to take wing. Of the Hirundinidæ, the Swift, House-Martin, and Sand-Martin were plentiful—the Chimney Swallow not being noticed, although that was in all likelihood owing to accident, rather than to the fact of its non-existence. By the river-side the Oyster-Catchers or Sea Pyets were tolerably numerous, flying up and down the course of the stream, and emitting as they went the strange cry which is an unfailing index to the species. The appearance of these maritime birds among the woods and glens so far removed from their natural element seems somewhat of an anomaly, and smacks so much of the sea breeze as to make it difficult for us to become reconciled to their presence in such opposite quarters from those they usually haunt. Nevertheless they are decided ornaments to the district,—the clearly defined black and white of the plumage, which forms so marked and beautiful a contrast, lending to them an air of distinction which goes far to obliterate any notions we may have entertained of their presence being incongruous. Oyster-Catchers are not singular, however, in their habit of breeding inland, as many Gulls and other sea-going species do the same. In exemplification of this, let any one cross the hill from Portnacraig Ferry to Grandtully, near Aberfeldy. The track (it does not attain to the dignity of a road) runs uphill for about two miles or so, until a comparatively flat waste of bog-land is reached, dotted over which are a number of small tarns, where in summer great gatherings of Gulls, chiefly the common *Larus ridibundus*, find sufficient seclusion to perform the labours of incubation in peace. Close to the largest of these tarns is a memento of bygone days in the form of three curious standing-stones, whose existence gives an interest to an otherwise desolate locality, and rather adds to than detracts from the weird aspect. When Gulls are nesting, they strongly object to being intruded upon, and if emboldened by numbers, will dash so uncomfortably near to one's face and head as often to preclude the possibility of approaching safely to the water's edge. Besides the ordinary screaming noise, they yelp like little curs in their rage, and clearly show by their persistent efforts that, so far as the interloper is concerned, they would much prefer his room to his

company. In fact, so pertinacious are they at times, that they will follow a person for a mile and more, every now and again swooping unexpectedly down so close to the head as to make one tremble for the safety of his eyesight. In this wild district also the Redshank and Peewit were busily engaged in the same object of propagating the species.

There is a certain indescribable charm about muirland scenery, especially when associated with its bird-life, that must have struck one who has passed any time amid such scenes,—whether owing to the complete solitude and desolate aspect, the antithesis of the livelier woodland or cultivated country, or to the strange wild cries of the feathered species, or to both combined, would be difficult to determine. Somehow or other, we always associate the "eerie" calls of the Peewit, Whaup, and Plover with bleak and barren country, although we know that for a great part of the year the muirs are deserted by these birds. Yet whatever the reason, it seems more natural to our minds to couple them together. Curiously enough, the weirdest and most melodious sounds are often heard in close proximity, as the melancholy whistle of the Plover or the complaining cry of the Lapwing mingle with the song of the Skylark and Meadow-pipit, which frequently choose the same locality for their nesting-ground. Another bird whose home lies among the muirs or the hilly slopes bordering on them is the Ring-ousel, perhaps the most interesting of all the Turdidæ or Thrushes. Distinguished from its congener the Blackbird by the browner tint of plumage, and the white crescent on the breast, it has yet a good deal in common with its near relative, the skulking habits and call of alarm being somewhat similar. But there the likeness, except in a few minor points, ends, as in choice of habitation it is widely different. Where broom or juniper-bushes cover the mountain-slopes, the Ring-ousel may generally be found, one pair seeming to monopolise a considerable tract to themselves. But perhaps a more usual place of abode, in the Highlands at least, is on the heathery hillsides or the rugged banks of an upland burn, where, under the protecting shelter of an overhanging rock or heather bush, the nest is often placed. For some time after their arrival in April, no birds are wilder or more difficult to approach. You may at a respectful distance see the pair sitting on a knoll or rock keeping a sharp look-out; but attempt to draw near, and off they fly to some other point of vantage, where they can scan the neighbourhood and avoid the apprehended danger. To follow them up when once alarmed is useless, the experiment requiring a greater amount of patience than has fallen to the lot of the average naturalist. But after the eggs are laid or the young hatched, the desired view may be much more readily obtained, their shyness disappearing in a great measure. The song of the male, which is heard to the best

advantage very early in the morning or towards the close of evening, is not distinguished by much variety, being merely a repetition of the same wild note—a sound, though monotonous, admirably in accordance with the dreary character of the surroundings amidst which it is uttered.

Reverting once more to the valleys, we find that on the rivers the Water Ousel and Common Sandpiper are of frequent occurrence, the latter migrant more particularly. The former harmless creature is unfortunate enough to come under the ban of gamekeepers and others who are interested in salmon-fishing, and is consequently an object on which to exercise their spleen, the supposed destruction of ova being the cause of resentment. But of all the absurd persecutions with which we are unhappily too conversant in Scotland, this seems to be the least justifiable, our most eminent naturalists having pointed out over and over again that the damage done is more imaginary than real. The Pied and Grey Wagtails are a most elegant addition to the fauna of the district, the last named being on the whole a closer sojourner by the sides of streams than the other, as well as a more frequent percher upon trees. While passing through the forest near Faskally, we had an opportunity of verifying the marked animosity of small birds to the Owl species. A loud and angry chattering suddenly arose in a bare part of the wood, and on moving in the direction of the sound, the cause was at once apparent. A large Tawny Owl having, unfortunately for itself, ventured into the open, its presence was at once the signal for all the small birds in the immediate vicinity (Chaffinches, Tits, Blackbirds, &c.) to assemble in force, and endeavour, by dint of loud screaming and fluttering, to drive it away. The poor wretch seemed most uncomfortable under the trying ordeal, and flew from tree to tree in vain endeavours to get rid of its tormentors, but they persistently followed; and although it was doubtful if they actually touched it, yet by their yelpings, so to speak, they contrived to make themselves sufficiently insufferable. At last a haven of refuge opened to it in the shape of a dense clump of Spruce-firs, into which it flew, and thus eluded further pursuit. Small birds evince this inherent dislike to predatory species in the case of Hawks as well, by frequently chasing them from place to place, but not always with impunity, as the Hawk does not labour under the same disadvantage as the Owl in daylight; consequently he often turns the tables on his pesterers, and becomes the pursuer instead of the pursued. In the Pass of Killiecrankie and the woods of Bonskeid the Tree-pipit abounded, a lively although not gaily attired species, whose pleasant little song is always an agreeable forerunner of genial summer weather. The Common Wren betrayed its existence—which, from the nature of the covert it frequents, would otherwise be overlooked—by its song, unusually loud when we consider

the size of the bird. In fact, if all birds emitted sound in proportion to their bulk, taking the Wren as our basis, we would look for a noise little short of thunder from the Blackbird or others of similar calibre. The Spotted Flycatcher could be readily detected from the peculiar manner of catching its prey, but on the whole seemed to be rather sparsely distributed, considering the apparent suitability of the ground. Of the Bunting family, the Yellow-hammer could be heard whistling his rather monotonous and melancholy note in all the fields around the village. The senseless but now almost defunct superstition regarding this beautiful little bird is a matter with which most people are tolerably conversant, but for the benefit of those who may be unaware of its existence, a very few words may be devoted to the subject. Within the memory of many still living, it was believed by the generality of country folks to be in some manner or other mysteriously connected with the Arch-Enemy himself. The zeal of our ancestors in the cause of so-called religion was of so ardent a nature (although it is at the same time notorious that their own private characters would not always bear strict investigation), that they necessarily felt it a duty to "abjure the devil and all his works"—especially his works. So the unfortunate Yellow-Yorlin being one of these, it fell under their proscription, and was destroyed whenever occasion offered. This silly notion had evidently a common origin with those grosser superstitions that led to the burning of witches and similar acts of intolerant cruelty. But as in these more enlightened times such deeds are impossible, so also the aversion to the harmless bird is gradually dying out. It has not wholly disappeared, however, as in a few districts of the Highlands the belief still smoulders in the breasts of the older portion of the community, who have all the will to put their dislike into action, but, deterred by the better sense of the younger generation, have no resource left them but to imitate the example of that pattern of amiability, Tam o' Shanter's wife, and "nurse their wrath to keep it warm."

There now remain only two classes of birds to notice—viz., the Titmice and Warblers. Of the former, the Great Tit, Blue Tit, and Cole Tit were as usual numerous among the woods and copses. Perhaps no order of birds save the Swallows display such constant and restless activity, being perpetually on the move hunting for food, and in their search clinging to the trunks and branches of trees in a variety of fantastic attitudes that cannot fail to call forth admiration, more particularly from the ease and grace with which the changing motions are performed. The most beautifully dressed of all the group is undoubtedly the Blue Tit or Blue Bonnet; and being a more frequent visitor to the neighbourhood of houses and gardens than the Cole or Long-tailed species, it is on that account more easily observed, the other two affecting Pine forests and

woods where there is sufficient abundance of large timber to guarantee a supply of food. Unlike most small birds, the Tits are bold and fearless in disposition, and if caught will show fight at once by furiously biting the hand of the captor, nothing daunted by the disproportion that exists between their own size and that of their adversary. The last but not least in point of interest are the Warblers, which at this late stage it would be impossible to do justice to: a simple mention of their names must therefore suffice. Placing them in the order of numbers, though not of merit, they occurred as follows: Willow Wrens, Wood Wrens, Whitethroats, Sedge Warblers, and lastly Garden Warblers or Blackcaps. From want of a near view, it could not be decided which of the two latter inhabited the district, but from later experience of both species in another part of Scotland, we incline to the belief that it was the Blackcap.

An apology is due for the very superficial glance taken of the various species; but from their number it would scarcely be possible, even were it desirable, to enter more fully into the merits of each; and, in conclusion, it only remains for us to say to those who hitherto have not paid much attention to ornithology, that if at any future time they should decide to take up the study, they will, without doubt, find it to be one of surpassing interest.

Blackbird, *Turdus merula.*
Bullfinch, *Pyrrhula europea.*
Chaffinch, *Fringilla cœlebs.*
Corn-crake, *Crex pratensis.*
Creeper, *Certhia familiaris.*
Cuckoo, *Cuculus canorus.*
Curlew, *Numenius arquata.*
Flycatcher, spotted, *Muscicapa grisola.*
Greenfinch, *Coccothraustes chloris.*
Grouse, red, *Lagopus scoticus.*
Gull, black-headed, *Larus ridibundus.*
Jackdaw, *Corvus monedula.*
Martin, house, *Chelidon urbica.*
,, sand, *Cotile riparia.*
Ousel, ring, *Turdus torquatus.*
,, water, *Cinclus aquaticus.*
Owl, tawny, *Strix aluco.*
Oyster-catcher, *Hæmatopus ostralegus.*
Peewit, *Vanellus cristatus.*
Pipit, meadow, *Anthus pratensis.*
,, tree, *Anthus arboreus.*
Redshank, *Totanus calidris.*
Redstart, *Ruticilla phœnicurus.*
Robin, *Erithacus rubecula.*
Rook, *Corvus frugilegus.*
Sandpiper, common, *Totanus hypoleucos.*
Skylark, *Alauda arvensis.*
Sparrow-hawk, *Accipiter nisus.*
Sparrow, hedge, *Accentor modularis.*
,, house, *Passer domesticus.*
Starling, *Sturnus vulgaris.*
Swift, *Cypselus apus.*
Thrush, missel, *Turdus viscivorus.*
Tit, blue, *Parus cœruleus.*
,, cole, *Parus ater.*
,, great, *Parus major.*
Wagtail, grey, *Motacillla sulphurea.*
,, pied, *Motacilla lugubris.*
Warbler, blackcap, *Sylvia atricapilla.*
,, garden (?), *Sylvia salicaria.*
,, sedge, *Salicaria phragmitis.*
,, whitethroat, *Sylvia rufa.*
,, willow, *Phylloscopus trochilus.*
,, wood, *Phylloscopus sibilatrix.*
Wheatear, *Saxicola œnanthe.*
Whinchat, *Saxicola rubetra.*
Wren, *Troglodytes parvulus.*
Yellow-hammer, *Emberiza citrinella.*

XI.—THE PENTLAND SKERRIES.

By Mr T. M. CRUICKSHANK, South Ronaldshay.

(*Communicated Jan.* 25, 1883.)

XII.—AN APRIL TRIP TO SOUTH RONALDSHAY

By Mr ROBERT THOMSON, LL.B.

(*Read Feb.* 22, 1883.)

(The above papers having appeared in the 'Orkney Herald,' are therefore not reproduced here.)

XIII.—A GOSSIP ABOUT PETS.

By Mr ROBERT STEWART, S.S.C.

(*Read Feb.* 22, 1883.)

It has been our good fortune to have had many friends among the so-called lower animals, and we propose, therefore, to introduce a few of the most uncommon of them. Before, however, allowing our first friend, a dog, to make his bow, we might say a word or two regarding the tricks which many animals are able to perform. In teaching an animal accomplishments, the first thing to be done is to make friends with the scholar. Having made friends, it is next necessary to get the animal's undivided attention, and thereafter to put it thoroughly at its ease. There is a time and a place for everything, and if the attention of our friend is taken up with other matters, it is of little use trying to persuade it to do anything, charm we ever so wisely. Patience is perhaps of most use in the process of training; and this includes command of temper. Most animals are exceedingly sensitive, and a cross word, or sometimes even an angry look, undoes in a moment the result of many previous lessons. Fierce animals are not necessarily the most difficult to train, and in many instances they best repay the labour expended on their behalf. Sullen or too easy tempered animals are difficult to manage; and those are to be preferred who are in possession of some spirit, even though it be a bad one. A dog who follows everybody is of no use to anybody; and to the saying regarding certain individuals who are nobody's enemies but their

own, ought to be added, "nor anybody's friends,—not even their own."

And now for our particular friends. And first, a word about dogs. A great deal has been written concerning these animals; but notwithstanding this, we are tempted to say a word or two regarding Twist, seeing we consider he is entitled to be placed on a higher pedestal than the most of even clever dogs. He was the size of an ordinary terrier, and had short bandy legs, and a broad powerful chest. He would have been positively ugly were it not for his intelligent-looking face, which made one forget all about his make. He was of no particular breed, but of that serviceable class known as mongrel. His first exploit came about in this wise. In a district where dairies are unknown, we had, in common with other lads, to bring our supply of milk every morning from a neighbouring farm. On these journeys our constant companion was a small terrier of the softer breed, which had only its affectionate nature and pretty appearance to recommend it. One morning it was set upon by a large watch-dog and severely worried; and not only so, but this was repeated on every possible subsequent occasion, so that reluctantly we thought it the best plan to leave Foxey at home. He appeared so hurt at this, however, that it was resolved to try and get Twist to form one of the party, knowing that if he did so the proceedings would, so far as we were concerned, be pleasantly varied. Strange to say, the expected happened. It was a rich treat to see Foxey's behaviour as we approached the place where the enemy usually lay in wait. Instead of cowering at the heel, he got briskly to the front—always, however, keeping an eye on his friend's movements. The big dog, who had as usual been in ambush, came on with a rush, and did not observe the addition to the party until it was too late, for before he could beat a retreat, which he seemed inclined to do, he was pounced upon by Twist, and received then and there such a thrashing, as ensured our passing and repassing daily the scene of the conflict, without receiving any unpleasant attentions on the part of the once dreaded foe. On another occasion a message was received that Twist's services were in instant requisition in connection with the relief of a terrier which had been put into a cask for the purpose of killing a couple of rats: but a hitch had occurred, and by the dog's cries it seemed as though the proceedings were being reversed, and that the rats were having the best of it. Twist was without ceremony lifted, and was dropped, nothing loth, into the cask, when the rats received their quietus in a couple of bites, and immediately thereafter there arose from the cask an unearthly howl that told at once its own tale. Twist, from insufficient instructions, was under the impression that he had to kill all the occupants of the cask, and having despatched the rats, immediately

set upon the terrier with deadly intent, much to that creature's horror and the owner's indignation, who seemed to consider the remedy much worse than the disease. It was at that time the height of our ambition to get a run through the woods with Twist; but as he had a supreme contempt for boys, it was difficult to enlist him as a member of the expedition. If, however, he could be coaxed within sight of the wood, the victory was ours, as Twist dearly loved a hunt; but to get him thus far we had to resort to stratagem, and at regular intervals we threw him a piece of bread, and so got him to follow bit by bit. But if the supply failed, or if he considered the piece too small, or the distance too great, he had no scruples in breaking his implied contract, and would then turn quietly on his heel and make for home. In addition to other accomplishments, he would recover a stone thrown into a field of standing corn with the same ease that he would take it from the bottom of several of the deepest pools in the river. On returning from a fishing expedition, it was customary to send Twist on before to announce the arrival of the party, so that the patience of hungry people would not be unduly taxed; and he would return again without partaking of any food himself, even though it was proffered to him. Every dog has his day, but Twist has more; for even now not a few recall with pleasure many enjoyable excursions under his guidance, during which unwittingly they acquired much interesting knowledge regarding bird and animal life.

The favourite of all the pets, however, was a beautiful squirrel, which was caught when quite young. It quickly made friends with all the other inhabitants, and exhibited a fearlessness and confidence which made it particularly interesting. It had not the slightest element of shyness in its composition, so far as animals of any kind were concerned; and I remember, on one occasion, a member of the family having received a present of a large cat, it became necessary that the new-comer be introduced to its future companions. Accordingly the proceedings were opened by the introduction of the squirrel, and, so far as the cat was concerned, they ended there. The cat was made much of, and as it lay purring contentedly on the knee, the squirrel was heard coming along the passage, with the peculiar sound which the strange formation of the hind legs gives to the movement of this animal over any hard substance. On hearing his name called, he at once obeyed the summons, and fearlessly climbed to where the cat lay, thrusting his nose in its face. It was no use trying to hold the cat, for with a terrified spring it made for the outer door, and disappeared, never more to return. The squirrel's abode was a drawer of the kitchen dresser, and it took possession of an old stocking therein, into which it used to creep, where it lay as snug as possible. Occasionally, however, it took a fancy to the pockets of one or other of the

jackets or coats which hung about, and it was no extraordinary thing to hear its peculiar cry when rudely awakened, by the owner putting the jacket or coat on. Sometimes the squirrel's presence was not discovered until the owner had gained the street, and then (for although Jack had no scruples in gambolling all over one, yet he had a decided objection to any but a very privileged few handling him) there usually ensued a severe struggle between duty and inclination, the one pointing clearly to not allowing Jack to get his freedom on the street; the other, and the stronger, to let him take his chance. But when the performance of one's duty was likely, in all probability, to result in an intimate acquaintance with the squirrel's teeth, it is no wonder that inclination often won the day, and that the squirrel had its freedom if so inclined, even though the possession of its liberty resulted, as it did on one occasion, in reducing to utter helplessness a linen-draper, who, from his look of horror, seemed to attribute the commotion among his window stock to some supernatural agency. The squirrel's chief delight was searching for nuts, and it was a common practice to rattle nuts in the hand to call the squirrel's attention, and afterwards secrete them about the person. Immediately on hearing the sound, the squirrel would come at a great rate on his searching expedition, and, however cunningly the nuts were concealed, he was not long in finding them out, and he never cared to commence his feast until the whole of the nuts were safely stored away in one or other of his storehouses. One day he was captured while on one of his excursions to a neighbouring garden, and confined in a cage with a wheel attached; but before the expiry of the usual statutory thirty days, the once merry little fellow died of a broken heart.

In addition to the squirrel we had a ferret, which was, however, only a pet to a few of us. I need hardly say that the long-suffering female population fairly rebelled when it was proposed to give this animal the run of the house, and its wanderings were consequently confined within certain limits. The treatment which these animals usually receive is most unnecessarily cruel. As many of you are aware, ferrets are used for forcing rabbits out of their holes; but the great drawback to their use is the habit they have of what is familiarly known as "sticking in the hole." This happens when the rabbits have been wounded or so frightened that they refuse to move, even when the ferret gets to close quarters; or perhaps the rabbit gets into some hole where there is no bolt, when the ferret kills it, and after sucking the blood coils itself up on the carcase and goes to sleep. When this occurs, the only thing to be done is to block up the hole and come back again next day, when the prisoner is usually glad to get out. To prevent ferrets catching and killing the rabbits, various methods are resorted to,

all of them more or less cruel—such as stitching the under and upper lips together, or tying the two jaws tightly together, both of which methods entail immense suffering on the poor brutes. Breaking the teeth, also, is often resorted to where the ferrets are to be used only in catching rabbits; but when rats are to be hunted they then require the whole benefit of their teeth. We proved by the ferret in question that these muzzling precautions are quite unnecessary, and that all these animals require to make them more tractable is better treatment on the part of their owners. Surely it is not wonderful that, seeing the only breath of air ferrets usually get when in captivity is inhaled through the bars of a not over-clean box, they resent this treatment, and when in possession of their liberty take full advantage of it, and sometimes even refuse to allow themselves to be taken from an empty hole, and bolt back the instant they see any one make an attempt to take hold of them. The ferret we had was worked unmuzzled, and with unbroken teeth, and he was so trained that he came at call. If we considered he was too long in the burrow, we had only to pat with the hand inside the mouth of the hole, when he came at once and allowed himself to be lifted. These brutes seem to have no bones, which makes it a difficult matter to handle them; and any one not accustomed to the process would find it impossible to lift one off the ground—especially if the ferret is moving—without giving it an opportunity of biting if so inclined. They can screw and twist themselves into a hole which one would think a mouse would find a difficulty in entering; and they can be rolled into a ball, and thereafter tied tightly in a linen bag, without apparently suffering any great harm thereby. This mode of carrying them is usually resorted to by poachers, as the ferrets are prevented from moving in such a way as to attract the attention of any one passing—which they are apt to do if simply carried loose—as, being of a restless disposition, they keep scratching with their feet at the lining of the pocket. In return for a day's shooting, we gave the loan of our friend to the lessee of a rabbit warren, who sent word in a few days that he had lost the animal; but we were quite sure that this was not the case, and that the ferret was simply retained on account of his good qualities. We had this consolation, however, that the gentleman would not profit long by his ill-gotten gain, for we well knew that a few weeks' ill-treatment would reduce our friend to the ordinary ferret level. Most animals, as well as ferrets, are in a great measure what man makes them, and we should never wish to have a quieter pet than this usually fierce creature. Kindness has a wonderful effect upon animals, and so has cruelty—which latter, however, is often the result of ignorance and thoughtlessness. The most affectionate and trustworthy dog we ever had came into our possession with a character which was quite alarming. He had been kept con-

stantly on the chain, and little attention paid to him; and at last he became so fierce, that his food had to be given to him at the end of a stable fork. Having broken his chain one day, he got into the owner's house, the occupants of which speedily vanished; and the question came to be, how was the dog to be destroyed? This never became necessary; for on a few kind words being spoken to him, and on his being quietly approached and his chain taken off, he was tractable as a child, and thereafter proved his gratitude by long years of faithful service and loving obedience.

In regard to the ferret's brother the weasel, and other animals at present outside the pale of respectable society, it occurs to any one who has given a thought to the matter that there is something radically wrong in the incessant warfare which gamekeepers and others wage against the animals known as vermin, which class has been augmented of late years by the addition of Rooks and Wood-pigeons. These outcasts often make the best pets, and no more amusing friends can be had than Ravens, Hooded-Crows, Magpies, Jackdaws, &c. In the indiscriminate war waged against vermin, many innocent suffer with the guilty, and it is useless in most cases to argue with the class of people in charge of game. But even as regards Hawks, Hooded-Crows, Stoats, Weasels, and the like, one is justified in thinking that game would be no scarcer, or if scarcer, of a decidedly better quality, were these creatures allowed to take their chance with others. "Live and let live" is a wise motto, and they who upset the balance of nature are certain themselves to be the sufferers,—as witness those districts where the inhabitants made a raid upon the small birds, with the result that the place was soon thereafter infested to such an extent with all manner of insects, that birds had to be brought from other quarters to supply the place, in so far as that was possible, of those which had been lately destroyed. If Hawks were allowed to live, they would keep small birds in check; and if small birds were let alone, they would look after grubs, which do more harm to fruit than whole regiments of Blackbirds. If it was not considered necessary to stamp out the weasel and his relatives, rabbits would not at the present time be the pests they are. The day will yet come, however, when ignorant men at cross-purposes will not be allowed to take upon themselves the task of regulating the animal world, and kill and slay the members thereof, not necessarily on account of crimes committed, but seemingly only because it is the tradition of their class that it is the proper thing to do. One would not have such a right to complain if there was any method in the madness of the believers in the vermin extermination theory, and if the vermin suffered because of the harm they were doing. But to kill, say for instance, a Hawk, simply because he is a Hawk, is surely too bad. Then as regards Owls: Owls have always been noted for their wise

look and puzzled expression, but may not this arise from a too constant consideration of the ways of this wicked world, and of the problem why they, with only one bad habit—viz., prowling about at night—are considered fair game for the exercise of the talents of all the possessors of fowling-pieces,—from the urchin with his old-fashioned muzzle-loader, to the owner of the double-barrelled breech with all the latest improvements.

In addition to the four-footed animals, we had hosts of feathered friends, all of them more or less interesting. Most small birds, however, unless got when quite young, never do get reconciled to captivity; and when this is the case, it is a pity to keep them caged up. Others, however, speedily make themselves at home, and notably the Bullfinch, which we have repeatedly seen take seeds out of the hand on the very day of its capture. Of the larger birds, the most amusing was a Jackdaw, who occasionally ranged about no one knew where, for he had perfect liberty, his wings never having been clipped. But, like a sensible fellow, he always put in an appearance at dinner-time, and again when he wished to retire for the night. Our friend was no exception to the general Jackdaw failings, but he was no common thief, and only interfered with such objects as he considered the owner held in special esteem. Consequently it was not safe to have anything of value about, as even the cat found with regard to her tail. In consequence of numerous offences, he was presented to a nurseryman, and took to his new quarters nicely; but, as might be expected, it was not long before he won fresh laurels in his new situation. One night he of design got shut up in the hothouse, and next morning it was found he had been hard at work during the silent watches, having carefully collected all the "tallies" into a heap on the floor, thereby entailing an immense deal of trouble on his new master. He must have been very fatigued; but from his mischievous look and knowing croak, he seemed to consider that his master's indignation and fruitless rage more than compensated him for any trouble he had had. He fell a victim at last to his besetting sin, for some workmen having left a quantity of white lead lying about, this substance was first admired from a distance, then it underwent a nearer inspection, and finally was freely swallowed, with the result that our black friend was gathered to his fathers, in what was to a Jackdaw the flower of his youth.

And now let me say, in conclusion, that though animals can be taught many really clever tricks, we cannot help thinking that, to a certain extent, these so-called accomplishments are degrading to our friends' talents, and our admiration on viewing them is tinged with the same feeling of pity which we experience in witnessing the agility or laughing at the antics of a circus clown. While therefore, in certain circumstances, it is justifiable to have wild

animals as pets, or under control, still, if we wish to see them at their best, we must of necessity make their acquaintance at their own abodes. No doubt some of them are shy, and it is difficult in many cases to gain their confidence, but we should not on this account refuse to make the attempt, and in doing so, let us always keep in mind that animals are partial to *practical* kindnesses, and attach little importance to words without deeds. In some districts the country people believe that the lady Chaffinch is averse to take even her would-be husband on trust, and that when, during the pairing season, he registers vows of eternal devotion, she receives these with the cry of "Prove it! prove it!" Such being the case, *we* can hardly expect to walk at once into the good graces of our four-footed or feathered friends, and more is expected of us than protestations of attachment. But if we once "prove it," there is no limit to the confidence and trust they will repose in us. How can we prove it? So far as our feathered friends are concerned, the matter is simple. "The Society for Prevention of Cruelty to Animals" does a good work, and all honour to its promoters and supporters; but we might go a step further, and supply a felt need, by organising a company, the title of which sufficiently explains the objects thereof—namely, "The Society for Augmenting in Winter the Smaller Livings of the Birds."

XIV.—SHAP SPA AND ITS SURROUNDINGS.

By Mr JOHN WALCOT.

(*Read Feb.* 22, 1883.)

Shap Spa is situated in the very heart of the Westmoreland Fells. It is near the foot of a plantation which covers the banks of a mountain stream, and which skirts a triangular flower-garden, opposite to which stands the hotel. It is a solitary building, in a sheltered spot, and to the front has a pleasant outlook. Five minutes' walk in any direction from the hotel enables the visitor to overlook a vast stretch of moorland, surrounded on every side by lofty hills covered with heather. Over this district any one may wander without restraint; and as it is almost houseless, and is from 900 to 1500 feet above the sea-level, he may realise the full benefit of quietness and ozone. The hotel has been in existence for many years, and in its present improved condition is able to accommodate from sixty to seventy persons. Fortunately advertising is not one of its necessities, for its homely character, excellent management, generous diet, and moderate charges have sufficed

during every season to attract as many visitors as can be accommodated. In company with some lady friends, I visited this place for the first time last autumn; and from my experience of its influence upon health, I was not surprised to learn that many persons are not content with a yearly visit, but go whenever they feel the need of rest and recruiting. Of these visitors, the late Mr George Moore of London was one of the most frequent and appreciative.

Whatever attractions this district may have for the invalid or the jaded, it has equal attractions for the naturalist. There, if anywhere, he may find the opportunity of profitable and exciting toil. Probably the geological features of the district will first of all arrest his attention. These, speaking generally, consist of a wide stretch of limestone on the high grounds to the north-east; of a large granite hill to the west; of old red sandstone cropping up in the river-beds and in the bank at the back of the hotel; and of green slates and porphyries (common in the Lake district) spreading over the entire valley. The outcrop of granite in Wansdale Crag is worthy of special note. It forms one of the most conspicuous hills in the district, and from its summit an extensive view can be obtained. The granite of this hill is distinct from most of the other granitic formations in the island, and is known by the designation of "Shap granite." It is easily recognised by the large size of its crystals, and has acquired fame for its peculiar hardness and durability, as well as for its attractive appearance. This hill is now being energetically quarried by the Scottish Granite Company; and the quarries are connected by a branch railway line with extensive polishing works at the foot of the hill, about two miles distant. These polishing works are said to be the most perfect of their kind in the kingdom, and reveal to the visitor some of the wonders which can be wrought by first-class machinery and skilled labour. The power to turn waste substances to useful and profitable account has long been recognised as a means of advancing national progress and personal fame. This power is most advantageously exercised in these polishing works. All the waste chippings at the quarry are crushed by powerful machinery, and these are despatched to the works, where they are formed into granolithic slabs, to any measurement and to any shape. In connection with the outcrop of granite, I must not omit to mention the existence of an immense number of granite boulders, not only in the river-bed, but for miles across the moor. In one place, near the ridge of a hill, five or six miles distant, there is a large circle of these boulders, supposed to have been gathered and utilised by the Druids. These boulders all bear distinct marks of their origin, and undoubtedly once formed a part of the granitic mass called Wasdale Crag. Professor Sedgwick states that boulders of the same material may

be traced across the mainland eastward as far as Scarborough, and in another direction as far as Morecambe Bay. We do not now consider by what agency these boulders were torn off from the parent mass, and removed to so great a distance; but all will see how much there is in these facts to awaken inquiry and provoke reflection.

The number of Ferns in the Shap-Spa district is sufficiently large to make it attractive to any one whose pulse can be quickened by the sight of a delicate or stately frond. During my stay there I gathered seventeen different kinds: Pteris aquilina; Polypodium vulgare, P. Phegopteris, P. Dryopteris, and P. calcareum; Allosorus crispus; Cystopteris fragilis; Polystichum lobatum; Lastrea filix-mas, L. Oreopteris, L. dilatata; Asplenium viride, A. Trichomanes, and A. Ruta-muraria; Scolopendrium vulgare; Blechnum boreale; and Athyrium filix-fœmina. Some of these were in great abundance. This was specially true of Cystopteris fragilis, Asplenium viride, A. Trichomanes, and Scolopendrium vulgare. These grow in the water-worn recesses of the limestone rocks, either on the underside of blocks lying on the surface or in the deep perpendicular clefts which abound in the district. The appearance of these Fern-clad clefts is singularly charming—all the more so, that many of the plants were out of reach, and never likely to be extirpated. Orton Scar presents strong attractions for the botanist, and affords a wide field for work. It is only about four miles from the hotel, if the footpath across the moor be followed; and this, under the influence of the pure, bracing breezes of the fells, is an easy morning or afternoon excursion.

Before closing this paper, there are two other subjects to which reference must be made. On the right hand of the garden through which you pass to the Spa, a large number of Swallows had gathered in the trees, probably as a rendezvous before migrating to summer skies. These, from early dawn to dusky eve, were an endless source of amusement to the visitors. Their incessant and pleasant chatter seems to tell us of conference, of courage, of hope, of caution, and of joy. As the season was advanced, and the cold was increasing, we daily watched for their departure. One morning we missed a large number: they had flown off, leaving about one-fourth behind. Why was this? Was it a part of a preconcerted plan to gain some end which could not otherwise be gained? or was it because those left were not strong enough to endure the flight, and before doing so, needed to increase their energy? Whatever the reason, however, after three or four days had elapsed these departed too, giving us as visitors an impressive lesson as to the near approach of wintry blasts and gloom.

During my visit there, Government tents were pitched under the Wasdale Crag, to accommodate men who were engaged in taking

down telegraph wires, and carrying them along in cast-iron pipes underground. The necessity for doing this arose from the great destruction of game, caused by the birds flying against the wires. It had been no uncommon thing for the keeper to find many of the hill birds lying dead along the line of wire. To prevent this, by removing the wire, was an act as merciful as it was wise. It is sometimes said that the necessities of commerce have *no* law; but there is *one* law to which they ought to be subject—namely, the law of working, if possible, by other means than those which en danger or destroy life; and it was the operation of bringing these necessities into subjection to this law that we saw so successfully carried out on Shap fells in the way we have described.

XV.—SPECIMENS OF LIZARDS FROM SOUTH AMERICA.

Exhibited, with Remarks, by Mr P. B. GIBB, M.A., Vice-President, *February* 22, 1882.

The specimens exhibited were the Salimpinta, Iguana, Alligator, Crocodile, and several smaller Lizards presented to Mr Gibb by a gentleman lately returned from British Guiana.

At the same meeting there was exhibited a collection of Ferns and Lycopods from New Zealand, by Miss M. Fraser.

XVI.—A DAY'S RAMBLE IN THE NORTHERN PART OF THE ISLAND OF ARRAN, WITH NOTES ON THE GEOLOGY AND BOTANY.

By Mr W. IVISON MACADAM, F.C.S., F.I.C.

(*Read March* 22, 1883.)

The Flora, Fauna, and Geology of Arran have received so much attention at the hands of so many eminent men, that the subject would appear completely worked up. The island, however, is so very interesting to the student of Botany, Geology, or Entomology, that I may be excused for laying before you one or two points that may be seen by any one undertaking the walk I describe. That the island should give, for its size, results greater than any other ground in the country, is easily explained when one remembers that there you have the sea with its salt marshes, lowland bog and highland bog, and the hard igneous rocks with their Alpine

flora,—from the cold northern portion round Corrie, with its somewhat bleak but bracing winds, to the balmy recesses of the south, with that gem of a hamlet, Lag, nestling amongst trees and sheltered by rocks, and where you may pick flowers and gather insects belonging to the south of Ireland and England.

The country over which I purpose to travel is in the northern half of the island. Beginning at Corrie, we will proceed along the sea-shore to Sannox burn; then up North Glen Sannox, down Glen Chalmadale to Loch Ranza, and after a brief stroll on the sea-shore and amongst the equiseta and rushes in Loch a' Mhuilian, proceed up Gleann Easan Biorach to Loch na Davie, then up the Castles and Chior Mhor, down the Saddle, and over the Creaggan to Goat Fell, and after passing down the scarp, proceed by White Water and the shore back to Corrie. The distance from Corrie at any one point may not exceed twelve to fourteen miles, but the long round we take opens out some of the very best of scenery, portions of geology unrivalled in the kingdom, and a flora sufficient to induce even an old botanist to return time after time.

Passing through Corrie, we notice at the harbour the cave-like openings of the old limestone workings. These strata gave a first-class limestone for both building and agricultural purposes, but they have been stopped for several years, owing, it is said, to an accident in which two men were killed. At present all the lime required for agricultural purposes is obtained from Ireland, and burned on the island by the consumer, who constructs for the purpose a temporary kiln, exactly similar to those used some two or three hundred years ago on the mainland. The Corrie limestone abounds in fossils, more especially large *producti*, and it is deserving of note that the valves always rest on the convex side, showing they must have been deposited in very tranquil water. Mixed with the limestone are beds of shale somewhat ferruginous in character; and a higher stratum yields nodules of hæmatite iron-ore.

Proceeding along the shore northwards, we notice several trap dykes, and the more curious hard ridges in the red sandstone, some of which stand up a considerable height above the surrounding rock, having defied the sea which denudes away the softer stone. We pass some very large boulders of granite, whilst the sea-shore is strewed with smaller rounded stones. The latter are at present being broken up by dynamite, and shipped to Glasgow and other places, to be ground down and used for compounding the "glaze" for stoneware. Already large quantities have been exported, and the shore has somewhat changed its general character. Of the larger boulders, one on the left side of the road is a giant, and, according to Bryce, weighs 200 tons, but from my own measurements must exceed that by at least 50 tons. One other is a rocking-stone, and can be easily moved from at least two points by a

single man. The amount of displacement is, however, very small. All along the left side of the road, and within 30 or 40 feet of it, we see the old sea-cliff of red sandstone, with its caves and rocks, covered with ferns and flowers. We now pass the small hamlet of Sannox, then over the burn which comes down Glen Sannox, and which has deposited at its mouth thousands of tons of granite sand. This sand is also sent to Glasgow. The road then rises 200 feet, giving us a glance up Glen Sannox, with its granite ridges surmounted by Cioch nah Oighe (2168 feet) on the left, and the Suidhe Fhearghas (1500 to 1750 feet) and the three sharp points of Caisteal Abhail (2735 feet) on the right, and closed by the grand and precipitous height of the Chior Mhor (2618 feet). The road then passes into North Glen Sannox, the burn of which it crosses by a bridge, and then gradually rises once more. A short distance farther on we look up North Glen Sannox, one of those favoured spots which have not yet been "run on" by tourists. This glen has scenery unlike any other part of the island, whilst its rocks and cliffs are as good as the veritable Glen Sannox. The flora is unusually rich, especially in the Alpines and bog-loving plants, for the spade of the ditcher has not yet reached it, and robbed it of its treasures. Everywhere along the road one sees the ruined walls of the old crofters' habitations, who, until the year 1832, inhabited this glen. In that year the crofters, to the number of somewhere between 500 and 600, were deprived of their homes and compelled to leave the island. Near the bridge the conglomerate passes into slates, which are at places striated. The conglomerate is extremely coarse, containing pebbles sometimes as large as from 8 to 10 inches in diameter. Further up Gleann Dubh, and near the 500 contour line, there is a most interesting junction between the slates and the granite. It is well exposed in the bed of the burn. The granite is coarse, and abuts on the slate, which is changed into a hard mass, and much laminated. One hundred feet higher (600 feet) and we reach the summit, from which we have one of the finest views of the Caisteal Abhail and Suidhe Fhearghas: this time, however, we see the north-west flank. We have now entered Glen Chalmadale, and a rapid descent of between two and a half and three miles brings us in sight of Loch Ranza. The road is cut out of the side of the hill, and at some points is about 100 feet above the burn. The flora is not unusual, all the ordinary flowers and ferns being obtainable, but, so far as I have seen, nothing rare. The glen is shut in by a sudden turn near the foot, so that we have descended to the 300 contour line before we get even a glimpse of the sea.

At Loch Ranza there is a most comfortable cottage hotel, where one can get refreshment if they so indulge; but as we have still the heavier part of our walk to do, we must be careful. Meantime, a short stroll on the beach will repay the trouble in salt-marsh

plants—Spergularia marina (Sea Sandspurry), Arenaria peploides (Sea Purslane), Aster Tripolium (Sea Aster), Triglochin maritimum (Sea Arrow-grass), Gentiana campestris, &c. To the south of Loch Ranza village, and hidden behind a knoll so completely that it is rarely if ever seen by the passer-by, lies the little marshy Loch a' Mhuilian. Here we get specimens of Potentilla Comarum (Marsh Potentilla), Drosera rotundifolia and D. anglica, Menyanthes trifoliata (Buckbean), Crepis paludosa, Sparganium simplex, Hypericum Elodes, Equisetum hyemale, Potamogeton natans, Pedicularis palustris, &c.; whilst the Water Beetles, Butterflies, and Dragon-flies would well repay a day's work.

A dozen yards or two leads us to the track by which we join the path for Gleann Easan Biorach. The small river has cut a channel through the slates to the depth of probably 30 or 40 feet, and as this gorge is impassable, we must keep higher up on the hill flank. On the right we have the Meall Mhor, or round-topped mountain (1602 feet); on the left Torr Nead an Eoin, or the Hill of the Birds' Nests (1057 feet). How rapidly these mountains ascend can be gathered from the fact that the top of the first is within three-quarters of a mile and the second one quarter of a mile, on the Ordnance map, from the actual burn. The gorge is narrow and short, and you find yourself suddenly in a somewhat broad valley, quite uncultivated, absolutely alone, shut out from the sea behind, and with nothing but a wide expanse of moor and bog. But so much have we to see, so careful must we be of our steps, so continuously are we engaged, that when we arrive at the end of our four or five miles' walk, we regret the fact. We shall first descend to the river and examine the junction of the slates and granite. Note the many beautiful veins of granite, coarse and fine, that intersect the broken slates, and trace these on various parts of the hillside. From this point upwards we are on the granite; but the interest does not cease, for we find that it is far from constant in grain; and that the junctions in the granite itself will well repay our labour. Whilst passing up the glen, we encounter plants of Pinguicula lusitanica, Pedicularis sylvatica, Potentilla argentea, and Hypericum pulchrum; and whilst taking shelter from a passing shower, procure from the overhanging rocks Salix herbacea, Loiseleuria procumbens, and, to our great delight, a shrub of Pyrus pinnatifida, the deep-cut-leaved Beam-tree. Of course the Rowan (Pyrus aucuparia) abounds. We afterwards pick up a specimen of Carduus heterophyllus, or Melancholy Thistle. Loch na Davie lies exactly on the highest part of this long valley, and sends its waters both north down Gleann Easan Biorach and south to Gleann Iorsa. The only addition to our specimens obtained from this loch is Lobelia Dortmanii, which occurs in great abundance. This plant is said by the local guides to occur in Loch a' Mhuilian, but I could not find it. In Loch na Davie, however, any amount can be had.

We are now 1182 feet above sea level, and can look down Glen Iorsa, the longest of the Arran valleys. As, however, we are to climb Caisteal Abhail, we do not wait longer than sufficient to examine the view. A mile and a quarter good hill walking brings us to the crest of the Castles (2735 feet); and now we have a noble view of Glen Iorsa, with its beautiful stream trickling over granite gravel, passing into small lakes, and latterly into Loch Iorsa. On the hills to the south-west lie Loch Tanna and Loch Dubh, both of which are 1065 feet above sea level. The former loch affords good sport, as it contains large quantities of mountain trout. It is most easily got at from Catacol. From the Castles we fall 700 feet, and attack Chior Mhor (2618 feet). No one who has ever ascended this mountain will compare any other Arran view to it. True, you cannot see the Largs shore on account of Goat Fell; but otherwise the view is grand,—Brodick, Iorsa valley to Dougrie, Bute, Cumbrae, Cantyre, the Paps of Jura, the Irish coast, are a few of the most prominent; whilst Sannox and Rosie Glens lie at your feet. The hill is difficult of ascent, but the way we have come is comparatively easy. Alchemilla alpina is added to our collection. With very great care we pilot our way down to the scarp between the Chior and Goat Fell, and lying at the top of Glen Rosie. We fall 1600 feet in little more than a quarter of a mile, so you can readily understand that heather or grass is a most welcome aid in lowering yourself. All the guide-books I have seen declare this way impossible; and probably were I to suppose valuable lives accompanied by dizzy heads were to follow me, I should do the same. No one not thoroughly accustomed to hill walking, or not having a perfectly steady head, should even attempt the inner igneous circle in Arran. A good clear head, strong, well-trained body, and a good compass and map, will carry one anywhere in the island. By a slight track used by shepherds occasionally, we proceed to Goat Fell (2866 feet), and here we enjoy an August sunset. As it is somewhat chilly, we get behind a rock, and after a slight refreshment start down the east scarp. Already the stars are out; and as the moon is not yet up, it darkens very rapidly. By the time we are on the moor it is quite dark, and we steer our way home to Corrie by means of the lighthouse on the Little Cumbrae, arriving tired, not exhausted; and after a wash and tea, break out into that magnificent glow—a luxury only known to the healthy, and to them only after severe exercise in the mountain air. A good sleep finds us next morning desirous to be at it again, and only sorry that yesterday's experiences do not come more often. If we are not in permanent lodgings, we are safe with Mrs Morrison at the Corrie Hotel.

At this meeting Mr MacAdam also described certain diatomaceous deposits from the peat of Aberdeenshire, Sutherland, and Lewis, and exhibited slides of the Diatoms under the microscope.

XVII.—ON THE CATHCART ETHER FREEZING MICROTOME.

By Mr ALEXANDER FRAZER, M.A.

(*Exhibited in operation, with remarks, March* 22, 1883.)

The increasing attention which in recent years has been given to investigations in which the microscope is used has led to the invention of many instruments by means of which thin sections of animal and vegetable tissues may be prepared for examination. The construction of an instrument by means of which sections of comparatively hard substances may be cut does not present special difficulty, and need not be further alluded to. But the cutting of thin sections of soft substances is a difficult matter, and one upon which much ingenuity has been expended. The method now almost universally adopted is that of freezing the tissue to be cut, so that for the time being it is not a soft substance, but a hard one. Freezing is effected in two ways,—first, by using a freezing mixture, such as ice and salt; and second, by the rapid evaporation of ether. For most purposes, microtomes which effect freezing by means of a freezing mixture are to be preferred; but many circumstances render the use of these instruments inconvenient, and in some cases they are quite inapplicable. When a freezing mixture is employed, ice and salt are the usual elements of the freezing compound. Now salt may be carried to any part of the world, and is procurable in most places; but ice cannot, and even in cities time and trouble are required to procure it, after which the laborious process of reducing it to a finely divided condition must be undertaken. Further objections are to be found to ice-and-salt microtomes, in the facts that they are slow in action and rather uncleanly.

It is obvious that ether is not liable to the objections attending the use of ice and salt. Ether may be carried anywhere, and can be procured in most places,—while it is at once ready for use, and is quite cleanly. The principal objection to the use of ether microtomes has been, that they have hitherto been both expensive in first cost and in after use. The cause of the expense of using ether microtomes is due to the fact that ether is comparatively a costly fluid. The instrument about to be described has been designed by Dr Cathcart to overcome these objections. The first cost (15s.) is inconsiderable, being less than half that of a well-made Rutherford's instrument; while the microtome has been so arranged as to freeze with a very small quantity of ether. In most ether microtomes hitherto devised, ether has been used not only to freeze the

tissue to be cut, but also to reduce the instrument itself to a corresponding temperature. In the Cathcart microtome only those parts which it is essential should be cooled are reduced in temperature, the results of this being that a saving is effected in the amount of ether used, and at the same time freezing is quickly effected. The instrument consists essentially of two parts, which are shown in figs. 1 and 2. Fig. 1 is a perspective view of the microtome, with all the parts shown except the spray-bellows. Fig. 2 is a sectional view of the ether points which are shown in position at E in fig. 1. It will be seen that the upper tube of E is

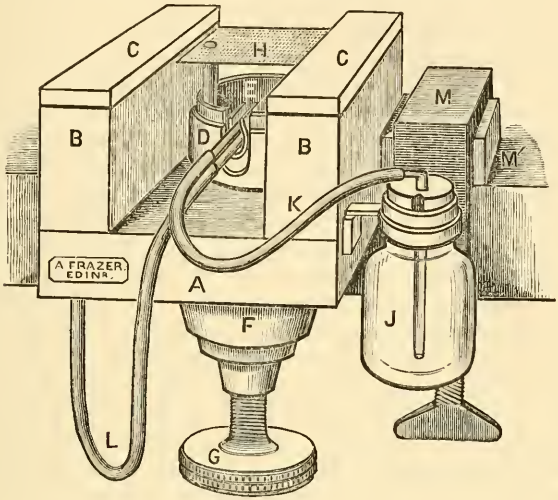


Fig. 1.

connected with the bottle J, in which the ether is contained, while the under tube of E communicates with the rubber-tube L, which is led to the spray-bellows, not shown in the figure. When the

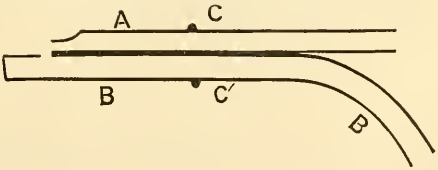


Fig. 2.

bellows are worked, a stream of air is driven through the tube B, and allowed to escape by the orifice in the upper side; in so doing it passes the front of the small capillary-tube A, and first having sucked out the air, afterwards divides the stream of ether, which has been driven by atmospheric pressure from the bottle J, into

a finely divided state. In this finely divided state the cloud of ether impinges upon the zinc plate H. From this plate it rapidly evaporates, and in so doing causes the plate to become so cold that it is capable of freezing any moderately sized tissue which is placed upon its upper surface. It is found in practice that at an ordinary temperature (about 50° Fahr.) a tissue about $\frac{1}{2}$ inch in diameter and $\frac{1}{4}$ inch thick may be frozen in two minutes by the expenditure of $\frac{1}{4}$ oz. of ether. The body of the instrument may be briefly described. The framework is of $\frac{1}{2}$-inch oak, and consists of a base, A, with two uprights, B B, screwed upon it. The base is bored, to allow the tubes D—for raising the section—to pass between the parallel uprights, and has a projecting part, so as to permit the instrument to be clamped to the table M′. Upon the top of the upright pieces, B B, are cemented two plates of glass, C C. These plates allow the section-knife to move easily along their upper surface, and are so arranged that the knife in its middle part will not touch anything but the tissue. The method of raising the section-plate is as follows: Two accurately fitting brass tubes are taken, and into the outer one, D, the nut, F, of a fine screw is firmly soldered at its lower end. The inner tube has the section-plate fixed to its upper end by two short brass pillars; between these, however, two small vulcanite washers are introduced, so as to prevent the heat of the body of the instrument from being communicated to the section-plate. The milled head, G, pushes the inner tube and accompanying plate, H, gradually upwards. The instrument is the invention of Mr Charles Cathcart, M.B., Lecturer on Anatomy in Surgeon's Hall, Edinburgh; while my connection with the matter may be seen from the description published by Mr Cathcart in the 'Journal of Anatomy and Physiology' for April of this year (1883).

XVIII.—NOTES ON SPRING VEGETATION AS OBSERVED AT MORNINGSIDE.

By Mr GEO. L. BROWN.

(*Read March* 22, 1883.)

After returning home from our first excursion for the season, when we visited the Snowdrops at Arniston, it was suggested to me by our Secretary that I might offer a few remarks on Spring Vegetation for the current month at our next meeting, together with as many specimens of different species as might be in flower in Morningside district, but more particularly those plants which, under my own personal care and superintendence, I love to cultivate and minister unto.

With February, along with the Snowdrops, the Crocus pokes up his smiling face. The yellow Jessamine is also bursting into beauty, sprays of which I cut freely, as I find they bloom perfectly well in water, clean out to the tip, if the buds are anything like matured. Garrya elliptica, now due, cannot fulfil its obligations in whole, having been nearly burned out. Daphne Mezereon presents itself beforehand, along with Rhododendron dahuricum; while we are further comforted by dozens of Violets putting in an appearance. Leucojum vernum, being in sympathy with Galanthus plicatus, hangs its graceful bells; while the Scilla upheaves the soil and bursts its little folds. Erica herbacea is well forward. Pips of Polyanthus and Primroses are quite plentiful, as are also charming blooms of always welcome purple, red, and white Hepaticæ. Altogether a more delightful February I never remember, and in a fit of exuberance I roll and cut the grass! (The lowest reading for the month was on the 19th: 28°.)

Now that March has come, we think our different coloured "regiments on the line" in fine form, and look grand as we march past them, the sun beaming on their shining coats! Further than this foretaste we do not get, however, as from catching midges, rolling on a sunny slope, we are engaged, a few days later on, shovelling snow, more or less of which we have hardly been without since. However, if there be any comfort in affliction, we have it in the fact that a distinguished Edinburgh professor, writing from Cannes to his family, states that, as regards weather, he might as well be in Morningside! On the rockery we notice Arabis lucida looming forth, as if in mockery to the snow; while red and white Daisies are to be got flowering bravely, and whispering lovingly to their companion, Aubrietia, to wake up, and with its purple rays dissolve the snow. The Sedum, too, is putting on its spring coat; while the Sisyrinchium shakes out its purple bells. Primula denticulata we behold tucked up in bed, and under the depressing circumstances we cannot expect him to rise just yet, but meantime draw the curtain over him, and all our dear little ones, without a doubting heart. May they smile upon us soon again!

XIX.—GEOLOGICAL NOTES ON A FEW OF THE EXCURSIONS.

By Miss CRAIGIE.

ST DAVIDS—*May* 27, 1882.

On Saturday, May 27th, the Geological section of the Club examined the rocks exposed on the shore between Inverkeithing and St Davids. The crater-shaped cavity of Inverkeithing Bay is enclosed

by walls of basalt intruded among the carboniferous strata of the district. The soft sandstone and shales have been removed by the denuding forces of rain, frost, &c. The hard basalt offers more resistance, and forms the headlands and hills along the coast. Some good sections of basalt were seen in the quarries, showing the characteristic double system of jointing, each block weathering in concentric spheroidal coats, and changing in colour from black to yellow as its iron oxide becomes transformed into the hydrous peroxide limonite. Some of the newly exposed surfaces were slicken-sided. The variety of basalt is a fine-grained greenstone, generally containing grains of iron pyrites. A little west of St Davids the carboniferous strata appear—finely laminated black shale overlying fine-grained sandstone; these dip about 20° N.W. under the greenstone. The ballast heaps presented a wayside museum of schists, sandstone, granites, and flints, which probably once formed part of the shores of the Highlands or Scandinavia.

EAST LINTON AND PRESSMENNAN—*June* 3, 1882.

The high-road between East Linton and Pressmennan lies over the carboniferous strata, which extend through the lowland valley from the coast of Ayrshire to Dunbar. Fertile fields lie on either side, and these owe their fertility not so much to the immediately underlying rocks as to glaciers of the Ice Age which ground down the face of the country over which they passed, and carried with them a happy mixture of sand, clay, and lime. The intrusive volcanic rocks of the neighbourhood—*e.g.*, Traprain and Berwick Law—give diversity to the scenery because of their hardness. The sandstones have been worn away, and the basalt, weathering equally all round, has assumed a shape somewhat like a true volcanic cone.

Pressmennan Loch lies in a hollow, bounded by steep rocky banks and closed in at each end by rocks. Its formation has not yet been explained. The brooks in the neighbourhood are not large enough to have hollowed out such a basin, and its form is not such as would have resulted from glacial action.

CRAIGMILLAR—*June* 7, 1882.

The high-road between Powburn and Craigmillar again lies over carboniferous sandstone, red and white. At a small quarry an interesting example of slicken-sides was seen. The sandstone had been removed down a line of jointing for several yards. Between the sides of the joint water containing a mineral had passed, enamelling the surface. The grinding together of the rock along the line of jointing had produced the usual fine striations. The castle is situated near the summit of a hill formed by an anticline. The strata on which it rests are nearly horizontal, and dip away on either side.

WEST LINTON TO DOLPHINTON—*June* 10, 1882.

Our walk to-day lay over the old red sandstone, which in the Pentland district is faulted down between the Silurian greywacke on the S. and S.E. and the carboniferous on the W. Towards the south stretched the Peeblesshire hills, rising peak over peak, "with long smooth summits that join on to each other, and once formed a wide tableland." About a mile west rises Mendick Hill (1500 feet), formed of brownish conglomerate, and capped by porphyry, which has protected it from denudation.

Above the bridge at Linton are a series of beds of sandstone, which gradually pass into a calcareous claystone. They are almost horizontal, but change suddenly about 200 yards above the bridge. The beds vary much in colour and hardness—being harder in proportion to the quantity of lime.

PEEBLES—*June* 1, 1882.

Peebles is situated in one of the valleys of the great Lower Silurian tableland of the south of Scotland. The rocks of the neighbourhood, as seen in the quarries and along the basin of the Tweed, consist of hard grey and blue grit, shale, and greywacke. The last is exceedingly hard, locally termed whinstone, and much used for road-mending. The surface-soil and underlying strata in the valleys generally date from the Ice Age. At the railway bridge above Neidpath Castle there is a fine section of boulder-clay and its accompanying beds. The fertile meadow-lands on either side of the Tweed are good examples of the flood-plains of alluvium which our rivers form as a slight return for the tremendous waste of their channels.

FALKLAND AND LOMOND HILL—*June* 24, 1882.

This district lies on the northern boundary of the carboniferous sandstone series, where this passes into the old red sandstone of the Ochils and Dura Den. The hills are of sandstone capped by greenstone, which has protected them from denudation. West Lomond is particularly interesting as an example of the power of a river to cut its way downward through solid rock. The sandstones rise for 900 feet above the vale of Eden, the bare edges of the strata sometimes jutting through the green hill slope. These are capped by a thick bed of greenstone, which is in turn covered with beds of sandstone and limestone, and finally the greenstone of the summit. The truncated edges of the sandstone are faced by similar strata on the other side of the valley. It is evident the river has cut its way down through them at least 900 feet.

GULLANE—*July* 22, 1882.

From the coral limestone at Aberlady several specimens of Lithostrotion irregulare and Lithostrotion junceum were obtained. This limestone is the eastern representative of the carboniferous limestone beds at Portobello. The Edinburgh carboniferous strata lie in a basin-shaped cavity, the edges of which appear in the calciferous sandstones of Leith on the west and North Berwick on the east. The limestone series overlies this, and is overlaid in the centre of the basin by the millstone grit and coal-measures between Musselburgh and Joppa. From a bed of fossiliferous shale between Aberlady and Gullane our hostess[1] had obtained some good specimens of Sigillaria.

Obituary Notice.

Mr John Sadler, Curator of the Royal Botanic Garden, and one of the founders of the Club, died December 9, 1882.

At the meeting of 22d December 1882, before proceeding to the business of the evening, the President said: "I must detain you for a few moments in alluding to a sad event which has happened since our last meeting. I am sure I express the unanimous feeling of all present when I say how very deeply we regret the death of our friend, and one of the founders of our Club—Mr John Sadler, —and how sincerely we sympathise with his widow and children. He was a man of a kindly and genial disposition, with a deep scientific knowledge of the subject which had been the study of his life; and he had a very happy manner of imparting information. Many of us remember the very interesting addresses he delivered to ourselves and others; and very fresh in our recollection is the kind and hospitable manner in which Mr and Mrs Sadler have on several occasions entertained the Club at the Royal Botanic Garden. I am sure you all coincide with me in expressing our deep regret at this sad event."

The Secretary was instructed to engross these remarks in the minute of the meeting, and send a copy of the same to Mrs Sadler.

[1] Our member, Mrs Bryden, who was residing at Aberlady, kindly entertained the Club to tea on the occasion of its visit.

I.—THE HIRUNDINES.

By Mr A. B. HERBERT, President.

(*Read Oct.* 26, 1883.)

I propose, at this our first indoor meeting for the season, to submit to you a few remarks on our Hirundines; but before doing so, I should like to say a little on the position and prospects of the Club;—and in these there is indeed much cause for congratulation. You will learn from the Secretary that, as regards the number of our members, the net gain is an accession of thirty-six in the past year; and I hope and believe this is not our only gain, but that our intellectual is commensurate with our numerical acquisition, and that among our new members will be found many from whom we may derive valuable information, and to whom we may also look for instructive and interesting papers. The field of Natural History is, we all know, most extensive—indeed we might say almost unlimited; and there are many branches we should be glad to see more fully investigated. We need not confine ourselves to Botany, Geology, and Ornithology. We have made a commencement in Entomology, and there we have a grand field for observation; and I see no reason why we should not have papers on the mammalia of the country, and also on the fishes, molluscs, and reptiles. Again, in microscopical research where shall we find a limit? Let us indeed consider nothing in nature unworthy of our investigation; for what it pleased an all-wise and benevolent Creator to form, cannot be beneath His intelligent creatures to inspect and elucidate. Perhaps I cannot give a more apt illustration of what I mean than by mentioning a most despised insect, the common Wasp. Our first and only thought, when we see one in our rooms, is to destroy it—and perhaps we are right; but we may learn something even from a Wasp. Who can tell for how many centuries these insects were paper-makers, and, moreover, from wood pulp, before the Scandinavians started their pulp-factories? And I am disposed to think that if the latter had paid more close attention to the operations of the insects, they would have avoided some early errors in their manufacture, and have had less sawdust and more fibre; for just listen for a few moments to what a writer 130 years ago says of the *modus operandi* of these insects:—

"Big and short pieces of wood like sawdust would not suit; it is necessary to have a sort of thread, and in getting such we must notice the sagacity of the Wasp. She doth not merely hash the wood, which would give her sawdust; but before she cuts it she makes a sort of scraped lint; she presses the

fibres between her talons, raises them up, and by that means separates them; having done this, she afterwards cuts them." [1]

On a recent visit to Kenilworth, I found a young relative very busy in the observation of the habits and instincts of Wasps. He took me into his study, consisting of a disused loft, telling me at the same time to be rather careful what I touched. There I saw many nests in full work, the insects passing to and fro through an open window; and three different species of British Wasps were fully explained and exhibited. One large and beautifully constructed nest was suspended from a beam; another was in a basket; a third was in its casing of clay; and a fourth, which had been accidentally broken, was in process of being restored by the joint efforts of the student and the insects. He took from a nest and placed in my hand a male Wasp, which, like the male Bee, has no sting, and explained to me how it was distinguished from the females and workers by its peculiar and beautiful antennæ. He was about to remove to his loft the same evening a populous nest from the thatch of a cottage, the old woman who inhabited it being desirous of parting with her too numerous yellow neighbours. I merely mention this as an instance that in the habits of the most insignificant or most despised creatures we may find something of interest.

We have, during the past summer, had many enjoyable trips, which I venture to assert were fully appreciated; and few of us who were there will forget the Snowdrop-day at Arniston, the Primrose-days at North Berwick and West Linton, and the Cowslips at Long-Niddry. I am sure I am only expressing the general feelings of our Club, when I mention our obligation to the noblemen and other proprietors who kindly allow us to perambulate their domains; and foremost among these I would name a very kind friend to our Club, Robert Dundas, Esq. of Arniston. It is our earnest desire, as I trust it ever will be, to do no harm to any one, and not to exterminate rare plants, but merely to take a few specimens. Indeed there is one somewhat rare plant which we hope next summer to translate to other localities. With these preliminary remarks I will now proceed with my paper.

The Hirundines, or Swallows, in which term I include also our Martins and Swifts, though the latter are now generally known under the designation *Cypselinæ*, form a very interesting tribe of the birds of these islands, and their habits and migrations have always attracted much attention. We have four species, all common as summer migrants—viz., the Swallow (*Hirundo rustica*); the House-martin (*Hirundo urbica*); the Sand-martin (*Hirundo riparia*); and the Swift (*Cypselus apus*); and besides these, there is that very rare

[1] Wildman on Bees and Wasps.

occasional visitant, the large Alpine Swift (*Cypselus alpinus*), only one specimen of which I have ever seen in the flesh, and that was about thirty years ago, in the hands of a taxidermist in London. We always welcome with pleasure the arrival of Swallows in the spring as the harbingers of mild genial weather. The small Sand or Bank Martin is usually the first to appear. There is a peculiarity about the breeding habits of this species which, I believe, is not generally known; but as we have the statement on the authority of those who have, in studying ornithology, paid close attention to these birds in their African winter quarters, we can scarcely dispute the fact that, unlike their congeners, they breed both here and also during our winter in Africa, and to this is probably to be attributed their greater numbers as compared with all others of the Swallow kind. Their mode of nidification, too, is quite *sui generis;* for, unlike the other Swallows and Martins, which construct their nests of clay or mud, the Sand-martin, with indomitable perseverance, perforates a hole, about two feet in length, usually in a sandbank, and in a small hollow at the end deposits its eggs. It is extraordinary that a bird with so small a bill and such short legs should be able to accomplish this excavation; but this is one of those instances of what can be done with small powers by perseverance and industry. A colony of these birds build in a sandbank to the east of Inverleith Row, and until recently there were always a few in the bank at Powderhall; but where I have seen them in the greatest numbers was in a railway-cutting at St Marys Cray, in Kent. There they form quite a remarkable sight, the whole face of the cutting being perforated by them, and you see many hundreds, perhaps thousands, of them together on the wing. Another place where I have seen them in vast numbers is in a sandstone quarry at Bebbington, near Liverpool. The Sand-martin is readily distinguished from the House-martin by its brown back, which in the latter species is bluish black.

The House-martin is the species with which we are most familiar, from its habit of fixing its nest under the eaves of our houses or in the corners of our windows; and it is not easily driven away from the spot it has selected, for I have known the nest destroyed four or five times, and still the birds persevered, as Thomson describes it—

> "To build their hanging house intent."

Often, when the nest is nearly completed, a pert Sparrow will drive the builders away and take possession; and there is an anecdote related that on one occasion the pair of Martins, not being able to dislodge the intruder, were joined by many others of their kind, and with their united efforts succeeded in plastering the Sparrow up by filling the entrance with mud. A short time ago a number of House-martins were disporting themselves over the classic Avon, when a Swan underneath them began to preen his plumage,

and many white downy feathers floated down the river. These the birds caught in their flight and carried up into the air, evidently for mere amusement, as one would repeatedly release a feather and another catch it before it touched the water. This pleasing game continued for some time, and was observed with much interest by many spectators on the bridge. It was very interesting to notice with what unerring activity and adroitness the birds caught the feathers in their flight, and seemed thoroughly to enjoy their amusing and sprightly game.

The true Swallow, or Chimney Swallow, as it is called, is readily distinguished from every other species by its long forked tail; and it has, moreover, a very pleasing warble, ending with a long-drawn-out note, and in the early summer it often sings on the wing. The earliest date at which I have ever seen it in Scotland was on the 16th of April in the present year, when one flew over my head as I was returning from church; and the latest date I ever saw a Swallow in England was on the 5th November. There are, however, instances recorded of their having been seen as late as December, but never in any numbers. I once witnessed a very sad sight as regards this species,—I forget the exact year, but I think it was about 1860,—after genial weather in April it became at the end of the month excessively cold and stormy, and one day, when fishing at Combe Abbey in Warwickshire, I noticed many dozens of poor Swallows lying dead in the boat-house. The keeper informed me that they had perished there from cold and hunger. It was, I assure you, to a lover of birds, a melancholy sight, and, we will hope, one of very rare occurrence. The Swallow usually fixes its mud nest on a beam in an out-house, and returns regularly to the same spot for years. There is every year a nest under the portico of a large house at Blackford, the proprietor of which is most careful in protecting them from interference. The strangest place I have ever heard for a Swallow to build her nest, was on a beam fifteen fathoms down the shaft of a coal-mine.

The Swift is the largest of our four common species, with great length of wing and power of flight, and readily known by its uniform dark-brown colour. It does not make its nest of mud, but builds in holes in walls, and often under a thatched cottage roof. It is the latest to arrive and the earliest to depart, coming in May and leaving in August or at the beginning of September. I once caught one of these birds while fishing with the natural May-fly. It drew out in its flight a considerable length of line, but I soon brought it to the ground, and found the small hook had penetrated through only a minute portion of skin inside the beak: this I severed carefully with a penknife, and gave the bird its liberty, happily very little injured. Swifts seldom or never settle on the ground, but perform all their functions on the wing, even to the propagation of the species, and collecting materials for their

nests. Noticing this latter habit, idle boys at Rome manage to capture these useful birds by a process at once surprisingly simple and efficacious. They procure a silken line of sufficient length to reach above the eaves of the houses. To one end of this they attach a small curled feather or two, and behind these is formed a running noose. This apparatus is taken up into the air by the current of wind blowing along the street, and as the poor birds are on the look-out for materials wherewith to line their nests, they strike at the floating feathers and get their necks into the fatal snare, when they are taken to the bird-market in the Rotunda for sale. This ornithological amusement is often carried on in the street of the Propaganda during the months of May and June. It seems to be a great delight to Swifts on a summer's evening to collect together and fly, with peculiarly harsh screams, round our churches, ruins, and rocks.

The Alpine Swift is, as I have before remarked, a very rare occasional visitant to these islands. It is white underneath and brown on the back. The figure which I exhibit (painted by my daughter) gives a very good idea of this bird, and you will observe from it that the flight feathers of the wings, when closed, extend considerably beyond the end of the tail; and while in the common species the expanse from point to point of the wings is seventeen inches, in the Alpine Swift it is fully twenty-six, giving the bird extraordinary powers of flight.

In former times it was a subject of much wonder and conjecture where our Swallows went in the winter; and the fact of their congregating in the autumn in the willow-beds on our rivers in such vast numbers just previously to their disappearance altogether, probably led to the idea that they retired under water, and there lay dormant till the return of spring—a very strange notion certainly, and long since exploded. We now know as a certainty that vast numbers winter in North Africa. They do not, however, reach the southern part of that continent; for my son, who was for some time in Natal and the Transvaal, informs me that though he saw many species of Hirundines there, not one was identical with those indigenous here. It is strange and interesting to note, that whatever new country we may visit, we find in its bird-life species very analogous to our own, and yet entirely distinct.

I met with rather a curious anecdote in an old book on animal biography respecting migration, which may not be uninteresting, though for its truth I cannot vouch. It is said that a shoemaker in Brazil tied a label to a Swallow with this inscription, "Pretty Swallow, tell me whither goest thou in winter?" and that it or another Swallow returned the next spring with a label on which was written in Greek characters, "To Antonio in Athens: why dost thou inquire?"

The subject of migration, we are glad to know, has been for several years, and still is, engaging the attention and research of the British Association, and a committee has been formed for elucidating the matter, of which a gentleman well known to many of us, Mr Harvie Brown, is a most active and efficient member. This committee is in communication with the coastguard service and the keepers of lighthouses on our coasts, and is bringing to light many curious and previously unknown facts, especially that some of our birds, which are residents with us throughout the year, in certain places and under certain circumstances migrate in enormous numbers. Two of these are the Jay, and the smallest of British birds, the Gold-crested Regulus. At the recent meeting of the Association, it was stated that migrations of the latter species had been observed last autumn in twenty-one stations, comprising, amongst others, the Faroe Islands, the Isle of May, and Guernsey. Mr Garrioch stated that on the 9th October very large flocks of these diminutive birds, with a few Fire-crests, were seen crossing the island of Bressay; and Mr Gatke remarks that at Heligoland, on the 28th October, to use his own words, "we had a perfect storm of Gold-crests perching on the ledges of the window-panes of the lighthouse, and preening their feathers in the glare of the lamps. On the nights of the 28th and 29th the whole island swarmed with them, filling the gardens and over all the cliff, hundreds of thousands of them. By 9 A.M. on the 30th, most of them had passed on again." It is gratifying to hear that these pretty little birds, generally seen here only in twos and threes, exist elsewhere in such vast numbers.

But to return to the Swallows—that pleasing writer, Edward Jesse, in his 'Country Life,' gives a very graphic account of some Swallows reared by hand, which I think may be interesting. He says:—

"Some years ago three Swallows fell down one of my chimneys. Their naked and helpless condition having excited the pity of my family, it was determined to endeavour to rear them: I therefore became their foster-parent. On rainy days they were fed with egg, and in sunny weather with various species of flies. I found it, however, a very difficult task to supply them with a sufficient number. I could only do so by sweeping the heads of umbelliferous plants with my fly-net. All the Swallow tribe continue in their nests a long time before they take their first flight, but I was anxious that my *protégés* should exercise their wings as soon as possible, and thus prepare themselves for emigration. I therefore threw them into the air as soon as I could do so prudently. At first they appeared much alarmed, and clung to the nearest object they could fasten upon, but in a few days they not only flew about but caught their food expertly. Some time, however, elapsed before they could satisfy the cravings of appetite through their own exertions. This occasioned them frequently to appeal to me for assistance in a manner too intelligible to be mistaken. They would utter a plaintive cry in flying around me, and sometimes settle on me. On these occasions I usually led to those places where the Asters abounded, from the flowers of which I easily captured various species of Syrphi in the hollow of my hand.

It was truly amusing to observe the eagerness with which the movement of my hand was watched, and with what voracity the produce of my efforts was devoured. As soon as my birds could fly, an open basket having a perch across it was set apart for their use. Here they rested by day and roosted at night. It was placed in the open air in the morning, and removed at night into the house. It often happened that my little charges had enjoyed two or three hours' disporting before I was prepared to walk. I was, however, recognised and greeted as soon as I appeared; and whether I pursued the course of the roads or rambled into the fields, they generally encircled me in their flight, sometimes resting upon me and accepting a fly from my fingers. These amusing proceedings continued four or five weeks, but after that period, according to my wish, our intercourse diminished daily. They associated more and more with their congeners, who were collecting together as is usual at this period of the year, and were absent more frequently and for longer intervals; but whenever and wherever I again appeared, they seldom failed to come to me when I summoned them with my call. Having disappeared for two or three days, I considered that our connection was altogether dissolved; but as I was walking to an adjoining village, one of the birds gave me his wonted salutation in passing, and on my invitation perched on one of my fingers. In this position I conveyed it to the village green, and there in the presence of several persons cast it into the air, with some exclamation expressive of my wish for its welfare. I was often solicited to continue my interesting charge throughout the winter, but I had accomplished my object. I had promoted the enjoyment of existence; that was sufficient. By attempting more, and thwarting the demands of instinct, I should probably have terminated that happiness which had been the object of my care and interest."

There is a very similar instance to the above of rearing a Swallow by hand given in Bewick's work, in a letter written in the year 1800 by the Rev. Walker Trevelyan of Long Witton, Northumberland. It is wonderful how utterly devoid of fear birds are when reared in this manner from the nest and allowed their liberty; and to my mind they are infinitely more engaging and interesting than any caged bird can be, which, to borrow from the nursery rhyme,—

"Hops all day long on a straight bit of stick."

Two instances have come to my knowledge of young Sparrows reared in a similar manner to these Swallows, and in both instances they seemed to have lost, or perhaps, more properly speaking, never to have acquired, a fear of mankind. One of these cases I should like to give a little in detail. A worthy doctor near Edinburgh found in his garden a young Sparrow blown out of its nest. It was reared by his family, and kept in a cage in the dining-room, but allowed to come out at its pleasure, and, when old enough, to fly out through the window, but it always returned to its kind protectors. Dining there one day, I asked one of the ladies, as we walked from the drawing-room, whether I should see her friend the Sparrow. She said, "Certainly, for he always comes to dinner;" and during our repast, when I was not thinking of him, he flew in by the window and settled on my shoulder, then hopped on to the table and took some crumbs from my fingers. Then he settled on my host, went the round of the

table, afterwards flew to his cage for some seed and water, and departed through the open window, paying us another visit during dessert. I never saw any bird so utterly free from fear. He used to make a pretence of building by collecting in his beak small bits of worsted spread about for him on the floor, but it was not known whether he ever entered on the matrimonial state. At any rate, if he did, he never had the courtesy to introduce his spouse to his friends. He slept out of doors in the summer, and in a corner of the dining-room in the winter. He seemed not afraid, but angry, when caught in the hand, and screamed and pecked till released. He continued an inmate of the house for more than two years, when he disappeared. Whether he had lived the span of Sparrow life, or become a victim to some prowling cat or sharp-eyed hawk, we can never know.

That Swallows are great benefactors to man there can be no doubt, as their food is exclusively winged insects, and some of these, in their larval state, most destructive to vegetation. I will content myself with mentioning only one species of insects to which they are most partial, namely, the large *Tipula oleracea,* commonly known as "Daddy Long-legs." This large gnat, in its larval state, is well known to be very destructive to farmers' root-crops, especially to turnips. Walking one day with Mr Scot Skirving, he pointed out a turnip-plant withering away, and told me we should find one of these larvæ devouring the tap-root. We forked it up, and found the grub, just as we anticipated. I once saw four young Swallows, having just left the nest, sitting together on the top of a door and being fed by their parents with these insects, and in such numbers that the young birds could not swallow them fast enough, and the legs of "Daddies" stuck out on both sides of their beaks, giving the birds a most grotesque appearance.

I have never known any year when the "Daddy Long-legs" abounded in such myriads in England as in the late summer. They flew into the lamps, on to our plates, left their legs in the butter, and were indeed a perfect pest. One day, in Worcestershire, while a stiff breeze was blowing, I noticed several hundred Swallows beating up slowly against a strong wind over a turnip-field, and devouring the "Daddies" by thousands as they rose from the plants. You might see them almost settle on the plants in snapping up the insects; and when I returned from my walk, the Swallows were still there, hunting over the field in increased numbers, and the quantity of insects destroyed by them is quite beyond calculation. After speaking thus of the great utility of these birds, it is sad to read the following statement of cruelty on the part of an Italian. The account, which I fear is only too true, is as follows, and is very properly headed "Disgraceful Butchery":—

"An Italian sporting paper is responsible for the following account of a wicked butchery of Swallows perpetrated by an Italian, Signor Paglia, who

evidently is considered by the Italian sporting world as a hero of great skill and endurance. We give the facts as recorded by an eyewitness: 'I send you intelligence of a most important Swallow-shooting accomplished by Signor Paglia, and which, as a feat of endurance and skill, will make the round of the sporting papers. On Sept. 2, Signor Paglia, with a retinue of seventeen persons, men and boys, went to a place called Battiferro, some two kilometres distant from Bologna, about 6.30 A.M., with six central-fire breech-loaders. The day was very favourable for the match, being rainy. The Swallows passed in large numbers during the whole day, and the shooting lasted till 6.15 P.M., with the interval of an hour for refreshment. The insuperable (!) Paglia closed this splendid day, killing 2186 Swallows (I repeat, two thousand one hundred and eighty-six), bringing them down one by one on the wing. They were picked up before a jury composed of Signori Cavaliere, Neri Baraldi (president of the Bologna Shooting-Club), Count Massai, Grazioli, Caprini, Giorgi, Bragaglia, and Giudicini.' The shooting, no doubt, is marvellous, but when we consider the untold good these little insect-feeders do, how they seek for the companionship of man, and, as it were, for his protection during nesting-time, and fearlessly pursue their daily work almost within his reach, it seems the more cruel that this little harmless innocent should have been selected for this disgraceful exhibition. . . . To find such a deed as this actually attested by respectable burghers of the country, shows the degraded state of humanity amonst the Italians."

It is an amusing sight to watch Swallows feeding their young on the wing. If you notice them carefully, soon after the young have flown—and you can easily distinguish the old birds by their fully developed long forked tails—you will hear a gentle twittering call, and then see the parent and young rise up with their breasts together in their flight, and the food transferred from one beak to the other. I will conclude these remarks with a short extract from White's 'Selborne.' The author says:—

"The Swallow tribe is of all others the most inoffensive, harmless, entertaining, and social. All, except one species, attach themselves to our houses, amuse us with their migrations, songs, and marvellous agility, and clear the air of gnats and other troublesome insects, which would otherwise much annoy and incommode us. Whoever contemplates the myriads of insects that sport in the sunbeams of a summer evening in this country, will soon be convinced to what degree our atmosphere would be choked with them were it not for the friendly interference of the Swallow tribe."

II.—NOTE ON A RABBIT KILLED BY A WEASEL.

By Mr ROBERT STEWART, S.S.C.

(*Read Oct.* 26, 1883.)

We have on several occasions come across a Rabbit while in the clutch of the Weasel, and were curious to know how it had been caught; but it was only this summer that we were fortunate enough

to witness the capture of a Rabbit by this, the most dreaded of all its many enemies. No doubt the Weasel kills many Rabbits by coming upon them unexpectedly while they are lying out in the bushes, or hunts them to death in their burrows, but what we saw proves that the Weasel is more than a match for a full-grown Rabbit, notwithstanding the disparity in speed, even in that longest of all chases, a stern one.

The river Findhorn, which is hemmed in by immense rocks in its higher reaches, makes up for its temporary confinement as it approaches the mouth. Here it laughs to scorn all attempts to keep it within proper bounds. It makes many beds, but refuses to lie in any of them. The consequence of this is, that the river hardly ever occupies the whole of the channel between the two banks, so that if the stream runs close to the bank on one side, there is usually a tract of shingle intervening between the river and the bank on the opposite side. It was such a place where we witnessed the following.

One forenoon, during the last week of August, we happened to be fishing near the mouth of the river, when we heard from the opposite side the cry of what seemed to be a Rabbit in distress. On looking in the direction from which the cry proceeded, we observed a Rabbit coming out from the bushes on the opposite bank and running in a zigzag fashion among the stones on the beach, crying piteously all the while. We at first thought that a Weasel had hold of it, but this was not the case, for, as it turned out, what we saw was only the first act of the tragedy. The Rabbit had run a short distance only, when there issued from the bushes in full pursuit a Weasel, which, so to speak, flitted in and out among the stones so quickly that it was difficult to keep it in view. As the Rabbit was almost powerless through extreme terror, and as the Weasel kept a straight line while the Rabbit ran from side to side, it was not long ere the pair came to close quarters, at the very edge of the river, and where the bank sloped gradually towards the stream. As is usually the case, the Weasel took hold of the Rabbit behind the ears, and proceeded to viciously bite its victim, until such time as a wound large enough to enable it to suck the blood was made. For a few minutes there was a struggle at the water's edge, the Rabbit still crying in a very piteous manner, and making frantic efforts to break loose from its fierce little foe, but to no purpose. When, however, we thought all was over, the Rabbit, in making a last effort to escape, rolled down the bank into the river, carrying the Weasel with it. The Rabbit then struck out boldly into the stream, and swam up the river in a slanting direction. The Weasel, on finding itself in the water, at once let go its hold, and having reached the shore did not attempt to follow the Rabbit, but got to the top of the bank and ran quickly backwards and forwards opposite the place where the Rabbit had entered the river. This appeared to be done for the purpose of keeping itself in the Rabbit's

view, and a horrible fascination it must have had, for the Rabbit, which seemed to have fairly escaped, turned itself in the stream and swam straight back for the spot where the Weasel was. Before, however, it reached the side, the Weasel took to the water and had a firm hold of its victim ere it landed, and for fully five minutes thereafter we had to look helplessly on, while the poor Rabbit, who struggled hard, was "done to death" by an animal not a tithe of its size. During all the time this was going on, we noticed another Rabbit among the bushes at the edge of the bank, watching the whole proceedings in a dazed state. One could not help admiring the courageous, though perhaps relentless, way in which the Weasel hunted and killed the Rabbit; and neither our shouts, the Rabbit's cries, nor the exposed place where the deed was done—not a bush or tuft of grass to conceal the pair—could make the Weasel stay for a moment its cruel work, much less frighten it into giving up altogether its contemplated meal.

At this meeting Mr A. D. Richardson exhibited under the microscope a most interesting collection of plant stems, exogenous, endogenous, and acrogenous,—drawing attention, in a few descriptive remarks, to the characteristic features in the structure of each.

III.—A NEW METHOD OF TAKING IMPRESSIONS OF LEAVES.

By Mr JOHN TURNBULL, Galashiels.

(*Communicated by* Mr A. Frazer, *Dec.* 27, 1883.)

The process of taking leaf-impressions by means of carbonised paper is exceedingly simple and inexpensive. The materials required consist of a sheet of *fresh* carbonised paper, such as is used for taking duplicates of letters, &c.; two sheets of thin, tough paper; and the paper upon which the leaves are to be copied. The latter ought to have a very smooth surface, otherwise the finer lines or veins will not be distinctly shown. Place the leaf to be copied upon the carbonised paper, and over it lay one of the sheets of thin paper. With the soft fleshy extremities of the fingers and thumb press the leaf into close contact with the carbonised paper. Continue this until the entire surface of the leaf is covered with carbon. Although not often necessary, this can be ascertained by lifting and examining it from time to time. The leaf thus *carbonised* is now transferred to the paper on which it is desired to take the impression. Carefully spreading it out, cover it with the second or clean sheet of thin paper.

Press, or rub, as before, so as to ensure complete contact between the leaf and the sheet beneath. During this, the second and final, operation, it is of the utmost importance that the leaf be kept in its place, because, if allowed to shift at this stage in the slightest degree, a blurred and unsatisfactory copy will be the result. If done with care, on lifting it a beautiful impression of the leaf will be found on the paper beneath—every vein, even the most delicate, being faithfully and accurately copied. Unlike drawings, these impressions bear close examination, even with a lens; and in this consists their scientific value, as every line shown may be relied upon as having been actually in the original.

With regard to the permanency of the impressions, it may be mentioned that my specimens have been used with almost as much freedom as engravings, without showing any traces of deterioration.

[A specimen of leaf-impression by Mr Turnbull's method will be found opposite.]

At this meeting Mr Banks read a short note on the occurrence of Stellaria aquatica, Scop., in the immediate neighbourhood of Edinburgh, but for obvious reasons the precise locality was not given. Mr Mark King also exhibited a collection of "interesting British plants," and made short descriptive remarks on each. Among the plants thus exhibited and described were the following: Brassica monensis, Dentaria bulbifera, Iberis amara, Orobanche minor, Woolfia arrhiza, Lemna polyrhiza, and Hierochloa borealis, the last gathered by the late Robert Dick in Caithness.

IV.—THE STOAT OR ERMINE WEASEL (MUSTELA ERMINEA).

By Mr R. SCOT SKIRVING.

(*Read Jan.* 24, 1883.)

This subject was suggested to me by a paper read at a former meeting entitled "Note on a Rabbit killed by a Weasel." The chief interest of that paper lay in the fact that, on the occasion described, the Weasel followed its prey into the water, swam after it, and killed it there. This incident was worthy of notice as being rare, though I am aware Weasels hunt Water-rats from their holes, and follow them in the water. By people who are not naturalists, the Weasel (*Mustela vulgaris*) and the Stoat (*Mustela erminea*) are constantly confounded together. They are both members of the same family

Dyctiocium falcatum
(showing sporangia)

group—and a most bold, cruel, bloodthirsty, ill-conditioned, and withal inquisitive family they are. They do not live in the odour of sanctity at all, but they do possess an odour of a very different nature, and that in a considerable degree. The members of the Weasel family in this country consist of the Weasel, the Stoat, the Polecat, the Marten, and the Pine Marten. There is also the Ferret, but that species of Weasel can be looked on in this country as a domestic animal only. The Pine Marten is now exceedingly rare, though one may still occasionally be met with in the larger Pine woods of the north of Scotland. The common Marten, as it was formerly called, is not quite so rare, and I read recently of two specimens being shot; and I saw a large one in the flesh very lately in the shop of Mr Small, bird-stuffer, George Street. The Polecat, an animal very like a large-sized, dark-coloured Ferret, is still far from extinct; but as it inhabits wild rocky woods, it is not often seen, and I have only met with it twice in my life. When abundant, in the earlier portion of this century, it was the terror and abhorrence of henwives, and of all persons who kept poultry. By far the most common of the Weasel tribe is the common Weasel. This active little creature is much persecuted by gamekeepers, but it may well be called the friend of the farmer, as, when it takes up its abode in a barnyard, it very soon clears the stacks of rats and mice. I confess to have been very inconsistent in my treatment of the Weasel, as I invariably preserved it about the farm-offices, and as invariably shot it when, gun in hand, I met with it in the fields. The Weasel, like all its congeners, is so active and vigilant, that its name has given rise to the proverb, "Catch a Weasel asleep!" I had once, however, an opportunity of making a poor pun very much at the expense of an individual Weasel. I was walking on the public road, whilst a friend who bore the not altogether uncommon name of Brown happened to be some fifty yards in advance of me. A Weasel chanced to run across the road between us, but, catching sight of Brown, it suddenly stopped and gazed upon him so intently, that it allowed me to slip up and stamp my foot upon it. "If I have not caught you asleep," I said, "I have at least surprised you in a *brown* study!"

But it is the Stoat, and not the Weasel, that is the subject of this paper. The chief apparent difference, at least in summer, between the Stoat and the Weasel, is that of size. The Stoat, I should say, is fully double the weight and bulk of the Weasel, though in length it only exceeds it by some four inches. In winter, however—at least in severe winters—a very striking difference takes place, as the Weasel retains its summer coat of reddish-brown, while that of the Stoat becomes pure white, the tip of the tail only excepted, which remains jet-black. No prettier little animal exists in Britain than the Stoat, when clothed in its wintry habit of snowy white, con-

trasting as it does with the bright black of its tail. It is the skin of this lowly creature that has for ages ornamented kings, and adorned alike grave judges and gay ladies. The name of Stoat, given to this variety of Weasel, is said to be merely a corruption of the word "stout," in reference to its robust make; while the designation of "ermine" is believed to have been given to it because Armenia is supposed to be the country where it is most abundant.

The question as to the cause of certain mammals and birds changing their varied summer colour to pure white in winter is a very interesting one, and in some respects I think a very obscure one. Of course, roughly speaking, it seems to be a provision of nature to assimilate the colour of the bird or animal to the snow-covered ground, of which, for some months, they are to be inhabitants. This, no doubt, must act as a protection to the creature itself, and also, as regards the carnivora, it must facilitate their securing their prey. But the question which must immediately arise is this, If Providence is so kind to the Stoat, why is it so unkind to its cousin-german the Weasel? No two creatures can be more alike. They are alike in race, in appearance, in habits, and, I may add, in habitats. Yet the Stoat is furnished with a snowy coat for winter, and the poor Weasel is left out in the cold. It has been matter of discussion among naturalists whether, in changing their colour to white in winter, animals change their hair, or whether the existing hair becomes white. This question, I think, was set at rest by Captain Ross, the famous North Sea navigator. He placed a Lemming which still retained its summer fur where it was exposed to a cold of 30° below zero, and the result was that it became partially white on the day following, and at the end of a week was entirely so. Stoats do not become white all over at the same time, but break out in white patches, and in passing from brown to white there is a transition state when they have a piebald appearance. It requires a considerable amount of cold to turn Stoats white, and this winter has been so mild that I do not believe there will be a single white Stoat in Scotland. In a severe winter I have shot a Stoat as white as the new-fallen snow I trod on, whilst on the 16th of January of a mild winter I have shot a Stoat which had not in any way changed its colour. I should like to try the experiment of subjecting a Weasel to a cold of minus 30°, as Captain Ross did the Lemming, to see if it too would turn white,—but woe to the man who did so! He would have all the anti-vivisection old ladies down upon him, who would place him in an atmosphere disagreeably warm. Though I have been familiar with Stoats all my life, it is during the last nine years that I have been in Islay that I have had the most frequent opportunities of observing their habits.

Stoats in Islay are only too abundant, yet there is not a *single Weasel* in the island, which is in itself a rather singular variation in

the distribution of the two animals. While islands enjoy the society of many species of birds, the quadrupeds are necessarily more or less restricted in number, and I think it must ever remain a curious question how the selection has been made,—why certain animals are present, whilst others are absent. We have in Islay no Foxes, no Badgers, no Hedgehogs or Moles, no Squirrels, no Wild-cats, no White Hares, and no representative of the Weasel tribe except the Stoat. On the other hand, we can boast of the Red-deer, the Fallow-deer, and the Roe-deer. We have the common Hare and the Rabbit. We have Otters, and Water-voles, and Mice, domestic and long-tailed and short-tailed, and there are Shrews. We have at least one variety of Bat, and that one of a large size, with huge ears; and we have, of course, multitudes of that constant attendant on man, the Brown Rat. Here, also, Frogs and Toads are multitudinous. Lizards are not uncommon, and Adders are very numerous. We have, too, all the domestic animals, though I cannot just now remember having noticed either a mule or an ass in Islay. I allude, of course, to the quadrupeds!

As I have already said, there is a very large number of Stoats, and I shall now mention a few anecdotes regarding them, as illustrating their habits and mode of life. I doubt if any creature on earth, insects excluded, is so fearless and ferocious as the Stoat. He seems indeed to look upon even his arch-enemy, man, with something like contemptuous indifference. I have often read accounts of small packs of Stoats (or, as the narrators generally called them, Weasels) voluntarily attacking men—rushing upon them and attempting to worry them; but I never personally met with any instance of this. Last summer, however, I had an instance of what a single infuriated Stoat may dare to do. I have said that there are no Wild-cats in Islay, but there are numbers of domestic Cats that have gone wild, and have even been bred in a wild state. These are exceedingly destructive of all kinds of game. Seeing one of those prowlers, I procured a couple of traps, and set them for him. Next day no Cat was caught, but a Stoat was. I took one of the traps, and striking the Stoat with it again and again, put, as I imagined, the little creature out of pain. It seemed perfectly dead, and I took it out of the trap and threw it a considerable distance away, where it lay motionless, while I leisurely reset the two traps. I had just finished, when suddenly the apparently dead Stoat had a resurrection. It got up, and for a second seemed stupefied, but the instant it caught sight of me, in place of running off, as any other animal in Britain at least would have done, it seemed inspired by fury, and "went for me" with what was for it a roar of rage. It seemed for the moment like a Lilliputian lion, as it rushed towards me. I had nothing to defend myself with, so I too gave as loud a roar as I possibly could; and as it sprang at me, I struck it with my fist. This stopped it. It turned and fled, and I

thought I was seeing the last of it, when the unfortunate wretch had the strange mishap to run right into the very trap in which it had originally been caught.

As showing the indifference of Stoats to the presence of man, I shall give an instance. I was, with a friend, shooting Rabbits, which were being bolted from their burrows in a steep bank by the aid of Ferrets. I had wounded a Rabbit, which got into a hole, and a labourer with pick and spade set to work to dig it out. Many shots were fired, people shouted, and dogs barked, when presently we heard the cry of a Rabbit in distress, not a yard from the spot where the man was driving his pick. Presently the Rabbit rolled out of the hole, and I shot it, when, to my surprise, I discovered the cause of its cry. It was firmly grasped by a Stoat, and the two creatures were killed by the same shot. Thus, in spite of guns, men, and dogs, and the noise of a pick within a yard of it, the reckless Stoat had set to work to destroy the wounded Rabbit, and allowed itself to be dragged out into daylight before us all. The following is a still stronger instance of this little creature's almost contemptuous indifference to man. One of my servants saw a Stoat kill a half-tame black Rabbit on the lawn, a few yards from the drawing-room windows. He rushed after the brute, in the hope of killing it. In the middle of the pursuit a Rabbit happened to cross the Stoat's line of flight. In an instant it turned aside, sprang on the Rabbit, killed it with one blow, and, leaving it dead, continued its flight, and ultimately effected its escape. Polecats, when they were abundant, attacked hen-houses, and slew the inmates wholesale, turning the place into a shambles; but it was during the night they committed their burglaries, whereas the Stoat will attack and kill poultry in broad daylight. Again and again I have heard the cry, in recent years, that a Stoat, or a couple of them, were about the poultry-yard. Running for a gun, I have found the little brutes had run into a loose wall, having perhaps been driven off a chicken they had just killed. Then their curiosity proved their ruin. Ever and anon they would peep out at you from their fancied security in the wall, and stare impudently at you with their sharp cunning eyes. Poor fellows! they do not understand breech-loaders and the swiftness of shot. This curiosity, which is a characteristic of the Stoat, often leads them into a trap. If a little house is built of half-a-dozen bricks, and an opening left in it, a Stoat, if he sees it, is almost sure to pop in, like Paul Pry, to see what is inside, and he finds there an iron trap. There is no better bait for a Stoat than the body of one of his dead brethren. I had hoped he went to visit his departed relative from motives of family affection, but I have been told by eyewitnesses that his love is for the flesh of the deceased—and thus to his other amiable qualities he adds that of cannibalism.

I read the other day, in the 'Field,' an anecdote of a Stoat. A

gentleman riding across a field, observed a great commotion among a large flock of Rooks. They had risen from the grass, and were hovering over one of their number which remained fluttering on the ground. The flock filled the air with angry cries. Just as the gentleman rode up, the Rook rose slowly from the ground with something attached to it which the gentleman could not make out; but when about thirty yards from the ground, a Stoat, losing its hold of the Crow, fell almost at the horse's feet, and immediately scampered off, quite unhurt by its fall.

I have never seen Stoats hunt in packs, but it is certain both Weasels and Stoats do so. A person once told me he had seen as many as fifteen running on scent, like a pack of hounds. My cousin, Mr Skirving of Croys, Kirkcudbrightshire, once saw seven or eight thus occupied. They were evidently on the trail of a Hare or a Rabbit, and were keeping well together, uttering a shrill little cry while they ran. He threw a stone at them, and killed one of the pack.

It has frequently been matter of discussion what the nature of the seeming paralysis may be which Hares and Rabbits often take when pursued by a Stoat. In the open a Hare could, with the utmost ease, run quite away from a Stoat or any of the Weasel tribe. Puss would not be in the slightest danger if she only would trust to her heels, but she seems to lose her head altogether. She hops about, rather than runs, in a stupid, helpless sort of manner, till she allows her tiny foe to leap on her back. A very pleasant book on country subjects has recently been published, called 'Nether Lochaber,' by the clergyman of that Highland parish. The frontispiece represents a Weasel on the back of a Hare, sucking it to death. On looking at the text, I see that, though a shepherd carried the Hare to his minister, he did not produce the Weasel; and I strongly suspect it was our stouter friend, the Stoat, which did the deed.

Having now given several instances of the boldness of the Stoat, I shall conclude with an anecdote which shows that courageous animal in a totally different light. It proves that a poor timid Rabbit, which is helpless when its own safety is alone concerned, may become a heroine when the lives of its little ones are in question. One day last summer we were driving along a road with the sea on one side and a rabbit-warren on the other. On the road in front of us we saw some creature conducting itself in a most extraordinary manner. It was rushing backwards and forwards in a strange eccentric sort of way. Soon we saw that it was a Rabbit, and, from its fur, evidently a mother, engaged in mortal combat with a Stoat. But we were vastly surprised when we saw that the Stoat was the pursued, and not the pursuer. The Stoat fled, the Rabbit madly chased. Its mode of fight was to butt at the Stoat like a sheep. Sometimes it hit it, and then the Stoat was sent flying. Oftener the lithe Stoat eluded the

blow. It became clear that the Rabbit must eventually kill the Stoat if the latter did not find some haven of refuge, which it fortunately did in a thick clump of briers. Then the victorious Rabbit went back to its young. Oddly enough, I was much amused during the same month (last July) by an encounter conducted on the same principles, by a brooding Grouse and a large Irish Setter. I was taking a stroll, the dog being with me, when suddenly a Grouse (the mother Grouse of course) started up in the heather, and, with wonderful fury, and every feather of her body on end, rushed at the dog. The big Setter stood for a moment pointing, and then, all training, all discipline at an end, he gave me one look, and, with his tail between his legs, turned and fled. I think it did honour to both sexes. It was glorious in the female Grouse to attack a huge animal in defence of her nursery; and it was manly and proper on such an occasion that the big masculine dog should run away. Truly does Lord Byron say—

> "There's nothing whets the beak, and arms the claw,
> Like an invasion of our ducks and ducklings."

V.—CONCERNING LYCOPODS AND SELAGINELLAS: PAST AND PRESENT.

By Mr JOHN LINDSAY.

(*Read Jan.* 24, 1884.)

In the class of plants known as Vascular Cryptogams there are two divisions with which all are less or more familiar: these comprise the Equisetaceæ and the Filices—Horse-tails and Ferns. There is a third division, however (now termed by Sachs "Dichotomeæ," from the bifurcating nature of the roots and branches of the plants comprising it), which may not be so generally well known, and it is here proposed to make a few remarks on two of the genera found in this class, and which are the most highly developed and most prominent members of it—viz., Lycopods and Selaginellas. It is true that these are but sparsely represented by native species, for in the British flora we find only five Lycopods and one Selaginella; yet the exotic forms of each are numerous, and often beautiful. Many species and varieties of Selaginellæ are to be found luxuriating in greenhouses; but the exotic Lycopods are so difficult to cultivate that they are, with rare exceptions, only known to us by herbarium specimens. Our indigenous Club-mosses, likewise, though found flourishing in their native habitats, on heath, moor, or bog, do not take kindly to their new quarters when

introduced to a more civilised state of existence. Yet these shy and intractable plants can boast of a very ancient ancestry, for their representatives flourished in the "forest primeval" long ages before man was ushered on the scene, and when it could truly be said of the vegetable kingdom that "there were giants in the earth in those days." Of this the Lycopods furnish an illustration; for the lowly plant now found trailing along the ground, a mere slender stalk, to the length of a few feet, was then an upright stately tree, reaching occasionally to a height of 100 feet, and measuring twelve feet in circumference at the base of the stem. We have thus an example before us, not of "development," but of its counterpart, "degradation." Our subject, therefore, naturally divides itself into "past" and "present": we shall take the latter division first, and say a little concerning Lycopods and Selaginellas as these are found now subsisting on the earth.

Beginning with the Lycopods,—as already remarked, there are but five native species, and some of these, as Lycopodium annotinum, and in particular L. inundatum, are rather difficult to find. The others, however — L. alpinum, L. clavatum, and L. Selago — are more abundant. It is unnecessary to give here a minute description of the distinctive features of each, seeing these may be easily learnt from any standard "Flora," as that of Hooker or Babington. A few remarks, however, may be made on the mode of growth, structure, and distribution of the Lycopodiaceæ.

All our British Lycopods except L. Selago have creeping stems, and bear their spore-cases singly, in curious terminal spikes of modified leaves. In L. Selago the stem is erect, and the sporangia are borne in the axils of the leaves, and often distributed impartially over the whole stem, though sometimes confined to the upper part of it. In this species bulbils, or small buds, are also found at the upper part of the stem. The sporangia of Lycopods fulfil a precisely similar function to those of Ferns and Equiseta, for example, in the same class, in giving rise to a prothallium which bears both antheridia and archegonia—this forming the first or sexual generation of the plant. But while the spores of Ferns germinate readily, and the prothallium is borne on the surface of the ground, and has therefore been often investigated, the spores of Lycopods are most difficult to germinate, and the prothallium is underground. It has thus scarcely ever been seen by any one, in spite of the many attempts made to grow it. In 1857 Professor De Bary partly succeeded with the prothallium of L. inundatum; and in 1872 Fankhauser found in Switzerland, growing amongst moss, perfect prothallia of L. annotinum. Further than the observations then made, little or nothing is yet known of the development of the embryo.

The second or asexual generation of the Lycopod is the perfect plant, with root, stem, and branches, developed from the monœcious

prothallium, bearing both antheridia and archegonia. Though the spores which give rise to this prothallium are alike in size and shape, it does not necessarily follow that they are hermaphrodite. In other words, it is quite possible that there may be some occult difference betwixt them, and that certain spores always produce antheridia or male organs, and others archegonia or female organs, as in the Selaginellas and Rhizocarps with differing spores. This is one of the points in the germination of Lycopods on which we have as yet no certain knowledge.

The normal stem of the Lycopodiaceæ is thickly covered with small narrow leaves, these being simple, unbranched, and sessile, and possessing only a midrib without lateral veins. The structure of the stem is very characteristic. It is composed of an axial cylinder, surrounded by layers of cellular tissue, the whole being enclosed in looser tissue or parenchyma. From the cellular tissue the long adventitious roots found in most species proceed. We will again have occasion to refer to this stem-structure when speaking of the fossil Lepidodendra.

Lycopods are natives of many parts of the world. Besides our native species already enumerated, numerous forms, many of them very beautiful and some rather curious, are found on the Continent, in the United States, in Canada, the East Indies, Peru, the Fiji Islands, &c. As already said, it has proved to be almost an impossibility to grow the exotic forms successfully in greenhouses, and we have to rest content with dried specimens of these for a knowledge of their form and appearance.[1]

Passing on to the Selaginellas, we are first called upon to notice our solitary native species, Selaginella selaginoides. This is the Lycopodium selaginoides of Linnæus, but is generically separated from the Lycopods by the possession of *two* kinds of spores, large and small—or, as they are usually termed, macrospores and microspores. The plant possesses close affinities, nevertheless, with the Lycopods, as evidenced by the name "Selaginella," which is the diminutive form of "Selago," the old term for Lycopodium, and said to be derived from the Gaelic, meaning "beneficial to the eyesight." The Club-mosses, indeed, were at one time frequently used medicinally, but are now banished almost entirely from the British pharmacopœia, though still in favour on the Continent. It occurs to one, on a little reflection, that Selaginella selaginoides is not a very appropriate name for this plant, now that it has been removed from the class of Lycopods, and that the synonym S. spinosa of Babington and others would be much more descriptive of it. But as it is always as well not to disturb a familiar name without very good cause shown, it may be wiser to

[1] The exotic Lycopods exhibited were from the Herbarium at the Royal Botanic Garden, having been kindly lent by Dr Macfarlane.

retain the better known nomenclature, and continue to term it Selaginella selaginoides. It is pretty widely distributed in Britain, from Wales northwards, and may be found on the Pentland and Lomond hills, as well as on most of our Highland hills, growing in boggy ground.

As noted above, we have numerous exotic Selaginellas growing in greenhouses, a few of these being perfectly hardy, so that this is a class of plants which can always be examined in the living state. Some forms, as S. Poulterii, S. helvetica, and S. Kraussiana with its varieties *aurea* and *argentea*, grow very luxuriantly, and form a lovely carpeting for Ferns, under a bell-glass or in a Wardian case. The stem of the Selaginellæ is almost always flat and slender, branching abundantly. Its structural form is somewhat akin to that of Ferns, in so far as that there is no axial cylinder, and the vascular tissue is arranged in separate bundles, the form varying in the different species. The leaves are small, often of two sizes, and, like the Lycopods, have only one fibro-vascular bundle penetrating them—viz., the midrib. At the apex the leaves are altered to form a spike, which carries the fructification—the two kinds of spores already mentioned. The macrospores, or female spores, are generally four in number, but sometimes two or eight are found; while the microspores, or male spores, are numerous. The former are borne at the *base* of the fertile spike, while the latter are found on the *upper* part. Both kinds of spores develop a small rudimentary prothallus within the spore-case, before the spores are shed. It is extremely interesting to trace the connection between flowerless and flowering plants as represented by the Selaginellæ. Indeed they seem to form, in a marked degree, the connecting link between these two great classes of plants, joining on the higher Cryptogams in the one class to the lower Gymnosperms in the other. This is the more evident when we consider that the antheridia and archegonia respectively of the one have their analogue in the pollen-grains and the embryo-sac and ovule of the other. It is true that the Rhizocarps, including the aquatic or sub-aquatic Salvinia and Marsilia, with Isoëtes and our native Pillwort, also possess two kinds of spores; but these Vascular Cryptogams are all less highly developed in their structure than the Selaginellæ. Again, attached to the embryo of flowering-plants there is always present what is termed a *suspensor*, from which the first root proceeds. Among Cryptogams, Selaginellas alone are furnished with this body. A good illustration is thus supplied of the dictum of Linnæus, "Natura non saltus facit"; for here we find the members of the less highly developed class of plants which are at the top of the scale in that class beginning to anticipate, as it were, the reproductive structure and mode of growth of the lowlier members of the other and higher class.

Unlike the embryo of Lycopodium, that of Selaginella has been

thoroughly investigated, since 1869, by those patient workers, the German botanists, and the results of their observations can readily be learnt by any who have a liking for that particular kind of study. When we know more regarding the growth of the embryonic Lycopodium, we shall be better able to compare the two in this respect. One point, however, is clearly evident from the remarks already made—viz., that with something of similarity, there is yet enough of diversity between the two genera to warrant their separation. Yet we find growers and others frequently confounding the two, and indeed speaking and writing of both sections as "Lycopodiums." In some botanical works, also, where we should have expected greater accuracy, the same indefiniteness of statement may still be noted.

In examining the thirty different forms of greenhouse Selaginellæ exhibited, it will at once be admitted that many of them are very beautiful, rivalling Ferns in their graceful form and habit. Among these, there is at least one species which calls for special remark. This is S. lepidophylla, so called from the curious scale-like markings on the stem and leaves. It is a native of South America, and is a rather rare plant in cultivation. From the hygroscopic properties it possesses, it has been popularly named the "resurrection plant." All that is needed to revive it is immersion in water, when the ball-like mass it assumes in the dried state soon begins to swell out, and the leaf-shoots to unroll. The specimen shown is believed to be about fifty years old, and still retains its reanimating powers, as may be proved by ocular demonstration.

Like the Lycopods, Selaginellas are found in many parts of the globe, especially the warmer countries, as Mexico, Jamaica, the East Indies, South America including Brazil, and Japan.

Turning now to the second part of our subject—the ancient representatives of the Lycopodiaceæ—a panorama of vast forests in the world's youth, crowded with giant forms, is called up before the mental vision. In these forests there grew not only Lycopodiaceous plants, but also, and chiefly, Ferns, both herbaceous and arborescent, with Equisetaceæ, Coniferæ, &c. If mere bulk is considered, the flora which reached its greatest perfection in the Carboniferous era, existing for a period of time to which we can only apply the word "æons," was certainly the grandest that ever flourished on our continent. And what shall we say of the flora of North America, concerning which it has been estimated that the older coal-deposits of the New World are "twenty times as great as all those of all Europe put together"! [1] But we are at present interested only in the Lycopodiaceæ, represented at that period by the well-known Lepidodendron or "scale-tree," by Lepidophloios or "scale-bark," and by other allied genera. Of Lepi-

[1] Hugh Miller's 'Testimony of the Rocks,' Lect. III.,—"The Two Records, Mosaic and Geological."

dodendra alone, more than forty species have been constituted, distinguished by the beautiful markings on the stem; but as these markings are found to vary on the same stem, the number is probably overestimated. The genus Lepidodendron has been described as comprising "numerous large arborescent plants, which attain their maximum in the Carboniferous period, but which appear to commence in the Upper Silurian, and are well represented in the Devonian. . . . The bark is marked with numerous rhombic or oval scars, arranged in quincunx order, and indicating the points where leaves were formerly attached. The branches were covered with slender, pointed leaves, closely crowded together; and the fructification was carried at the ends of the branches in the form of cones or spikes. These cones have generally been described under the name of *Lepidostrobi;* and they consist of a central axis, surrounded by imbricated scales or bracts, each of which supports a sporangium or spore-case." [1] In addition to this graphic description, it may be mentioned that these Lepidostrobi or fruiting-organs are generally empty in the fossil state, the spores having been shed. But we know for certain that many, if not all, of them possessed both macrospores and microspores—the microspores being produced in the *upper* sporangia of the spikes, the macrospores in the *lower,* or in the same relative position as in Selaginellæ. That the spores must have been present in vast numbers is evident from the remnants which have been left us, and which yet form such a mass that seams of coal several feet in thickness are almost wholly composed of them. It is owing to their presence that shales and several English coals owe their high degree of inflammability. Their existence in coal was noticed fifty years ago, but their nature was then unknown. The spores of some of our native Lycopods, as L. clavatum and L. Selago, are also very inflammable. The yellow powder which issues from their spore-cases is known in Britain as Lycopode or Vegetable-brimstone, and in Germany as Lightning-meal and Witch-meal. It was largely used in theatres for producing artificial lightning, but modern science is providing electricity for this purpose.

Another feature of the fossil Lepidodendra claiming attention is the structure of the stem. We have already seen that the stem of Lycopodium is composed of a central cylinder of fibro-vascular bundles, surrounded by a zone of cellular tissue, which becomes looser as it proceeds outwards to the epidermis. The Lepidodendron stem, in the young stage, was almost identical in its structure. Indeed, if we leave out of account, for a moment, the difference in size, the affinities between the living and extinct forms are seen to be very close. But as the extinct genus, while growing in the forest, became more mature, and the tree required greater strength and stability, a curious modification of the structure took place. An *outer* cylinder of vascular tissue was formed, the vessels being arranged in radiating wedges,

[1] Nicholson's 'Manual of Palæontology,' vol. ii. p. 457.

separated by medullary rays, growing by additions to their exterior margins. In fact, if this description is a correct one, we have here a Cryptogam exhibiting a true exogenous structure. On this point, however, a tough battle has been waged. Prof. Williamson and others hold to this growth being really of an exogenous nature; while the opposing party, headed by Mr Carruthers, maintain that there is no true exogenous growth, and that the so-called wedges are but the result of the fibro-vascular bundles proceeding from the central axis to the branches and leaves. The final decision, therefore, may be said to be still in abeyance.[1]

When we consider the fragmentary nature of the material with which the palæobotanist has in most cases to deal, it is not surprising that the results are often unsatisfactory. Thus, the stem, leaves, and fruit of one and the same plant have been each assigned to different genera. The Calamites were originally figured upside-down, with the roots in the air and doing duty for branches. Stigmaria was for some time a generic designation, but now it has been satisfactorily proved that what were so termed are but the rootlets of Sigillaria and Lepidodendra. The affinities of the fossil Sigillaria have not yet been decided. Principal Dawson of Montreal considers them to be allied to the Cycads, while Mr Carruthers holds them, with some show of reason, to be Cryptogamic and Lycopodiaceous. What were really the varied forms of the ancient "Club-mosses," or how great their number, it is impossible to fix with any degree of certainty. Indeed it is remarkable how much original work yet remains to be done in this special domain of science, although so many patient and enthusiastic investigators have already occupied the field. Every discovery helps on the cause of truth, and adds to our stores of information; and Nature has many secrets yet locked up in her breast, ready to be yielded up to the true knight-errant. In this quest some of our members have already been ardently engaged, and we may hope to hear the results of their labours at a future time. Meanwhile, if I have only been successful in the much humbler task of drawing attention to this subject, and of showing that our lowly Club-mosses have a most interesting life-history, stretching far back into the past ages, then these remarks have not missed their purpose.

[Besides plant-specimens and specimens of fossil Lepidodendra and Strobili, the following preparations were shown under the microscope in illustration of the above—viz., (1) trans. sect. of Lycopodium stem; (2) trans. sect. of Selaginella stem; (3) longit. sect. of do.; (4) Sporangia of Lycopodium; (5) Sporangia of Selaginella; (6) trans. sect. of (fossil) Lepidodendron stem.]

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[1] In connection with this controverted subject, see 'Trans. Bot. Soc.,' vol. viii., "On the Structure and Affinities of Lepidodendron and Calamites," by Mr Wm. Carruthers; and Prof. Williamson on Fossil Lepidodendron, in Sachs' 'Text-Book of Botany,' 2d ed., pp. 484, 485.

VI.—THE SYLVIIDÆ OR WARBLERS.

By Mr ARCH. CRAIG, Jun.

(*Read Jan.* 24, 1884.)

Perhaps no birds attract the attention of the generality of people in a lesser degree than do the Sylviidæ, or Warblers; and in contradistinction to that assertion, few or none possess a greater interest in the eyes of the naturalist. The first statement may be accounted for readily enough in any of the following ways, such as the diminutiveness of the species—their shy, retiring habits, which render observation at times difficult—their total want of gay plumage, and, in addition, the peculiar character of their haunts,—all combined having a tendency to make the average observer pass them by in many instances unheeded. If they partake of all these apparent disadvantages, the question may naturally be asked, What is there which makes them so prepossessing to the ornithologist? Having put the query, the duty devolves upon me to attempt an answer, which shall be done as briefly as possible. The fact of their migration from the more genial climes of Southern Europe and Northern Africa to our colder and comparatively sunless country, is of itself matter of sufficient moment to recommend them to all lovers of bird-life. When we take into consideration the great distance to be covered, and the dangers that have to be encountered *en route*, it is indeed wonderful how such little creatures manage to perform the journey in safety: and besides, the regularity with which they, generally speaking, reappear in their old resorts at, or very near, the same period every spring, calls for special remark. The migration of birds is undoubtedly a theme of surpassing interest, but it is too large and difficult to be attempted by one possessing such slight knowledge of the subject as myself. Although, as has been already mentioned, their plumage is of a sober cast, this defect, if it be a defect, is more than compensated for by the beauty and peculiarity of their song, which, delightful in itself, is enhanced by the extraordinary powers of imitation with which many of the species are endowed. Were size of body to be taken as the groundwork on which to gauge the vocal powers, very faint music might be expected to issue from the throats of Warblers: but bulk has evidently nothing to do with the matter, as it is no uncommon feature for several of the species to emit sound that does not seemingly fall far short in point of volume to that produced by much larger birds. To prevent misapprehension on this point, however, there is one thing to be said, that although, to the ears of a person in close proximity to the songster, the sound appears to rival that of the larger species, yet it does not in reality penetrate

to anything like the same distance, which fact may in part be explained by its not possessing the same force, as well as from the sound being deadened by the thick foliage or brushwood amidst which the bird usually takes up its position. It is to this power of mimicry that we are indebted for much of the pleasure derived from the songs of several species; for in the case of the Sedge-Warbler, Whitethroat, &c., the natural melody is somewhat disappointingly broken up by a guttural kind of twittering, curious enough in itself, but certainly not tuneful. Whatever may be the difference of ideas as to the quality of the music, there can be but one opinion as to the quantity, the little singers being no niggards in that respect, as for some considerable portion of their residence here they warble more or less continuously during the day, and some among them prolong the strain far into the night as well. Being to a large extent insectivorous, the benefit they confer on our country during their sojourn is an important item, and far exceeds the trifling damage committed upon fruit or other garden produce, of which they are sometimes accused. As an illustration, in passing, of the narrow-mindedness that prevails in some quarters,—a gardener, of average intelligence on ordinary subjects, gravely informed me lately that it would be much better in every way for the success of his labours if *all* birds were destroyed, no distinction being made on his part between insectivorous and granivorous species. It is almost superfluous to remark, that with a man who held such sweeping opinions, argument was out of the question. In a merely æsthetic point of view, the Warblers must always be welcome visitants, as, arriving in large numbers, they help greatly to enliven with their presence those woods and hedgerows which, during the long and dreary winter months, have borne such a cold and deserted looking aspect.

With this short introduction, we may now turn to examine more particularly the birds themselves. Properly speaking, the family known as Sylviidæ contains other birds, such as the Robin, Redstart, Chats, &c., but in this instance the term is only meant to comprehend those which are generally recognised by the title "Warblers." Of these Yarrell gives the names of twenty which have visited England; some of these, however, come under the category of chance stragglers only: but in our less favoured country of Scotland we can barely lay claim to half that number. These are as follows:—

Blackcap, *Sylvia atricapilla.*
Garden-Warbler, *Sylvia salicaria.*
Whitethroat, *Sylvia rufa.*
Lesser Whitethroat, *Sylvia curruca.*
Sedge-Warbler, *Acrocephalus schœnobænus.*
Wood-Warbler, *Phylloscopus sibilatrix.*
Willow-Warbler, *Phylloscopus trochilus.*
Chiff-Chaff, *Phylloscopus collybita.*
Grasshopper-Warbler, *Acrocephalus nævius.*
Reed-Warbler, *Acrocephalus streperus.*

The last three are the least common—the two latter, indeed, being *rarœ aves.*

Notwithstanding many false rumours to the contrary, that prince of songsters, the Nightingale, does *not* visit Scotland; but, as compensation for the loss, we have the Blackcap, whose melody is said, by those whose good fortune it is to have heard both birds, to be little inferior in sweetness and flexibility. The latter cannot be reckoned a common species anywhere in Scotland, although its range is extensive, having been found nesting in Glen Urquhart, Inverness-shire; and, according to ornithological works, specimens have been procured as far north as Caithness and Orkney. The examples shown here were shot at Kirkhill, on the banks of the South Esk, near Arniston,—where, indeed, most of the others were obtained as well. Both sides of the river at that point are lined with rows of very large trees, and close to the water's edge grow an abundance of small scrubby bushes and other tangled vegetation, which render the locality a favourite breeding-ground of Warblers—so much so, that within a radius of half a mile six of the species already named are to be seen in the proper season. The season, without being too exact as to a week or so, may be said to commence about the middle of April and end with the last days of September—although the various species do not necessarily arrive together, some being much later in putting in an appearance than others; and a certain allowance must of course be made for favourable and unfavourable weather, which may either hasten or retard their arrival. The male, as the name implies, has a black cap on his head, which, quoting the authority of Dr Bechstein, has given rise to the *sobriquet* of "Monk," applied to it in Germany, from a fancied resemblance to the cowl of a member of that fraternity—this distinctive mark precluding the possibility of its being mistaken for the female, which, in lieu of the black hood, has one of reddish brown. As must be evident to any one who has tried the experiment, it is next to impossible to convey an adequate idea in writing of the song of any particular bird, and it is only by actual listening that a true knowledge can be acquired. Again, from the habits of imitation previously touched on, it is sometimes a matter of no small difficulty, particularly when the bird is not visible, to discriminate between one species of Warbler and another, even although we may have come to the decision that the singer is assuredly only a mocking-bird after all. There is a clear rich tone, however, about the lay of the Blackcap, that stamps it at once as of superior merit to that of its fellows, being more sustained throughout, and not so subject to the constant breaks and harsh interjections that mar the song of the Sedge-Warbler. The nest, which is a pretty structure, made of toughish grass and other fibrous material, is usually placed in a thick bush or garden-hedge, a few feet above the ground. If unobserved, the bird sits very close; but when discovered

it immediately shows its anxiety and resentment by restlessly skulking amidst the undergrowth close at hand, endeavouring at the same time to conceal its movements from the intruder. If the eggs are interfered with, the bird is very apt to desert the nest altogether.

Next in order comes the Garden-Warbler, which partakes of the same shy nature as the last—if anything, being more anxious to secrete itself and keep out of view. When the foliage becomes dense, towards the end of May, it is a pretty severe trial on the eyesight, not to mention the patience, to discover the bird, even when from its singing we know that it must be in the immediate neighbourhood, as it shifts about so assiduously among the branches as frequently to baffle all our attempts. At one moment you feel certain that you have brought the sound to a focus (if it is permissible to make use of the word in such a sense), and expect every moment to catch sight of the songster, when a few seconds afterwards it appears to emanate from a different quarter altogether,—and so on, until the listener is sometimes fain from very weariness to give up the task as hopeless. Its note at times is uncommonly like that of the Blackbird, and apt to deceive even one who may consider himself an adept in diagnosing the songs of different species. A certain safeguard against falling into that error, however, is to listen attentively at the moment the loud note dies away, and the characteristic low chattering of the Warbler will in most cases then become audible—a sure index to the singer's identity. It is not easy of decision whether the Blackcap or the Garden-Warbler is the commoner in Scotland, so much depending apparently upon locality; but, judging from my own imperfect experience, I should be inclined to give the precedence to the latter, the more especially as the Garden-Warbler being of a sombre and less distinctive plumage, its occurrence is more likely to be overlooked than that of the Blackcap, whose sable top-knot would readily attract attention and be the subject of remark. Stobo, Peeblesshire, may be recorded as a locality where it breeds.

Turning now to the Whitethroat, we arrive at a species of perhaps more frequent occurrence than any, save the Willow-Wren; at least appearances go far to prove so, from its habit of resorting to the outskirts of woods, and also in a great measure to hedges that border the public pathways, thus giving passers-by better opportunities of observation than do the other members of the family. Beds of Nettles and parts of woods where there is a mass of matted vegetation in the shape of Brambles, Thorns, &c., are also favourite habitats, and it has a fashion of dodging about among these latter that calls to mind a similar trait in the character of the Hedge-Sparrow. The common name is derived from the purity of the white feathers on the throat, which, along with the bluish-grey head and reddish-brown margins of the wing-feathers, are sufficiently marked objects to prevent confusion with other species. The breast during life is tinged with a

beautiful rose-coloured hue, but it is noticeable that after death this fades to a great extent, therefore in stuffed specimens the proper plumage is not retained. The male throws a vast deal of energy and pith into his singing, whether in self-gratification, or with a desire to appear fascinating in the eyes of his female partner, is a problem scarcely worth our while attempting to solve—a combination of both these influences, along with a spirit of rivalry, being perhaps the real incentive to such vivacious action. There is one peculiarity about the Whitethroat that, so far as I am aware, does not pertain to any of the other Warblers, which is, that very often, while flirting about the bushes, he ascends abruptly, with a strange circular movement, for a few yards into the air, as if actuated by some sudden impulse, and while performing this evolution sings lustily until the descent is made. Likewise, in watching the bird steadily, it may be seen hopping from twig to twig, or ferreting its way among the intricacies of the hedge and undergrowth, shaking its tail and wings, erecting the feathers on the crown of the head, and all the while rattling away with an evident sense of enjoyment. The song, of which there is full measure "heaped up and overflowing," is more curious than beautiful, there being an absence of the mellow clear ring that is the predominant feature of the last two species. With reference to the sexes in Warblers, the females in most, save the Blackcap already noted, resemble the males, but upon close inspection can be distinguished from the last named by the plumage, on the aggregate, being duller and less distinct.

From various sources we find that the Lesser Whitethroat occurs in several districts of Scotland, but having no personal knowledge of it or its habits, I shall not presume to give a description, as such would simply be extracted from a work on ornithology. The Sedge-Warbler is a tolerably common bird all over Scotland, and is generally found in moist reedy places, or by the sides of ponds and rivers, although it may often be observed as well in thick hedges, and among long grass at a considerable distance from water. Nevertheless, as a rule, its proper habitat is close to watery ground. The plumage is sufficiently diverse from the other Warblers to prevent mistakes being made; but as it sedulously conceals itself as much as possible from view, the song is undoubtedly the surest method of identification. The latter, once heard, is easily retained in the memory, being formed of a medley of guttural and very clear liquid notes, the latter thrown in promiscuously, as it were. It displays a deal of vigour in its singing, and would seem to have a more than ordinary aptitude for imitating the notes of other species. When most birds have retired to roost, and all sound is hushed, it is somewhat startling in a lonely spot to hear this little creature burst unexpectedly into full song, with as much gusto as if the sun still shone high in the heavens, night seeming to it on those occasions as congenial as day. This

habit has given birth to numerous premature reports among folks whose knowledge of bird-life is not always to be accepted as accurate; consequently the upshot is that many an individual, on hearing the unwonted strains for the first time, immediately jumps to the conclusion that he has been listening to a veritable Nightingale, and, elated with what he considers to be a wonderful discovery, forthwith seeks to enlighten an unsophisticated public, and immortalise himself at the same time, by chronicling the fact in the columns of some local newspaper. As must be in the recollection of many, we had several examples of such letter-writing a few years ago in the columns of the 'Scotsman.' Just one word more about the Sedge-Warbler before passing on to the next. The assertion that a stone thrown into the thicket where the bird is lurking causes it to renew the song, is sometimes scouted at as nonsense, but notwithstanding, I believe it to be quite correct, having frequently tried the experiment with successful results. Of course, to maintain that such a procedure will always produce the desired effect would be absurd; but, in the majority of cases, the plan will be found to work well.

The other aquatic species known as the Reed-Warbler is very rare, so in its case the same course must be adopted as was done with the Lesser Whitethroat—merely mention its occasional appearance, and turn to the more familiar Wood-Wren. This and the Willow-Wren are sometimes confounded, but a glance at the two species suffices to disconnect them, the Wood-Warbler being greener in colour, longer in body and wings, and moreover, it has a much yellower streak over the eyes. The Wood-Wren also affects the neighbourhood of tall old timber in a greater degree than the other; and the songs, besides, are quite divergent. In some parts of Mid-Lothian, particularly the valley of the South Esk, the Wood-Wren is abundant, but taking it all in all, is not nearly so numerous as the Willow-Warbler. I have sometimes fancied, while listening to the Wood-Warbler, that several of the notes bear a family likeness to those of the Common Wren (*Troglodytes parvulus*), both possessing in common a curious succession of sounds, the effect of which cannot perhaps be more happily expressed than by applying to it the old Scotch word "birling." It is observable that some Wood-Wrens are much brighter in the green and yellow tints than others, the age of the birds probably regulating this difference—it being natural to suppose that as a bird becomes older and more mature, the intensity of its colouring will increase likewise. The Willow-Warbler is by far the best known in this country, and seems, both from its numbers and lively motions, to be more associated in our minds with the recurrence of spring than any other species. They must indeed be dull and unsympathetic by nature who do not welcome this little visitor, and rejoice to hear once again his simple modest song, which, though it lacks the fine resonance of its more accomplished compatriots, somehow appeals to the heart with greater

success, this result being probably aided by the performer's confiding disposition, which demeanour other Warblers do not show to anything like the same extent. It is not by any means a shy bird, but will admit of a near approach, in which respect it differs very markedly from others of the Sylviidæ. In favourable districts during May the woods actually swarm with them; and if this is the case before nidification, it is trebly so after the labours of incubation are over, when the parents, accompanied by their offspring, hunt the woods for food. At that season, if one only remains quiet in the vicinity of their haunts, he will often be surrounded by whole families so intent upon searching the branches for insects, as, heedless of his presence, to venture within reaching distance, all the while chirping to each other in a low melancholy tone that carries with it a singularly soothing effect. Both the Wood and Willow Wrens build their nests on the ground, in form like a dome, with the entrance-hole at the side, a sloping bank being a favourite situation, where the long herbage drooping over forms an excellent screen from the prying eyes of idle boys, whose bird-nesting proclivities are too notorious to need comment.

The Chiff-chaff is almost identical in plumage with the Willow-Wren, but the legs and feet of the former are much darker in colour, which test may be safely applied to dead specimens should any doubt arise in one's mind. As yet I have not been fortunate enough to identify the bird in Mid-Lothian, and have arrived at the conclusion, prematurely perhaps, that it must be very local in its distribution. Our President, Mr Herbert, informs me that he has heard it at Polton, on the North Esk, among the tall Fir-trees there, and more recently on the Water of Leith near Colinton; but frequent searches on my own part, in the woods contiguous to the South Esk, have not as yet been productive of good results. As a sequel to this remark, the suggestion just occurs to my mind, that if those members of our Club who are ornithologically inclined would take notes of all the birds, with locality and date, observed at the outdoor meetings, or on the occasion of any other country excursion they may take independently of the Club, a great deal of interesting material might by that means be gathered, and I feel confident many birds, of whose existence in Mid-Lothian we are unaware, could be added to the list of local fauna.

The only other bird now to be mentioned is the Grasshopper-Warbler, whose visits to Scotland, like those of angels, are "few and far between"; but within the last few years several instances of its occurrence have been recorded from time to time. As might be inferred, its name is derived from the song, which is said to resemble in a measure the chirping of a Grasshopper.

In conclusion, let us hope that, with the growing taste for Natural History which is undoubtedly extending more widely every year among all classes, our Field Club will not be behind-hand, but show

an increased interest in the study of Ornithology, amidst whose numerous families there are few more deserving of notice, or more calculated to repay any little trouble expended upon them, than the Sylviidæ, or Warblers.

At this meeting Mr D. Percy Aitken read a short note on the use of carbonised paper in taking leaf-impressions, called forth by Mr Turnbull's communication to the December meeting on the same subject. Mr Aitken also exhibited a small roller-machine which had been used in taking similar impressions.

VII.—ON THE STRUCTURE AND POLLINATION OF THE FLOWER OF CALATHEA ZEBRINA.

By J. M. MACFARLANE, D.Sc.

(*Feb.* 28, 1884.)

Dr J. M. Macfarlane gave a short account of the structure and mode of pollination of the flower of Calathea zebrina, Meyer, as observed from specimens in the Royal Botanic Garden, and which agreed with the previous accounts given by Hildebrand and Nicholson. He showed that in addition to the petals, certain of the stamens assumed a petaloid character, one in particular being rounded and pouch-like at its free extremity. Against the pouch-like extremity the end of the style strongly pressed—the under surface of the latter, near the anterior end, having a saddle-shaped depression, which received the pollen from the single anther-lobe before flowering; while the stigma constituted the tip of the style. On an insect visiting the flower, he showed that the style, when delicately touched, coiled up with great force, causing first the stigma and next the pollen to be driven against the insect's body, so that the stigma first received pollen brought by the insect from another flower, and new pollen was next deposited on its body. After coiling up, the style rapidly lost its purple-white colour, and assumed a rich brown hue, so that flowers already visited by insects were at once recognised by those succeeding.

VIII.—NOTE ON THE MOUNTING OF MICROSCOPIC OBJECTS IN MONOBROMIDE OF NAPHTHALINE.

By W. IVISON MACADAM, F.C.S., F.I.C.

(*Read Feb.* 28, 1884.)

I have thought it might be of interest to the members of the Club if I gave a few notes on the method of mounting objects for the microscope in the new medium, Monobromide of Naphthaline. The index of refraction of this medium is so different from that of the ordinary Balsam, that the striation of Diatoms is brought out with a clearness never before obtained. Weissflog of Dresden, who has employed the medium for over three years, says that in mounting Diatoms he uses only a thick solution of shell-lac, and never wax or gold-size. After making the ring with the shell-lac, a drop of the medium is placed with the Diatoms on the cover, and put in position on the ring. After removing extra liquid with blotting-paper, the edges are coated with thick gum-arabic, and allowed to dry. When quite dry, it should then receive one or two coatings of sealing-wax dissolved in alcohol, and lastly a coat of pure shell-lac. Common glue will be found good for the cell, and the last coat may be one of water-glass.

The substance is by no means an easy one to work with, and failures may be expected during the early trials. However, the result, as may be observed from the slides shown, is well worth the trouble and pains necessary. When successfully conducted, the slides remain perfect for a long period, the great point being the careful coating of the edges with the gum-arabic. The Rev. George Davidson of Logie-Coldstone has had slides for over five years, and they are as perfect now as when first obtained. The slides shown, both in balsam and in the new medium, are mounted by that gentleman.

IX.—THE STRUCTURE AND HABITS OF CARNIVOROUS PLANTS.

By Mr A. D. RICHARDSON.

(*Read Feb.* 28, 1884.)

To sustain plants in a healthy condition, a supply of nitrogen is essential. Although that element forms nearly four-fifths of the air we breathe, plants have no power of taking it in from the atmosphere

in a free or uncombined state. The source from which they derive their supply is the nitrates and salts of ammonia contained in the soil in which they grow, and the medium through which it is conveyed into the substance of the plant is the root. In some plants, however (the so-called Insectivorous or Carnivorous plants), the roots are so feebly developed that they are quite inadequate to fulfil all the functions which they perform in ordinary cases; and in these plants all or part of the leaves are modified for the purpose of capturing insects and other small animals, from the absorption of which they are able to supplement their otherwise defective nitrogenous supply.

Carnivorous plants are of two kinds,—viz., 1st, those in which there is a true digestive process; and, 2d, those in which there is merely decomposition and absorption of the liquid products. To the first group belong Drosera, Dionæa, Pinguicula, Nepenthes, and Cephalotus; and to the second, Sarracenia, Darlingtonia, and Utricularia.[1] We shall consider several members of these two groups, taking up in order, in the first, Drosera and Dionæa (*Droseraceæ*), Pinguicula (*Lentibuliariaceæ*), and Nepenthes (*Nepenthaceæ*); and in the second, Sarracenia (*Sarraceniaceæ*) and Utricularia (*Lentibuliariaceæ*).

Drosera.

This genus is distributed over the temperate parts of nearly the whole world, the plants generally inhabiting marshy or boggy ground. In Drosera rotundifolia, the plant consists of a spreading rosette of radical leaves, from the centre of which one or more flower-stalks spring. Each leaf consists of a round leaf-blade supported on a leaf-stalk, and the upper surface of the blade is beset with numerous hair-like structures, with glandular knobs, to which Mr Darwin has applied the term "tentacles." Each tentacle consists of a stalk, at the extremity of which is a glandular knob surrounded by an extremely viscid fluid secretion, which, from its glittering in the sun, has given the plant the poetical name of "Sundew." In the centre of the leaf-blade the tentacles are short and erect, but towards the margin they get longer and more inclined outwards. A fibro-vascular bundle, consisting of a spiral vessel with some simpler tissues, runs in the interior of the stalk of each tentacle, these elements being continuations of the fibro-vascular system of the leaf. The glands consist of two outer layers of small cells, which are filled with purple granular matter or fluid; and in the centre are a number of elongated cylindrical spiral cells, which seem to be connected with the spiral vessel of the stalk.

Fully more than a century ago, the discovery was made by two

[1] There are a few other genera in both groups, but most of them are not as yet in cultivation. These are, in the first group, Drosophyllum, Byblis, and Roridula; and in the second, Aldrovanda and Heliamphora.

persons, the one a German (Roth, 1779) and the other an Englishman (Whately, 1780), that the tentacles were sensitive, and that insects were imprisoned by the leaves. These observations were confirmed by another German observer (Nitschke) in 1860; by an American lady (Mrs Treat) in 1871; and the subject has been carefully worked out in this country by Mr Darwin and others. If a small object be placed on the short tentacles in the centre of the leaf, a motor impulse is conveyed to the surrounding ones, which become inflected over it, those nearest the centre becoming first bent, and then those further off, until the whole of them are closely inflected over the object. The tentacles in the centre of the leaf do not bend in this case, but remain in their original erect position. Should the object be placed on the glands away from the centre of the leaf, however, the short tentacles of the centre become bent towards the point of excitement, through a motor impulse being conveyed to them from the excited glands. When a very minute particle of meat is placed on one of the long exterior tentacles, it bends towards the centre of the leaf, while those surrounding it retain their original position. If the object be not too minute, and especially if it contains soluble nitrogenous material, immediately it comes in contact with the glands of the central tentacles a motor impulse is transmitted to the surrounding tentacles, which all bend towards the centre.

It is astonishing how minute an object will cause the tentacles to bend. Darwin found that a bit of blotting-paper weighing $\frac{1}{465}$ of a grain, placed in contact with three glands, caused them to curve slowly inwards. A bit of cotton-thread $\frac{1}{50}$ of an inch in length, and weighing $\frac{1}{8197}$ of a grain, was next placed on a tentacle, and was carried to the centre in 1 h. 40 m. Two particles of the thinner end of a human hair, one being $\frac{18}{1000}$ of an inch in length, and weighing $\frac{1}{35,714}$ of a grain, the other $\frac{19}{1000}$ of an inch in length, and weighing a little more, were placed on glands on opposite sides of the same leaf, and these two tentacles were inflected half-way towards the centre of the leaf in 1 h. 10 m., all the other tentacles round the same leaf remaining motionless. The smallest particle which was tried, and which caused the tentacle to bend, was only $\frac{8}{1000}$ of an inch in length, and weighed $\frac{1}{78,740}$ of a grain.

Darwin's surprise was greatly excited not only by the minuteness of the objects which caused inflection, but as to how they could possibly act on the glands; for he found that small drops of water many times heavier than the particles which were placed on them, although repeatedly added, produced no effect. Neither did the disturbance of the secretion produce any effect; for long threads were drawn out by a needle and affixed to some adjoining object, and thus left for hours, but the tentacles remained motionless. If repeatedly touched or brushed, however, although no object was left

upon them, the marginal glands curved inwards. It would appear, from what Darwin has been able to make out, that an object must come in contact not only with the secretion surrounding the gland, but with the gland itself; and this is brought about by the object absorbing the secretion, and thus sinking through it to the surface of the gland. Particles which merely rest on the secretion, and do not come into actual contact with the gland, never produce any effect; and the same may be said of one or more contacts with any hard substance. Excessively small doses of certain organic fluids and saline solutions cause strongly marked inflection. Darwin found that the phosphate of ammonia was by far the most powerful in causing this. When a leaf was immersed in thirty minims of a solution of one part by weight of the salt to 21,875,000 parts of water, the absorption of the twenty-millionth of a grain by a gland was sufficient to cause the tentacle bearing it to curve to the centre of the leaf. The amount of heat which the leaves will stand without being injured is also remarkable. Darwin found that when they were immersed in water at a temperature of between 115° and 125° Fahr. they were quickly inflected, and the protoplasm became aggregated; but when afterwards placed in cold water, they slowly expanded. When exposed to a temperature of 130°, inflection did not immediately take place; but when afterwards placed in cold water, they often became inflected, and then re-expanded. When placed in cold water after exposure to a temperature of 145°, they sometimes became slightly though slowly inflected; but when placed in water at a temperature of 150° for a short time, they were killed.

The secretion surrounding the glands is extremely viscid, so that an insect alighting on the leaf is immediately entangled amongst the glands, which, on becoming excited, transmit a motor impulse to all the surrounding tentacles, which immediately bend over and soon kill it. The time during which the tentacles remain inflected depends on the age and vigour of the leaf, and Darwin mentions that they so remain for a much longer time over soluble nitrogenous substances than over those which yield no such matter. The time varies from one to seven days, and he states that he has seen the glands of the same leaf inflected three successive times over insects placed on the disc. The leaves are more quickly inflected over animal substances, and they remain so for a longer time during very warm weather than during cold weather. A living insect is more efficient in causing inflection than a dead one, as it struggles and presses against the glands of many tentacles; and an insect such as a fly, with thin integuments, is more efficient in causing prolonged inflection than a beetle with a thick coat.

When an organic or inorganic object is placed on certain glands of a leaf, the secretion from the other glands is increased in quantity, and becomes acid, and this takes place before they come in contact

with the object. At the same time, a remarkable movement of the protoplasm takes place, first within the cells of the glands and then within those of the pedicels. This movement Darwin calls "aggregation." When this takes place the cells present a different appearance. Instead of being filled with a homogeneous purple fluid, they now contain variously shaped masses of purple matter suspended in a colourless or almost colourless fluid. The secretion appears to possess, like the gastric juice of the higher animals, some antiseptic power. During warm weather Darwin placed two equal-sized bits of raw meat, one on a leaf and the other on wet moss. After forty-eight hours, that on the moss swarmed with infusoria, while that on the leaf was quite free from them. Small cubes of albumen placed in similar circumstances showed that those placed on the moss became threaded with mould, while those on the leaves remained clear, and were changed into a transparent jelly.

Although the leaves appear at a glance to be of a reddish colour, they nevertheless contain chlorophyll in their petioles, both surfaces of the blade, and the pedicels of the tentacles, so that they are able to decompose the carbonic acid of the air; but owing to their feeble root-development, the plants would not be able to obtain a sufficient supply of nitrogen if they had not the power of obtaining that important element from captured insects. Many plants entrap insects without apparently deriving any benefit—*e. g.*, the sticky buds of Horse-chestnut and the leaves of Saxifraga tridactylites; but Francis Darwin has proved beyond doubt that Drosera derives benefit from the insects which it captures. He grew two lots of plants under similar conditions: one lot he fed with nitrogenous substances, while from the other all such material was carefully excluded. The number of seeds produced by the fed plants was as 240 to 100 of the unfed ones; while the weight was as 380 to 100. The number and weight of the flower-stalks and seed-capsules were also in favour of the fed plants.

Dionæa.

Dionæa muscipula is confined to the eastern part of North Carolina, where it inhabits damp situations. From the rapidity with which it closes its leaves, it has received the name of "Venus's Fly-trap." The leaf-blade is bilobed, and the petiole is foliaceous. The lobes of the blade stand at rather less than a right angle to each other, and the edges are set round with bristle-like projections, which interlace like the teeth of a rat-trap when the leaf closes. The upper surface of each lobe, towards the midrib, is thickly covered with minute red glands, which give it a rosy appearance, and the lobe also bears three erect sensitive filaments arranged in a triangular manner. The filaments are further provided with a joint or hinge near the base, so that when the leaf closes they fold down, and thus escape injury.

In 1768 an English naturalist named Ellis sent a drawing of this plant to Linnæus, along with a description of it, in which he suggested that Nature might have a view to furnishing the plant with nourishment in forming the upper joint of its leaf like a machine for catching food. He went on to state that minute red glands discharged a sweet liquor, which acted as a lure to insects, which, the moment they touched them with their feet, caused the leaf to close instantly and squeeze them to death; and that if the insects were strong, three erect spines fixed amongst the glands effectively put an end to their struggles. The movement described by Ellis is substantially correct, but he made an error in stating that the glands were sensitive, and that the erect spines played an important part in putting an insect to death. His description, however, failed to convince Linnæus that there was anything more in it than a case of extreme sensitiveness. That the sensitiveness resided in the hairs was discovered first by an English botanical draughtsman named Edwards, and subsequently by Dr Curtis, who published an account of it in the 'Boston Journal of Natural History' in 1834; and in the same account Dr Curtis states that the secretion is not a lure, but a true digestive fluid poured out after capture. The hairs are sensitive over their whole surface, so that an insect alighting on the leaf is almost certain to cause it to close. When touched, a motor impulse is conveyed from the excited hair through the cellular tissue of the leaf-blade to the midrib, the result being that the lobes instantly close. This closing, however, is not at first perfect, the teeth only slightly interlacing, so that if the insect be small it is allowed to escape; but if the insect is large, the glands are induced to secrete and absorb the animal matter, which, according to Darwin, has the effect of causing the lobes to press closely against the body of the insect. The pressure is often so great that the outline of the body of the insect can be seen on the outside of the leaf. These hairs are extremely sensitive to a momentary touch. Darwin found that a piece of human hair $2\frac{1}{2}$ inches long, held dangling over one of them so as to touch it, produced no movement, but a rather thick cotton thread of the same length caused the lobes to close. It would appear, however, that although these hairs are more sensitive to a momentary touch, they are far less sensitive to prolonged pressure than the tentacles of Drosera. A piece of human hair ten times the length of that which caused the tentacles of Drosera to bend, when cautiously placed on one of the hairs produced no movement, although in the case of Drosera they were supported by the dense secretion.

When the lobes are induced to close by mechanically touching the sensitive hairs, they remain closed only a short time; but when an insect is caught, they remain closed for many days, and Darwin mentions a case where the leaf remained closed for thirty-five days over a large Tipula. On an insect or other animal substance being

thus entrapped by a leaf, the peptic glands on the upper surface of the lobes pour out an acid secretion immediately the animal matter comes in contact with them. Moist nitrogenous substances, when placed on the glands of a leaf, even although the sensitive hairs are not touched, not only cause the glands to secrete, but the lobes slowly close.

Pinguicula.

The species of this genus are distributed principally over the north-temperate regions, and are mostly inhabitants of moist mountainous places. In P. vulgaris (Common Butterwort,—so called from its power of coagulating milk) the leaves are oblong, sessile, of a pale-green colour, and form a spreading rosette, from the centre of which the flower-stalks spring. Their margins are slightly incurved, and their upper surfaces are thickly beset with stalked and sessile glands: these secrete a viscid, colourless fluid, which can be drawn out into long threads. When the glands are excited by the pressure of an object, the margins curve inwards; but drops of water, or mere irritation of the surface without continuous pressure, produce no movement. Darwin found that the pressure of fragments of glass produced incurvation as soon as nitrogenous matter, but in a less degree. A motor impulse does not appear to be conveyed to the other glands when any individual one is irritated; for although the excited gland may secrete copiously, the others remain passive. Darwin found that although fragments of glass produced incurvation, they caused little or no secretion; but when a solution of carbonate of ammonia was applied, there was increase of the secretion, but no movement. It would thus appear that the secretion and movement take place independently of each other. The shortest time in which Darwin observed plainly marked incurvation was 2 h. 17 m.; and the longest time during which a leaf remained incurved was less than 48 h. In the majority of cases they had re-expanded in 24 h. The use of this incurvation is apparent, as insects are washed into the incurved margins by rain, and are thus, by the rolling in of the margins upon them, brought into contact with a greater number of glands, which are thus induced to secrete more freely. When Darwin placed large pieces of meat on the leaves, he observed that they were not embraced, but were pushed in by the incurving margins towards the centre of the leaf, in some cases as much as $\frac{1}{10}$ of an inch. The use of this pushing he conjectured was to bring large insects into contact with as many glands as possible. The incurving of the margins also serves another purpose. When many glands are induced to secrete, the secretion trickles down and is caught in the incurved margins, so that insects are more quickly and completely dissolved there than on any other part of the leaf. Insoluble substances, such as bits of glass, have little or no power of causing secretion from the glands; but

non-nitrogenous fluids cause them to secrete freely. The secretion in this case, however, is not acid. Nitrogenous substances, on the other hand, cause an increased flow of the secretion, which is invariably acid, and in this state it has the power of digesting insects or other animal matter. Before absorption of animal matter, the glands are green; but after that takes place, the protoplasm contained in them becomes aggregated, and of a brown colour.

Nepenthes.

The species belonging to this genus are upwards of thirty in number, and are, with a few exceptions, natives of swamps in the hotter parts of the Asiatic archipelago. They are half-shrubby plants, and climb by the aid of their leaves, which have the power of coiling or twisting themselves round supporting objects. The leaves are metamorphosed as flattened expansions, which narrow into long tendril-like bodies, at the extremities of which the pitchers are developed. These pitchers are often highly coloured, and generally contain a fluid, into which insects, and sometimes even small quadrupeds or birds, find their way. The pitchers vary in size from an inch or two to nearly a foot in length, and one species at least has them no less than eighteen inches long.

The minute structure of the interior of the pitcher is of a very complicated nature. It presents three distinct surfaces. The first is the "attractive" surface, which occupies the inside of the lid and the mouth of the pitcher. The inside of the lid is in most species studded over with honey-secreting glands. These consist of masses of cells embedded in depressions of the cellular tissue of the lid, and each is surrounded by a ring of guard-cells. Round the mouth of the pitcher is a corrugated rim, which projects into the cavity, and which helps to keep the mouth distended, and the corrugations are often prolonged as sharp downward-directed teeth. Hooker observed that the rim secreted honey; and it has been discovered recently by Professor Dickson that a circlet of glands is present in it. These glands alternate with the corrugations of the rim, and open into the pitcher a little above its lower edge. They are of enormous length (in some cases $\frac{1}{12}$ of an inch) compared with the other glands found in the pitcher, but are comparatively narrow. They are embedded in the tissue of the rim, and open into the pitcher cavity by short canals. Next comes the "conductive" surface, which occupies a variable portion of the upper part of the interior of the pitcher. This surface is composed of smooth glassy cells, which afford no foothold to insects, and it is generally studded over with minute reniform or crescentic ledges. The remainder of the interior of the pitcher is occupied by the "secretive" surface. This is thickly covered with glands resembling those of the lid, but the depressions in which they are lodged

have their concavities directed downwards, resembling much in appearance inverted waistcoat-pockets. Hooker mentions that in N. Rafflesiana 3000 of these glands occur in a square inch. A fluid is formed at the bottom of the pitcher which is secreted by these glands, and is present before the lid of the pitcher opens.

Insects are induced to visit the pitcher for the sake of the honey secreted by the lid and the corrugated rim, and in doing so they are apt either to fall into the pitcher or to be led on to the conductive surface, down which they glide till they reach the fluid secretion, by which they are effectually "detained." Hooker states that the fluid is invariably present, and that when emptied out of a pitcher which has not received animal matter, it collects again in small quantities, the formation going on for days, and even to some extent after the pitcher has been removed from the plant. He did not find that inorganic substances produced an increased flow of the secretion; but when animal substances were placed in the fluid, there was a marked increase. The fluid is always acid, even before the opening of the pitcher, and it seems to have the same digestive properties as Drosera, Dionæa, and Pinguicula. It would appear, however, that the digestive power of the fluid is not due entirely to the fluid first secreted by the pitcher, but that a substance resembling pepsine in its action is given off from its inner wall, chiefly after the placing of animal matter in the fluid. In support of this idea, Hooker states that very little action took place on any of the substances placed in the fluid drawn from pitchers and deposited in a glass tube, although the disintegration of the substances was three times more rapid in the fluid than in distilled water. On the other hand, substances placed in the fluid in the living pitchers were acted on in a very rapid manner. Cubes of boiled egg had their edges dissolved in 24 hours, and their surfaces gelatinised. Fragments of fibrine weighing several grains were dissolved, and totally disappeared in two or three days; while lumps of cartilage weighing 8 to 10 grains were greatly diminished, and reduced to a transparent jelly in three days.

Sarracenia.

This genus consists of eight species, all of which are natives of the eastern States of North America, where they are found growing in marshes. The leaves are funnel-shaped, and spring from the ground in tufts. The plants send up long slender stalks in the flowering season, each of which bears a solitary flower of a remarkable appearance, due to the termination of the style in an umbrella-like expansion, which caused the first English settlers to give it the name of "Side-saddle flower." There are two distinct forms of pitcher. Into one form rain enters easily; into the other, with difficulty. In the first form, of which S. purpurea may be taken as the type, the

lid is either erect, or thrown back so as to direct all the rain that falls upon it into the pitcher; and in the second, of which S. variolaris may be taken as the type, the lid is thrown somewhat forward, so as to prevent the rain from entering. The pitchers generally contain water, and it was supposed by Catesby that these receptacles served as a secure retreat for insects from Frogs and other animals which feed upon them; and by Linnæus and others, that they served as water-reservoirs for birds and other animals, especially in dry weather. This idea probably originated from the fact that some birds slit open the pitchers with their beaks; but the probability is that these birds slit open the pitchers to get at the larvæ of insects which have dropped their eggs amongst the mass of decaying organic matter, where they would get suitable nourishment.

It was Linnæus who first made the suggestion, which has since been worked out in detail by Baillon, that the pitchers of Sarracenia are analogous to the leaves of Water-lilies; and he supposed that they were originally aquatic in their habits, and had Nymphæa-like leaves, but that they afterwards took to terrestrial habits, and their leaves became hollowed out to contain the water in which they could not float. The pitcher-lid would thus represent the apex of the leaf. The internal structure of the pitchers is exceedingly beautiful, and in most species presents, like Nepenthes, three distinct surfaces. The first is the "attractive" surface, which occupies the inner part of the lid and the mouth of the pitcher. The lid is often more highly coloured than the rest of the pitcher, and, in common with the mouth, is studded over with honey-secreting glands. These glands are also found on the outside of the pitcher. The epidermis cells of the inner surface of the lid are wavy in outline, and many of them are prolonged on their free surface into sharp downward-directed hairs. Occupying the upper part of the inner surface of the pitcher proper, and extending some distance down its cavity, is the "conducting" surface. In this each epidermis cell is prolonged downwards into a short, glassy, sharp-pointed hair, which is finely striated. These hairs overlap like the tiles of a house, and they thus afford no foothold to insects. The whole of the cavity of the pitcher below the conducting surface is occupied by the "detentive" surface. In this many of the epidermis cells are prolonged into enormously elongated downward-directed hairs, which increase in length towards the bottom of the pitcher; and as the cavity diminishes in width, they meet in the centre, and thus completely prevent the escape of any insect which may have been lured into it. Secreting glands are embedded in the detentive surface of all the species with the exception of S. purpurea. In this species, however, there is a special glandular surface which occupies a portion of the wall of the pitcher between the conducting and detentive surfaces. The epidermis cells of this surface are wavy in outline, and embedded amongst them are numerous secreting glands.

Insects are induced to visit the honey secretion of the lid and mouth of the pitcher, and are thus led on to the conducting surface. This affords no foothold, and they glide down till they reach the detentive surface. When once amongst the hairs of this part of the pitcher, there is no possibility of returning, their struggles only serving to wedge them deeper and more firmly. The secretion "wets" an insect much more rapidly than water: but it apparently has no digestive properties, appearing rather to hasten decomposition. The broad wing of the pitcher is also said to be baited with honey, so as to lure insects to their destruction by presenting a pathway from the ground.

Utricularia.

The British species of this genus are all aquatic, but some exotic species are terrestrial. The aquatic plants are entirely destitute of roots, and the submerged stem and branches are clothed with leaves, which are dissected up into slender filiform segments; and on these segments numerous little bladders or ampullæ are developed. The leaves are tipped with short straight bristles. The plants float near the surface of the water, above which they send their flowers supported on slender stalks.

In U. vulgaris the bladders are supported on short footstalks, and are about $\frac{1}{10}$ of an inch in length. They are generally filled with water, but sometimes they contain air-bubbles. At the apex is a small orifice, around which are a number of hair-like prolongations called antennæ. On the inside of this orifice is a small hemispherical valve, which shuts against the rim or collar of the orifice. The valve is elastic, and can be pushed back by a small insect, which thus easily finds admission to the inside of the bladder. When once in, there is no chance of its getting out, for the valve springs back against the collar and completely closes the entrance. All over the interior of the bladder small processes called "quadrifids" are placed. These consist of very short stalks, which spring from angular cells at the junctions of the angles of the larger cells; and at their apices four arm-like processes are developed, each of which consists of a single cell. In U. vulgaris two of these arms are long and two short, but in U. montana they are all nearly of the same length. The bladders were supposed by some to act as floats; but as they seldom contain air, it is probable that the plants are floated up by the air contained in the intercellular spaces. The real use of the bladder is to capture small insects, which they do in great numbers. As already mentioned, they enter the bladder by pushing back the valve; and the free edge of this is so thin, and shuts so closely against the collar, that a Daphnia which Darwin mentions as having inserted one of its antennæ into the slit was held fast for a whole day. The insects captured are all small water-insects, such as Cyclops, &c.; and, as in

Sarracenia, they are not digested, but simply undergo decomposition. The quadrifid hairs are supposed to be the active agents in the absorption of the liquid products.

Such is a short survey of a few of these most interesting plants. While their general structure includes them in the Vegetable Kingdom, their habits, in some respects, are curiously allied to those of the members of the Animal Kingdom. It is only of recent years that these habits have been investigated and understood, principally through the laborious and painstaking experiments of Darwin, Hooker, and others, in this country. Now that attention has so largely been drawn to them, and so many workers have entered on the task of their further elucidation, even more startling facts than any yet discovered may some day be brought to light.

[In illustration of the above, a number of microscopic preparations were shown, which included the minute structure of most of the plants enumerated and described.]

X.—NOTE ON THE NEST OF THE REED-WARBLER (*SALICARIA ARUNDINACEA*).

By Mr A. B. HERBERT, President.

(*Read Feb.* 28, 1884.)

The Reed-Warbler is extremely rare in Scotland, and not so abundant in England as the Sedge-Warbler. It is a migratory species, coming in April and leaving in September. Its note is pleasing and varied, and uttered with little intermission during the day, and occasionally at night. The nest is a most peculiar structure, very ingeniously suspended from three reeds, and so deep that when the reeds wave about in the wind, there is no danger of the eggs rolling out. The one I exhibit was given to me by Mr Miller, the agent for the Earl of Craven at Combe Abbey, in Warwickshire—a place which is a perfect paradise for all small birds. In the year 1882 there were three of these nests in the same cluster of reeds near the decoy, where no gun is allowed to be fired, and even loud talking is strictly prohibited, so that the little Reed-Warblers live in perfect peace, and have a kind friend in Mr Miller, who is an enthusiastic ornithologist. Excepting the mud-nests of the Hirundines, I know of only two species of British birds which build suspended nests, namely, this one and the Gold-crest. On examining the nest before us, we cannot

fail to be struck with the clever manner in which the fine fibres are interlaced round the reeds. I have often thought how extremely difficult it must be for the small bird to form the commencement of such a nest, while every breath of wind must alter the relative position of the reeds. At Combe there is a large Heronry on an island in the lake, and the bird-life is always interesting to me on the occasion of my annual rambles there.

XI.—SOME AMERICAN PLANTS WORTH NOTICE.

By Mr MARK KING.

(*Read March* 27, 1884.)

The plants of North America are both numerous and varied in character. They are found on the prairie and the mountain, on the river-bank and the lake-margin, in the wood and the cultivated field. The region embraced in the following brief notes is confined for the most part to the State of Ohio, which contains an area of more than 39,000 square miles, and includes within its range a great variety of soil, climate, and situation. Even in the comparatively limited extent of this one State, it will be evident that the flora must be very abundant, and all that can be done in the short time at our disposal is to select a few plants which are noteworthy either on account of their beauty or utility, showing herbarium specimens of these, and adding a few comments on them. The plants chosen for this purpose are included in the following eleven natural orders, viz.:—

1. **Ranunculaceæ.**—The plants comprised in this large order are mostly natives of cool, damp climates, those of the tropical regions growing only at high elevations. Nearly all the genera possess acrid and narcotic properties, while some of them are highly poisonous. The order is rich in ornamental cultivated plants. The Clematis or Virgin's Bower is a large genus in the American flora, containing no less than fifteen species. It is a plant well known to all in the cultivated form. The twigs are capable of being made into baskets; and the leaves of certain kinds are employed as an external application in rheumatism. A section of the wood is a very interesting object under the microscope. Among other fine plants in the order are the tall and showy Delphiniums; while those harbingers of spring, the Hellebores, Hepaticas, and Anemones, are also included in it.

2. **Magnoliaceæ.**—This is a small order, the North American representatives being three genera and fourteen species, including some

of the most splendid of flowering trees and shrubs. Among these is the Tulip-tree (*Liriodendron tulipifera*), a remarkable tree, which in May and June puts forth numerous campanulate flowers. It was early dispersed throughout Britain; and a specimen we saw in Roxburghshire in 1850 was twenty feet in height. It is only in the southern part of our island that it flowers well. The bark has a bitter aromatic taste, and has been used as a substitute for Peruvian bark. It may be added that there are some fine specimens of the Tulip-tree growing in the Edinburgh Royal Botanic Garden, one in especial measuring about 60 feet in height.

3. **Anonaceæ.**—Of this large order, comprising trees and shrubs, only four species, belonging to the genus *Asimina*, are found within the limits of the United States. A. triloba, which bears the Custard-Apple, is a small but beautiful tree, fifteen to twenty feet high, found growing on the banks of streams. The fruit is one of the most delicious products of tropical countries.

4. **Berberidaceæ.**—This is said to be an order hard to define, containing plants of widely different habit and of very doubtful affinities. Five genera and six species are found in the flora of the United States and Canada. One of the most curious and interesting plants of America belongs to this order—namely, Podophyllum peltatum, or the May-Apple. An extract from the root of this plant, named Podophyllin, is now well known in this country as a remedy in liver-disease. Another curious plant of the order is Jeffersonia diphylla, or Twin-leaf, named in honour of President Jefferson. It is known in Ohio as the "Rheumatism plant."

5. **Nymphæaceæ.**—This is an inconsiderable order, yet it has a wide geographical range. The representative now exhibited is Nuphar advena, which has been described as "a well-looking and very curious plant, but from its filthy habits it has been called, with justice, the Frog-lily."

6. **Tiliaceæ.**—To this order, comprising trees and shrubs, belongs Tilia americana, or Bass-wood, a common tree in the northern and western States. The wood is white, soft, and clear in colour, being much used in the panelling of carriages. The inner bark, which is very strong and tough in texture, is manufactured into ropes. When in flower, the trees are a favourite resort for bees.

7. **Rhamnaceæ.**—The Buckthorn family contains 42 genera and 250 species, many of these being natives of America, though found in all parts except the frigid zone. One genus, however, is peculiar to North America, namely, Ceanothus. The representative shown is Ceanothus americanus, a lovely dwarf shrub, with a profusion of white flowers. The leaves, which are very downy, with soft hairs on the under-surface, have been used as a substitute for tea, giving the plant the name of "Jersey Tea." Another cognomen is "Red-root,"—the root, which is large, and of a red hue, being used for colouring purposes.

8. Sapindaceæ.—This order, known as "Indian soapworts," is so named from the saponaceous principle contained in the seed of some of the species. In the order is found the genus Æsculus or Horse-Chestnut, known in America as the Buckeye. The plant selected is Æsculus glabra, or Ohio Buckeye,—a small tree found growing along the banks of the Ohio and its tributaries. Its flowers, which are yellowish-white, have by no means a pleasant odour.

9. Leguminosæ.—This is a very large and important order, distributed nearly throughout all lands, "from pole to pole." Of the 6500 species now known, 350 are natives of America. No other order possesses a greater claim on general attention, whether as regards beauty or utility. In it mankind find materials for food, shelter, ornament, and medicine. It contains such diverse products as Beans, Peas, and Lentils; Rose-wood, Sandal-wood, and Laburnum; the Acacias and splendid varieties of Cercis; Liquorice, Senna, and Gum-tragacanth. We have chosen two representatives of the order, Cassia marilandica and Cercis canadensis. Cassia marilandica, or American Senna, is a handsome plant, often met with in alluvial soils in the United States, growing in masses, from three to five feet in height. The flowers are in axillary racemes and terminal panicles, the petals being bright yellow in colour. The leaflets are in pairs, six to nine in number: their cathartic properties are well known. The Cercis canadensis is popularly known as the Judas Tree and the Red-bud. It is a very handsome tree, from twenty to thirty feet high, the blossoms appearing in early spring before the leaves, and clothing the whole tree in purple flowers arranged in small lateral clusters. Gerarde remarks of it, "This is the tree whereon Judas did hang himself, and not on the Elder-tree as it is said."

10. Rosaceæ.—This order is highly prized for the delicious flowers and fruits included in it. With the exception of the Almond family, none of the 1000 species it contains are injurious. It embraces many forms of plant-life, as the umbrageous tree, the trailing herb, and the flowering shrub. The determination of the species in some of the genera, as *Rosa* and *Rubus*, is still an open question. The Pear and the Apple both claim descent from the genus Pyrus, the most widely diffused of fruit-trees. Varieties almost without number are raised of these delicious fruits; and nearly a thousand kinds of Apples are cultivated in the United States alone. We have selected two forms of Pyrus—*coronaria* and *arbutifolia*. Pyrus coronaria, or the Sweet-scented Crab-tree, is a small tree of from ten to twenty feet high. Both flowers and fruit have an agreeable fragrance. The Apple is yellowish, hard, and sour, but in favour for preserving. Pyrus arbutifolia, or Choke-berry, is a small shrub, from five to eight feet high, found growing in moist woods. The flowers are white, growing in terminal corymbs; while the fruit is the size of a Currant, and astringent in taste.

11. Cornaceæ.—This small order, the last we will notice at present, is distinguished for the astringent properties of the bark. The nine genera and forty species comprised in it are found in the temperate zones of both hemispheres. The specimen exhibited is Cornus florida, or the Flowering Dogwood. It is a tree from twenty to thirty feet in height. The bark is exactly similar to Peruvian bark in its properties as a tonic. "The true flowers are inconspicuous, greenish-yellow, but the involucre is very large and showy, of veiny, white, obovate leaves, ending in a callous point, which is turned up or down so abruptly as to appear emarginate." The wood is extremely hard, and very durable.

XII.—NOTE ON THE WESTWARD MIGRATION OF THE FLORA AND REPTILIAN FAUNA OF THE EUROPEAN CONTINENT, AS EVIDENCED ON THE MAINLAND OF SCOTLAND, SOME OF THE SOUTHERN HEBRIDES, AND IRELAND.

By Mr SYMINGTON GRIEVE.

(*Read March* 27, 1884.)

It is now generally admitted that, during the last glacial period or ice age, there was a very general depression of the land in the northern hemisphere. This depression, it is believed, was caused by the tremendous ice-cap that covered this part of the world, the enormous weight causing a displacement of the earth's centre of gravity, and also altering the position of sea and land by causing the sea to rise much above its present level. On the strong grip of the ice age being relaxed, there is supposed to have been a gradual upheaval, until Britain and the adjoining islands were no longer insular, but formed part of the European continent. By the time that Britain had become continental, very probably the ice had melted from the lowlands, and had receded some distance up our mountain-sides, and the climate had become sufficiently temperate to admit of the existence of those plants that we now find at the summits of our highest peaks, and which we call "arctic alpines," a few of which we still meet with at the sea-level—the stragglers that were left behind by the migrating army of arctic alpines on their onward march. But we must not suppose that those stragglers fell out of the ranks from being too weak to continue their travels: it was the circumstance that they met on our shores with congenial conditions of climate and soil, combined with freedom

from competition with other forms of plant life that choked off, in most instances, the stragglers that dropped out of the ranks at inland situations at lower levels than the arctic-alpine zone. The plants of the alpine, sub-alpine, lowland, and littoral zones all came in succession to take possession of their new home.

It is not for us to consider at present whether this, the "first post-glacial period of elevation," was for a long or a short time; but there is good evidence that, from some cause or other, it was succeeded by a period of great depression, when Britain and Ireland, with their adjoining islands, became insular. This may be gleaned from an examination of the distribution of the reptilian fauna, and on that account we refer to the subject here. The arctic-alpine flora, or that portion of it which had taken possession of the Irish hills, would, through the submersion of the land, be brought much nearer the sea level, and would have to compete for existence under the disadvantages of an unsuitable climate with the remains of the alpine, sub-alpine, and lowland vegetation that had found, as stray plants, a home upon the higher ground. These might possibly be poor starved plants that had struggled hard for existence, but under their changed conditions they would gain strength every day, soon grow vigorous, and become strong competitors with the arctic-alpines, many of which would be killed out. This period of depression, which we may call the "first post-glacial land depression," was succeeded by another upheaval, but not to the same elevations as those attained by the land during the first post-glacial period of elevation. There appears, however, to have been once more a land attachment between Britain and the European continent, and a further influx of flora and fauna; but probably some of the islands off the west of Scotland were insular at this time, as the upheaval had not been sufficient to give them a land attachment to the mainland. This "second post-glacial period of elevation" was succeeded by a depression of the land to about present levels, by which Britain became insular, and was separated from Ireland and those other islands which had become part of the mainland during the period of elevation.

Our "raised beaches" and "shell deposits" give us a good index as to the depressions to which our country has been subjected; and the beds of peat and the remains of sunken submarine forests that extend seawards round our coasts, and also from the shores of the European continent, are clear indications that at one time the land was more elevated than at present, and that as the trees composing those forests grew on dry land, there has been a depression of the land by which the forests have been submerged beneath the ocean. The shallowness of the sea that intervenes between Britain and the Continent,[1] and again between Britain and Ireland and the adjoining

[1] See "Depths of the German Ocean,"—'Climate and Time,' by Dr James Croll, p. 479.

islands,[1] is some evidence in itself, for if there is admitted to have been depressions of the land, what is there to have hindered elevations? We have, however, the best evidence in our flora and fauna of a land attachment with the European continent, for we find these to be in the main an extension of those of Germany, and altogether different from those insular floras rich in endemic or peculiar types which characterise oceanic islands. We may therefore conclude that most of our flora and fauna came from the east or south-east across the continent of Europe. That comparatively few of the forms of plant or animal life reached the limit of their journey westwards, but that they gradually decreased in numbers the farther they extended from the areas to which they had been driven by the cold of the last glacial period, may be understood by some statistics of the flora of Great Britain, Ireland, and Colonsay, compared with those of some of the Continental countries bounding the northern portion of Western Europe. Mons. A. Decandolle, in his 'Géographie botanique,' gives the following as the number of plants in each of the countries:—

France, which covers a large area with considerable elevations, .	3614
Holland, which covers a small area compared with France, and is a country with no great elevations, ...	1210
Denmark, also without great elevations, ...	1197
Scandinavia, with considerable elevations, but at the same time having a rigorous climate, ...	1677
Great Britain, insular, but with considerable elevations, was said by the late Mr H. C. Watson, the greatest authority on the subject, to have	1425

This gives us the number of plants in England and Scotland combined; but we have thought it well also to try and give the numbers for each country separate, which we think may be stated as follows:—

England, ...	1357
Scotland, ...	1055
Ireland.—Mr A. G. More, of the Science and Art Museum, Dublin, and one of the authors of Moore and More's 'Contributions towards a Cybele Hibernica,' kindly informs us that they believe Ireland has about	970
Colonsay and Oronsay.—The combined flora of those islands will serve to show the decrease to the west of Scotland, and from our own lists we would state it at	360

If we glance at these statistics, we find that, with the exception of Holland and Denmark, all the Continental countries we give have a much more extensive flora than Britain. Holland and Denmark have no alpine or sub-alpine flora, still they have nearly as many plants as Great Britain, which covers a much wider area, besides

[1] See Chart accompanying Paper by Prof. James Geikie, LL.D., F.R.S., "On Geology of Colonsay and Oronsay,"—'Transactions of Geological Society of Glasgow,' vol. vi. p. 157.

having considerable elevations, and we think that the evidence obtained from those countries only helps to bear out the belief we have, that the further west we go we find the flora more restricted. If we compare Scandinavia with Iceland, we find the same rule again applies, for Decandolle gives 402 as the number of varieties in that island, which is of large extent, having great elevations, and a less rigorous climate than Norway and Sweden,—yet the decrease is very great. If we compare England with Ireland, there is the same falling off in the number of varieties the further west we go; and if we do the same with the mainland of Scotland, and Colonsay and Oronsay, it is only to obtain an illustration of the same fact, as there is not a single plant found on Colonsay and Oronsay that is not also found on the mainland. Take these islands, and compare them with Ireland, remembering the limited area covered by the former compared with the latter, and we will find, after making all allowance for those differences, and the presence of higher elevations in Ireland, that probably the two floras represent forms of plant life in nearly the same ratio of abundance. These statistics and remarks do not refer to Mosses, or any of the lower forms of vegetation.

The fauna is more difficult to obtain information about, but we have the evidence acquired by the excavations in our English bone-caves, especially Kent's Cavern, which all point to two periods when different migrations of animals into Britain took place. It is generally supposed that the newer forms, which are conspicuous by the absence of their remains in the lower strata of the caves, but which become common in the upper strata, must have come to Britain overland by a recent connection with the Continent. Those English caves have yielded abundant remains of animals, principally mammalia, but we merely mention the fact in passing, as we intend only to refer to the reptilian fauna, and, as regards that, very briefly. In his interesting and instructive book, 'Island Life,' Mr Wallace gives the following information regarding the distribution of reptilia and amphibia, which shows the remarkable diminution in the number of varieties the further west we proceed; and the same fact is said to be observable as regards the mammalia, from a study of their past and present distribution:—

Belgium, . . .	22	species of reptilia and amphibia.	
Great Britain, . .	13	,,	,, ,,
Ireland, . . .	4	,,	,, ,,

The decrease from 22 to 13 and from 13 to 4 species is very great; but that it is not singular may be understood from our own observations on Colonsay and Oronsay, for there we find only two varieties of reptilia—namely, the Slow-worm (*Anguis fragilis*) and the Green Lizard (*Zootoca vivipara*), and no amphibia. It is possible that the absence of Snakes, and such common forms of amphibia as the Toad

and Frog, may indicate that they are of a later type than the two reptilia we now find existing on the islands; but more probably they were slower migrants to Western Europe, and did not reach the west of Scotland until Colonsay and Oronsay were insular. There is, we think, some evidence of this in the fact that the common Viper is abundant on Jura and Islay, the nearest land to Colonsay and Oronsay; but if we find the Viper on the former, why should we not find it upon the latter? This question, we confess, is not so easily answered; but it appears to us that the probability is, that as these reptilia could only reach Colonsay and Oronsay while the land connection lasted, the moment that connection was severed by a depression of the intervening land, which was then covered by the sea, they were completely isolated and shut off from the posterior migrations of reptilia that either travelled westwards slower, and had not reached the west of Scotland, or only came into Britain after Colonsay and Oronsay, with the Western Isles, had become isolated at the first post-glacial period of land depression. But how are we to account for the presence of the Viper in Jura and Islay, and its absence from Colonsay and Oronsay, at the present time, if, as we have every reason to suppose, the first post-glacial period of land depression was a great one, submerging the islands to at least 150 feet above the present sea level? This is a most important and interesting question, and we think it can only be answered by supposing that from the time of this depression Colonsay and Oronsay, from the depth of the intervening sea, have continued insular, while Jura and Islay, at the time of the second post-glacial upheaval, became once more an integral part of the mainland of Scotland, which enabled the Viper, and possibly other reptilia and amphibia, to have access to those islands. If this is so—and we think there is good reason to believe it—the flora and reptilian fauna of Colonsay and Oronsay have a peculiar interest to the student.

We have been asked, Why confine your paper to the flora and reptilian fauna, and not rather take the mammalia, to prove the theory you advance as to the migration of animals to Colonsay and Oronsay? and this, no doubt, is a very pertinent question. We may answer it as regards the flora, by reminding you that, with few exceptions, there was little probability of the plants that represent the vegetation of Colonsay and Oronsay having reached those islands previous to their occupation by man except by a land connection, though possibly a few seeds might be introduced by such agencies as wind and birds. Yet, speaking generally, the flora would require to reach the islands during a period of land attachment with the mainland of Scotland. With regard to the reasons why we should choose the reptilia in preference to the mammalia, we must ask you to bear in mind that most of the forms of the latter were able to swim, and that the evidence regarding the impossibility of their not being able

to reach Colonsay and Oronsay at a later time, supposing that they had not arrived in those islands during the time of a land connection with the mainland, would be more difficult to prove to the satisfaction of most persons than that a Slow-worm or a green Lizard could not get over the intervening stretch of ocean. The swimming feats of some animals are remarkable, and perhaps none more so than the Red-Deer, which, though now extinct on many of the islands round our shores, still has left a record of its presence at one time on almost all of them, in its remains. The evidence obtained during a series of excavations in ancient deposits on the islands of Colonsay and Oronsay leads us to believe that, in all probability, numbers of the mammalia at one time found there, but now extinct on those islands, originally reached them during a period of land attachment with the mainland. But it would lengthen out our subject too much to enter upon our reasons for that conviction.

We must now ask you to join with us in briefly reconsidering the probable physical changes that Western Europe has undergone since the close of the last glacial period. In imagination, suppose yourselves standing upon an eminence that enables you to survey at one glance the tract of land—now partly sea—that intervenes between the west of Scotland and the western shores of the Continent, and stretch back in thought into the immense period of time that has elapsed since the last ice age. You will see (after the ice melted from the littoral zone, and retired up the mountain sides, where it remained in immense glaciers) what is now the bed of the German Ocean becoming dry land, and the ground taken possession of by the arctic-alpine flora, which ever pressed westwards, followed rapidly, as the climate ameliorated, by alpine, sub-alpine, and littoral plants, all in quick succession pressing to the new home they were in search of in the country of the setting sun. As with the plants, so with the animals—all are rushing west to take possession, as soon as the conditions exist that enable them to live. The climate gradually becomes warmer and warmer, each recurring season, until it is like that which now exists in the south of Europe. This continental period has lasted a long time, when there are sudden and violent changes that alter the position of land and sea, causing Britain and Ireland to become insular, some of their outlying elevations becoming islands. This submersion has the effect of drowning out almost the whole of the lowland flora, and kills many of the alpine and arctic-alpine plants, from a withdrawal of the suitable conditions for life. The fauna has to flee from the plains before the rising waters, and take refuge on the bare mountain sides, where many animals die from want of food. Another long period elapses, and the plant and animal life have got settled down into their new circumstances, the fittest surviving; when an upheaval takes place, and Britain and most of the adjoining islands once more become continental, though the land

attachment is only a narrow neck that stretches across near where the present Straits of Dover exist. Across this narrow isthmus came another migration of plants and animals to invade Britain, and they gradually spread westwards and northwards to habilitate and occupy the vast tracts of lowland country that had recently risen from the sea, and which were only partially supplied with vegetable and animal life from the remains of the previous migration that had taken refuge on the hills at the time of the great submersion of the land just referred to. Some time elapses,—the country that was submerged has recovered from the effects of the sea,—and the hills and valleys are clad with trees, and from a waste there has risen a paradise, when once more there are violent convulsions of the earth—some upheavals, but many subsidences—and the connecting isthmus with the Continent disappears beneath the waves. Britain and Ireland, with the adjoining elevations, once more become islands, and when at last Mother Earth settles down into quietude, the present levels and contour have been attained by the British Isles. Some have supposed this convulsion of nature to be the same as the Deluge, but we confess we cannot throw any light upon the subject, so leave it to our theologians, who will find it a difficult point to settle. In discussing the subject before us, we have tried to describe what are the probable changes that have taken place in the relations of sea and land in Western Europe since the last ice age, but we would advise every one to avoid accepting them as definite conclusions until they have verified the evidence for themselves. We need not try to continue this stretch of thought further, as it would be hopeless. For though it may be profitable and instructive to look back upon the past,—whether it be as regards the physical history and changes of a country, or the introduction of its flora and fauna,—we cannot grope into the darkness of the future as we have been doing into the dimness of the bygone ages, so must leave it alone.

XIII.—ANIMAL AND VEGETABLE SYMBIOSIS OR CONSORTISM.

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(*Read March* 27, 1884.)

Although the highest animals are readily distinguishable from the highest plants, the two kingdoms approximate so closely in their most lowly organised members, that no sharp line of demarcation can be definitely laid down between the two groups of organisms.

The points of distinction—to all of which there are found exceptions of more or less importance—that are generally stated are as follows:—

(1) Animals are endowed with *locomotive* power. This same power, however, is found in the case of the reproductive cells of many of our lower plants, such as Ulva, Pandorina, &c., these cells existing as zoospores or zoogonidia, which are provided with actively motile cilia, enabling them readily and rapidly to change their place; and the male reproductive cells or antheridia of even higher Vascular Cryptogams, such as Ferns and Horsetails, are similarly provided with locomotive organs.

(2) Animals possess *irritability*. This is also exhibited by plants, such as the well-known Sensitive Plant (*Mimosa sensitiva*), the leaves of which suddenly droop if subjected to mechanical, chemical, or electrical stimuli,—vapour of chloroform, for example, producing drooping of longer continuance than a similar effect brought about by mere mechanical irritation. The stamens, too, of the Barberry are sensitive to mechanical stimulation. They are jointed to the receptacle, and, when touched, move inwards towards the centre of the flower. A reverse movement takes place in the case of the stamens of Rock Rose (*Helianthemum*), when similarly affected: these, in the normal, unstimulated condition, are erect, but by gently squeezing the outside of the flower, a movement away from the pistil occurs.

(3) Plants possess cellulose in the walls of their constituent cells. This substance is chemically an isomer of starch ($C_6H_{10}O_5$), and, although not occurring widely in the Animal Kingdom, it seems identical with the "tunicin" found in the tests of Ascidians; while the amyloid and saccharine matters which are so conspicuous vegetable products are also "of very wide, if not universal, occurrence in animals" (Hux.), being represented by the glycogen of the liver. It is, however, a well-known fact that the combustion odour of feathers, or other animal products, is markedly different from the odour given off by burning wood, and here we have a general distinction of importance between the two kingdoms.

(4) In plants generally there is a preponderance of the ternary compounds of carbon, although of vegetable protoplasm nitrogen is also an important constituent, nitrogenous food being necessary for the full complement of seed in such insectivorous plants as Pinguicula, Nepenthes, and others. Animals, on the other hand, abound in quaternary or quinary carbon unions—the albumen, so well seen in the white of egg, possessing a constitution indicated, according to some, by the formula $C_{144}H_{110}N_{18}O_{42}S_2$; while hæmoglobin, or the red colouring matter of blood, is perhaps one of the most complex of all organic bodies, being represented, according to Preyer, by the formula $C_{600}H_{960}N_{154}FeS_3O_{179}$; the fact that iron (Fe) is

essential in the hæmoglobin of blood, as well as in the chlorophyll of plants, being a remarkable point of affinity between these very important and very active organic products.

(5) Most animals possess a distinct alimentary tract, which, although not found as a definite elongated digestive tube in vegetables, is still represented by the pitchers of Sarracenia, Darlingtonia, and Nepenthes. These perform all the functions of a stomach, being specially constructed for the capture and digestion of insects, as cockroaches, &c.; while the glands found in them function in the same way as the gastric glands of the most highly developed mammalian stomach, by secreting a vegetable gastric juice. Moreover, these pitchers are epidermic involutions of leaves, just as the primitive archenteron of an animal gastrula is in many cases an invagination of an original epiblastic wall of cells.

(6) All plants except the Fungi and a few highly organised yet parasitic Phanerogams, such as Lathræa, possess green colouring matter or chlorophyll, the function of which is the decomposition of carbonic acid (CO_2) in sunlight, and the fixation of carbon with liberation of oxygen, so that organic matter, such as starch, is formed by plant agency out of such simple inorganic bodies as carbonic acid and water; while even Fungi like Penicillium can form organic constituents "out of ammonium tartrate, sulphate, and phosphate dissolved in water," although these Fungi may in most cases directly assimilate proteinaceous substances contained in the bodies of the plants or animals which they attack,—the Saprolegnia of Salmon disease removing the rich albuminous products of its host, no less than the Peronospora of Potato blight.

Animals, on the other hand, are, *for the most part*, incapable of elaborating organic compounds out of their simple inorganic components, in virtue of an absence of chlorophyll, so that we have here to deal with a reciprocal action between the two organic kingdoms. Yet the existence of green animals is well known; and the list of Alga-bearing animals, as given by Professor Lankester and Dr Karl Brandt, includes organisms of very different grades—Infusoria, Foraminifera, Radiolaria, Cœlenterata, Ctenophora, Vermes, Crustacea, Mollusca, Bryozoa, and Echinodermata. It is to be remarked, however, that greenness in animals need not be due to the existence of chlorophyll as such. There would seem, indeed, to be other green pigments developed chiefly for protection,[1] and not of the same physiological significance as chlorophyll,—pigments which have sometimes received special names, according to the animal in which they have been found. Thus we have the Bonellein of

[1] In the same way Grasshoppers (Acridiidæ) tend to be protected by their colour; and the orthopterous Phasmidæ—the "walking-leaf" and "stick" insects—curiously mimic leaves and pieces of branches. Of such protective resemblances there are many illustrations in organic nature.

Bonellia viridis, the Anthea green of Anthea cereus, the Crustacea green of Palæmon viridis, and the Pentacrinin of Pentacrinus—this last named pigment changing from a green to a purple hue on acidification. Yet green pigment of functional value equivalent to chlorophyll is apparently sometimes developed by true animal protoplasm; while, on the other hand, greenness in animals may be due to the existence of green or greenish-yellow plant organisms existing inside the animal tissues, in which case we have the curious phenomenon of an animal and a plant agreeing to live together, and, as we shall see below, "reciprocally accommodating" one another from a physiological standpoint. These organisms are said to be Symbiosists, Commensalists, or Mutualists.

It is at this stage to be remarked that of this association of one organism with another we find many illustrations, differing at once in kind and in degree. The simplest type is perhaps represented by cases where the guest is external and the host is entirely passive. Thus we find Diatoms epiphytic on Algæ; Lichens, Algæ, or Mosses, on trees; Algæ epizoic on Snails, or even on the more active Cyclops and Daphnia; while the list of Seaweeds found growing on other Algæ is a very large and comprehensive one, although the precise kind of this association—whether wholly or partially epiphytic or wholly or partially parasitic—is not in all cases clearly determined. In addition to the fact of association of plant with plant, we find similar associations of animal with animal. Thus the Commissioners on the Fisheries of New South Wales, in a report published in December 1883, remark that "the very young fry of Trachurus trachurus have a most extraordinary and ingenious way of providing for their safety and nutrition at the same time. They take up their quarters inside the umbrella of the large Medusæ, where they are safe from their enemies, and are, without any exertion on their part, supplied with the minute organisms which constitute their food, by the constant current kept up by the action of the curtain-like cilia of the animal." In Fol's 'Recueil Zoologique Suisse,' vol. i. (1883), pp. 65-74, a similar association of Caranx melampygus and Crambessa palmipes is recorded from the Mauritius. Annelid tubes, too, have been found surrounded by the corallum of Poritidæ and other coralline zoophytes. On the other hand, there are associations of organisms in which both host and guest are active and mutually beneficial to one another, as in the case of Anthea, Lichens, &c., to be referred to below.

The distinction between Commensalists and true parasites, such as the Dodder, Peronospora and other Fungi, Tæniæ, Trachinæ, Oxyuridæ, &c.—all of which exercise a deleterious function upon their host—was first drawn by Van Beneden, who explained the phenomenon of Commensalism by a "sympathy" existing between host and guest. But, more recently, Mr Geddes ('Proc. Roy. Soc.,' Lond., 1879), by submitting a number of green Convoluta Schultzii

to the direct influence of sunlight, has demonstrated that oxygen gas is evolved in large quantities (45 to 55 per cent), and that starch is abundant in the green cells, so that the action is equivalent to that of vegetable chlorophyll; while he has also given reasons for believing that, in cases of consortism, we have illustrations of an ideal, complex existence on the lines of mutual or reciprocal physiological accommodation. L. Macchiati, too ('Bull. Soc. Entomol. Ital.,' 1883), has asserted that certain Aphides (Siphonophora malvæ and S. rosæ) lose their colour when subjected to darkness, and believes that this coloration is due to chlorophyll, although its physiological action remains as yet undetermined.

It is not necessary, however, that Algæ thus associated with animals should be green. It is well known that the green colour of chlorophyll is often masked by other hues present in the cells, producing, for example, such shades as the brown of Diatomaceæ, or the olive of Fuci and Laminariæ, or again the red of Florideæ. So we find in marine Sponges bluish-green Oscillatoriæ, and in Radiolaria certain yellow bodies of ovoid outline, which Prof. Huxley first named "yellow cells." The views that have been held regarding these yellow cells may be summarised as follows:—

(1) Johannes Müller believed that they were concerned with the reproduction of the Radiolarians—a conception which he subsequently abandoned.

(2) Haeckel ('Die Radiolarien,' p. 136) maintained that they represented the liver cells of the simple saccular liver of Amphioxus, and were accordingly functionally secretory cells, or simple digestive glands; but at a later period they were found to contain starch, and he thereupon regarded them as related to the function of nutrition of the Radiolarians ('Amylum in d. gelben Zellen d. Radiolarien,' Jena, Zeitschrift 1870, p. 582).

(3) Cienkowski, in 1871, enunciated the belief that they were parasitic Algæ, resting this view on the three considerations that their number varies in the same species, and that after the death of the Radiolarian they are capable of multiplication, and of passing through encysted and amœboid phases.

(4) Richard Hertwig, in 1876, maintained that the yellow cells, being developed from the protoplasm of the Radiolarian, acted as storehouses of reserve food material, as the starch in a Potato tuber, as the albumen of a seed, or as the adipose tissue of an animal does; but in 1879, after observing that the yellow cells were absent in some species, and that the origin of their nuclei from Radiolarian nuclei was improbable, he regarded them as parasitic Algæ.

(5) Huxley, in 1877 ('Anat. Invert. Anim.,' p. 90), speaking of the same "cellæform bodies," remarks that "the possibility that they may be parasites must be borne in mind."

(6) Dr Karl Brandt, in 1881 ("Untersuchungen an Radiolarien,"

'Monats. Akad. Wiss. Berlin'), adopted the parasitic view taken up by Cienkowski, for the following reasons:—

(*a*) The yellow cells survive two months after the death of the Radiolarian host.

(*b*) They agree in widely different families—*e.g.*, in Radiolaria and some Actiniæ.

(*c*) They appear first in the outer part of the colony of Collozoum, and gradually make their way inwards.

(*d*) Their nuclei stain more deeply with carmine than Radiolarian nuclei.

(*e*) Their limiting membrane consists of cellulose, becoming blue after treatment with an acid and iodine.

(*f*) All yellow cells have a chlorophyll-like pigment nucleus and a starch-like product of assimilation, that assimilation product being of two kinds—either (α) starchy, vacuolated, colourless, or pale-blue granules, coloured violet or blue-violet by iodine, and not doubly refractive; or (β), compact, irregular, reddish or violet, doubly refractive granules, upon which iodine produces no change—(Brandt in Pfluger's 'Archiv.,' 1883).

(7) Mr Geddes ('Proc. Roy. Soc. of Edin.,' 1881-82, pp. 382, 383) has stated the subjoined grounds for regarding the yellow cells of Radiolarians as algoid in their nature:—

(*a*) They survive in dead Radiolarians, and have encysted and amœboid states.

(*b*) Their mode of division is algoid.

(*c*) Starch is present in them, as noted by Haeckel.

(*d*) Their cell walls consist of true cellulose, as made out by first preserving the animal in alcohol, then macerating for some hours in weak KHO, which is thereafter neutralised by weak acetic acid, and finally treating with weak iodine and strong H_2SO_4.

(*e*) Their yellow colour becomes green on treatment with alcohol, and is identical with the pigment of Diatoms.

(*f*) There is a copious evolution of oxygen during sunshine, as referred to below.

Brandt has named these parasitic yellow algoid-cells Zoozanthella, and has asserted that they represent the resting-stages of various marine Algæ, belonging chiefly to the class Melanophyceæ ('Mt. Zool. Stat. Neapel.,' 1883); and again (Pfluger's 'Archiv.,' 1883), that "if large quantities of the green cells be treated with filtered water, they usually become zoospores provided with two cilia anteriorly, having their pigments arranged in parietal plates, and possessing starch in their interior."

As bearing on the important physiological inferences that are to be drawn from such cases of consortism, the experiments of Geddes on the evolution of oxygen in sunshine are very valuable. They are as follows:—

Organism experimented on.	Algæ.	Oxygen gas evolved.
Collozoum inerme . . .	Present	Appreciable.
Velella	,,	21 to 24 per cent.
Anthea cereus var. plumosa .	,,	32 to 38 per cent.
Do. var. smaragdina	Absent	None (greenness is not algoid).
Ceriactis aurantiacus . .	Present	Much.
Do. . .	Absent	None.
Aiptasia chamæleon . .	Present	Much.
Helianthus troglodytes . .	,,	,,
Actinia cari	Absent	None.
,, mesembryanthemum .	,,	,,
Sagartia parasitica . . .	,,	,,
Cerianthus	,,	,,
{ Red Gorgonia verrucosa . .	,,	,,
{ White Gorgonia verrucosa .	Present	Appreciable—physiological varieties.

Mr Geddes's inferences from his experiments are these :—

(1) The starch of the Algæ, when dissolved, passes out into the animal tissues by exosmosis: the animal at the same time possesses much amylolitic ferment capable of converting starch into sugar.

(2) When the Algæ die they are digested by the animal, and so act as a food supply.

(3) When alive the Algæ remove CO_2 and nitrogenous waste, thus performing an *intracellular renal function*—the abundance of these substances probably accelerating, at the same time, their powers of multiplication.

(4) The Algæ evolve oxygen, which in time accelerates the vital processes of the animal, and so functions as stationary hæmoglobin in the blood—a substance that has also been found by Prof. Lankester stationary in the tongue muscles of Mollusca, &c.—('Brit. Assoc.,' 1871, p. 140.)

(5) Since free Diatoms and Seaweeds evolve from 40 to 70 per cent of oxygen, whereas not more than 25 per cent is got from consortial Algæ, it follows that the animals use up part of the oxygen as it is being formed.

(6) There is reason to believe that consortism is favourable in the struggle for existence—inasmuch as Anthea cereus with Algæ is the most common of Sea Anemones, while Radiolaria with yellow cells are more common than those without these structures.

(7) Consortism is important in the economy of nature, "for, since the Radiolarians, and doubtless also, at least to a large extent, the Foraminifera, are thus chiefly maintained, and since they serve as nutriment, directly or indirectly, to most of the higher pelagic animals, the apparently disproportionate abundance of animal life in the open sea becomes no longer enigmatical." It is also to be borne in mind, however, as has been pointed out by Hooker, that in arctic and antarctic regions in particular, the Diatomaceæ, which abound in enormous numbers, afford in a large degree food-material to the surface animals of these regions.

Dr Karl Brandt, in 1883 ('Mt. Zool. Stat. Neapel.'), enunciated the same physiological inferences as Mr Geddes reached, stating—(1) that the assimilation products of living yellow cells partly serve the animals; and (2) that possibly assimilation is more rapid when the Alga is inside the animal, because an abundance of CO_2 is got from the animal—the former of these propositions being based on the action of iodine on Collozoum, small starch granules having been observed in the protoplasm of that organism. These granules were chiefly found on the outer surface of, or in close proximity to, intact yellow cells, and they agreed with the starch granules found in the yellow cells. As to the action of the oxygen that is evolved by the symbiotic Algæ, as affecting the movements of the associated animals, diverse views have been adopted by Mr Geddes and Dr Brandt. The former believes that in sunlight this oxygen causes the animals to move their tentacles as if they were subjected to mild stimulation—too protracted hyper-oxygenation of Radiolarians, however, resulting in sickness or death. Brandt ('Mt. Zool. Stat. Neapel.,' 1883) maintains—

(*a*) That Algæ-bearing Actiniæ, when brought from diffuse to direct sunlight, suffer no irritation *if the temperature is not allowed to rise.*

(*b*) That Actiniæ heated from 26° to 36° C. move more actively, whether the heat be derived directly from sunlight or whether it be artificial heat; and that the same result follows whether Algæ are present or absent.

(*c*) That Algæ-bearing Anthozoa are killed in direct sunlight, not by the oxygen produced, but by heat.

(*d*) That all Algæ-bearing Actiniæ throw off a number of cells when heated to 30° or 35° C., and that the yellow cells so extravasated are capable of development or assimilation.

Of the three classes of green animals, then,—namely (1), those containing green pigment which is not chlorophyll, *e.g.*, Bonellia; (2) those containing chlorophyll in symbiotic Algæ, *e.g.*, Anthea, Radiolaria, &c.; and (3) those provided with intrinsic chlorophyll, such as Hydra and Spongilla,—the latter class still remains shortly to be considered. Various observers have considered the green corpuscles of Hydra and Spongilla, and the results at which they have arrived may be stated thus:—

(1) Professor Semper of Wurzburg ('Animal Life'—"International Scientific Series," p. 73) regards the occurrence of these green bodies in animal tissues as a case "either of parasitism or of a community of two organisms so different as an animal with true tissues and organs and a one-celled plant."

(2) Dr K. Brandt holds the same views as Semper, and bases his belief in their algoid nature on the following considerations:—

(*a*) The green bodies consist of hyaline protoplasm, are provided with a nucleus and curved chlorophyll granule, and are capable of division. The green bodies were isolated by pressure, and their

colour was found not to be of a uniform green hue, but to be modified by the presence of hyaline protoplasm. The nucleus was observed by use of hæmatoxylin as a staining agent. On the other hand, Professor E. Ray Lankester has found, by use of picro-carmine, that no nucleus is determinable.

(*b*) The green bodies survive isolation.

(*c*) Though isolated, they develop starch in sunlight. With reference to this, Professor Lankester points out that it need not imply the existence of symbiotic Algæ, as it would only prove that "a bit of protoplasm, with its associated envelope or cap of green substance, can retain its vital activity, just as a piece of an Amœba can;" and again, Dr Brandt "does *not* state that he observed starch grains in association with the chlorophyll corpuscles, when observed in fresh living cells of Spongilla (or of Hydra)." Moreover, "by removing the chlorophyll corpuscles from the mass of surrounding protoplasm, Dr Karl Brandt has found a method by which the *product of the activity of the chlorophyll corpuscle may be, as it were, forced to remain in the corpuscle,* there being no surrounding protoplasm to take it up and operate further upon it. Hence, possibly enough, we get a deposit of starch grains in the isolated corpuscle, which would never occur in the normal condition, since the product of assimilation is in that condition rapidly diffused, and so removed from the chlorophyll corpuscle"—it may be, to appear as amylum in vacuoles in the adjoining protoplasm of the animal cell.—('Quart. Jour. Micr. Sci.,' April 1882.)

(*d*) Specimens of green bodies from Hydra were taken in and retained by Paramœcium, whereas the green bodies of Spongilla were digested or expelled by Infusors. To this Lankester replies that, "had Dr Brandt's view been confirmed, the green corpuscle ought to have multiplied in its new host;" and even then, this need not indicate any independent nature: they may still be but "parts of the protoplasm of the cell in which they are normally found."

(*e*) The green bodies, on the supposition of their morphological independence, have received from Dr Brandt specific names: those from Hydra are called Zoochlorella conductrix, and those from Spongilla, Zoochlorella parasitica. The facts, however, which are referred to by Professor Lankester—namely, (1) that a cellulose wall is absent from the green corpuscles; (2) that their form is varied; and (3) that their green colour *may be absent* when an irregular angular corpuscle is seen—militate against their being regarded as independent organisms.

(*f*) Dr Brandt, finally, has observed—(1) that Radiolarian colonies do not digest foreign bodies when Algæ (*i.e.*, yellow cells) are present, as he succeeded in keeping them alive in filtered sea-water; and (2) that Spongilla containing green bodies lived in filtered water, but died when removed into a half-darkened spot, and he therefore con-

cludes that the life of the Spongilla depends on the action of the green bodies.

In addition to the destructive criticism given by Professor Lankester of Dr K. Brandt's inferences, Mr Geddes adds—

(*a*) That the green bodies of Spongilla and Hydra are quite unlike any Algæ hitherto described, but closely resemble the chlorophyll granules of plants, both in form and mode of division.

(*b*) That the indigestibility of chlorophyll is quite in keeping with the retention of the green bodies of Hydra which were taken in by Paramœcium.

(*c*) With reference to Brandt's sixth position, while admitting the truth of his statements, he adds that "they constitute an extraordinarily slender foundation for the doctrine of 'symbiosis.' Many Radiolarians can be easily observed to digest foreign bodies; every Sponge, whatever its colour, requires great quantities of thoroughly pure water to keep it alive; while, of course, every one who has worked with living Radiolarians must have felt the necessity of transferring them, when he wished to prolong their life, from the impure water of the 'Auftrieb,' teeming as it is with dead and dying Crustaceans, fragments of Siphonophores, and all manner of other impurities, to pure water."

(3) The general conclusion at which Professor Lankester arrives is, that the green or "chlorophyll corpuscles" of Spongilla and Hydra are equivalent to the chlorophyll bodies of plants, and that they are no more symbiotic Algæ than the "green corpuscles in the leaf of a Buttercup." He accordingly concludes, and his conclusion is endorsed by Mr Geddes, that true chlorophyll may be formed by animal organisms. It is also pointed out that certain angular fragments which are present alongside of the normal chlorophyll bodies in Hydra, as noted by Kleinenberg and Lankester, are inexplicable on the symbiotic theory of Semper and Brandt; and it is further remarked that the angular corpuscles in pale Spongillæ become green by exposure to sunlight. The green corpuscles of Spongilla are for the most part concavo-convex, and sometimes a very large one is found with green colour around its outer margin: they are non-nucleated, and are capable of division. Keller ('Zeit. f. Wiss. Zool.,' vol. xxx.) first detected amylum vacuoles in Spongilla cells near these corpuscles, treatment with iodine producing a beautiful violet colour, which disappeared after the action of KHO, although this coloured substance remained insoluble in absolute alcohol or in water; and it has also been determined that osmic acid (dilute), followed by picro-carmine, produces a red coloration, so that albuminoid material may be present. This starchy solution need not be "identical with vegetable starch. . . . At the same time, it cannot be denied that the probability of the endogenous nature of the chlorophyll corpuscles, and of their non-parasitic character, is greatly increased by the demonstration of the

fact that the Sponge cell is capable of forming amyloid substance, and depositing it in vacuoles in large quantities." It has, moreover, been suggested that this amylum is in some way related to the formation of winter gemmules, to which they may act as a store of food-material, being "most abundant in specimens of Spongillæ which are actually breaking up and dying down at the incoming of winter" (Lankester, 'Quart. Jour. Micr. Sci.,' 1882). In connection with this, the ingenious suggestion of the mechanics of sinking or floating of Radiolarians, given by Mr Geddes, is worth noting: "The starch formed during the morning's exposure to sunshine would increase the specific gravity of the Radiolarian, and so sink it; while its digestion and oxidation would again lighten it," and so cause the animals to float nearer and nearer to the surface of the water.

The analytic method adopted by Dr Geza Entz ('Biol. Centralbl.,' 20th Jan. 1882) for demonstrating the independent nature of some consortial Algæ is especially interesting. He has succeeded in removing green bodies from Infusors, and has traced their development to adult algoid genera—Palmella, Glœocystis, and Pleurococcus; while he has, conversely, observed the entrance of spores of these animals into Infusors. About the same time, Professor Percival Wright ('Nature,' Feb. 1882) also recorded the entrance of Chlorochytrium and other algoid spores into the bodies of animals, having previously (in 1877) suggested a possible relationship to the Lichen-gonidial theory.

Finally, Dr Brandt ('Mt. Zool. Stat. Neapel.,' vol. iv., 1883) has pointed out curious changes of colour observable in the case of consortial Algæ found at different depths. Thus yellowish-green or yellow forms occur in surface animals like Radiolaria, brown forms are found in animals occurring at a slight depth, while red types occur in Phytozoa procured from still greater depths, such as Sponges.

In dealing with the great family of Lichens, so abundantly distributed over every stone and tree, we have again to face commensal problems, although it is only in recent years that the complete relationships of the associated organisms have been fully and securely established. Thirty-five years ago Tulasne sowed Lichen spores, and believed that he detected gonidia forming on the fungoid hyphæ. This same conception was originally held by De Bary in his 'Morphology and Physiology of Fungi,' where he remarks that a lateral branch of the hypha becomes shut off by a wall, and requires chlorophyll, so forming a gonidium capable of subsequent subdivision; although in his 'Handbook of Physiological Botany' (p. 291) his views become modified, Lichens being regarded as the complete fructifying states of plants hitherto called Algæ, or as typical Algæ that become "Lichens" because of the Fungus. The original view of Tulasne was also adopted by Berkeley ('Introd. Crypt. Bot.,' p. 273), and followed by Thwaites. But the researches of Schwendener ('Ueber die Algentypen der Flechtengonidien,' 1869) first demon-

strated that in a Lichen a consortial association is found,—that the Lichen is, in fact, made up of Algæ (=gonidia) belonging to various families (Chroococcaceæ, Nostocaceæ, Palmellaceæ), which agree to act as hosts to ascomycetous Fungi which are never found alone, although the Algæ are capable of existing in a free state, and, when free, of developing normally—that is, of forming zoogonidia or swarm cells, as was first observed by Famintzin and Baranetsky. According to Schwendener, then, the Algæ are merely disturbed in their mode of life, although not destroyed, by the Fungi becoming associated with them. At the same time, however, it is to be borne in mind, as Mr Geddes has suggested, that while the Fungus undoubtedly must obtain its organic food from its tolerant chlorophyllaceous host, by exosmosis of its starch, so that host may derive subsidiary aid from the Fungus by obtaining endosmotically advantage from the nitrogenous waste protoplasmic products of the hyphæ,—just as the symbiotic philozoon is subsidised by similar nitrogenous waste of its consortial animal organism, or as insectivorous plants like Nepenthes, Sarracenia, or Pinguicula are benefited by the nitrogenous products of insect digestion, or sometimes of insect decay.

This Schwendenerian doctrine of the constitution of Lichens has been corroborated by the subsequent synthetic experiments of Bornet ("Recherches sur les Gonidies des Lichens"—'Ann. des Sci. Nat.,' t. xvii., 1873), and Stahl ('Beiträge zur Entwickelungs-geschichte der Flechten,' i., ii., 1877). The former investigator experimented with the common brown-coloured Lichen so abundant on stones about the upper margin of our tidal belt—namely, Parmelia parietina —and found that when Parmelia spores were sown alone, they ramified less and formed no chlorophyll, and that when Protococcus was sown alone, it formed no hyphæ; but when the spores of Parmelia were sown with Protococcus, a Lichen (Parmelia parietina) was the issue. Stahl, in like manner, synthetically produced the Lichen, Endocarpon pusillum, which bore perithecia and spermogonia. It may be further remarked that the final shape which a Lichen assumes may depend on the gonidia (*i.e.*, the Algæ), as in Ephebe, or on the hyphæ, as in Usnea—the latter being the usual type; and that the gonidia and hyphæ may be equally mingled, when the Lichen is said to be "homoiomerous," or the gonidia may be confined to a single layer, as in Sticta, in which case "heteromerous" Lichens are the result.

Mr George Murray has drawn a very interesting parallel between certain consortial relationships found in Physophorid Cœlenterates, such as Velella, and in Lichens. In the former, Algæ occur in the gonophores or reproductive bells, which have been found to be capable of surviving longer—that is, of succeeding better in the struggle for existence—than gonophores devoid of Algæ. So hymenial gonidia—that is, gonidia found in the reproductive cups of such Lichens as Dermatocarpon and Polyblastia—are formed from the

thallus gonidia of the Lichen, and are *cast out along with* the spores of the Fungi, so that when these spores germinate, the hyphæ again enclose the gonidia. In this way, in both the animal and the Lichen, there is a provision by which the symbiotic Algæ are brought into the closest possible relationship with the reproductive cups, and every facility is offered for the continuance of the association through the successive generations. The hymenial layers of the apothecia may be exposed, as in gymnocarpous Lichens, or there may be an encircling perithecium, as in angiocarpous Lichens, and the spores which form in asci by free cell-formation escape by a small orifice at its extremity, that escape being effected by rupture of the ascal wall, brought about by swelling resulting from the penetration of moisture to the hymenium.—('Encyc. Brit.,' 9th edit., Art. "Parasitism.")

The only other point that may be noted in connection with Lichens is that their multiplication is sometimes effected by *soredia*, in which case one or several gonidia become surrounded by definite hyphæ, the gonidia divide, and the cortex of the parent ruptures, so that the soredia escape, and finally develop into a new Lichen. This type of multiplication is, from a symbiotic standpoint, closely correlated with the contemporaneous escape of fungoid spores and gonidia from the hymenial region of the reproductive cups of Lichens, and in a similar way corroborates the intimacy of the association of the algoid and fungoid constituents—an association which is capable of being prolonged through many generations without the production of any manifest pathological changes on either side.

XIV.—THE NUTHATCH (SITTA EUROPÆA).

By Mr A. B. HERBERT, President.

(*Read March* 27, 1884.)

This pretty bird, with its peculiar and amusing habits, has always been a favourite with me from my youth. The male and female are much alike in colour, the back and head being of a delicate ash shade, approaching to pale blue; the under parts cloudy white, with a slight roseate tint and marks of brown. Meyer's illustration before you gives a very fair idea of the bird. It is an extremely rare bird in Scotland, and I expect also in the north of England, for had one of such colours and habits been common in Yorkshire, it would not have escaped the acute observation of Waterton. It is very local in its habitat, for on the west side of my native town of Coventry, especially in the old avenue at Allesley Hall, I seldom failed

to see them when I wished; while on the eastern side of the town they were seldom met with. Of late years, however, I am happy to say they have become far more common in Warwickshire, and on my annual visit there I invariably notice them. When at school I learnt to imitate the singular call-note of the Nuthatch so exactly, that I could often induce it to answer me.

The food of the Nuthatch consists of nuts and filberts, caterpillars, insects, berries, hard seeds, and beech-nuts. Bewick mentions it as also fond of picking bones; and a lady friend in Hertfordshire who is in the habit of throwing Indian corn down for her poultry, informs me that she has frequent and welcome visits from a Nuthatch, which fixes the grains of Maize in the rough bark of a tree and pecks them to pieces. In the autumn nuts form the principal and most attractive food of the Nuthatch, and the method of extracting the kernel is at once quite unique and interesting. I was always careful in England to have some nuts left on my bushes for the especial use of the Nuthatch, and never tired of noticing his proceedings. The nut was carried by the bird to the stem of a tree having rough bark, and inserted, with the point of the nut outwards, in a fissure of the bark. The bird would then creep round the nut with his peculiar short jumps till he had a good position for the attack, usually with his head downwards. I think it would be in vain for it to attempt to break a nut by the mere use of the cervical sinews; but making his neck rigid and in a line with his body, with the beak at right angles, and the sharp claws as a fulcrum, the bird for the time assumes the form of a small pick or hammer, and pegs away with all his weight and might at the pointed end of the nut, where the shell is thinnest, and the noise of this pretty hammer I have heard at a considerable distance. It has been stated that the bird can in this way penetrate the hardest nut, but this is not strictly true, for I have more than once seen it fail, and well remember, as a boy, carrying one of these failures for some time in my pocket, with numerous marks of the bird's bill on the pointed end. I never knew it break a nut which contained no kernel, and I suppose the hollowness of the sound would at once indicate that its labour would be unproductive. I once saw the rough bark of an Elm near some Beeches entirely studded in every crevice with the shells of beech-nuts, evidently the work of the Nuthatch. The late Rev. W. T. Bree of Allesley records an instance of one of these birds being caught in a common brick-trap; and so persistent was it in hammering the bricks in its efforts to escape, that when found the point of its bill was quite worn away. I also heard of one being placed in an ordinary cage, which kept up a continuous attack on the woodwork for hours, till some one remarked that he feared he was making his coffin, which proved only too true, as in the morning the poor bird was found dead in the cage. But though

Nuthatches are very impatient of restraint when captured at maturity, they will become quite tame if taken young and brought up by hand. They are most amusing pets, running over their owner in all directions, up and down his body and limbs, poking their bills into seams and holes as if in search of food upon some old or rent tree, and uttering during the time a low and plaintive cry. The Nuthatch flies from tree to tree in short spasmodic jerks, and its mode of progression on the trees is very dissimilar from that of the common Creeper (*Certhia familiaris*). The latter uses its stiff tail as a support in climbing; the Nuthatch never does, but, clinging with its tenacious claws, it creeps by short jerks forwards and backwards and sideways with the greatest facility. The nest of the Nuthatch is often a hole made by the Woodpecker; and if the orifice is too large to be readily defended, the bird plasters part of it up with mud, and a hole thus diminished is always a safe find of a Nuthatch-nest to bird-nesting boys. These birds seem to have very little fear of mankind, and to be utterly regardless of his near approach, for they will hunt over the stems of trees for food and break nuts while an onlooker stands only a few yards away. I much regret that this bird, which remains with us in England throughout the year, is almost unknown in Scotland. We should all welcome its cheery note and amusing habits on our summer excursions. It has a wide range on the Continent. Two years ago, during a walk before breakfast at Thun, in Switzerland, I saw seven or eight of them; and I noticed one also at Lauterbrunnen, so that in that vicinity it cannot be a rare bird. There are many familiar rural spring sounds in England which one misses on coming to Scotland. I would instance the "chaff" of the Chiff-chaff, the laugh of the Yaffle, the charming and varied melody of the Nightingale, the plaintive whine of the Wryneck, the purring murmur of the Turtle, the shriek of the brilliant Kingfisher, and the whistle of the pretty Nuthatch, all of which would probably be heard at the end of April in the course of a five-mile walk in Warwickshire.

At this meeting the Rev. R. F. Colvin read a short paper on the Palms of India, which was illustrated by specimens obtained from the Royal Botanic Garden.

MEETINGS OF MICROSCOPIC SECTION.

At a meeting of the Club, held on the 26th October 1883, it was agreed to hold a series of meetings, during the winter months, for practical work with the microscope. Five such meetings were held,

which met with great acceptance, and were most numerously attended. At the first meeting, Dr J. M. Macfarlane was chosen President of the section, and the following is a sketch of the work done at the meetings :—

The method of cutting and staining vegetable sections, and mounting the same in Glycerine Jelly, Acetic Acid, and Canada Balsam, was demonstrated by Dr Macfarlane and Mr A. D. Richardson; and Mr John Heggie showed and explained the extraction, preparation, and mounting of molluscan palates.

At the fifth meeting of the section, Mr A. Frazer, M.A., optician, submitted a short paper descriptive of the various methods of micrometrical measurement. It was explained that the process is essentially the same as that followed in measuring the length of any substance by means of a foot-rule. The process was illustrated in a variety of ways. The construction of stage and eye-piece micrometers having been explained, the method of using them was demonstrated by measuring a blood corpuscle. It was also shown that the most convenient method of micrometrical measurement is that of using a stage-micrometer in conjunction with a camera-lucida. The action of the camera-lucida having been explained, Beale's method of using a sheet of paper divided into squares of a determined micrometrical value was also demonstrated, and the size of a blood corpuscle measured when its image was thrown upon the intersecting squares.

A short discussion followed, in which Mr Forgan, Mr Charles Fraser, and others, took part.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Club was held on the evening of the 29th November 1883. The Secretary and Treasurer presented a brief report of the work done during the previous Session; and also submitted his Financial Statement, which was approved of. The various Office-bearers were elected, and the list for Session 1883-84 stands as under, viz. :—

President.—A. B. Herbert. **Vice-President.**—P. B. Gibb.

Council.

T. B. Sprague.	Robert Thomson.	John Walcot.
John Heggie.	George Bird.	Symington Grieve.
Chas. F. Robertson.	Robert Stewart.	Geo. L. Brown.
W. Tait Kinnear.	Dr L. Dobbin.	Chas. Fraser.

Secretary and Treasurer.—Andrew Moffat.

Auditors.—Alex. Matheson; J. A. Brodie.

The Financial Statement showed an income, including balance from previous year, of £57, 11s. 5d., and an expenditure of £32, 14s. 4½d., leaving a balance in favour of the Club of £24, 17s. 0½d.

The following meetings were held during Session 1882-83—viz.: *Evening Meetings*—27th Oct. 1882, First Evening Meeting; 23d Nov., Annual and Second Evening Meeting; 22d Dec., Third Evening Meeting; 25th Jan. 1883, Fourth Evening Meeting; 22d. Feb., Fifth Evening Meeting; 22d March, Sixth Evening Meeting; 13th April, Conversazione. *Field Meetings*—24th Feb., Arniston; 21st April, Roslin; 28th April, Ratho; 5th May, Straiton; 9th May, East London Street, Edinburgh; 12th May, North Berwick; 19th May, Linlithgow; 26th May, Glencorse; 2d June, Gosford; 9th June, Arniston; 16th June, West Linton; 20th June, Salisbury Crags; 23d June, Winchburgh; 30th June, North Queensferry; 4th July, Blackford Hill; 7th July, Balerno; 14th July, Inchkeith, and Dredging in the Firth; 18th July, Blackhall; 8th Sept., Colinton; 15th Sept., Morrison's Haven,—in all, 27 meetings, with an aggregate attendance of 991, which gives an average of nearly 37 at each meeting. During the Session, 10 names have been withdrawn from the roll, and 46 new names have been added, making a net increase of 36.

I.—FIELD-NATURALISTS.

By Mr A. B. HERBERT, President.

(*Read Nov.* 27, 1884.)

By your favour, I once more have the honour of appearing as President of your Club, and I have much pleasure in again congratulating you on our continued prosperity. We were never so numerous a body as at the present time, and we will hope that we shall keep pace with the times in intellectual progress and development. The principal innovation we have made during the past year was the institution of winter meetings for microscopical work, and it is gratifying to know that these meetings, under the able presidency of Dr Macfarlane, so efficiently supported by many other members, have been well attended and most successful. Our summer excursions were also numerously attended and much enjoyed. There is, as I trust there ever will be, one pre-eminent characteristic of our Club—namely, the good-fellowship and unalloyed harmony prevailing amongst us, which I attribute in no small degree to the humanising and genial influence we derive from admitting lady members to the Club, some of whom are excellent field-naturalists.

By "field-naturalists," in the general acceptation of the term, we understand those lovers of nature who take delight in observing the habits and instincts of animals, the beauties and varieties of our flora, the formation and stratification of the rocks, and the vast wonders of the mineral kingdom; and we add also those who, by the aid of the microscope, investigate the minute forms of animal and vegetable life, and by careful scientific research elucidate many important discoveries.

Some comprehensive minds acquire knowledge in many branches of natural history, but the majority are content with taking up one or two subjects, and making these a hobby or speciality,—and I would here remark that a man who has no hobby in life connected with objects of nature is, in my opinion, one not to be envied; for of what a large amount of pleasure and innocent gratification is he not deprived in his daily walks or drives! A wealthy manufacturer recently told me that by sticking too closely to business in early life, and not observing natural objects and occurrences around him, he was convinced he had deprived himself of an endless amount of real enjoyment. Half a century ago, a person seen gazing for any

length of time at a bird or insect, or gathering and examining a weed, or breaking rocks and stones, was looked upon rather as a naturalist with the three last letters omitted, or, as they say in Scotland, "daft"; but now happily all this is changed, and any one pursuing these inquiries in the present age is not considered absolutely insane. It is true he may, under certain circumstances, run the risk of being considered a poacher, as occurred to a gentleman well known to many of us last summer. He wished to ascertain some details respecting the habits of birds near the Pentlands, and for this purpose, in Izaak Walton's words, he "prevented the sunrising," and just at dawn found himself suddenly confronted by a sturdy keeper, who exclaimed, with an air of evident disappointment, "Oh, it's you, is it! why, I have been watching you for the last half hour through the mist, in the hope that I was about to nail a poacher."

I purpose in these remarks to consider field-naturalists and their work, and to take as types of a class Gilbert White and Charles Waterton; and if I were to name a living author whose example we should do well to follow, it would be pre-eminently Sir John Lubbock, for it is impossible for any one to read his recent remarks on insects without being forcibly impressed by the indomitable patience and perseverance which characterised his researches, and how, in order to ascertain with accuracy any particular fact, he closely watched for hours and days the actions of the creatures who were then the subjects of his investigations. The discoveries and theories of Darwin would well occupy a whole evening or more, and may perhaps appropriately form the subject of some future president's address. Frank Buckland, too, has written much that is novel and instructive.

The first book I ever purchased with my scanty pocket-money, when nine years old, was a very minute and portable edition of 'The Compleat Angler,' often at that time perused in many a picturesque spot beside a midland stream, while waiting for a nibble by Perch or Gudgeon. My second purchase, a few years later, was White's 'Natural History of Selborne,' which I well remember I read with great delight and interest. It was kept under the school-desk on a ledge constructed for a slate, whence it could be furtively slipped out and placed open over a Latin dictionary, and perused, as Hood expresses it, "by stealth 'twixt verb and noun." There were three other boys at the same desk who heartily joined me in notices of natural objects, and we were in the habit of discussing any incident which occurred in our half-holiday rambles, often referring to White's 'Selborne' for confirmation of our remarks. I have met with all these three boys in after-life, and with the same good-fellowship which existed at school. One is now a dean; another a rector; and the third, a quiet but plucky boy, afterwards

led a body of Highlanders up the heights of Alma, and was "winged" in the Indian mutiny,—an event, he says, much regretted, because it obliged him ever after to play cricket with only one arm. He became *aide-de-camp* to the Queen, and a C.B., and now stands high in the service, and has recently written an autobiography in two portly volumes, designated 'The Life of a Soldier.' But he was ever mindful of his happy school-life, and I see in his book he refers to our kind-hearted master, and mentions me as one of the companions of his youth.

Gilbert White was born in 1720 at Selborne, a village near Wolmer Forest, a secluded and picturesque spot in the eastern corner of Hampshire. Wolmer is a corruption of Wolfmer, in the same way that we have Cranmer and Hogmer, all after animals since become extinct in these islands,—namely the Wolf, the Crane, and the Hog or wild Boar. After a school career at Basingstoke, White became a student at Oriel College, Oxford, where he graduated in 1743. He was elected a Fellow of his College in the next year, and was one of the senior proctors of the University in 1752. I need scarcely remark that he was always an ardent lover of nature. He was curate of Farringdon for eighteen years, when he accepted the same office in his native village of Selborne, where in patient observation and careful recording of facts and phenomena in natural history, he passed the remaining years of his tranquil and uneventful life. He was often offered Church preferment, which would have added much to his pecuniary emoluments; but this he always declined, from his strong attachment to his native village and its surroundings, and felt that he should better consult his happiness by remaining the quiet, unassuming, but very observant country curate, than by going to a populous locality where his favourite pursuits could not be followed. And we well believe he was right, for had he accepted the offered preferment, White's 'Selborne' would never have been written, to become, as it has, the charm and delight of future generations.

There is no portrait existing of Gilbert White. He is described by one of his parishioners as a little, slim, prim, upright man: another says he was thought very little of till he was dead and gone, and then he was thought a great deal of; that he was a quiet old gentleman, with very old-fashioned sayings; that he was extremely kind in giving presents to the poor, and that he used to give a number of poor people a goose each every Christmas. He died at Selborne unmarried in 1793, and his last illness must have been of short duration, for there is a certificate of death signed by him as curate on the 10th June, and he died before the expiration of that month. He suffered at times from deafness, and he laments this affliction, in a letter dated 1774, thus: "Frequent returns of deafness incommode me sadly, and half disqualify me for a natural-

ist; for when these fits are upon me I lose all the pleasing notices and little intimations arising from rural sounds; and May is to me as silent and mute, with respect to the notes of birds, &c., as August;" and he quotes Milton's words—

"Wisdom at one entrance quite shut out."

The well-known 'Natural History of Selborne' was first published in 1789. It consists of a series of letters extending over a period of twenty years, the first letter being written when White was about forty-five years old. The letters were addressed to Thomas Pennant and the Hon. Daines Barrington,—written with so much enthusiasm, painstaking accuracy, and simplicity of style, that White's 'Selborne' became, what it still remains, one of the standard popular favourites, "without which no English library is complete." The edition in two volumes is the most perfect and charming one which has been published: it is edited by the late Frank Buckland. The illustrations of those picturesque spots so often mentioned by White—as the Hanger, the Plestor, and the rocky lane—are beautifully executed; but I consider many of the illustrations of birds are not so true to nature as those of Yarrell or Bewick. After White's death his house became for many years the charming residence of Professor Bell. The Plestor or Pleystow, in the centre of the village, signifies a playing-place or playground. In the midst of the Plestor stood in old times a vast Oak, with a short squat body and huge horizontal arms, extending almost to the extremity of the area. This venerable tree, surrounded with stone steps and seats above them, was, we are told, the delight of old and young, and a place of much resort in summer evenings, where the former sat in grave debate, while the latter frolicked and danced before them.

I have never visited Selborne, but it is spoken of by Buckland as a very pretty place—a perfect type of English woodland scenery and country life. It can be reached from London in two hours by rail, and a five-mile walk or drive from Alton station; and the village is very little altered since White's time. I wish it were within easy reach of our Club.

White's style of writing is clear, concise, painstaking, and accurate, and he is most careful always to distinguish the record of a fact as the result of his own observation from what has been communicated to him by others. The naturalist's calendar contained in White's work is most copious and useful: it is a record of occurrences noticed by White in Hampshire, and by William Markwick in Sussex, placed in two columns, and records the arrival and departure of migratory birds, the dates of nidification of these and others, the appearances of insects, and the dates of flowering of many of our wild plants. It is remarkable that the dates of the ar-

rival of our summer migrants are all much earlier than our experience here would lead us to expect, making, of course, due allowance for the difference in latitude—though 500 or 600 miles is really not a matter of much time to a Swallow, whose rate of flight must be fully equal to that of the fastest express train. White gives the Sand-martin, March 21; the Swallow, March 26; and the House-martin, March 28.

White had peculiar views on migration, and never quite abandoned the idea that some of the Swallow kind hibernated here. I will give two brief extracts in confirmation of this. Speaking of the House-martin, he says: "I see by my Fauna of last year that young broods came forth as late as September 18. Are not these late hatches more in favour of hiding than migration?" Again he says, addressing Mr Pennant: "I quite agree with you that though most of the Swallow kind may migrate, yet that some do stay behind and hide with us during the winter."

It would occupy too much of our time to give many extracts from White's writings. I will therefore give you only two—one illustrative of his graphic and easy style, and the other where he puts his thoughts into verse. The first is his description of the nest of the Harvest-mouse (*Mus messorius*)—and we must remember that he was the first to call the attention of naturalists to this, the smallest of British quadrupeds, as a distinct species. He says:—

"Two of them, in a scale, weighed down just one copper halfpenny, which is about the third of an ounce, so that I suppose they are the smallest quadrupeds in this island. A full-grown *Mus domesticus* weighs one ounce lumping weight, which is more than six times the mouse above." "One of the nests of these small mice I procured this autumn, most artificially platted, and composed of the blades of wheat; perfectly round, and about the size of a cricket-ball; with the aperture so ingeniously closed that there was no discovering to what part it belonged. It was so compact and well filled that it would roll across the table without being discomposed, though it contained eight little mice, which were naked and blind. As this nest was perfectly full, how could the dam come at her litter so as to administer a teat to each? Perhaps she opens different places for that purpose, adjusting them again when the business is over: but she could not possibly be contained herself in the ball with her young, which moreover would be daily increasing in bulk. This wonderful procreant cradle, an elegant instance of the efforts of instinct, was found in a wheat field suspended in the head of a thistle."

As a specimen of White's verses, I give you—

THE NATURALIST'S SUMMER-EVENING WALK.

"When day, declining, sheds a milder gleam,
What time the May-fly haunts the pool or stream;
When the still Owl skims round the grassy mead,
What time the timorous Hare limps forth to feed.

Then be the time to steal adown the vale,
And listen to the vagrant Cuckoo's tale;
To hear the clamorous Curlew call his mate,
Or the soft Quail his tender pain relate;
To see the Swallow sweep the dark'ning plain
Belated, to support her infant train;
To mark the Swift in rapid giddy ring
Dash round the steeple, unsubdued of wing:
Amusive birds! say, where your hid retreat,
When the frost rages and the tempests beat?
Whence your return, by such nice instinct led,
When spring, soft season, lifts her bloomy head?
Such baffled searches mock man's prying pride,
The God of Nature is your secret guide!
While deep'ning shades obscure the face of day,
To yonder bench, leaf-sheltered, let us stray,
Till blended objects fail the swimming sight,
And all the fading landscape sinks in night;
To hear the drowsy Dorr come brushing by
With buzzing wing, or the shrill Cricket cry;
To see the feeding Bat glance through the wood;
To catch the distant falling of the flood;
While o'er the cliff th' awakened Churn-owl hung,
Through the still gloom protracts his chattering song;
While, high in air, and poised upon his wings,
Unseen, the soft enamoured Woodlark sings:
These, Nature's works, the curious mind employ,
Inspire a soothing melancholy joy:
As fancy warms, a pleasing kind of pain
Steals o'er the cheek, and thrills the creeping vein!
Each rural sight, each sound, each smell combine;
The tinkling sheep-bell, or the breath of kine;
The new-mown hay that scents the swelling breeze,
Or cottage chimney smoking through the trees.
The chilling night-dews fall: away, retire,
For see the Glow-worm lights her amorous fire."

I thus conclude my remarks on Gilbert White, and will now proceed to the consideration of the life and writings of Charles Waterton. Of Charles Waterton we know far more than we do of Gilbert White, because he published an autobiography, and it is a very interesting and amusing one. And he also has a good biographer in Mr Norman Moore. He was born on the 3d June 1782, and in the year 1837 he thus describes himself:—

"I was born at Walton Hall near Wakefield, in the county of York, some 55 years ago. This tells me I am no chicken; but were I asked how I feel with regard to the approaches of old age, I should quote Dryden's translation of the description which the Roman poet gives us of Charon—

'He seemed in years, yet in his years were seen
A vernal vigour and autumnal green.'

In fact, I feel as though I were not more than 30 years old. I am free from rheumatic pains, and so supple in the joints that I can climb a tree with the utmost facility. I stand six feet all but half an inch. On looking at myself

in the glass, I can see at once that my face is anything but comely: continual exposure to the sun and to the rains of the tropics has furrowed it in places, and given it a tint which neither Rowland's Kalydor nor all the cosmetics of Belinda's toilet would ever be able to remove. My hair, which I wear very short, was once of a shade betwixt brown and black: it has now the appearance as though it had passed the night exposed to a November hoar-frost. I cannot boast of any great strength of arm, but my legs, by much walking and frequently ascending trees, have acquired vast muscular power; so that on taking a view of me from top to toe, you would say that the upper part of Tithonus was placed on the lower part of Ajax; or, to speak zoologically, were I exhibited at a horse-fair, some learned jockey would exclaim, 'He is half Rosinante and half Bucephalus!' By giving this description of myself, it will prevent all chance in future of the nondescript's portrait in the 'Wanderings' being taken for my own."

This latter remark requires some explanation. Waterton had often severely criticised the very defective manner in which the skins of animals are stuffed for our national museums; and to show that a skin may be so prepared as to resemble almost anything, he stuffed a monkey's or some other skin so that it bore some faint resemblance to a human being, and this "nondescript," as he terms it, was figured in the 'Wanderings,' and a worthy Yorkshire baronet, on taking up the book and showing the frontispiece to his friends, said, "Dear me, what a very extraordinary-looking man Mr Waterton must be!" Waterton and all his family for generations were strong adherents of the Romish Church, and after a few years at a preparatory school near Durham, he went to the Jesuit college at Stonyhurst, and always looked back upon the time he spent there with a feeling of great respect and veneration for the Fathers of the Church who were his preceptors. He tells us that at college he soon became noted for his knowledge of the habits and instincts of animals, and was by common consent considered rat-catcher, fox-taker, and foumart-killer to the establishment. He says:—

"Moreover, I fulfilled the duties of organ-blower and football-maker with entire satisfaction to the public. I was now at the height of my ambition. I followed up my calling with great success. The vermin disappeared by the dozen; the books were moderately well thumbed; and, according to my notion of things, all went on perfectly right. The day I left the Jesuit college was one of heartfelt sorrow to me."

At Stonyhurst there are boundaries marked out for the students which they are not allowed to pass, and just outside the boundary was a very extensive labyrinth of Yew and Holly trees. This place was a great attraction to Waterton, as it was a chosen place for animated nature. He says:—

"Birds, in particular, used to frequent the spacious enclosure, and many a time have I hunted there the Foumart and Squirrel. I once took a cut through it to a neighbouring wood, where I knew of a Carrion-crow's nest. The prefect missed me, and judging I had gone into the labyrinth, gave chase

without loss of time. After eluding him in cover for nearly half an hour, being hard pressed I took down a hedgerow. Here he got a distant sight of me; but it was not sufficiently distinct for him to know for a certainty that I was the fugitive. I luckily succeeded in reaching the outbuildings which abutted on the college. I had just time to enter the postern gate of a pig-sty, when, most opportunely, I found old Joe Bowren bringing straw into the sty. He was more attached to me than to any other boy, for I had known him when I was at school in the north, and had made him a present of a very fine terrier. 'I've just saved myself, Joe,' said I; 'cover me up with litter.' He had barely complied with my request when in bounced the prefect. 'Have you seen Charles Waterton?' said he, quite out of breath. My trusty guardian answered, in a tone of voice which would have deceived any one, 'Sir, I have not spoken a word to Charles Waterton these three days, to the best of my knowledge.' Upon this the prefect went his way, and when he had disappeared I stole out of my cover strongly perfumed."

After leaving college Waterton spent some time on the Continent, and it was when sailing from an English port that the following incident occurred, which speaks well for Waterton as a generous-hearted man, and capable of using his good sense with promptitude on an emergency. A Scotch brig, bound for Vigo, was sailing from the same port at the same time as the vessel containing Waterton, and he learned from one of the sailors that the mate of the brig was in a conspiracy to murder the captain and run away with the vessel. Waterton questioned the sailor very minutely, and satisfied himself that the captain of the brig was in imminent danger; and he determined, if possible, to thwart the rascal's design. So he committed the sailor's statement to writing, and enclosed it in a bottle, then hailed the captain of the brig soon after leaving the port, and threw the bottle on the quarter-deck. The captain took it below, and soon returned on deck and made a very low bow to express his gratitude for the timely warning.

Waterton made four voyages to America, and afterwards wrote the 'Wanderings'—a very interesting work to naturalists, and which brought him into much public notice. He greatly delighted in observing the habits of birds, and other animals new to him, in the primeval forests of Demerara. He afterwards wrote an autobiography, extending over a large portion of his long life, and subsequently his 'Essays on Natural History.' These essays are to a student of nature most attractive reading, for Waterton had opportunities of carrying out his observations which few possess.

Walton Hall, near Wakefield, his ancestral home, is situated on an island in a picturesque lake, the access to the house being by a drawbridge. All animals, with one notable exception, were strictly protected; and from the windows, with the aid of a telescope, he could notice the habits of the wild-fowl on the lake, and the various other creatures under his protection,—and the result of these observations form the subjects of the Essays. Waterton's descriptions

are always graphic and simple, and his style pleasing; and it has been remarked that his Essays may very appropriately take their place beside White's 'Selborne.' The exceptional animal to which Waterton would give no protection, but with which he carried on war to the knife, was the common Brown Rat—an animal, as we know, not indigenous to these islands. Waterton asserts with great confidence that the same vessel which brought over William III. brought also the Hanoverian or Norway Rat, and he looked, as a Catholic and naturalist, on both arrivals as unmitigated evils.[1]

Waterton was very severe in his criticism of Audubon's account of the Passenger-pigeon, endeavouring to show that the latter's statement of the enormous congregation of these birds was a gross exaggeration. But after an assemblage I once witnessed of our common Starling, I can believe much of Audubon's essay. There is a place in my native county where the public road is separated from a small lake by a narrow belt of plantation, and at this part of the lake is a large bed of reeds—a favourite roosting-place for Starlings in the winter. Some years ago, about Christmas, I was passing this spot at sunset, on a calm evening, when, all at once, I heard what I supposed to be a rush of wind through the trees, and immediately a black cloud seemed to come over, making it very perceptibly darker. I looked up, and the sight which I then witnessed was one never to be forgotten. A cloud was indeed passing over, but it was not one of vapour, but a very dense one of Starlings, and the noise, as I supposed of wind, was made by the wings of the birds as they rose from the reeds. Above and all around me in the air, covering a large area, there was nothing to be seen but Starlings, and I can say with perfect truth that they darkened the air. No doubt we have all seen such large flocks, but this was evidently all the flocks from the country round met together, and it would be impossible for me to form at all an adequate estimate of numbers; and after witnessing this, I could not help thinking Audubon's account of the Passenger-pigeon might not be so improbable or impossible as Waterton would wish us to believe. Waterton on some questions in Natural History takes up a position which to my mind is untenable, though I should maintain on the whole that he was a most careful and accurate observer. He always denied the utility—nay, the existence—of the oil-gland in birds; and his reasoning on the subject is to me very unsatisfactory. I imagine no one can watch carefully the habits of our common Duck without being convinced that Waterton was wrong. Daily do I observe my beautiful little Call-drake pinch this gland with

[1] From information which has recently reached us, it appears that the Norway Rat has been unfortunately allowed to gain a footing in New Zealand, and is treating the indigenous New Zealand Rat as it did our Black Rat, rendering its extermination almost a certainty.

his mandibles, then preen his feathers, and roll his brilliant green head on the gland; and I cannot believe that these acts are without effect on the plumage.

Waterton's strong attachment to the Romish Church is manifest in almost all his writings; and he never forgave Oliver Cromwell for breaking down the drawbridge at Walton Hall, and firing musket-balls into the old oaken gates. He tells us these balls are still there; and that Cromwell, not being able to get in, carried off everything, in the shape of horses and cattle, which his men could lay their hands on. Waterton occasionally uses strong language when he speaks of controversial theology. He says he would rather run the risk of going to hell with St Edward the Confessor, the Venerable Bede, and St Thomas of Canterbury, than make a dash at heaven in company with Harry VIII., Queen Bess, and Dutch William.

It was a matter of extreme regret to Waterton, as it is to many of us, that all rare birds which appear here should be at once slaughtered and become specimens for our museums, and that we should now have to visit Holland to see the true habits of the Stork, or roam through Germany to enjoy the soaring of the Kite. It is now about forty years ago since I stood at the Devil's Bridge in Wales, and watched for some time the graceful gyrations of this splendid Hawk: I fear it would be difficult now to see one in all the Principality. And when recently, at Basle, a Stork flew by my bedroom window to his nest on a housetop, and was seen afterwards walking about in a field close to some peasants, it was, I confess, with a feeling of shame that I thought of our treatment here of these and so many other beautiful birds.

One of Waterton's visits to South America was undertaken mainly to procure the wourali poison with which the natives poison their arrows, and which, it was supposed, from its peculiar properties, might prove an efficacious remedy for those dreadful maladies, tetanus and hydrophobia. His experiments with this on three quadrupeds showing manifest symptoms of rabies were successful in two cases, failing in one; and Waterton was very desirous of trying the effect on a human being—offering to travel any distance to administer it, if telegraphed for. It is unfortunate that he was never able to ascertain its efficiency in this respect, for in the only instance in which he was summoned, the patient died before his arrival.

Both White and Waterton had observed that, in their respective localities, the Rooks in the several rookeries had some favourite resort for roosting in the winter. In the neighbourhood of Selborne, White tells us, they retired for the night to the beechen woods of Tisted and Ropley. Waterton says that in his neighbourhood they roosted in the woods of Nostell Priory. In Warwickshire they

go to the woods of Combe and Packington; and on the south side of Edinburgh, where there are many small rookeries, I believe they go to Dalkeith, for I have often observed them coming from that direction about sunrise.

One of Waterton's favourite birds was that most useful but persecuted bird the Barn-owl, for which he had constructed a nest in a ruined tower. He afterwards increased the number of nests to four, and, at the time he wrote, he hoped to have nine broods of these birds on his property. He says: "This pretty aërial wanderer of the night often comes into my room on wing so soft and silent that he is scarcely heard. He takes his departure by the same window at which he had entered." Waterton observed that these most valuable birds brought a mouse to their young every twelve or fifteen minutes. In his protection of the Barn-owl, Waterton found a warm sympathiser in his friend and correspondent, Alfred Ellis of Belgrave, in Leicestershire—all bird-life being protected there, as it was at Walton; and I chance to know, from some of his nearest relations, that there could scarcely be a more truly humane and kind-hearted man than the owner of Belgrave.

At Walton Hall there is a very extraordinary instance of the power of arboreal growth. Near the ruins of a mill a millstone seventeen feet in circumference had been left for some years, and a Nut-tree grew through the centre hole. Waterton would not have this disturbed, and the tree grew year after year till it filled up the hole in the centre, and then gradually began to raise the stone from its bed; and when Waterton wrote, the stone was eight inches above the ground, and entirely supported by the tree, which had grown to the height of twenty-five feet, and bore excellent fruit. Strangers often inspected this curiosity, and Waterton remarks that he never passed without its reminding him of poor old John Bull with a weight of eight hundred millions of pounds round his galled neck. It was a great pleasure to Waterton to walk with visitors over his domain, especially to such as took an interest in bird life, and show them the numerous living creatures under his protection,—not forgetting the hole in the old gateway with pendent ivy over it, which he constructed for the Barn-owl to rear her annual brood; or the twenty-four holes in the same erection made by him for the twenty-four pairs of Starlings which annually built there.

Waterton was a thorough enthusiast in his study of nature. Some years ago, on inquiring of an intimate friend of his what he was doing, he told me that information had reached Walton that a quadruped new to science had been discovered on the lower Nile, and that Waterton had at once started for Egypt to see it. He was most courageous under pain. He once had his finger shattered by a gun accident, and he gathered together the shattered tendons,

bound up the same, and then bled himself. He was a strong advocate for phlebotomy in all cases of fever, and always carried a lancet. He says he had been bled 110 times, in 80 of which he performed the operation on himself. Waterton's marriage was a very happy one, but unfortunately his wedded life was of short duration, for his wife died soon after giving birth to his only child. It was remarked that he never spoke a word to any one for a week after her decease. The old Squire, as he was called, died at Walton Hall in 1865, at the venerable age of 83, from the effects of an accidental fall while walking with a friend. He was, by his own desire, buried in a picturesque spot between two grand old Oaks on his estate, where in the previous year he had erected a plain stone cross. I need scarcely add that he was much and deservedly respected and beloved.

Gilbert White's writings are so universally known and appreciated, that they require no eulogium from me; but Waterton's are not so extensively read as they deserve. In both cases they are the productions of true field-naturalists, and well worthy of close perusal. My remarks on these two eminent field-naturalists have necessarily been of a sketchy character, for in an address of this kind it is impossible to do adequate justice to them. They had much in common—much that was diverse. The one, the quiet, patient, and benevolent country curate, carefully recorded everything interesting in animal life which he saw around him: the other, a more enterprising spirit, sought adventure and information in the primeval forests of South America. Both were thoroughly imbued with a love of nature, and a desire to see greater kindness and humanity practised in our treatment of animals; both were generous to the poor, and active in relieving distress. I venture to think we may derive much benefit and advantage from a more intimate study of the lives and writings of Gilbert White and Charles Waterton.

II.—NOTE ON THE DISTRIBUTION OF HONEY-GLANDS IN PITCHERED INSECTIVOROUS PLANTS.

By Mr JOHN LINDSAY.

(*Read Nov.* 27, 1884.)

At the close of Mr Richardson's paper on "Carnivorous Plants," read before the Club last session, it was remarked regarding these plants that "even more startling facts than any yet discovered

may some day be brought to light." It was then little thought, doubtless, that one such discovery would soon be made, and by a member of this Club. I refer to the interesting fact, just made known by Dr Macfarlane, that in the genus Nepenthes—the well-known Pitcher-plant—not only is honey secreted by the inside of the lid and the mouth of the pitcher, as we already knew, but the *outer* surface of the pitcher, as well as that of the lid, also possesses honey-glands. Further, the whole so-called "leaf," or expanded lamina, including the thong-like prolongation of the midrib to the end of which the pitcher is attached, may be regarded as a complete insect-lure, seeing it also is found to be studded with honey-secreting glands, thus presenting to unwary insects a long but pleasant passage to the cavity of the pitcher below. The stem, too, was found to possess glands for honey secretion—in some species to a greater extent than in others. On the Curator of the Royal Botanic Garden drawing Dr Macfarlane's attention to the viscid nature of the fluid secreted by Nepenthes when flowering, it was found that this also was a honey secretion, and glands were discovered to be present on the upper epidermis of the sepals. Dr Macfarlane then made a minute examination of the other three genera of pitchered insectivorous plants at present in cultivation—viz., Sarracenia, Darlingtonia, and Cephalotus—with the result that substantially the same condition of things was found to subsist in them all. The Pitcher-plants may thus be regarded as ingenious mechanisms for first attracting insects, in order to receive their aid in fertilisation; and next, for the capture of these insects, and their subsequent appropriation for purposes of nutrition.

This discovery is the more noteworthy, seeing that Sir Joseph Hooker has written an elaborate monograph of the genus Nepenthes; and it might naturally have been concluded that, when such an accurate and painstaking observer had wrought out the subject by making it a special study, it would have been practically exhausted. Only a year ago, however, Professor Dickson was the first to notice the "attractive" glands in the rim of Nepenthes, which he has named "marginal glands"; and this is now followed by the discovery here noted. Dr Macfarlane intends shortly to publish the results of his investigations; but it seemed to be a fitting thing to notice the matter here, though already pretty widely known to a circle of scientific friends, and to congratulate Dr Macfarlane on his important and interesting discovery.[1]

[1] A *résumé* of this subject appeared in 'Nature' for February 1885; and it also formed the basis of two papers read by Dr Macfarlane before the Royal Society of Edinburgh in June and July of the present year, and which will be found in that Society's Transactions.

III.—NOTE ON THE APPEARANCE OF THE SAURY PIKE IN THE FORTH.

By Mr A. B. HERBERT, President.

(*Nov.* 27, 1884.)

Mr Herbert brought under the notice of the Club the appearance in the Forth at Queensferry of that peculiar fish, the Saury Pike or Skipper (*Scomberesox saurus*), and exhibited several specimens sent by Mr Walter Meek, the resident engineer of the Forth Bridge, who found one had darted with such force into one of the bolt-holes of the iron plates of the bridge that it was unable to extricate itself; and a few days afterwards large shoals of them were observed, and many captured. Mr Herbert stated that their visits to the Forth occur at very irregular intervals, several years sometimes intervening, but these visits are always autumnal. The fish dart with wonderful rapidity along the surface, and often when pursued throw themselves out of the water for some distance, in this respect much resembling the habits of the Flying-fish. They are about 14 inches long, with sharp-pointed jaws, and are much esteemed as food, the flesh being firm and of good flavour, with very little bone except the line of vertebræ.

IV.—THE COMMONER BUNTINGS (EMBERIZIDÆ).

By Mr ARCH. CRAIG, Jun.

(*Read Dec.* 26, 1884.)

Compared with the Warblers treated of last session, the Emberizidæ or Buntings must be acknowledged to hold only an inferior place in the estimation of naturalists, contrasting as they do in many ways to the advantage of the former and their own prejudice. Apart altogether from the fact that our commoner species are, to all intents and purposes, non-migratory, thus losing, in a measure, the charm which always seems to be inseparable from birds which travel long distances to incubate in our ungenial climate, they labour under the more important disadvantage—to us at any rate—of being comparatively songless, in that respect being the very antithesis of our little Warbler friends. Music of a sort they undoubtedly indulge in; but, with every desire to make the most of their abilities in the direction of melody, and give them the benefit of every doubt, it cannot be affirmed with truth that their efforts

attain to the dignity of a song. Such music as they possess is of the melancholy order, pretending to no variety—the same few notes, with a prolonged one to end up with, being repeated again and again with monotonous frequency. In addition, mimicry would not appear to be a feature of their character, and in many other minor points they fall far short of several orders of birds in point of interest.

Having thus briefly recapitulated their drawbacks, let us now turn to the more pleasing side of the subject, and attempt to point out their good qualities and claims to our favourable consideration. In general form they are rather stout, with well-marked plumage, having in common shortish but strong bills of a conical structure, which, from their formation, are admirably adapted for removing the husks of grain and seeds, which form their staple diet. Inside the upper mandible on the palate is a little hard projection which materially assists the birds in shelling the grain — a propensity which, if all tales are true, some members of the tribe indulge in to no limited extent, this questionable conduct having frequently the effect of rousing the wrath more or less always slumbering in the bosom of that long-suffering martyr, the British agriculturist. While speaking of this, it may safely be asserted that there is almost no animal or bird, however destructive, which has not some redeeming trait of character—in the self-same way that the blackest villain shows on occasion a gleam of purer nature than might have been expected to emanate from such a reprobate. So the Buntings, although injurious to grain, offer a goodly compensation by devouring large numbers of beetles and other insects which, but for the joint efforts of our feathered fauna, would, if unchecked, do infinitely more harm to crops and other produce, in an insidious and unpreventable manner, than whole armies of "granivoræ."

Although previously designated as non-migratory, strictly speaking this is not absoluely true, as partial migration takes place even among the species which at all periods of the year may be observed somewhere in our islands; and it is believed that many of the flocks which collect in autumn cross to the Continent during winter, and that the numbers of the native species are reinforced once more in spring—but whether by the same flocks who departed, or not, it would be impossible to determine with accuracy.

Of the ten species described in Newton's Yarrell, I shall only bring under your notice four, the remaining six being so uncommon that, save for chance wanderers, they may be said not to visit Scotland. The names of the four are—

Corn-Bunting, . . .	*Emberiza miliaria.*
Reed-Bunting, . . .	*Emberiza schœniclus.*
Yellow-Bunting, . . .	*Emberiza citrinella.*
Snow-Bunting, . . .	*Plectrophanes nivalis.*

To commence with the Corn-Bunting: this bird is the largest of his order, and certainly the least numerous in North Britain, although found more or less in all arable parts over the island. Information has reached me from several gentlemen in different districts of Scotland that, whereas in the particular localities in which they live this species was at one time very plentiful, now it has, with the exception of a few pairs scattered up and down, almost entirely disappeared,—some among them attributing this extinction to the gradual cultivation and draining of the land, which has swept away many of the old ditches and moist places that used to border the tilled portions, and which they aver this Bunting was fond of frequenting. This may or may not be the correct solution, but it at any rate contains a strong element of probability, as you will often notice that, during the breeding season, where such ditches skirt the fields, this Bunting is on most occasions found inhabiting their vicinity. In the South of England, where it seems to be most numerous, the numbers are annually thinned by bird-catchers, who net them, along with Skylarks, to supply the food market. This hateful custom, which panders to a low gormandising taste, is, I am happy to say, except perhaps in a very few instances, confined to the southern portion of the island—and I feel confident you will all agree with me in devoutly wishing that the day is far distant when our countrymen of Scotland will be infected by such useless and cruel practices. Surely Providence has supplied us with quite a sufficient variety of food to permit of any palliation for those whose desire for change causes them to connive at the wanton destruction of our innocent little birds. In our own locality of Edinburgh the Corn-Bunting may generally be seen in summer near the road which runs by the side of the Braid Burn from the foot of Liberton Brae to the Blackford Quarry, and also in or near the irrigated meadow at Peffer Mill, now traversed by the Suburban Railway. Once observed, it cannot be mistaken for any other species, the peculiar harsh note alone amply indicating its presence. This note, which is nothing more nor less than what would be termed in Lowland Scotch a "skraugh," is his utmost effort at a love-song; but what it lacks in beauty is fully made up for by the patient manner in which the bird will continue for lengthened periods of time reiterating this dismal ditty to cheer his mate engaged hard by in nesting duties. Who knows but this rudimentary dirge may be just as pleasing in the ears of the female Corn-Bunting as the finer melody of the Nightingale is supposed to be in those of his partner. On a calm day the note is carried to long distances; and as proof of this, and also of the steady persistence with which the bird will remain seated at or near the same spot during the nesting period, I may mention that last summer, having occasion to pass and repass a certain field in the

country often as frequently as five times a-day, for ten days in succession, I noticed one particular Bunting always perched on a wire fence. When within three to four hundred yards of his haunt the note was quite audible, and notwithstanding the many times of passing he was never absent once, and never in any case fifty yards distant from a certain point which he had made his headquarters. If we can learn no other lesson from this bird, it at least inculcates upon us the merit of patience. A further peculiarity which distinguishes it from other small birds is one which, to observe, it is necessary that the spectator be in close proximity. As he rises from his perch he almost always allows his legs to dangle straight down, and flies off in that manner until, once fairly on the wing, he raises them up in the mode common to most species. A wall, a fence, the top of a small tree, or tall plant, are favourite points of vantage. The nest is placed, as a rule, on or quite close to the ground, among long grass or other rank vegetation; and though, on the whole, it is not what might be termed a shy bird, yet at times it is easily frightened from its position on the approach of an intruder.

The Reed or Black-headed Bunting is much more clearly defined in plumage, the male in his nuptial dress having a beautiful jet-black head and throat, which forms a marked contrast to the white collar round his neck. In old birds the black and white are much clearer than in less matured examples, in the latter the purity of colouring being marred by the presence of dirty brownish feathers, which mingle with the black and white. In winter the black of the head becomes of a brownish tint, the points of the feathers being of that colour, whereas in spring the ends wear off and reveal the black which forms the groundwork. The female has no black head, but instead it is of a reddish-brown hue, and in place of the white cravat, the feathers at the back of the neck are a dingy grey; otherwise in general appearance it resembles the male. Moist and swampy places are its natural habitat — the sides of rivers, ponds, lakes, especially where there are reeds and long coarse herbage. In the Highlands it is very common in those wet areas where rivers separate into various smaller branches before falling into lochs, and which localities are usually studded with clumps of Alder and Saugh trees. In tufts of coarse grass or among reeds it builds its nest, and displays occasionally great alarm when one inadvertently approaches too near the site. Some writers indeed assert that it feigns lameness, like the Lapwing, and resorts to other devices to draw off the interloper; but for my own part I never saw it do anything that could be construed into such actions, though it is most likely to be true, considering the experience of those upon whose authority the statement is published. It is not always safe to credit every

curious tale of extraordinary action in bird life, yet at the same time it is hardly just to condemn everything in that way that we may not happen to have ourselves observed, as both birds and animals sometimes perform manœuvres that it may not be the lot of an observer to notice in a lifetime. Indeed, it is beyond dispute that exigencies may arise when they are forced out of their ordinary rut into adopting tactics, in the interests of self-preservation, that are, as a general rule, foreign to their natures. The following device, however, is undoubted: when a person advances too near the nesting-ground to be pleasant, the bird—sometimes the male, and sometimes the female—takes up a prominent position on the top of a bush or bunch of rushes, and continues chirping to attract attention, at the same time exhibiting great reluctance to move to any distance, although closely approached. The individual, unless previously imposed upon, naturally jumps to the conclusion that the nest is very near at hand to the place where the bird is perched; but it is needless to say that such is not the case, and that this performance is only a ruse to deceive him as to its whereabouts. Its vocal powers are not extraordinary, but are superior to those of the last. The song, so-called, consists of a few notes strung together, and ending, as usual with the Buntings, with a longer note; but having regard to the somewhat uninviting surroundings of its habitat, it is rather pleasing than otherwise, there being a certain plaintiveness of tone that accords well with those precincts. In all its actions it is lively, and has none of the heavy lumpiness, so to speak, that pertains to the Corn-Bunting. During winter numbers collect in bands, and seem for the time being to forsake their natural sphere and roam about the country, visiting stack-yards and other unlikely places. One New Year's Day lately I was rather surprised to see a large flock in a district where I never anticipated encountering them—namely, a wide stretch of high-lying muirland, midway between Leadburn and the foot of the Moorfoot Hills, bearing the classic name of Cockmuir. If any present are acquainted with that delightful spot, they will doubtless incline to the belief that the being there at all at such an inclement season of the year showed a decided want of sense in both birds and man, as it may safely be affirmed, without fear of contradiction, that it would be difficult to discover a bleaker or more "God-forgotten" tract of country in all the lowlands of Scotland. They were in company with Yellowhammers, Greenfinches, and Chaffinches; but what they were obtaining in the edible way was not very easy to determine, unless it were the seeds of coarse grass, or perchance aquatic insects in the bogs. The Reed-Bunting may be seen in suitable localities all over Scotland, but would appear to shift about a good deal from one district to another during winter—the supply of food, no doubt, regulating its movements.

We come now to the Yellow-Bunting, and concerning it little need be said, as most people are well acquainted with the bird under its more popular names of Yellow-yite and Yellow-yorlin. It is one of our commonest, but at the same time most beautiful, species. Go where you will in the country, you are sure to meet it, except in very bare and wild districts, where cultivation does not exist nor trees flourish. But even to these secluded regions it sometimes penetrates. In a previous paper two years ago, I took occasion to mention the superstitions that used to exist in connection with it, so need not recur to them again, except to express the hope that the rising generation may be blessed with a little more sense on that subject than seemed to be possessed by our forefathers, to whom this innocent creature was a positive *bête-noir.* Some quarters abound with it, and none more so than the parish of Stobo, in Peeblesshire. By Tweedside, and all along the high-road, which is margined with fine hedges, it is conspicuous in summer time, as it flits from side to side when disturbed by passers-by, or, taking up its stance on some prominent twig or neighbouring tree, it essays to execute the ever-recurring notes that pass muster with it for song. The sad character of the chant is in reality its only merit, and although monotonous to a degree, it somehow strikes upon one's sense of hearing with a pleasing effect; and if, as an adjunct, the day be warm and bright, it has a tendency to increase in us that soothing sort of lethargy that seems to take possession of one's frame when in the open air on a genial summer day. Its abundance is apt to cause its being overlooked by the generality of folks, but among our commoner native birds we can pretend to few that surpass it in quiet beauty of plumage, which, without being too gaudy, has yet enough of brightness in its component parts to make it an object worthy our notice. A parallel instance to this might be given in the case of the Chaffinch, or, to descend lower in the scale, in that of the House-Sparrow. An old male of the latter species is by no means so despicable in his pure country garb as his sooty and saucy relation in our large cities: in fact, under those different conditions they hardly look like the same bird. When seated, the Yellowhammer has a habit of shaking its tail up and down, not from side to side, as is the ordinary practice of other birds, and at the same time utters a sharp, harsh note, which would appear to indicate that although seemingly occupied solely in enjoying itself, it has a quick eye to detect danger, as well as for the main chance, its lucky numeral on those occasions, like that of the human order, being "Number One." The adult males, from their extra colouring, are easily distinguished from the females; but the young cocks at first bear a strong resemblance to the old hens, until, in the spring succeeding that in which they were hatched, the pure yellow of the head and breast becomes so

prominent as to prevent confusion between the sexes. The curious scribbled egg is unfortunately too well-known an object to every bird-nesting youth. The old but now almost obsolete idea of the origin of these strange markings is founded, according to Yarrell and other naturalists, upon the belief that his Satanic majesty—in a fit of unwonted generosity, no doubt—presents the Yellow-Bunting every May with half a drop of his own blood, and hence the dark-purple streaks on the egg. To comment upon such idiotic nonsense would, of course, be waste of time. The nest is placed on, or very near, the ground; but instances have occurred when the usual order of things has been departed from—the most singular of which that I am personally aware of being lately communicated to me by a friend, Mr John Thomson of Stobo, Peeblesshire. The following is a sentence from his letter; "Several years ago I found a Yellowhammer's nest built in a stack of oat-straw in the stackyard here [Stobo], containing four or five eggs: the outer material of the nest was all of straw, to assimilate with its surroundings." It is not unusual for birds to accommodate themselves to existing circumstances where their more natural habitats cannot readily be procured, but this was a case where their ordinary sites were easily attainable, and on that account the choice of situation was all the more exceptional and interesting. The same gentleman also mentions seeing upwards of thirty feeding together in a field during winter, no other species being near. This, however, is not so worthy of record as his remark about the nest, although he is correct in saying that, while gregarious, they almost always mix with other birds, such as Greenfinches, Shilfas, &c., and rarely appear in such numbers entirely by themselves.

The last and most important on our list is the Snow-Bunting. This most attractive species is a migrant, and visits our islands during winter, leaving latitudes in and near the Arctic Circle for that purpose. Instances have been recorded of its remaining to nest in this country, but only in mountain solitudes such as the Grampians and similar elevated ranges; and though it is quite possible that some few are constant residents in Scotland, these undoubtedly form the exception, and not the rule. Desultory examples occur almost every summer, and a communication has lately reached me from a friend who observed a pair in June on Craig Na, a precipitous rocky hill in Glen Urquhart, Inverness-shire; but though convinced they were breeding, he could not discover the nest. During winters of unusual severity, immense flocks descend on the sea-shores, and scatter in bands over the muirs and upland districts. These bands again divide into small parties, and may be seen hunting about the same localities, until the occurrence of a sudden storm causes them to reunite, and descend to the verge of cultivation in the hope of finding a supply

of food, which the deep snow on the hills denies to them for the time being. Single birds and pairs may be noticed on those occasions in the low grounds, quite close to houses, and also in farm-yards, hunger having forced them from their ordinary haunts to make common cause with Sparrows and suchlike—a levelling of rank that suggests a union of patricians and plebs. During the very severe storm of January 1881, a friend and myself noticed a pair feeding on the road at the end of the Windy-Goul nearest Duddingston. They seemed devoid of all fear, and not to be the least embarrassed by the numbers of people constantly passing and repassing, but continued picking up something from amongst the snow on the road—most likely grain that had fallen out of the nose-bags of cab-horses, of whom, as the loch was "bearing," there had been a good many during the week conveying parties to the skating. The true sphere in which to observe the Snow-Buntings in their glory is on the wild and lonesome Highland muirs—those dreary solitudes which during winter are wellnigh devoid of other bird life, and which are as destitute of human beings. To one who has penetrated to such scenes, and experienced the oppressive stillness and desolation that pertains to them, a flock of Snow-Buntings comes as a sudden relief to the depression begotten by the surroundings. The intense enjoyment with which they seem to welcome the icy gusts that blow along the heights has something infectious in its character, and rouses in the beholder a species of excitement that defies the cold and disagreeableness of the situation, which at another time would be simply intolerable. As blast follows blast, they fly from point to point in a compact mass, never at any great height above the ground; and on the occasion of a lull, down they settle on the ground, to be again set in motion by the recurrence of the gale. Their mode of squatting is most abrupt, and so sudden as to have no appearance of any preconcerted arrangement on the part of the birds, although such can hardly be the case, as the entire flock collapse so unitedly at one and the same moment, as sufficiently to disabuse our minds of any such conclusion. They circle round and round with the most eccentric gyrations, striking off at a tangent, only to double back when least expected—presenting at one moment a brown surface to the eye, from the backs being most prominent, but at the angle of turning the colour changes instantaneously to that of pure white, consequent on the lower parts being exposed as they veer round. While engaged in these evolutions they chirp to each other in clear sweet notes, that are much more musical than any produced by the three afore-mentioned species; but although the males are said to soar somewhat higher in the scale of melody during summer time, yet, so far as this country is concerned, these few chirps may practically be said to embrace their entire *répertoire.*

Unlike mankind, the blinding snow-drift has apparently no terrors for them; and at those dismal moments when the bewildered traveller curses his ill-luck, and heartily wishes he had never left the safety of his cheery fireside, the Snow-Bunting seems happier and more lively than at any other time. A favourite resort after a storm is one of those upland crofts which can boast of a stack or two of corn; and in such spots they may be seen alighting in a flock, sometimes on the stacks, or on the ground close by, often clinging to the sides of the former after the manner of Sparrows, and no doubt doing their best to diminish the already too scanty stock of the crofter by swallowing his grain. On the average, however, they do not consume so much of the latter commodity as do the other Buntings, grass-seeds forming their chief food—oats and suchlike being only resorted to as a special *pièce de résistance* when their usual viand fails them. The plumage to which we in Scotland are most accustomed is of a reddish-brown chestnut colour in the upper parts, beautifully diversified by darker feathers, while the under portions are chiefly white, with a brownish band across the chest, much more marked in the male than in the female. The tail and wings, the latter rather long and pointed, are composed of pure white and dark-brown feathers, almost black in some cases, the former showing to most advantage during flight, or when the bird first alights.

A great deal might be written concerning this species. Its beauty of plumage; its welcome arrival at a season when bird-life is, in comparison with summer, almost *nil;* its friendly and harmless nature,—all these might be enlarged upon with advantage: but as time would not permit of that, allow me to conclude with the remark, that should any one, possessing the requisite amount of interest in ornithology, ever have the chance of visiting the Snowflake in its happy hunting-grounds, let me adjure him to permit no preconceived ideas of cold, danger, or physical exertion to interfere with that opportunity, as the pleasure derived from a near prospect of the birds will be ample recompence for any discomfort experienced while in their quest.

(Stuffed specimens were exhibited of the four Buntings above described.)

V.—THE HYMENOMYCETES.

By Mr A. B. STEELE.

(*Read Dec.* 26, 1884.)

The Hymenomycetes, of which our common Mushroom may be taken as a type, belong to the primary division Sporiferæ, or spore-bearers, of the order Fungi. By their complexity of organisation and economic value, they form the most important of the six families of this order. Although they occupy a very humble rank in the scale of organised existence, possessing none of the foliaceous or floral appendages of the phænogams, yet they are remarkable for their strangeness of form and beauty and variety of colour. Their rapidity of growth, as well as their tendency to a circular form, is extraordinary. The strange power of luminosity in the dark which some species possess still remains a mystery, and must have been a fertile source of superstition in the past. The change of colour produced when cut or bruised, and the manner in which the wounds are healed, resembling more the character of animals than of plants, are striking phenomena among species of this family. They germinate without cotyledons; and being without chlorophyll, they cannot decompose carbonic acid, and accordingly take up their nourishment from organic compounds. They exhale carbonic dioxide and inhale oxygen, like animals. No sexual organs, however, have been definitively discovered in these plants. Though comparatively simple in structure, they possess organs more or less complex. Most of them are composed of a mycelium or vegetative structure, a volva, ring, stem, pileus, and hymenium or fructifying structure bearing spores. Spores are to Fungi what the seed is in vegetables of a higher order. They are the reproductive organs. They are so minute that they cannot be seen with the naked eye; and their number is so vast at a certain period of a Mushroom's life, as to make it appear as if their union formed the whole hymenium, which is found then covered with a fine dust resembling the pollen of flowers. The spores, so long as they are adherent to the hymenium, are free, and supported by filaments which rest on small projecting bodies called basidia. At maturity the basidia project at the surface of the hymenium. Each basidium is composed of a single cell, round, ovoid, or elongated, which bears at its summit one or several filaments called spicules or sterigmata, at the extremity of each of which is a single spore. (This was discovered in the species Coprinus comatus as far back as 1780.) Each basidium bears four filaments or sterig-

mata, and each sterigma a spore. This number varies in some genera. Besides basidia, there may be noticed at the fructiferous surface of Mushrooms projecting cells, round, oval, or elongated, which are called cystidia or antheridia. The latter name has been given to them by botanists, who look upon them as organs destined to fertilise the spores and perform the *rôle* of anthers in phænogams. The spores can be seen with the naked eye when they are accumulated in great numbers on the same surface. This is managed by placing the fructiferous surface of a Mushroom on a glass or piece of paper: after some hours lift the plant, and the place will be found stained by a dusty matter entirely composed of spores. Agarics and Boleti leave traces of a very exact drawing of the fruitful surface. It requires millions of these minute bodies to cover the surface of a square inch. Single spores are so small as to escape the sense of touch, but when abundant they have the feeling of fine dust. They are composed of a single very delicate cell containing a fluid holding granulations in suspension. They are oval, elliptic, or spherical in shape, according to the species. In most Mushrooms they are smooth. Whether the envelope of the spore is simple or compound is still in doubt. Spores are of various colours, and on this fact Fries founded his principal subdivisions of the Agarics. In the Coprini the young spores are roseate or ashy grey, turning at maturity to a deep black. The gills follow their mode of coloration. The colour of the hymenium, however, is not dependent on the spores, several Agarics having the gills coloured and the spores white. Spores of certain species have a peculiar taste and colour.

Mushrooms have been classed as agamic plants: some botanists, however, assert that they have discovered male and female organs. The cystidia or antheridia—seen only in the higher Fungi—are supposed to be male organs; but as nothing has been discovered in them resembling either pollen or the liquor contained in the grains of pollen, it is improbable that these bodies are organs of fecundation. They are not arranged like stamens, nor as the spores themselves are in the basidia. They are awanting, too, in a great many species. "From the researches of Professor Oersted on Agaricus variabilis, it appears," says Carpenter, "that the true generative process in the Agarics and their allies is carried on in the mycelium, and that which has hitherto been considered as their fructification is really a mass of gemmæ like the urns in Mosses and the thecæ of Ferns, which are products of the sexual union which takes place in the earlier stages of these plants." It would seem, therefore, that the discovery of the process by which the spore is fertilised remains yet to be made. Germination begins in the spores of some species immediately after quitting the sporophore.

In Agarics and Polypori growth does not start till some time after their emission. A time of rest seems necessary before germination begins to operate, and if placed in suitable conditions, vegetation is then not slow to show itself. We see at first, coming from one or two projections opposite to the spore, a filament or radicle, which soon divides and multiplies into branches more or less numerous, and almost invariably white. These cross each other, intermingle, and form what is called mycelium, or white of Mushroom. On the mycelium there soon appears, when the conditions are favourable, the Mushroom proper, which, from its birth, has generally a globular or ovoid form, but as it increases it gradually assumes the form which characterises the species to which it belongs. The embryo Mushroom is surrounded with a membranous or hairy covering, which afterwards disappears. One or two membranes more or less persistent, called the volva and ring, protect the young plant till its complete development. The ring is somewhat similar to the calyx and petals of the higher plants, and is probably a place of shelter for the spores, which are perhaps fecundated before they are detached from the cap. Bulliard says the young Mushroom bursts through the volva and detaches itself from the ring sometimes with a noise as loud as that of a pistol. Cold destroys neither mycelium nor spores, and a dry heat of upwards of 100° does not kill the germinating faculty of the spores of most species. Mycelium and spores remain often latent for years until circumstances intervene to favour their development. Kept in a dry spot, the spawn retains its vegetative property for a long period. Gardeners state that they have kept it for several years, and then put it in beds, and quantities of Mushrooms have been produced. When once the Mushroom, however, has begun to develop, either intense cold or heat kills it. Very few species of fleshy consistence can resist the frosts of winter or the ardent heat of a dry summer. Mushrooms require a degree of temperature and moisture of certain definite limits in order to develop, and germination takes place only at fixed times of the year. Spores placed in unfavourable conditions do not germinate while these continue. In my garden the tufted Agaric has sprung up every autumn successively for the last five years, but this year germination has failed, owing perhaps to the dryness of the season.

Mushrooms are composed of interlaced fibres forming a net-like tissue, whose round or elongated cells communicate with external agents by means of minute pores. By these absorption and exhalation are performed. They have no proper vessels, like phænogams, for the circulation of sap. In these cells, of which the whole plant is composed, the nutritive fluids are contained, whose circulation, almost insensible, is performed by a sort of capillary attraction. The fluids penetrate by endosmose and are expelled by

exosmose. By the double process of absorption and elimination the phenomena of nutrition, assimilation, growth, and by-and-by of reproduction, are accomplished. At maturity the plant gives forth seeds like other vegetables, and their emission immediately arrests development. Some species arrive at maturity in a few hours. Thunderstorms favour their appearance, Mushrooms being found after such storms in places where there were no traces of them the day before. Coprini are very ephemeral, withering after a day's existence. Fleshy species last from six to twelve days, and some of the Polypori live for several years.

In discriminating species, the chief points to be attended to are the form of the gills, their mode of attachment to the stem, their colour, and more especially the colour of the spores. The colour of the pileus, the form and characteristics of the stem, are so variable often in the same species as to mislead and perplex the student. The preservation, too, of Fungi is exceedingly difficult—some fade so rapidly, melting almost before your eyes. Even the tough species, when cut into sections and dried, become unrecognisable in a few weeks. A fairly satisfactory plan of preserving the beauty of these interesting plants (which I hit upon rather late, however, for the most of my collection this autumn) is to dip them in melted paraffin. Care must be taken not to allow the paraffin to get too hot, and so injure the specimens by burning them. To get a thin and equal coating all over your specimen, the process must be carefully done. Some specimens now exhibited have been preserved in this manner for about two months, and if kept in a dry spot, it is reasonable to expect that they will remain in this condition for years.

This autumn I collected nearly forty species round Edinburgh. In the Meadows I gathered Coprinus comestus, Agaricus campestris, A. cristatus, A. fœnisecii, and A. rimosus. On Arthur's Seat I found, besides, A. albocyaneus, A. umbelliferus, A. dealbatus, A. ceraceus, Hygrophorus psittacinus, Lepiota excoriatus, and Boletus luteus. In Corstorphine Woods, Agaricus fascicularis, A. cinnamomeus, A. variabilis, A. dryophilus, A. semiglobatus, A. radicatus, Hygrophorus conicus, H. virgineus, and Lepiota granulosus. In Greyfriars' Churchyard I got Coprinus micaceus and Agaricus cortiles; and in gardens and nurseries in town I found Coprinus aliamentarius, Agaricus pratensis, A. velutipes, and Lactarius rufus, besides others I have not been able to identify.

The uses of the Hymenomycetes, though perhaps not of great importance, are both numerous and varied. Many species of this family are employed as food. The Dutch, who think that the devil gets the best of everything in this world, call them the devil's bread. Only one species, Agaricus campestris, the common Mushroom, is looked upon with favour in this country, and yet it is

the only edible one that is rejected in Italy. Three varieties of this Mushroom are cultivated in France—the white, grey, and blonde. The white is preferred, the blonde not being considered so tender, and having less perfume. The grey has a stronger taste, but blackens sauces. The finest variety of this species, however, is a native of the Swan River district, Australia. Another variety, Agaricus pratensis, is not quite so good as the common Mushroom. All these yield good ketchup. A. prunulus—the *Mouceron* of the French, and the origin of our word "Mushroom"—is much prized in Rome. It is dried and sold through Italy as "Funghi di Genoa." A. deliciosus, the Orange-milk Agaric, is as good as its name implies. A. procerus, the Parasol Mushroom, or Snake Agaric, is a favourite with mycophagists, and yields the finest ketchup. This and another allied species, A. rachodes, are sold together indiscriminately in the London markets. A. comatus, very plentiful at our doors, is eaten when young, and used for making ketchup. Lactarius volumum, the Warden-pear Agaric, and the "*Brötling*" of the Germans, is very common in the Highlands, and resembles lamb's kidney in taste, being very delicious even when eaten raw. Cantharellus cibarius or Chanterelle, so called from its fancied resemblance to a cock when crowing, is the finest of all the esculent Fungi. It smells like ripe Apricots, and is served as a *récherché* dish at the Freemasons' Tavern on high festivals. Boletus edulis is cut in thin slices, and sold in the chief towns on the Continent in every shop where meal and peas are sold. It is believed to be the *Smilus* of the Romans, who got it from Bithynia. It resembles the taste of our common Mushroom, and is still more delicate. In Hungary it is made into soup when fresh, and the Russians dry and string it for winter use. Hydnum repandum, the Vegetable Oyster, is common in woods. When eaten raw, it is peppery to the taste, but when cooked is much prized. It has the flavour of oysters when stewed. It is also dried for winter use. Clavaria coralloides, Hercules' Club, is also good eating. Indeed, all the Clavariæ are edible. Mrs Hussey relates that two species of Russulæ—*heterophyllus* and *vescus*—were not only relished but easily digested by a consumptive patient who was scarcely able to endure food of any kind, but who partook of them as often as found during the whole season. Vittælini, in his 'Funghi Mangerecci,' mentions Russula heterophylla as being more delicate than the true Orange Mushroom. These and many others yield excellent food both to rich and poor, and most of them have their habitats in our immediate neighbourhood. But there exists a strong prejudice in this country against using Mushrooms for food, and perhaps its existence is not without reason. Unskilful collectors are apt to mistake nearly allied species, or to gather edible species that are past maturity—for it

is known that species which are wholesome in the morning may become deleterious by the evening. We see examples of the ignorance displayed in discriminating good from bad species nearly every season, and unfortunately often attended by most disastrous results. No later than 7th October last the 'Times' correspondent at Boulogne wrote thus :—

"The cook at a school in the Gironde having gathered a quantity of Mushrooms in the vicinity, served them to the boys, thirteen in number, for breakfast. The whole of them were seized with most violent pains. Several doctors attended them, but in vain. Eleven of the children have died, and the rest, with the usher, are lying in a critical condition. In cooking this treacherous food, it is generally believed that if a silver coin placed in the same pan is not discoloured, the Mushrooms are wholesome. The test was resorted to on this occasion, but signally failed. Two little girls were poisoned at Arras through a similar misadventure; and a further case took place near Lyons, when a whole family were attacked—father, mother, and five children. Two of the children have died, and the remaining sufferers are in a precarious condition."

Dr Badham proved the silver-spoon test to be useless, as the kitchen-fire will sometimes extract the deleterious property. A more general knowledge, therefore, of the esculent Fungi is most important, and would tend not only to prevent such accidents in the future, but to increase a substantial food-supply. In many countries of Europe they are the only food-supply of the peasants during a part of the year; and in Terra del Fuego, and some districts of Australia, they are the staple food of the natives.[1] Mushrooms have also a place in Materia medica. The Polypori are used in the cure of phthisis and consumption, and as styptics; and also as a moxa by the Laplanders, whose dandies perfume themselves with the scent of Agaricus odorus. In semi-barbarous countries they are still believed to act as aphrodisiacs. In the industrial arts they claim some attention. Prussian blue and prussic acid are obtained from Mushrooms; Polyporus sulphureus is used for dyeing; Agaricus atramentarius for making ink; Polyporus fomentarius in the manufacture of *amadou* or German tinder, which, before water-beds were invented, had superseded the chamois-leather as a more elastic mattress for invalids. It is still manu-

[1] The following are the chief constituents of Mushrooms :—

	In 100 parts.	In 1 lb. oz.	gr.
Water,	90.0	14	175
Albuminoids, &c.,	5.0	0	350
Carbo-hydrates, &c.,	3.8	0	266
Fat,	0.7	0	49
Mineral matter,	0.5	0	35
	100.0	16	0

factured into warm winter hats and chest-protectors. The most fashionable *likus* worn by the Fijian ladies are made of a Fungus —probably one of the Sapballs. Polyporus betulinus, when cut into strips and rubbed with pumice-stone, is made into razor-strops. Polyporus ignarius is pounded and used as snuff by the Ostyacks on the Obi. Some species are put to strange uses. In Kamtschatka and Corea, Agaricus muscarius, or False-orange or Fly Agaric, is decocted with the runners of Epilobium angustifolium, or the berries of Vaccinium uliginosum, and made into a highly intoxicating liquor. Greville says that the most powerful effect is produced by drying this Fungus and swallowing it without mastication. The natives personify this Fungus, and allege that they are only obeying its behests when they commit suicide or other crimes under its influence. Monkhamorr, a strong drink used by the Russian peasants, is also extracted from this Mushroom; and among the Tartars this drink is an element in their worship. Polyporus sacer is worshipped in New Guinea and the west coast of Africa. Many of them are also highly destructive. Polyporus destructor, the common Dry-rot Fungus, known in Germany as *Hausschwamm*, and the Meruleus lachrymans in this country, are well known. The spawn diffuses itself through the substance of the timber, and rapidly destroys it. At the Forestry Exhibition held in Edinburgh this summer, seven or eight edible species of Fungi from Japan were exhibited, and a large Fungus collection by the natives of British Guiana, with the note that this is entirely a new study in British Guiana.

Before concluding, I should like to draw attention to the importance given to this branch of botany by other Field Clubs. The Essex Field Club have yearly forays for Fungi, and most interesting excursions they seem to be. At their October excursion this year thirty new species were found in the same localities that had been gone over carefully the previous season. The Woolhope Field Club had also their Fungus excursion in the beginning of November last, and found many very interesting kinds, although the past dry summer had not been favourable to their growth. The members dined together afterwards, and partook of Hydnum repandum and Cantharellus cibarius, both of which were generally appreciated. These facts show the increasing importance attached to this branch of Natural History, and ought to convince us as a Field Club of the necessity of making at least one excursion every season for the prosecution of the study of Fungi.

VI.—ON YEWS, WITH SPECIAL REFERENCE TO THE FORTINGALL YEW.

By Mr JOHN LINDSAY.

(*Read Jan.* 29, 1885.)

The Yew tribe (Taxineæ) has been relegated by systematic botanists to a sub-order of the Coniferæ. The Common Yew (*Taxus baccata*) belongs to the Diœcia Monadelphia of the Linnæan system. The leaves are in two rows, dark shining-green above, much paler below; branches dense and spreading; branchlets slender and drooping; male catkin axillary; female cone inconspicuous, consisting of a few minute scales, with a terminal, erect ovule on a fleshy disc, which enlarges into a scarlet fleshy cup containing a single brown oval seed. The "solitary Yew" is a tree familiar to all, and is found distributed throughout Europe, growing at various elevations up to 4000 feet. The stem is short and straight; the head pointed or pyramidal-shaped until the tree begins to decay, when it presents a rounded appearance. The leaves, as is well known, are poisonous to cattle browsing on them; and several cases are also on record of children having died from their effects, when administered as a vermifuge. It is said, however, that if cattle are accustomed to the use of the leaves, by a small quantity being mixed in their food, they can by-and-by partake of them alone with impunity. The seed contained in the scarlet disc is also reputed to possess poisonous properties; but the cup itself is sweet and innocuous, children being very fond of plucking and eating this bright-red berry. No insect subsists on any part of the Yew except the fleshy cup, the sweetness of which attracts Wasps and like visitants. The wood of the Yew is not subject to insect depredations, and is very hard, flexible, and of great durability. It is a common saying, in some parts of England, that a Yew post will outlast an iron one; and the wood has been found in bogs in Ireland, where it may have lain for centuries, yet remaining as fresh and sound as when growing in full vigour. It is a very fine-grained wood, as many as 280 annual rings, according to Loudon, being sometimes found in a piece not more than twenty inches in diameter. As will be noticed presently, it was at one time in much request for bows; and by a statute of King Henry VIII. it was enacted that "bowyers" should import the wood for the purpose of making the best bows, owing to the difficulty of procuring it at home in sufficient lengths or quantities for that purpose. The Yew does not grow very rapidly, but what it lacks in this respect is amply compensated for by the great age which in many cases it attains.

At one time this tree, as well as the Holly, was often found in gardens clipped into the fantastic geometrical shapes which the fashion of the day demanded. Evelyn gives a long and melancholy list of the dangerous properties of the Yew, some of which, however, he frankly says he does not believe; yet he quaintly and cautiously adds: "To prevent all funest accidents, I commend the tree only for the usefulness of the timber, and hortulan ornament." The Irish Yew (*Taxus baccata fastigiata*) is a well-known native variety, first found near Florence Court, in Ireland. That the common Yew is a native may surely be conceded, and yet, strangely enough, this has sometimes been disputed, though it is undoubtedly the oldest tree found in Britain. A safe rule has been laid down by an eminent forester, that "all those trees which propagate themselves freely from seed without our agency, and which are known to have existed in our country before the earliest records, are indigenous to it." The Yew fulfils both of these conditions. Many trees are found, for instance—especially in the north of England—growing in inaccessible places, where they must of necessity have been of spontaneous growth. That it has existed "before the earliest records" will appear in the sequel, as we proceed to speak more particularly of what is known as the Fortingall Yew.

Amongst the numerous Yew-trees in this country which are noteworthy because of their appearance or antiquity, the well-known specimen still growing in the churchyard at Fortingall, Perthshire, is certainly the most remarkable. The following, though of less note, are yet interesting, either because of their vast proportions, their age, or their historical associations. In the New Forest, as well as in the Forest of Dean, a number of Yews still survive whose youth stretches back to the time of William the Conqueror. In Tisbury Churchyard, Dorsetshire, a rather unique specimen is found, its trunk being 37 feet in circumference, the interior hollow, and with a rustic gate to admit visitors. In Buckland Churchyard, near Dover, there is another with a trunk 24 feet in circumference, which presents a strange appearance from the contorted shape it has assumed while growing. On the estate of the Marquess of Bath, in Wiltshire, there is a grand specimen, known to be upwards of 1000 years old, which is 50 feet high, and with a head 50 feet in diameter. The Brabourne Yew, in Kent, is described in Evelyn's 'Silva' (1665) as a gigantic ruin, with a trunk 60 feet in circumference; but of this monster growth not a vestige is now remaining. A very large Yew is growing at Inchbrakie, Crieff, which is said to have on one occasion concealed in its branches the Marquess of Montrose. In the county of East Lothian there are *two* very fine Yews still thriving in a green old age—viz., one at Whittinghame and the other at Ormiston Hall: besides the attraction of their stately proportions, these Yews are

both historically interesting, for it has been transmitted down to our own times that it was within the sombre enclosure of the former that the Darnley plot was hatched; while the latter, according to tradition, at one time accommodated a congregation of several hundreds under the arching canopy of its branches, when John Knox was the preacher. There are, besides, the historic English Yews of Fountains Abbey, Gresford, Ankerwyke, and Darleydale, described by Loudon, which are all undoubtedly over 1000 years old. But every one of these trees, and many others which might be mentioned, must give place to the Fortingall Yew. "This Yew," in the words of the late Professor Christison (to whom it was an object of great interest), "stands within the churchyard, four miles by road above the confluence of the Tay and Lyon, and about 400 feet above sea-level, in a valley very favourable to tree life. It is quite within the churchyard, in a walled enclosure thirty-three feet by twenty. But depredation has thus not been altogether prevented. Two railed openings and a railed gate allow inspection from outside of a mass of vegetation so confused, that the whole enclosure seems simply full of young Yews and vigorous spray. It is only by brushing through this mass on obtaining entrance into the interior, and not easily even then, that an adequate idea can be formed of what is still extant of the ancient tree." This tree was believed by De Candolle to be "possibly the most venerable specimen of vegetation in Europe," and this celebrated botanist estimated its age as over 2500 years; while Sir Robert Christison made a most minute and painstaking inquiry as to the growth of the Yew and other trees at various ages, in order to be able to arrive at an approximate estimate of the age of this particular tree. The result of his labours will be noted by-and-by, when we have glanced at the various published accounts of former visitors.

Though the Fortingall Yew is so noteworthy, there does not appear to be any very early notice of it. One would have expected to find it mentioned in the 'Black Book of Taymouth'; but though severe storms and other natural phenomena are there duly chronicled, this wonderful curiosity is not once alluded to by the compilers—at least, in the published portions of the MS. Nor does Evelyn, in his 'Silva,' refer to any Scottish trees whatever, though he mentions several ancient Yews: all his specimens are English. The early troubles of Scotland may in part account for such paucity of scientific observation; while as regards the Highlands, up to a comparatively recent period this part of the kingdom was regarded by Southrons as a region full of frightful mountains and precipices, and inhabited by savages no less frightful. It may, therefore, have been considered rather a bold adventure—the Great Magician not having yet arisen—when in 1768 the Honourable Daines Barrington (the "Judge Barrington" of the Welsh Bench)

penetrated into the recesses of the Highlands, and visited Glenlyon in order to inspect the ancient Yew of Fortingall. This gentleman reported in the 'Royal Society Transactions' in 1769 that he had "measured the circumference of this Yew twice," and found it to be 52 feet. Next year Barrington was followed by the well-known Welsh naturalist and antiquarian, Thomas Pennant, who then made his "first tour in Scotland"; and it may be remembered—as noticed by our President in his inaugural address this session—that it was to these two gentlemen the Rev. Gilbert White inscribed the letters which form the 'Natural History of Selborne.' Pennant merely notices the fact of the existence of the tree, states its circumference to be 56½ feet, and gives a small drawing of it. After the notice of this drawing at the beginning of his book, he adds: "The middle part is now decayed to the ground, but within memory was united to the height of three feet,—Captain Campbell of Glen Lyon having assured me that when a boy he has often climbed over, or rode on, the then connecting part." Three years later (in 1772) Pennant again visited Scotland, accompanied by Dr Lightfoot, who founded his 'Flora Scotica' on the material furnished by this tour. Though in the account of this second journey he supplies some gossip about Yew-trees in general, nothing is added by Pennant to his former account of the Yew at Fortingall, which he again inspected. In 1785 the wall was built round it by the father of Dr Irvine of Pitlochry; and the worthy Doctor informed Professor Christison that his mother had often told him that when she was a girl—viz., about 1785—she "could with difficulty squeeze through the gap." The volume concerning Perthshire in the old 'Statistical Account of Scotland,' which appeared in 1792, only furnishes us with the information that the Fortingall Yew is "a very remarkable tree"! We are thus brought down to 1822, when Strutt published a splendid figure of the tree in a Supplement to his 'Silva Britannica,' but with the gap so large that a funeral is in the act of passing through it—a clergyman walking in front reading the burial service, and a straggling company following behind the bier. It is added that this mode of entrance into the churchyard for funerals, by passing through the gap, was the usual practice, and this has been followed by Loudon, who repeats the story. Yet, as we have just seen, an eight-feet wall was built round the tree thirty-seven years before, when the gap was extremely small; and it may safely be concluded that funeral processions never took such a route. In 1833 the late Mr Patrick Neill visited Glenlyon, and wrote a minute account of the tree for the 'Edinburgh New Philosophical Journal.' He mentions that "large arms had been removed, and even masses of the trunk carried off, to make drinking-cups and other curiosities." It is added, however, that "happily further depredations have been pre-

vented by means of an iron rail which now surrounds the sacred object." We now come to the period when the 'New Statistical Account of Scotland' was written. The notice here given in 1838 by the Rev. Robert Macdonald, the late minister of the parish, carries the history of this Yew back to a century earlier. He says: "At the commencement of my incumbency, 32 years ago" —that is, in 1806—"there lived in the village of Kirktown a man of the name of Donald Robertson, then aged upwards of 80 years, who declared that when a boy going to school"—say in 1736, when Donald would be ten years of age—"he could hardly enter between the two parts"—this being just what Dr Irvine's mother said fifty years later. "Now a coach-and-four," he adds, "might pass between them; and the dilapidation was partly occasioned by the boys of the village kindling their fire of *Bealltuinn* at its root. It is now from 52 to 56 feet in circumference." It is to be premised that the boys climbed over the enclosure to kindle their Beltane fire; but an eight-feet wall to a young Celt would not be an insurmountable difficulty.

Lastly, we come to the observations of Sir Robert Christison, as given in the 'Transactions of the Botanical Society' for 1879, and to which we would refer any who may wish fuller information as to the increment of Yews at different ages, with proper systems of measurement, &c. The Professor's observations are so minute and explicit—being also accompanied by drawings of the tree and a ground-plan of the enclosure—that in after-ages, if the tree still survives, there can be no difficulty in drawing comparisons as to its relative conditions. As we have said, Sir Robert's main object was to discover the probable age of the tree, and the conclusion arrived at by him is so astounding that we give it in his own words. He says: "The tree, in the first place, may be assumed to have attained a girth of 22 feet in a thousand years. After that age, no information yet got warrants a rate of more than an inch in 35 years. Taking the lowest measurement of Barrington at 52 feet, the difference will thus add 2000 years to the age of the Fortingall Yew, making it in all 3000 years old when measured in 1768-69. The result is startling, but not so improbable as may at first sight be thought, if it be considered that several English Yews of scarcely half the girth are, not without good reason, held to surpass materially a thousand years of age, yet still appear to be in vigorous health, and steadily increasing; and that upwards of 3000 rings have been actually counted on the stump-surface of a Californian Sequoia." This is the result, then, of Professor Christison's laborious and careful measurements—viz., that the Fortingall Yew has now attained the truly venerable age of 3117 years! It is therefore held to be proved that the Yew is indigenous, seeing it thus existed in our country "before the earliest records." It

must be added, however, that several authorities believe this estimate to be excessive. The following remarks on the growth and decay of Yews, and the probable age of the Fortingall Yew, have been courteously contributed by Mr J. Gordon, late forester at Luss, who was a *collaborateur* with Sir Robert Christison during the investigations of the latter just referred to:—

"The vagaries of the growth of Yew-trees are numerous, and go far to invalidate the most praiseworthy efforts to evolve a factor unknown in a particular tree by means of corresponding well-known factors in Yews generally. It is so difficult, for instance, to compute the age of a very old Yew which does not itself afford ready means for computation, that blame can scarcely be said to attach to failure. The results of the late Sir Robert Christison's labours to compute the probable age of the venerable Yew at Fortingall, Glenlyon, will have astonished many and convinced a few. For myself, I feel neither astonished nor convinced, but consider these results such as must always be expected from a trained intellect operating upon incomplete data. In the paper read to the Botanical Society in 1879, Sir Robert gives not the slightest indication why the Yew at Fortingall decayed *from the top* downwards, nor why its trunk exhibited two lunate shells bearing on their convex sides a crop of living, growing branches. Nor does he indicate why he preferred to adopt for his purpose the smaller of two different recorded measurements. It is too evident that, with the data and methods of Sir Robert, conjoined with an unaccountable preference for the larger measurement of Pennant, one could easily add a few centuries to the age which the late Baronet has ascribed to this tree, provided the actual facts were not allowed to regulate the argument.

"The manner of its decay seems to prove this tree's manner of growth in a way not dealt with by Sir Robert. It seems to have had originally *two* adjacent separate stems, which coalesced as growth advanced. These two stems would continue separate at the top, while forming one undivided trunk near the ground. In such a case—far from uncommon—the point of divergence of the coalesced stems is notably prone to generate decay,—a fact regarding which I am prepared to satisfy the most incredulous, but of which the bulky literature of this curious old Yew takes no notice. The accounts of the progressive widening of the gap between the two shells of trunk are very suggestive. At one time the gap is said to admit the passage of a boy through it; at another time a coach-and-four could pass through it. Later, the size of the gap has become so indefinite that Strutt can venture to figure an entire funeral *cortège* as in the act of *strutting* through it! Now, without reading between the lines of these various accounts, it is not too much to state that among the purposes to be served by them,

trustworthiness of results computed with measurements taken while the tree was in this condition is not for a moment to be looked for. Suppose, however, we were, with Sir Robert, to accept Barrington's 52-feet measurement, the foregoing theory of the tree's growth would enable us to reduce by fully a third the enormous age imputed to this Yew by the learned Baronet. The time may come when occasion to do so will present itself."

The subject of the Fortingall Yew naturally suggests the question—which, indeed, has often been asked—Why are Yews so frequently found growing in churchyards? The ready answer has usually been given, prompted by the law of association, that they are thus found because of their funereal appearance:—

> "A black Yew gloomed the stagnant air."

But other reasons are not wanting. Thus, it has been affirmed that as the pagan nations of antiquity in Southern Europe adopted the Cypress as the emblem of immortality, so in Northern Europe the Yew had the same symbolic meaning attached to it:—

> "Oh, not for thee the glow, the bloom,
> Who changest not in any gale,
> Nor branding summer suns avail
> To touch thy thousand years of gloom."

Another explanation, of a more utilitarian kind, is that the Yew was planted thus near the parish butts, which were generally in the close vicinity of the church, in order to supply wood for making bows. It has further been suggested by Sir Thomas Browne, the well-known author of the 'Religio Medici,' that sprigs of Yew which had been used at funerals might have taken root, and grown into churchyard trees. It is true that the custom of using Yew-branches at funerals was an old one; and of the half-dozen notices of the Yew by Shakespeare,[1] one of them—that in "Twelfth Night" (Act II. sc. iv.)—refers to this practice. But the objection applies to all these various solutions of the problem, that most of the old trees now found in churchyards were in all probability planted before the existence of the parish church or burying-ground; while the Fortingall Yew, at all events, was a goodly

[1] The mention of "Hebenon" or "Hebona" by Shakespeare, Gower, Spenser, and Marlowe, has given rise to much conjecture as to what "deadly poison" was meant by these writers. On this point Canon Ellacombe says: "The question has lately been very much narrowed and satisfactorily settled (for the present, certainly, and probably altogether) by Dr Nicholson and the Rev. W. A. Harrison. These gentlemen have decided that the true reading is Hebona, and that Hebona is the Yew. Their views are stated at full length in two exhaustive papers contributed to the New Shakespeare Society, and published in their Transactions."—'The Plant-Lore and Garden-Craft of Shakespeare,' 2d ed. (1884), p. 119.

tree before the beginning of the Christian era. The same objection also applies to a belief mentioned in an old work by Robert Turner, dated 1664, and entitled 'Botanologia,' which is yet worth quoting. The author says: "The Yew is hot and dry, having such attraction that if planted near a place subject to poysonous vapours, its very branches will draw and imbibe them. For this reason it was planted in churchyards, and commonly on the west side, which was at one time considered full of putrefaction and gross oleaginous gasses, exhaled from the graves by the setting sun. . . . Wheresoever it grows," the old botanist adds, "it is both dangerous and deadly to man and beast: the very lying under its branches has been found hurtful, yet the growing of it in churchyards is useful." We thus find that the Yew was early regarded with a superstitious awe; but the explanation here given of its occurrence in churchyards is of couse fanciful, and characteristic of the times. A very plausible reason which has been urged is, that Yews were connected with the heathen worship of our ancestors; and that, according to the accommodating tactics of the early Christian Church, of retaining and turning to its own use what in the older ritual it was found impossible to remove, the Yew under which the heathen rites were celebrated was permitted to stand, and a Christian place of worship was built beside it. The only objection to this theory is, that we have no certain evidence connecting the Yew with the heathen worship of our island. It is just possible that, seeing the Yew may be regarded as undoubtedly indigenous to Britain, and was at one time probably far more common than now, the ancient specimens found in churchyards may owe their preservation to the accident or design of their having been enclosed in this sacred place, while many of those scattered over the face of the country had to succumb to the wasting effects of time, or to the axe of the woodman. Its reputedly poisonous properties, too, might often cause it to be levelled; while its being diœcious—having staminate and pistillate flowers on different trees—would tend still further to lessen its numbers, as solitary forms were left in isolated places. Whatever the reason may be, the fact remains that many of the ancient Yews still surviving *are* found growing in churchyards.

The subject of Yew-trees, as we have seen, is intimately connected with that of archery: indeed, the generic name of the Yew (*Taxus*) is in all probability derived from the Greek τόξον, a bow. It may therefore be interesting to make a few remarks, in closing, on the use of bows in our own country during historic times. The first mention of archery in the statute-book is in the latter part of the twelfth century, during the reign of William the Lion, where it is explicitly stated that every man, unless mounted, was expected to have a bow and arrows. In 1319 King Robert the Bruce or-

dained "that ilk man haveand the value of ane kow in gudes shall have ane bow with ane schaife of arrows." The old Yew-trees on Inch-Lonaig, or "the Island of Yews," in Loch Lomond, are traditionally said to have been planted at this period by the king's command, in order to supply wood for future bows; but none of the Yews now on the island can be so old, though most of them probably number centuries. Further, in the earliest Parliament of King James I. (1424), it was enacted "that all men busk them to be archers fra they be twelve zeirs of age." It was about this time that the Scottish Archer-Guard of France, so graphically described in Sir Walter Scott's novel of 'Quentin Durward,' was formed. But archery never seems to have taken the firm hold in Scotland that it possessed in the South; for by the English bowmen,—

"Who drew,
And almost joined, the horns of the tough Yew,"—

the tide of battle was often turned, and many a victory won. The early Scottish sovereigns launched frequent denunciations against football and golf, which had usurped the place of archery in the affections of the people.[1] But the use of the bow as a weapon of war was soon to cease. Its palmy days in our island extended from the Norman Conquest to the period when artillery and firearms became general in warfare. Thus in the reign of James V. there is no mention of archery in the statute-book; but in the 'Book of Sports' compiled by King James VI. it is said to be the king's pleasure "that after the end of divine service, our good people be not disturbed, letted, or discouraged from any lawful recreation, such as dancing, either men or women, archery for men," &c. Shooting at the butts seems thus early to have become the mere amusement which it still remains to the present day. In connection with this subject, it may be mentioned that the Royal Company of Archers, in our city, have in their possession two valuable Yew-bows, which they received in 1840 from Dr Thomas Spens. One of these "belonged to Mr Wallace, a member of the Company, admitted in 1776. On the occasion of the visit of Lord Aylesford, his Lordship offered Mr Wallace fifty guineas for it, but did not succeed in tempting him to part with it. . . . The second bow, which is smaller, Dr Spens declared to be the most beautiful piece of Yew he had ever seen. It had been presented to his father, Dr Nathaniel Spens, by an old family in Fife, in whose possession it was."[2]

We would sum up our subject in the words of old Evelyn.

[1] "That fute-bal and golfe be utterly cried down, and that bow-markes be maid at ilk parish kirk."—Skene's Scottish Acts of Parl., James II., c. 65.

[2] 'Hist. of Royal Company of Archers,' p. 208.

"Since the use of bows is laid aside," he says, "the propagation of the Yew is likewise quite forborne; but the neglect of it is to be deplored, seeing that the barrenest grounds, and coldest of our mountains, might be profitably planted with them." The same state of matters still exists as in the time of Charles II., for Yews are seldom planted for their timber, though many of the dwarf and shrubby varieties are grown for ornamental purposes. Some of these varieties are beautiful plants, with bright golden-green foliage, and very unlike the grim, funereal-looking parent. It may be added that there is a splendid collection of Yews in the Royal Botanic Garden of our city. The "folk-lore" of the Yew, including the various superstitions connected with it, and the numerous references to it in the poets, though very enticing, is too wide a subject to enter on at present. It is hoped that what has already been said has not been altogether without interest.

[The Secretary exhibited a piece of wood from the Fortingall Yew; and the Curator of the Royal Botanic Garden kindly furnished specimens of the most distinct and striking varieties of the Yew, in illustration of the above paper.]

VII.—WHO WERE THE EARLY INHABITANTS OF THE SHELL-MOUND NAMED CAISTEAL-NAN-GILLEAN, ON ORONSAY?

By Mr SYMINGTON GRIEVE.

(*Read Jan.* 29, 1885.)

It was our good fortune, during the summer of 1881, to discover that a supposed tumulus on the island of Oronsay was in reality an ancient shell-mound. The name of this shell-mound is Caisteal-nan-Gillean, which means "the castle of the servants or gillies," and we have been assured that the deposits found here indicate that they belong to the Iron Age. As this term has rather a wide meaning, it may not be uninteresting if we endeavour to obtain some light as to who were the inhabitants of this place by an examination of the references by the early historians to Celtic Scotland, though the subject differs somewhat from those usually brought under our notice at these meetings.

We have tried in vain to obtain any thoroughly reliable information regarding the earliest inhabitants of the Hebrides, or Innisgall, or "Isles of the Strangers." But perhaps the nearest approach that can be attained to the actual truth of history is to be found in the statements of the Roman writers, and the Irish

ethnologic legends contained in the Leabhar Gabhala or Book of Conquests. Some things they mention, such as the occupation of these islands by a small dark race, appear to receive some corroboratory evidence from other sources. It seems likely that they originated from the same parent-stock as the Iberian race that is now to be found in the Basque Provinces.[1] That the Romans knew the sea to the west of Scotland by the name "Caledonius Oceanus," may be gleaned from Valerius Flaccus, who writes about A.D. 70 ('Argonautica,' i. 8). Pliny (lib. iv. c. 16) mentions that there were thirty islands named Hæbrides, which is wonderfully near the truth; but some succeeding Roman historians only mention five, which may be accounted for by their having got their information from an overland expedition, while Pliny must have got his from some early voyager. We are also informed by Solinus, in his 'Polyhistor' (c. 22) that from the Promontorium Caledoniæ could be seen the five islands of the Hebudes, and this promontory we conclude to be the district of Kintyre. Ptolemy gives a map of these islands, but the only one that can be identified with any certainty is the most northerly, which he calls Maleus, and which is doubtless Mull. The other islands are therefore south of that, and may possibly be represented by Colonsay (with which Oronsay might be included), Jura, Isla, and Gigha, and the names given them by Ptolemy are Epidium, Eugaricenna, and two outer islands marked Ebuda. It may, however, be doubted whether the Romans could actually distinguish five islands, as, unless they had the depression pointed out in which is the Sound of Isla, they would almost certainly take Isla and Jura to be one island. And unless the view-point from which they looked out upon the Atlantic was the top of some of the higher mountains, it is very unlikely they would get even a glimpse of Colonsay, unless they were at the extreme north of the district of Kintyre. From these considerations, therefore, we form the conclusion that most probably after reaching the shores of the Atlantic, the Romans noted the statements of the natives and saw some islands. But that they did not apprehend their position properly may be seen at a glance by referring to Ptolemy's map.

In the year 87 A.D. Agricola appears to have penetrated to the Western Ocean, where he saw the shores of Ireland in the dim distance, and the five islands of the Hebudes and the coast of the mainland of Scotland running due north. But of all the Roman authors, Solinus gives us the fullest statement regarding these islands, their inhabitants and singular customs, in his 'Polyhistor' (c. 22). He says they heard that the inhabitants did not know how to cultivate the ground, but depended entirely upon *fish and milk* as their food. They were reported to be ruled by one king,

[1] Professor Huxley, 'Critiques and Addresses,' p. 167.

who was not permitted to possess property, as it might cause him to be avaricious and unjust; and he was not allowed to have a wife, as a legitimate family might create ambition. We do not think it likely that the race that occupied Caisteal-nan-Gillean is here referred to, as unless some of the Deer remains, which are supposed to belong to the Red-deer, should turn out to be those of the Reindeer, we have no domestic animal giving milk that would be used for human food except the Sheep, and its bones have only been discovered in the upper layers of the deposit, showing that in all likelihood it was introduced to the island during the later period of the occupation of the mound; while the Deer bones are found all through from the lower to the upper strata. It appears to us that though the dwellers at Caisteal-nan-Gillean were certainly accustomed to eat fish, it is doubtful if they had milk to drink—the probability being that they lived before the time to which Solinus refers, and that this kitchen-midden was formed by a more ancient people than those of whom he writes. Another reason for arriving at this conclusion is to be found in the fact that, though the deposits in the Crystal-Spring Cavern on Colonsay are very ancient, it is only in the lowest strata of the cave-floor that we find the remains of Deer—which points to their extinction on Colonsay and Oronsay at a very early period. It is evident that it must have been prior to this time that the kitchen-midden was accumulated, when Deer were more plentiful on the islands, and fell an easy prey to the primitive inhabitants with their rude weapons, on which they would require almost solely to rely to kill the quarry—as there is no indication of their having had dogs, so far as we can judge from the remains.

We now turn to the Irish tradition, said to have been preserved by Fintan, who was baptised by St Patrick. After mentioning the various settlements that took place in Ireland, and all of which are reported to have come from the East,—either *viâ* the Mediterranean Sea and the Straits of Gibraltar, or across the continent of Europe, —he goes on to inform us that a people named the Firbolg came to Ireland from Thrace. He says they were slaves to the Greeks, having been conquered by that nation, who obliged them to dig the earth and raise mould, and carry it in bags or sacks of leather, known in Irish as *bolgs;* and that, being oppressed, they determined to escape from their masters by making boats out of their leathern sacks in which they had to carry the soil. They succeed in carrying out their plan, and at last arrive in Ireland, which was divided into five provinces, ruled over by five brothers; but the people were only divided into three septs—viz., the Firbolg, or "Men of the Bags," who, under Gann and Seangann, landed at Jorrus Dommann in Connaught; the Fir Domhnan, so called from the *domhin* or pits they used to dig, and who arrived under Gean-

nan and Rughruidhe at Tracht Rughruidhe in Ulster; and the Fir Gaillian or "Men of the Spear," so named from the *gai* or spears with which they used to protect the rest while at work, and who landed under Slainge at Inverslainge in Leinster.

After the Firbolg had been in Ireland for thirty-six years, it was invaded by a tribe of people from Alban or Scotland, named the Tuatha de Danaan, who landed on a Monday, the 1st of May, in the north of Ireland. In a great battle, fought at a place named Muigh Tuireadh, they defeated the Firbolg, who are said to have lost ten thousand men; and then this important statement is added: "The remainder of the Firbolg fled to the islands of Arran, Isla, Rachlin, and *Innisgall*, where they remained until they were driven out of the isles by the Cruithnigh or Picts." Among the islands of the *Innisgall* were Colonsay and Oronsay; and some reliance may be placed on the above legend as narrating certain facts in history, though surrounded with a halo of myth, which has probably increased as time progressed. Still our knowledge of the early inhabitants of the Western Isles all points to the southern portion of them, if not also the northern, as having been peopled from Ireland; and this tends to show that there is a certain essence of truth contained in these legends, even though it may be difficult to eliminate it from that which is false.

Nearly two hundred years are said to have elapsed, when, according to the 'Book of Conquests,' a colony of Cruithnigh, or Picts, came from Thrace overland through France to Ireland, having been allowed to settle there by the sons of Miledh, on condition that they drove out a people that were called the Tuatha Fidhbhe. This conquest they succeeded in achieving; but having become rivals to Eireamon, the reigning king of Ireland, he in turn drove them out of Ireland. But he seems to have somewhat relented, for he is said to have given them the wives of some of his own men that had been drowned, and even allowed six of them to remain in Meath, locating them in the plains of Bregia. Those that left Ireland went to dwell *in the country beyond Ile or Isla*, and this last statement is corroborated by the 'Chronicle of the Picts and Scots' (p. 30), which is quite an independent source of information; and it adds,—"From there they went and conquered Alban or Scotland, from Cath to Forchu," or from Caithness to the Firth of Tay. Such statements as we have given require to be received with great caution; but the investigations of the best Celtic critics go to prove that in these legends there are certain elements of truth. Generally speaking, they may be accepted as telling facts when they treat of the settlement or expulsion of a nation, or when they give the names of men or places in Ireland or Scotland. But when they narrate the heroic deeds of warriors in battle, or the immense number of killed, the annihilation of a

race, the exact number of years between events, or similar things, they may well be doubted; and it is only when we have evidence of a confirmatory nature to bring to bear from independent sources, that we should be prepared to accept their assertions.

It is somewhat remarkable that the extraordinary story told us of the Hebrideans by Solinus is so far borne out by an equally reliable author, Julius Cæsar, who ascribes to the inhabitants of the interior of Britain the same habits and customs as Solinus, living some three centuries later, does to the inhabitants of the Hebrides. These primitive people, driven westwards, would most probably, three hundred years after Cæsar's time, be found only in those remote parts of Britain to which they had retired. And the legends told us by the Irish authority lead us to suppose they may be one of those tribes who came, as stated, from the east, or, in other words, Britain, to Ireland, and thence withdrew to the Western Isles of Scotland. That they were the Firbolg, the first-mentioned of these immigrations to the Innisgall, is not probable, as the race mentioned by Solinus had cattle; and we have already given our reasons for believing that the people who lived on Caisteal-nan-Gillean had none—if we except sheep during the later period of its occupation. We are therefore led to the conclusion that this tribe succeeded the Firbolg, and that most probably they were the Cruithnigh or Picts, who are known to have had some remarkable customs regarding succession to the throne. From some recent discoveries we have made, which have led to the identification of one or more places in Colonsay mentioned in connection with important events in Pictish history, we believe there is now no doubt that Colonsay and Oronsay were at one time occupied by this people.

The learned Historiographer-Royal for Scotland says: "The Celtic race in Britain and Ireland was preceded by a people of an Iberian type, small, dark-skinned, and curly-haired. They are the people of the long-headed skulls, and their representatives in Britain were the tin-workers of Cornwall and the Scilly Islands, who traded with Spain; the tribe of the Silures in South Wales; and in the legendary history of Ireland, the people called the Firbolg. The Celtic race followed them in Britain and in Ireland." [1]

The same writer also says: "The names Firbolg and Firdomnan harmonise very singularly with the legendary accounts of the tin-workers of Cornwall and the Tin Islands. It is not difficult to recognise in the tradition that the Firbolg derived their name from the leathern sacks which they filled with soil, and with which they covered their boats, and in the Firdomnan from the pits they dug, the people who worked the tin by digging in the soil and transporting it in bags in their hide-covered boats." [2] As we are not

[1] Skene's 'Celtic Scotland,' vol. i. p. 226. [2] Ibid., p. 177.

aware that there was ever any mining carried on at Oronsay, we suppose that the only use the Firbolg could have in carrying soil would be to lay it upon the sandy stretches at the south end of the island, so as to raise better crops.

But if this was the case, they must have had a much higher civilisation than we have reason to believe, and cannot be the people mentioned by Solinus, as they did not cultivate the soil. It is more probable that if, as we suppose, the Firbolg came to Oronsay, they suited themselves to the circumstances of their new home, and became hunters and fishermen; but that they tilled the ground there appears to be no evidence to advance, and the inference is that they were entirely ignorant of agriculture. It is interesting to know that whoever the people were who inhabited the Danish localities where kjökken-möddings or kitchen-middens are found, they were also to all appearance ignorant of the cultivation of the soil. But though there are some similarities between the kitchen-middens at Oronsay and those in Denmark, still there are great differences, and it is possible that this may be accounted for by the Scottish deposit being formed at a subsequent period to those of Denmark. The wave of immigration whose population formed the kjökken-möddings in Jutland would take a long time, as it continued on its journey from the east, before it reached the extreme west of Scotland. The most striking difference in the remains is in those of the sheep, which seems not to be found in the deposits in Denmark; but it must also be kept in remembrance that the bones of the animal were only found at the top of the upper layer of the Oronsay kitchen-midden, and that they must have been deposited there during the latest period of the occupation of Caisteal-nan-Gillean, or possibly at a later time, before the human deposits were covered over with the blown sand.[1]

The following description of the Firbolg is found in one of the Irish manuscripts: "Every one who is black-haired, who is a tattler, guileful, tale-telling, noisy, contemptible; every wretched, mean, strolling, unsteady, harsh, and inhospitable person; every slave, every mean thief, every churl, every one who loves not to listen to music and entertainment, the disturber of every council and every assembly, and the promoters of discord among the people,—these are the descendants of the Firbolg, the Fir Gailinn of

[1] Sir John Lubbock, in his paper on the Danish kjökken-möddings, in the 'Natural History Review,' 1861, p. 496, says: "In the lake-habitations of the Stone Age in Switzerland, grains of wheat and barley, and even pieces of bread, or rather biscuit, have been found. It does not appear that the men of the kjökken-möddings (or Danish shell-mounds) had any knowledge of agriculture, no traces of grain of any sort having been hitherto discovered —the only vegetable remains found in them being pieces of burnt wood, and some charred substance referred by M. Forchhammer to the *Zostera marina*— a sea-plant, which was perhaps used in the production of salt."

Liogairné, and of the Firdomnan in Erinn. But, however, the descendants of the Firbolg are the most numerous of all three. This is taken from an old book." [1]

This, then, must surely be that Iberian race of small dark men of whom Professor Huxley [2] and Dr Bedoe [3] write, who have left some slight traces of their existence on the West of Scotland in the name of the island of Isla, or *Ile*, as it was anciently spelt; [4] also in two of their skeletons, and some other remains found in a cave in the Old Red Sandstone near Oban during 1869 by Mr Mackay, and described by Professor Turner.[5] But may we not ask, Where are there traces of their dwellings? or, if we find none, had they any? and the only answer we can give is, that no such traces of their habitation in the West of Scotland have been left, excepting, perhaps, the small ruined fortification on St Kilda, named after them Dunfhirbolg.[6] It is likely, from its remoteness, to have been the last stronghold of the race before its individuality was blotted out by absorption into the succeeding immigrations of other tribes. But though blended with that of the later immigrations, the blood of the Firbolg seems to have been so strong that it has more or less permeated the present natives of the Western Isles, and has left its traces in the small dark people that are so frequently met with in these localities. However, let us hope there has been eliminated from them all those questionable qualities mentioned by M'Firbis, and that they have been replaced by virtues even greater than were their faults. This may have been the race who dwelt upon the shell-mound, Caisteal-nan-Gillean, Oronsay; and their rude houses, if they had any, made of wood or wattles, would soon disappear, their site being only marked by the accumulation of the remains we have referred to. If this tribe formed the deposits, then they probably belong to a period not later than the Christian era, and possibly long before it.

At this meeting Mr A. B. Herbert, President, read a short note on the Hornet (*Vespa crabro*), which was illustrated by specimens.

[1] M'Firbis's "Book of Genealogies," in O'Curry's 'Lectures on MS. Materials,' p. 223.

[2] 'Critiques and Addresses,' pp. 134, 167.

[3] Dr Bedoe's Essay, 'Anthropological Society's Memoirs,' vol. iii. pp. 384-573.

[4] Skene's 'Celtic Scotland,' vol. i. p. 216.

[5] 'British Association Report,' 1871, p. 160.

[6] Skene's 'Celtic Scotland,' vol. i. p. 184, note 31.

VIII.—SKETCH OF THE GEOLOGY OF THE PENTLANDS.

By Mr JOHN HENDERSON.

(*Read Feb.* 26, 1885.)

The Pentland Hills, lying so near the city, have always been a favourite resort of Edinburgh naturalists; and no doubt most members of the Edinburgh Naturalists' Field Club are familiar with the zoology and botany of these hills. But as I understand the members of the Club have not as yet devoted so much attention to another kindred branch of natural science—viz., Geology—I thought it might not be out of place to give a brief sketch of the geology of the Pentland Hills, hoping to direct the attention of some of the members, at any rate, to this by no means the least interesting of the physical sciences.

The Pentland Hills geographically occupy a belt of country extending from the south side of Edinburgh to Dunsyre in Lanarkshire. They run north-east and south-west, and are about 16 miles in length and from 3 to 6 in width, and their greatest height above the sea-level is about 1900 feet. In the north-east portion of the range, where the hills attain their greatest elevation, the principal rocks are of volcanic origin, while in the middle and south-west portions the rocks are mostly of sedimentary character. Before going into detail regarding these rocks, I take the liberty of giving you a list of the different sedimentary formations or systems that form the known crust of the earth, so as to keep us in mind of the position the rocks forming the Pentland Hills occupy in the geological record. The different systems or formations are arranged in the following order, beginning at the lowest—viz.: Archæan, Cambrian, Silurian, Devonian or Old Red Sandstone, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, Tertiary, and Post-Tertiary. Such is the arrangement of what is known as the *sedimentary* deposits—that is, rocks formed by the deposition of mud, sand, gravel, boulders, and other materials, through the agency of water; while the term *volcanic* or *igneous* is applied to all those rocks which have been ejected from below, either in the condition of lava, ashes, or volcanic mud, or consolidated between the strata into which they have been injected. The term *contemporaneous* is applied to those volcanic products which have reached the surface and become interbedded in the sedimentary deposits; while the term *intrusive* is applied to those that have been consolidated between the rocks into which they have been injected.

The north-eastern portion of the Pentland Hills is composed principally of igneous or volcanic rocks, consisting of a series of

beds of felstone and felstone-porphyry in long bands, running north-east and south-west, and apparently overlapping each other from north-west to south-east in an ascending order. These beds or bands of volcanic rock extend south-west to Habbie's Howe and the west Kipp Hill, and one narrow band runs as far south as Carlops. The middle portion of the Pentland Hills is mostly made up of sedimentary rocks, belonging to three different formations—viz., Silurian, Old Red Sandstone, and Carboniferous. The oldest of these—the Silurian—occurs as a number of patches cropping up through the newer rocks. The first of these patches we meet with, going south from Edinburgh, occurs at Craigentarrie, on the north-west side of the hills, a little to the east of Threipmuir Pond; the next lies to the south of Bavelaw Castle; another patch occurs at Habbie's Howe; but the largest and most important exposure of Silurian rocks in the Pentland Hills occurs at the head of the North Esk and Lyne Water. These patches of Silurian rocks are separated from one another by overlying beds of conglomerate, sandstone, and igneous rocks. The conglomerates and sandstones lie unconformable on the Silurian, and the unconformability between these rocks is extreme, for the Silurian beds, where they are exposed in the Pentland Hills, stand nearly vertical, while the conglomerates and sandstones lie in a nearly horizontal position upon their upturned ends. The conglomerates that lie upon the Silurian are mostly made up of rounded pieces of these Silurian rocks. These pieces have evidently been broken off the upturned edges of the beds, and rolled about in water and rounded in a most complete manner, as can be seen in the gorge which the Logan Burn has cut at Habbie's Howe, where the rounded pebbles of all sizes up to a foot in diameter are exposed in cliffs from fifty to sixty feet high. The beds gradually get finer as they rise in the series, till they end in the sandstones of the Hare Hill and Cairn Hill. The rest of the Pentland Hills to the south-west are mostly made up of conglomerates, grits, and sandstones, and the hills in that portion of the range are carved out of the nearly horizontal beds. With regard to the age of these conglomerates and sandstones which lie in the middle and south-western portion of the Pentlands, we have little data to go upon to show what system they really belong to. In all likelihood the conglomerates and sandstones that lie immediately above the Silurian, and unconformable to these rocks, belong to the upper portion of the Old Red Sandstone system; while the sandstones that flank the hills on their north-west side, and the sandstones that form the hills at the south-west end of the range, may be considered as Carboniferous.

Now it is part of the geologist's work to endeavour, from the facts he has gathered, to look back into the world's history, and depict the changes which have taken place over the district he

may have examined. If we try to do so in the Pentland Hills district, we are forced to the conclusion that a most complicated series of phenomena have taken place between the Silurian period and the present time. The first picture presented to us by the study of these rocks is a comparatively quiet Silurian sea, teeming with life, in which nearly every class of marine invertebrate fauna was represented. Sponges, corals, star-fishes, crustaceans, and molluscs swarmed in that Silurian sea. That this sea existed here for a long period there is every evidence, from the immense deposits of Silurian strata that can be seen in the largest patch exposed at the head of the North Esk and Lyne Water. Here we have an unbroken series of Silurian strata upwards of 4000 feet in vertical thickness, consisting of thin and thick bedded shales, sandstones, and conglomerates, and occasional beds of limestone. They belong to what is termed the Upper Silurian series. Above them in the Lyne Water lie another set of beds, about 1000 feet thick, conformable with these Upper Silurians, which in all likelihood belong to the lower portion of the Old Red Sandstone system. These Upper Silurian and lower Old Red Sandstone beds, now standing in a nearly vertical position, must have been deposited in a nearly horizontal position in a gradually sinking sea-bottom, and often at a very slow rate, as the nature of the beds and their fossil contents show. But a sudden and extraordinary change came over this long-standing and comparatively quiet sea of Silurian and Old Red Sandstone times in the neighbourhood of what is now the Pentland Hills. This enormous thickness of strata was ruptured and turned up on edge, sheets of molten lava were ejected through the uptilted ends of the Silurian beds, while at the same time the waves attacked these rocks, breaking them up into fragments, rolling them into pebbles, and piling up the materials in the hollows of the sea-bottom. Neither did the materials ejected from the interior escape the general denudation, for the sections now exposed show that the volcanic matter was attacked and reduced to a paste which helped to cement the pebbles and other fragments of rock which form the conglomerates and sandstones contemporaneous with those outbursts. How long this battle between Vulcan and Neptune raged we have no means at present of knowing, but it is evident that, before the close of the Carboniferous period, Neptune had managed to bury the works of his antagonist beneath several thousands of feet of sedimentary strata; for from a study of the geology of Mid-Lothian, we are forced to the conclusion that the Carboniferous rocks of the district lay in an unbroken sheet over where the Pentland Hills now stand—at least, over the north-eastern portion of these hills. But after all this deposition of Carboniferous strata, amounting in all to possibly about 10,000 feet, another convulsion, or other convulsions, shook the district, and all this

immense thickness of Carboniferous rocks was bent into anticlines and synclines, and broken and faulted, and a long section of the district now occupied by the north-eastern portion of the Pentland Hills pushed up to a height of 2000 or 3000 feet. This is proved by the two great faults that run parallel with the hills at their north-eastern portion. That enormous denudation again took place is abundantly proved by the shorn-off and levelled-up condition of anticlines, synclines, and faults. The long stony ridge that had been upheaved was denuded of its superimposed sedimentary strata, and the buried volcanic rocks again exposed to the action of the waves, carving glens and valleys through the ridge, and leaving the harder portions standing up as hills: and so in the middle and south-western portions of these hills the same denudation had been going on, for what must have been a great platform of nearly horizontal beds of sandstone has now got valleys scooped out of it in every direction, some of them nearly a thousand feet deep. That the ice of the glacial period had a great hand in finally moulding these hills and the adjacent country into their present form, there can be no doubt. Evidence of ice-action is common all over this range of hills. Rubbings and scratchings produced by ice—or rather the hard materials fixed in the ice—are found high up on the hill-sides, and in one instance, at least, on the top of one of the highest hills; boulders, some of them ten and twelve tons in weight, from far-off distances, strew the hill-sides; while boulder-clays lie packed in the valleys, in many places containing materials foreign to the district. All these tell of a time when this country was under severe arctic conditions—when a great ice-sheet swept with slow but irresistible force over the face of the country, rubbing and grinding down the rocks, packing the eroded materials into the hollows, and forming what is known as boulder-clay and other glacial deposits. Nor has nature been idle among these hills since the glacial period, for frost, rain, and wind have been busy on their sides and in the valleys, breaking up and carrying away to lower levels the materials of which the hills are composed, as the deep ruts and glens formed by the burns that run from their sides testify.

Such is a brief, and, I feel, very imperfect sketch of one of the most interesting districts in Scotland, and you will readily see that to do anything like justice to such a subject would take much more time than the nature of our meetings will allow. However, I hope that the few remarks I have made may induce other members of the Club to take hammer in hand, and go and investigate for themselves.

IX.—DIATOMS.

By Mr JOHN RATTRAY, M.A., B.Sc.
Scottish Marine Station, Granton.

(*Read Feb.* 26, 1885.)

Among the vast and varied array of micro-organisms with which the student of nature has to deal, there are perhaps none that offer more attractive and interesting features than those presented by the Diatomaceæ. These unicellular organisms, with their characteristic and, in most cases, delicately-sculptured siliceous walls, are to be found in fresh and salt or brackish water, as well as on damp ground generally, either in a free state or not unfrequently adhering to stones or to decaying or healthy plants of larger size than themselves. Viewed under a moderately high power, they are found to possess a very great variety of outline—from the narrow elongated Nitzschiæ and Synedræ to the cuneiform or wedge-shaped Meridions, the discoidal Coscinodisci, the curved and saddle-shaped Campylodisci, the sigmoid Pleurosigmæ, the navicular Cocconeës, the tri- or poly-angular Triceratia, and the geniculate Achnanthidia. Appendages of various forms, and presenting various differences as to disposition and dimensions, are also not uncommon. These occur sometimes in the form of marginal or submarginal alæ, as in Surirella; sometimes as elevated keel-like ridges, as in Nitzschia; and sometimes as tubular horns, which may be simple or branched, as in Chætoceros or Rhizosolenia. But throughout the wide range of external configuration, a remarkable symmetry is, with few exceptions,—such as Achnanthes and some others,—generally very apparent. This significant characteristic at once forces itself upon the attention, the entire Diatom cell being composed essentially of two[1] valves and a connecting hoop or cingulum intervening between the former. The valves are in most cases similar to one another, but the cingulum may vary very greatly in its appearance—that is, in its state of development; and it is in all cases of the utmost importance to remember that the outline of any given frustule need not present the same contour when viewed with the valves next the eye—*i.e.*, from the valval or side aspect—and with the cingulum next the observer—*i.e.*, from the zonal or front aspect. No more striking contrast in this respect need be sought than that which is found in the case

[1] In some cases pseudo-multiple frustules are found: thus, a Triceratium breaks up into two triangular end plates and three rectangular side plates, while the latter may again divide into several paralleliform pieces.

of Triceratium, where, in the one view, the organism is triangular, but in the other quadrilateral.

Seeing, then, that the configuration of the siliceous cell-wall is so prominent, it is evident that it will be of the greatest importance in the elaboration of any system of classification; hence it becomes necessary to designate its various component parts by a well-defined phraseology. This has been recognised since the time of Ehrenberg, who introduced the terms *dorsum* and *venter* to signify a convex and a concave surface respectively; but it is obvious that these designations could readily be applied to non-homologous parts, hence Kützing, Rabenhorst, and others adopted an improved but somewhat misleading nomenclature, which may be most clearly explained in the following manner:—

Front view (Ralfs and W. Smith)—*i.e.*, hoop next observer,	=	Lateral surfaces (Ehrenberg). Primary side (Kützing). Secondary side (Rabenhorst). Zonal view.
Side view (Ralfs and W. Smith)—*i.e.*, surface of valve next observer,	=	Dorsum and venter (Ehrenberg). Secondary side (Kützing). Primary side (Rabenhorst). Valval view.

There can be no doubt that the terms having reference to the connecting zone and valves are those which are most natural, and which will ultimately gain the acceptance of all.

In habit, as in form, great variations occur in this interesting group. In very many instances the individual frustules are met with in a free condition, but in others stipitate and concatenate or ramose forms are to be found. It is hardly necessary to note that the form of any chain, whether straight or curved, will depend on the figure of the component frustules; but it may be mentioned that both the degree and nature of the attachment of adjoining frustules vary within wide limits. Thus in some cases the union is so slight that one frustule can glide over the other (*e.g.*, Bacillaria); while in others the junction surfaces are dentated or provided with excrescences and pits, in order to effect a more complete connection. The nature of the attachment, moreover, may be temporary or permanent. In the former case the free forms become adherent by one extremity, but no special connecting medium exists; while in the other there may be a nodule or pedicel for fixation. This stipes, again, may branch either in a dichotomous manner, as in Gomphonema, or irregularly, as in Licmophora; but its length is a matter of secondary importance, as it is found to vary in any species according to the inherent vigour of the species or the nature of the external influences to which it is subjected.

Instead of possessing a simple or compound pedicel or stipes, many Diatoms—which Ehrenberg included under the name "Lacernata"—are embedded in a gelatinous substance; and since numerous frustules are often embraced in this covering, *frondose* appearances are the result. These frondose forms may be either membranous, filiform, or filamentous and ramulose,—differences in thickness and in expansion being at the same time often clearly recognisable. Reinhardt[1] remarks that the modes of formation of the pedicel of stipitate species and of gelatinous colonies present phenomena analogous to those found in palmellaceous Algæ, intercalation of cell-walls being sometimes found in Mastogloia, in which outer gelatinous and inner more consistent layers are to be recognised, a pedicel being the result of local mucilaginisation of the outer layer. Within the muco-gelatinous envelope the disposition of the frustules may be either regular, as in Schizonema—a not uncommon marine genus—or irregular, as in the marine Dickieia. In the determination of species, the flaccid or rigid consistence of the fronds, the character of the branching, and the nature of the union of the ramuli into fascicles, are important.

The siliceous substance which is incorporated in the cell-walls of living Diatoms varies very greatly in its amount in different genera. In some cases, such as Rhizosolenia and Thalassiosira, it is very deficient, the wall being even in a *quasi* flaccid condition; and, generally speaking, there is less siliceous matter in filamentous than in free forms, and less in tubular processes than in the walls of the frustule bearing these processes. The silex is associated with organic matter, and, according to Frankland, with iron as silicate or protoxide—a circumstance which explains the occurrence of a brown colour when Diatoms are moderately heated, the protoxide absorbing oxygen and becoming brown peroxide.

In addition to the siliceous lamina, various other membranes or cell-tunics have from time to time been recorded, and among these it is interesting to recall (1) the soft primordial membrane enclosing the cell contents; (2) Nägeli's third tunic, or mucilaginous layer, inside the primordial layer; and (3) Kützing's third or cement tunic, extending often over a considerable part of the frustule *outside* the siliceous coat. This layer is to be regarded, according to Kützing, as equivalent to the connecting matter of the frustules when these occur in union; while Frankland believes that the stains on whose existence it was established are attributable to the oxidation of iron salts in chemical union with silica. On the other hand (4) Shadbolt's third tunic, which has been said to be sometimes "cellular," and to present markings different from those of the siliceous valves below it, was regarded as horny, somewhat pliant, and possessing a certain amount of elasticity, so

[1] 'Sitzungb. Versamml. Russ. Naturf. u. Aertze.' Odessa: 1883.

as to enable it to return to its original condition when bent or rolled up. With regard to the character of the siliceous lamina, Nägeli has spoken of it as extra-cellular, while Meneghini has maintained that the silica must permeate some form of connective or organic membrane. Smith,[1] on the other hand, has held that by macerating the frustules in acid, the cell membrane partly or wholly becomes detached from the valves, and has thereby deduced that the siliceous coat is an independent structure.

The sculpturing of the valves is often of the most elegant and beautiful description. It may appear in the form of distinct ribs or costæ, of more or less minute and well-defined dots or puncta, of stripes or striæ of very variable arrangement, or of "cells" or areolæ. More than one kind of marking may occur on one and the same valve; and the ornamentation may cover the entire frustule or may leave certain areas unaffected. The real nature of the various types of sculpturing thus indicated has been very variously stated. A point has sometimes been ascribed to a depression, sometimes to an elevation, and sometimes to a condensation or thickening of the siliceous matter. The costæ have in some instances been attributed to furrows, in others to ridges, and in yet others to canals or to incomplete internal partitions or septa. The striæ are in some cases resolvable into dots or puncta, and are called *moniliform;* but in others they cannot be so resolved, and are said to be *continuous.* Recently Dr Flögel,[2] from a series of microscopic sections of frustules which he has been able to procure, stated the following general conclusions:—

The marking is caused—

(I.) By sharply projecting wall thicknesses—

- (α) on the inner surface of the membrane, *e.g.*, Achnanthes (transverse striæ), Isthmia (valves);
- (β) on the outer surface of the membrane, *e.g.*, Isthmia (girdle band).

(II.) By chambers within the membrane—

- (α) with distinct openings—
  - (i) on the outer surface of the cell, and closed inwards, *e.g.*, Triceratium, Coscinodiscus;
  - (ii) on inner surface, chambers large, *e.g.*, Pinnularia.
- (β) Without distinct openings, but of considerable size—
  - (i) with smooth chamber-walls, *e.g.*, Coscinodiscus centralis;
  - (ii) with nodular thickened chamber-walls, *e.g.*, Eupodiscus.
- (γ) Closed on all sides and extremely small, approaching the limit of discrimination, *e.g.*, Pleurosigma, Navicula lyra, Surirella.

[1] 'Ann. Nat. Hist.,' 1851. [2] 'Jour. Roy. Micr. Soc.,' 1884.

Strasburger, Abbé, Weiss, Prinz, van Ermengem, Errera, Deby, Grunow, Stephenson, Slack, Morehouse, Müller, Wells, Schumann, Pfitzer, Hallier, Borscow, Walker-Arnott, Dippel, Max Schultze, Burgess, Kitton, Cox, and van Heurck have, among others, recently expressed opinions on this most difficult problem, but of these the conclusions arrived at by Cox and van Heurck need alone be selected, in contrast to those of Flögel above quoted, as indicative of the great difficulties that are encountered in the solution of this complex question.

Dr J. D. Cox[1] infers generally—(1) That the Diatom shell is usually formed of two laminæ, one or both of which may be areolated, and may be strengthened by ribs which have been described both as costæ and as canaliculi. (2) That the normal form of the areolæ is circular, but that these, if crowded, become hexagonal or subhexagonal. (3) That the areolæ are pits or depressions in the *inner* surface of one of the laminæ, so that when two laminæ are applied together, the exterior surfaces of the shell are approximately smooth, and the cavities are within. (4) That the apparent thickening on the exterior of the lines bounding the areolæ in some species (Eupodiscus argus) is not in contravention of, but is in addition to, the formation above described. (5) That however fine the dotted markings of Diatom valves may be, the evidence from the colour of the spaces between the dots, and of the dots themselves, supports the conclusion that they follow the analogy of the coarser forms, in which both fracture and colour are found to prove that the dots are areolæ and the weaker places in the shell.

Dr van Heurck[2] has, on the other hand, stated his general conclusions as follows :—

(I.) The valves in the Cryptoraphidieæ generally consist of two layers—

- (α) The lower single lamina, with more or less delicate punctations on its inner face.
  - (It could not be determined whether the punctations completely traversed the lower layer, or only proceeded to a certain depth.)
- (β) The upper lamina varies—
  - (i) It forms alveoli, usually closed from above, in Triceratium favus and Coscinodiscus oculus-iridis.
  - (ii) The alveoli are open above in Eupodiscus argus.
  - (iii) In some cases the upper layer may entirely disappear (Triceratium intricatum), the various stages in this process being traceable in different species.

[1] 'Jour. Roy. Micr. Soc.,' Dec. 1884.

[2] 'Synop. d. Diat. d. Belgique,' pp. 35-37.

(II.) The valves in the Pseudoraphidieæ and Raphidieæ present the same structure as those in the Cryptoraphidieæ; but the alveoli, though much smaller, may be observed in some genera of Raphoneis, Pleurosigma, &c., by the use of Smith's medium.

(III.) The beads of Diatoms are formed by alveoli and striæ, and often by the walls of the alveoli.

The general inference arrived at by Professor Smith as to the nature of the valvular sculpturing was, that it was all reducible to modifications of a "cellular tissue," analogous to that which is so manifest in the cases of Triceratium and Isthmia. In the confluence of the component "cells" of this "tissue" along certain lines, he found an explanation of the appearances generally known under the designation of "costæ" or unresolvable striæ. The longitudinal band or raphe, which has been made the basis of a system of classification by Professor H. L. Smith, was regarded as a strand of condensed or more solid silex, its median and terminal spots or nodules being but expansions of that band of a similar character, and both being designed for the purpose of giving greater firmness to the frustule, so as to enable it more effectively to resist the external pressure to which it might be subjected. The fact that, as a result of pressure, the internal protoplasmic contents never escaped at the raphes or noduli, and that when fractured no disposition to break at this region was manifested, were, moreover, adduced as proofs that no perforations of the valve existed here.

The genera Pinnularia, Navicula, and Gomphonema, among others, may be cited as affording good examples of nodulated valves; while the genus Stauroneis is provided with a transversely elongated central nodule to which the special name of "stauros" has been applied. On the other hand, a simple, bare, or unornamented area on diatomaceous valves has been designated by Smith a "pseudo-nodule."

In contrast to the views which have just been noted, it is interesting to recall the circumstance that Ehrenberg regarded the valvular puncta as in many cases real *pores;* these, he believed, played the part of apertures of exit for the pedal organs, which might be few or many, and which were supposed by him to be essential to explain the locomotion of living frustules. Similarly this observer regarded the striæ and costæ as in many cases real *fissures*, which were supposed to possess the double function of serving at once as exit-channels for the ova and as means for bringing the internal protoplasmic substance in close contact with the external medium.

Kützing also maintained the belief that valve-pores existed, and that through them the muco-gelatinous mass so prominent in

Schizonemæ and other frondose forms was extravasated. Schleiden, on the other hand, regarded the longitudinal band as a cleft, but the median and terminal nodules as thickened areas of siliceous matter. This conception has also been held by Siebold and Nägeli, who regarded the nodules as minute monticules or eminences; but it was rejected by Professor Bailey, who found by dissolving the siliceous substance of the valves with hydrofluoric acid—the objective of his microscope being protected by a slip of mica fixed by means of Canada balsam—that the nodules and longitudinal band were the last to disappear, and that they must accordingly be looked upon as the thickest regions.

The true nature of the striæ, as well as of the more clearly defined bands and valve nodules, was disputed by the earlier observers, as well as by those of the present day. By some they were regarded as depressions, by others as elevations—various arguments having been adduced in support of both hypotheses.

Structures in the Diatom valve called "vittæ" were believed by Kützing to possess a very special function, and were employed by him in naming a subsection of the group—the "Vittatæ." Smith, however, held that these appearances were not special organs, but mere modifications in the outline of the valve, which was simply inflected at the positions in question. The "canaliculi," so often referred to by Professor W. Smith, were, on the other hand, regarded by him as inter-lamellar channels or hollows intervening between the siliceous coat and the internal membrane, and formed by undulating flexures of the epidermal envelope, their function being supposed to be the conveyance of the nutriment which was believed to enter from without—through pores existing along the line of suture—to the surface of that membrane.

A considerable amount of discussion has recently taken place on the question of the value of the external markings of Diatom valves, from a systematic point of view. Ehrenberg regarded the number of striæ or costæ as constant in a given space on the valves of members of the same species; while Smith maintained that the striæ were constant in frustules originating from the same embryo, though they might vary in those from different embryos. Castracane,[1] by the application of photo-micrography to this question, concludes generally (1) that the number of striæ is constant in frustules of the same species, though these are of different size and outline; (2) that the striæ are not always of absolute specific value, being in a few cases irregular, but that they are so when regularly disposed; (3) that in a series of valves originating from different sporangial frustules belonging to the same

[1] 'Atti. Accad. Pontif. Nuovi Lincei,' vol. xxxi., ser. vi.: May 26, 1878.

species, the variation in the number of striæ never exceeds one-fifth; and (4) that there is never any difference in number in species originating from the same stock. Dr Wallich[1] had previously, in 1877, expressed the general conviction that though the *total* number of striæ on the valves of a Diatom may be almost constant in every valve of the same species, the number on any fractional part of any valve (*e.g.*, on the thousandth of an inch) would vary in proportion to the size of the valve.

To the opinion of Castracane just quoted both Kitton and Professor H. L. Smith[2] have offered objections, and among these perhaps not the least important, from a practical point of view, is that pointed out by Smith — namely, the multiplication of species which must follow its adoption; although it ought always to be borne in mind that, by basing their limits on broader and firmer principles, their number should, if practicable, be reduced, while the very diverse character of the striæ in Stauroneis gracilis, and its sporangial frustule, Stauroneis phenicenteron, is referred to as an extreme case proving the unimportance of the deductions. Nevertheless in the description of any given frustule, the position of the striæ, whether radiate or parallel, their moniliform or confluent nature, and their occurrence over the general surface of the valve or only over certain more or less definitely circumscribed areas of it, should be noted, as well as the presence or absence of a median raphe, the existence or non-existence of central and terminal nodules, and the figure and position of the surface areolæ.

So far the valves. The cingulum or connecting membrane cannot be regarded as of essential importance, but it is often present in some degree of prominence. In circular and discoidal Diatoms it presents the form of a continuous ring—*e.g.*, in Coscinodiscus radiatus, a form not uncommon in the littoral areas of the Firth of Forth. In oblong frustules, again, such as Navicula, it has an oblong or navicular outline. In not a few cases it presents an elegant sculpturing either in the form of areolation or striation, as in Isthmia and Achnanthes. In general, however, the proportion of siliceous matter present in it is, as above noted, less than in the valves. In size it varies very much, being very small in Pleurosigmæ, while in some instances it is distinctly larger at one extremity than at the other—*e.g.*, in Gomphonema. The mode of its development, and of its behaviour during the temnogenetic process, has not in all cases been clearly determined.[3]

[1] 'Month. Micr. Jour.,' vol. xvii. p. 61 : 1877.

[2] 'Amer. Micr. Month. Jour.,' vol. ii. pp. 221-223 : 1881.

[3] See, however, Flögel's results in 'Jour. Roy. Micr. Soc.,' 1884, p. 676 *et seq.*

The contents of the diatomaceous frustules consist of the following distinct structures: (1) the soft, mucilaginous, yellowish-brown or orange-brown endochrome or "gonimic substance" of Kützing; (2) a distinct central nuclear body, which is probably, as indicated by Schleiden, the point at which, as in other organisms, fissiparous division originates, and which, according to Nägeli, is either primary (*i.e.*, active) or secondary (*i.e.*, inactive), and includes a distinct nucleolus; and (3) translucent globules, which, on the whole, are definite and constant in position, and occupy less space than that taken up by the nucleus. These globules, according to Smith and Kützing, are fatty or oily, and have been looked upon by Kützing as equivalent to the starch of higher vegetables; while, on the other hand, Ehrenberg regarded them as the male reproductive organs of the living frustules, the vesicles in the vicinity of the nucleus being regarded as "stomach sacs." Objections were, however, soon raised to this polygastric view, among which may be noted the circumstance that colouring matter could not be detected to be carried along towards the middle, where these sacs should lie. The mucilaginous endochrome may be either diffused irregularly in the interior of the cell, or may form parietal layers or plates, or be more aggregated towards the centre, or it may be disposed in lines radiating from the nucleus. The green colouring matter is concealed by a buff-coloured substance called "phycoxanthin."[1]

Whether the mucilaginous contents of Diatom cells come into actual contact with the external medium cannot yet be said to be clearly decided, owing to the great difficulty experienced in determining the minute structure of the cell walls. That such a contact does occur along sutures between the opposed valves, or between the valves and cingulum, has, however, been asserted by several observers, especially by those who maintain that the movement of the frustules in their watery medium is due to cilia.

To account for the movements of living Diatoms, which are often of an extremely interesting and are always of a puzzling character, various hypotheses have been advanced, but no satisfactory explanation of the phenomena has yet been forthcoming. Free as well as concatenated frustules may move, and even fixed forms sometimes exhibit such characteristics. The motion in many cases consists of a series of jerks in a given direction. These are followed by a pause, and the frustule then returns to its original position by a series of jerks in the opposite direction, and in the movement an obstacle is not avoided. As, however, other undoubted vegetable organisms are capable of locomotion, the phenomenon cannot be looked

[1] Sachs' 'Text-Book of Botany,' 2d ed., p. 260.

upon as indicative of an animal nature. Ehrenberg has ascribed the motion to the existence of a snail-like foot projecting from the central pore or umbilicus, but no such structure can be detected by the eye. Nägeli, in 1853, denied the existence of special locomotive organs, and declared that the motion was due to the attraction and emission of fluids which were necessary for the maintenance of the nutritive processes. The fluids in question were supposed to be unequally distributed over the surface, and to be sufficiently powerful to overcome the resistance of the water. By further supposing that one-half of the cell admitted while the other emitted currents, and that a regular alternation of these processes took place at the two halves, the alternate forward and backward movements were explained. Hogg, in 1855, attributed the motions to cilia, while Smith ascribed them not to any external organs, but to exosmotic and endosmotic processes occurring simultaneously, and at the extremities of the frustules. This view has been accepted by Rabenhorst; but another probable cause had already been pointed out by Wenham, and accepted by Siebold, namely, the undulations of an external membrane, which, however, may not have been clearly recognised by any observer. An ingenious suggestion has recently been made by Engelmann,[1] namely, that the unseen gaseous molecules escaping from the Diatom cell cause the movement, he having found in Bacteria a means of demonstrating under the microscope the evolution of oxygen by the living frustules. O'Hara, in 1882, again accepted the general explanation previously advanced by Wenham; while still later, 1883, Hogg attributed the movements to contractile prehensile filaments. In the same year, van Ermengem[2] ascribed them to thermo-dynamical, and, perhaps, electro-capillary forces; while Adams[3] has even speculated on the occurrence of cilia lining the surface of the enclosed vegetable matter, which might bring about the results observed. This view, however, can hardly be looked upon as tenable, the hypotheses ascribing the movements to cilia, to osmotic or other physical processes, to the undulations of an external membrane, or to the escape of gaseous molecules, being much more probable.

The velocity of the movements of Diatoms varies very greatly. Some advance at the rate of about one-third of an inch per minute, while others do not pass over more than one fifty-fifth of an inch in the same space of time. Between these numbers many other speeds have been recorded.

The methods of multiplication hitherto observed among Diatoms are (1) fissiparous division or temnogensis; (2) conjugation; and

[1] 'Bot. Zeit.,' 1881, p. 441 *et seq.*
[2] 'Bull. Soc. Belg. Micr.,' vol. ix. pp. 41-43.
[3] 'Amer. Month. Micr. Jour.,' vol. iv. p. 59.

(3) sporular multiplication. In the first of these processes, the nucleus divides, then the soft protoplasmic substance, and finally a wall is formed along the divisional plane, in connection with which the siliceous matter for the valve of each daughter frustule is deposited. As a result of conjugation, according to Smith, two parent frustules may give rise to one or two sporangia; or the valves of a single frustule may separate, and the contents increase so as to form two sporangia, or in other case finally condense into a single sporangium. In the case of sporular multiplication, which has been regarded as sufficient to account for the enormous multitudes of some species,—the other modes of multiplication explaining the rarity of others,—the protoplasmic contents break up into a number of sporules, which form the starting-points of new frustules. Examples of this have been observed by O'Meara, Castracane, and others. The exact nature of the so-called auxospores has been disputed. By Pfitzer they are looked upon as the starting-point of a new descending series of forms, being produced only after any given species has been reduced to its minimum size by successive temnogenetic processes. This interpretation of their function thus implies that increase of the silicified cell-wall does not take place during or subsequent to fission. But Smith has given figures of frustules that go to show that such increase may go on; and the belief has been held by some that the auxospores are more properly abnormal structures, to be regarded rather as the expiring phases of the Diatom than as the means of inaugurating a new and vigorous series of forms.

From the geological point of view, Diatoms play an important *rôle*. Their habits as marine or fresh-water may be made use of in determining the exact mode of origin of geological deposits; while the enormous banks of frustules in course of formation, found in recent times by Hooker in the Antarctic Ocean, and more lately by the naturalists of the Challenger,[1] go to show how these great deposits may have originated. The persistence of some genera and species from Carboniferous or even Silurian times to the present day is noteworthy.

It is of great importance to observe that Diatoms sometimes occur on the surface of the sea in enormous masses, and give a characteristic tinge to the ocean water. This is not unfrequently the case with Rhizosoleniæ and Thalassiosira, isolated specimens of which not unfrequently occur in the Firth of Forth; and such aggregations are of importance from the fact that they may influence the formation of deposits at the mouths of rivers, of sediment in harbours, and so on.

It may be interesting to append a short list of some of the species of Diatoms which have recently been observed floating on

[1] 'Proc. Roy. Soc. of London,' vol. xxiv. p. 533.

the surface of the waters of the Firth of Forth.[1] They include specimens of—

A. Raphidieæ.

Pleurosigma strigosum.
" balticum.
" formosum.
" fasciola.
Cocconeis scutellum.
Navicula aspera.
" distans.
" digitoradiata.
" interrupta.
" convexa.
" tumida.
Amphiprora striolata.
" vitrea.

B. Pseudoraphidieæ.

Raphoneis amphiceros.
" belgica.
Rhabdonema minutum.
" arcuatum.
Diatoma minimum.
Nitzschia sigma.
" constricta.
" punctata.
" closterium.
Dimeregramma minus.
Surirella ovalis.
Thalassiotrix nitzschioides.

C. Cryptoraphidieæ.

Coscinodiscus concinnus.
" centralis.
" radiatus.
" fimbriatus.
" excentricus.
" minor.
" polyacanthus.
" perforatus.
Biddulphia aurita.
" granulata.
Auliscus sculptus.
Actinocyclus crassus.
" Ralfsii.
Actinoptychus undulatus.
Hyalodiscus stelliger.
Chætoceros boreale.
" decipiens.
" incurvum.
Melosira sulcata.
Syndendrium diadema.
Rhizosolenia styliformis.
Thalassiosira Nordenskiöldii.
Cerataulus turgidus.

Species of frondose forms, such as Schizonema Grevilii, are not uncommon in the tidal belt. They often occur attached to various Algæ, such as Polysiphoniæ and Ceramia, and not unfrequently bear other Diatoms on the sides of their muco-gelatinous filaments, such as Synedra gracilis, Rhipidophora elongata, Grammatophora marina, Amphitetras antediluviana, &c.

Various fresh-water species have also from time to time been noted, among which may be mentioned the following:—

A. Raphidieæ.

Amphora ovalis.
Cymbella scotica.
" helvetica.
Pleurosigma attenuatum.
" lacustre.
Navicula elliptica.
Navicula amphisbæna.
Gomphonema geminatum.
" acuminatum.
Cocconeis Thwaitesii.

B. Pseudoraphidieæ.

Epithemia gibba.
" turgida.

[1] The classification of Diatoms at present generally accepted is that by Professor H. L. Smith, and may be found in the 'Lens,' vol. i., 1872. It is based on the character of the raphe on the siliceous valves.

Fragilaria capucina.
Eunotia arcus.
Synedra splendens.
" ulna.
Tabellaria flocculosa.
Licmophora flabellata (marine).
Grammatophora marina (marine).
Denticula ocellata.
" tenuis.
Diatoma elongatum.
" " var. β.
" vulgare.
Nitzschia linearis.
" sigmoideæ.

C. Cryptoraphidieæ.

Isthmia nervosa (marine).
Cyclotella operculata.

X.—*NOTE ON THE GENUS LAMIUM.*

By Mr MARK KING.

(*Read Feb.* 26, 1885.)

The Natural Order of the Labiatæ, in which the genus *Lamium* is found, is one of the best marked and most easily recognised of all the botanical groups. The Labiates are confined to the temperate regions of the earth, their number diminishing towards the tropics and either pole. The *Lamiums*, or Dead-nettles, are perhaps the best-known plants of the Order,—indeed they are so familiar to all, that they are frequently passed by with, it may be, a single glance; and yet, like many of their humble neighbours, they possess a most interesting structure, and well repay any labour which may be spent in their study, as is evidenced by the remarks upon the common Dead-nettle in Sir John Lubbock's most readable book on the 'Fertilisation of Wild Flowers.' Although mainly following Hooker, in his last edition of the 'Student's Flora of the British Islands'—(the latest and best arrangement of our native plants)—I may state that I have given some attention to the genus *Lamium*, and would desire to add my own remarks from observation of the living plant from time to time. Perhaps the most striking family resemblance in the *Lamiums* is found in the whorled inflorescence, with the leafy bracts, these latter being often three or four times as large as the leaves. The generic name is probably derived from the Greek word for a throat, in allusion to another well-marked characteristic — namely, the throat-like corolla. There are at least *five* species of *Lamium* indigenous to, or thoroughly established in, this country, and of these *four* may be considered as generally distributed over Britain. The genus is conveniently divided into *annual* and *perennial* plants,—the annual forms being Lamium purpureum, L. intermedium, and L. amplexicaule; while

the perennials are L. album, with its ally L. maculatum, and L. Galeobdolon. Yet this division is not constant, for all the annual specimens now exhibited are biennial plants—that is, all have lived over the winter, and are now in their *second* year's growth, if indeed not older. In mild seasons I find L. amplexicaule invariably biennial, but L. purpureum is less persistent. The following are the characteristic features of L. purpureum: leaves petioled cordate crenate, whorls crowded, corolla-tube *shorter* than calyx, bracts crowded with bases not overlapping, stem decumbent below. This species has further been divided by some botanists into four or five varieties, but these all partake less or more of the character just given of the type. L. intermedium, again, is a somewhat anomalous species, rare and local, though very abundant where it does occur. The history of this plant, as a separate species, is noticed by the late Mr F. M. Webb, in an article in the 'Transactions of the Botanical Society,' 1877, entitled "On Plants in the British Herbarium at the Royal Botanic Garden, Edinburgh." Mr Webb says: "It was before the Society on 12th May 1836 that Mr N. Tyacke read a paper, and illustrated it by specimens, to show that a *Lamium*, not uncommon in some parts of Scotland, was L. intermedium of Fries; and we possess specimens of his gathered in the Edinburgh neighbourhood and in the Hebrides during that year." It is added that this plant "had previously been amalgamated—rather than confounded—with L. incisum." My own observations of this plant, in its growing state, agree well with Hooker's description, and I venture to give the result of these observations—viz., Leaves petioled orbicular cordate crenate, whorls sub-terminal crowded, calyx slightly hairy, teeth spreading in front much larger than the tube. The plant is intermediate in character between L. purpureum and L. amplexicaule, but approaches very nearly the sub-species L. purpureum var. hybridum, though differing from it in having the corolla-tube longer than the calyx. It is not a very easy plant to determine, contrasting in this respect with L. amplexicaule, which is a well-marked species. The specific name *amplexicaule*, or "stem-embracing," refers to the mode of growth of the bracts or floral leaves. The following are its characteristic features: Leaves petioled cordate reniform crenate, bracts sessile lobed with upper small bases overlapping and lower large *not* overlapping, calyx much longer than capsule, teeth with long white hairs. The popular name of the plant, Henbit Dead-nettle, is explained by some authorities to refer to the serratures of the leaves, which appear as if cut by fowls. The popular names of plants, however, are often obscure in their origin, as well as frequently misleading. This plant, L. amplexicaule, has been introduced into North America, and has a very wide geographical range.

To treat now shortly of the *perennial* forms. There are, first, L. album, the white Dead-nettle. This species seldom varies in habit or general appearance, thus forming a marked contrast to its purple relative, which sports, as above remarked, into several varieties. Both the white and the purple forms may be found in flower nearly the whole year round, and it becomes an interesting question how these insect-fertilised plants, with such as Gorse, Butcher's-Broom, Daisy, and Dandelion, when flowering in winter, can be fertilised at a season when the number of insects about is small indeed. The difficulty is found to be met by self-fertilisation in this case, the anthers discharging their pollen *in the bud* before the flower is opened, as in the so-called "cleistogenous" flowers. A plant of L. album, gathered in bud in the last week of December, showed the stamens "completely curved down and brought into contact with the bifid stigma—the pollen being at that time freely discharged from the anthers." This mode of fertilisation in winter-flowering plants which are normally insect-fertilised, is one worth testing in order to place it on a still broader basis of fact. In the two last editions of Hooker's 'Student's Flora,' L. album is stated to be "rare and local in Scotland and Ireland." In all the localities in the east of Scotland which I have visited, I have found this plant always abundant, though by the botanists of the West of Scotland it is reckoned a rare plant. I have been favoured, on this point, with the following remarks from Mr R. Turner, a Vice-President of the Natural History Society of Glasgow: "As to the Dead-nettle (*Lamium album*), the plant is not at all common in the Glasgow district. Our former local authorities—Hopkirk, Patrick, and Hennedy—state in their Floras that it is frequent; but my own impression is, that 'rare and local' is a much better term. I have hardly ever seen it in any of the localities mentioned by Hennedy, and where it does occur it exists in no great abundance. I do not recollect seeing it anywhere about the Firth of Clyde, or indeed along the West Coast at all. To the north of the Firth of Clyde it is almost unknown, and it is certainly far from common in the counties of Wigtown, Dumfries, and Kirkcudbright. Even so far south as Lancashire, it is, I believe, scarce. I have observed it in a few stations in the interior of the counties of Lanark and Renfrew; but it does not in the least approach, even in the places where it occurs, the profusion which it attains in some eastern counties, as in Roxburghshire for instance, about Kelso, where it makes every hedge-bank and waste place beautiful in early summer. I observed a year or two ago, in our Royal Botanic Gardens here, a label resting lonely on a plot for botanic students bearing the words '*Lamium album*,' and not a single plant anywhere. It does not seem to take kindly with our soil or climate, and is a rarity compared with L. intermedium, Fries,

which is frequent in the district." That it is indigenous, however, is generally conceded. On the other hand, L. maculatum is not accepted as indigenous anywhere in the British Islands. Though closely allied to L. album, the calyx and corolla of this species are different, the flowers fewer, the leaves more wrinkled and with the white spots or blotches from which it derives its specific name. About ten years ago a seedling was raised from the plant in the neighbourhood of London, having yellow foliage, and named L. maculatum aureum, and this form has been since extensively used in carpet-bedding, and for front lines to flower-borders. In rich soil, however, it reverts to the original type, and by no treatment with suitable soil will it then return to the golden form. Seedlings from the species exhibit all the varieties of yellow, green, and spotted foliage.

The last perennial species is L. Galeobdolon—a plant rejoicing in the popular names of "Yellow Weasel-snout" (from the Greek specific name) and "Archangel." It is not found native farther north than Cumberland. Two localities are given for it in the 'Flora of Edinburgh,' somewhat wide apart—viz., Lomond Hills and Dunglass; but "introduced" is added. The specimen exhibited was gathered near Airthrey Castle, Stirlingshire. Mr Turner informs me that it appears to have become naturalised in one or two stations in the neighbourhood of Glasgow. This plant has been hustled about a good deal by botanists in their different classifications, but seems to have settled now amongst the Lamiums. Unlike the White and Purple Dead-nettles, which, as already remarked, may be found in flower almost the whole year round, the Yellow Dead-nettle flowers only from the middle of April to the middle of June. Its bold and finely-cut foliage has suggested its use as a bedding-plant.

I may add, in conclusion, that I have found the perennial Lamiums, as a whole, much more constant in habit then their annual congeners.

XI.—LIST OF THE LESS COMMON PLANTS GATHERED AT THE EXCURSIONS DURING 1884, WITH LOCALITIES.

By Mr ANDREW MOFFAT, Secretary.

At the meetings of 27th November and 26th December 1884, and 26th March 1885, the Secretary read a series of notes on the less common plants gathered at the excursions of 1884; but as the list of the plants, with their localities, is the only part of the notes of permanent interest, that alone is given here. The following list being *strictly* confined to the plants gathered at the Club's excursions in 1884, is not to be considered as exhaustive in respect to the rarer plants to be gathered within an easy distance of Edinburgh. Another list, it is hoped, will be contributed to the next number of the Transactions, giving those plants gathered at the excursions of 1885, where these differ from those of 1884. In this list I have followed the arrangement of Hooker's 'Student's Flora,' which is also that of the 'London Catalogue of British Plants.'

Ranunculus hederaceus L. Ditches near West Linton.

Ranunculus Lingua L. Duddingston Loch.

Ranunculus sceleratus L. Duddingston Loch.

Trollius europæus L. Caribber Glen, and banks of the Avon near Canal aqueduct at Manuel.

Chelidonium majus L. Near Manuel; a garden escape.

Glaucium luteum L. Seashore near Cockburnspath.

Corydalis lutea L. Near Manuel; a garden escape.

Viola lutea Huds. Near West Linton; variety with purple flowers very abundant.

Silene inflata Sm. var. **puberula**. Borders of fields near Longniddrie station.

Lychnis Viscaria L. Samson's Ribs.

This very rare plant owes its continued existence in this locality to the inaccessible rocks on which it grows. It is still found abundantly on the south of Blackford Hill, but in more accessible places: now that this hill is about to be opened to the public, the likelihood is that it will soon disappear from the Blackford locality.

Cerastium arvense L. Found sparingly on the Links at Gosford.

Stellaria glauca L. Duddingston Loch.

Arenaria verna L.

This local plant was gathered abundantly on the rocks at the Windy-Goul, Queen's Park, and other rocks on the south of Arthur's Seat: it is also found on Blackford Hill.

Geranium sanguineum L.

Very abundant on Gosford Links, the patches of which would cover several acres. To see this splendid plant in full flower in the month of July would well repay a visit.

Geranium sylvaticum L. In Caribber Glen; very plentiful.
Euonymus europæus L. Foot of Pease Dene, Cockburnspath.
Genista anglica L. Tynehead.
Trifolium arvense L. Queen's Park.
Astragalus hypoglottis L. Gosford Links; plentiful.
Vicia sylvatica L.

This rare plant was gathered abundantly on the cliffs on the side of the Lyne, near West Linton.

Lathyrus macrorhizus Wimm. On the roadside from West Linton to Dolphinton.

Rubus saxatilis L. Banks of the Lyne above West Linton.

Rubus cæsius L. Roadside between Cockburnspath and Pease Bridge.

Potentilla Comarum Nestl. Marshes near Bavelaw and foot of Black Hill, Currie.

Potentilla reptans L. Gosford Links.

Agrimonia Eupatoria L. Gosford Links.

Saxifraga tridactylites L. Wall-top between Gosford and Aberlady.

Saxifraga granulata L. Gosford Links.

Saxifraga hypnoides L. Banks of the Lyne above West Linton.

Sedum villosum L. In a bog by the roadside between West Linton and Dolphinton.

Drosera rotundifolia L. In a bog near Bavelaw.

Hippuris vulgaris L. Duddingston Loch.

Astrantia major L. Well established in a partially disused road leading from Caribber Glen to Canal aqueduct; a garden escape.

Sanicula europæa L. Caribber Glen.

Conium maculatum L. Inchcolm. Plants growing most luxuriantly nearly 6 feet high.

Sium angustifolium L. In ditches at the foot of the road leading from Longniddrie station to the beach at Gosford.

Œnanthe crocata L. Same station.

Ligusticum scoticum L. A very local plant: was gathered on Inchcolm, and at the mouth of Pease Burn, Cockburnspath.

Caucalis nodosa Scop. Queen's Park on the bank between Samson's Ribs and railway.

Linnæa borealis Gronov. In a fir wood on the Bavelaw Burn 3 miles from Balerno station.

Linnæa borealis has been known in this locality for about fifteen years, and was probably introduced to it some few years before that

time. It is now thoroughly established, and no fitter station than this could have been chosen for the plant. By the assistance of a friend, I was enabled to discover another locality for the plant, about two miles distant. It was first noticed as a British plant by Professor James Beattie, jun., in an old fir wood at Inglismaldie, on the borders of Kincardine, in 1795.

Valeriana dioica L. In a bog between West Linton and Dolphinton.

Valeriana officinalis L. Caribber Glen.

Dipsacus sylvestris L. Inchcolm.

Centaurea Scabiosa L. Found near the seashore half a mile east from North Berwick.

This somewhat rare plant is known to occur from Gosford to North Berwick; and the only other locality from which I have obtained specimens is on the other side of the Firth, directly opposite—viz., Kilconquhar.

Eupatorium cannabinum L. Pease Mill, and near railway station at Cockburnspath.

Inula dysenterica L. Foot of road leading from Longniddrie station to beach.

Antennaria dioica Br. Between West Linton and Dolphinton.

Filago germanica L. Queen's Park.

Doronicum Pardalianches L. Caribber Glen; naturalised.

Hieracium aurantiacum L. Side of railway between Manuel and Causewayend; an escape.

Oxycoccos palustris Pers. In a marsh by the side of Slipperfield Loch, West Linton.

Pyrola minor Sw. Fir plantation by the side of Bavelaw Burn.

Erythræa Centarium Pers. Gosford Links.

Menyanthes trifoliata L. Slipperfield Loch West Linton.

Symphytum officinale L. Near Caribber Glen.

Myosotis sylvatica Hoffm. Banks of Lyne above West Linton.

Cynoglossum officinale L. Gosford.

Hyoscyamus niger L. Inchcolm.

Solanum Dulcamara L. Gosford.

Verbascum Thapsus L. Inchcolm.

Scrophularia vernalis L. Gosford; an escape.

Primula vulgaris Huds. var. **caulescens.** North Berwick.

Primula farinosa L. In a bog between West Linton and Dolphinton.

This, the only Scottish station for this plant, I have visited annually during the last eight years, and have always found the plant plentiful. The only chance of extermination is the draining of the bog and the encroachments of agriculture, of which there are evident signs. In view of its extermination in this locality, I am happy to state that our President is taking means to have it introduced into similar habitats in the Pentlands.

Orchis incarnata L. Gosford Links.
Habenaria viridis Br. Gosford Links.
Listera cordata Br. Fir wood on Bavelaw Burn near Balerno.
Neottia Nidus-avis L. Caribber Glen.
Galanthus nivalis L. Arniston; naturalised.
Milium effusum L. Caribber Glen.
Melica nutans L. Caribber Glen.
Melica uniflora Retz. Caribber Glen.
Aspidium angulare Willd. Pease Dene.
Botrychium Lunaria Sw. On a mound midway between West Linton and Dolphinton, in great abundance.

XII.—NOTE ON THE SQUIRREL (SCIURUS EUROPÆUS).

By Mr JOHN THOMSON, Stobo.

(*Communicated by* The Secretary, *March* 26, 1885.)

Though now so common in most parts, the Squirrel, as is well known, was at a period not so very remote unknown in Scotland, having been introduced from England only in the early part of the present century. In the parish of Stobo, Peeblesshire, where the following observations were noted, the animal seems to have made its first appearance about the year 1825. A forester who had lived in the district for the better half of a century related to me that, about the year just mentioned, while engaged one day with his assistants in the woods, their curiosity was aroused by the sight of a strange little creature, which ran up a tree in making its escape. One of the men, whose proclivities tended towards natural history, but who was unaware of the leaping powers of the animal, climbed up the tree with an eye to its capture, but it is almost needless to remark that his somewhat quixotic attempt was not crowned with success. It is more than probable that this individual specimen was among the first of its order to arrive in the district.

Few quadrupeds are more pleasing, amusing, and interesting in their habits; yet to see the Squirrel in the full enjoyment of life, a little stealth is necessary, because if you come within his range of vision, his actions are restrained, and, though you may not think so, his eye is always upon you. When you come upon one unobserved, and watch him for a little, his movements are seen to be much more lively and sportive: he frisks and gambols along the

branches, pries into crevices in quest of hidden food, ventures out almost to the extremity of very slender twigs, sits up on his hind legs, and throws himself into a variety of curious attitudes. Should another Squirrel come upon his feeding-ground, the speed and agility displayed in the ensuing chase is most wonderful, and probably exceeds what any one unacquainted with his powers would imagine him capable of. In the food on which the Squirrel subsists there is considerable variety. Fir-cones, beech-nuts, acorns, and haw-thorn-berries are staple articles of diet; young shoots of the Spruce Fir are also frequently gnawed through, to enable him to eat out the heart of the small buds which grow around the stem of the shoot; and, unfortunately for his own preservation, his somewhat omnivorous appetite leads him even to attack the bark of trees. The different species of Pines are those generally attacked, and, in some instances, serious injury is done to the tree. In an old wood I once saw many large Scotch Firs with long strips of bark eaten off from the upper part of their trunks, and on some of the trees there were bare patches six or eight feet long, and about half a foot broad. The occasional indulgence of this taste marks out the Squirrel as an animal to be destroyed; and in the interests of forest preservation there is, I own, a necessity for keeping their numbers within certain limits. But that is all that requires to be done, for when in moderate numbers, any injury inflicted will, I think, only be of trifling consequence.

About October the Squirrels leave the large pine-woods, where, during the summer, the most of them have been rearing their offspring, and spread themselves into more open ground. Clumps and groves are then visited, and excursions made from these to straggling trees in search of food. At this season they may often be seen on the ground feeding on the seeds and nuts which have fallen from the trees. When they arrive at a spot where food is abundant, a halt is made, and should a suitable abode for the night be near, in the shape of a few Fir trees, residence is there taken up. If such a spot be in the vicinity of dwellings, the Squirrel very soon, if unmolested, becomes so familiar as to sit on the ground and eat with composure while you are looking at him six or seven yards off. When moving forward, where the trees stand some distance apart, much caution is used to ensure safety. The nearest tree is made for at full speed, and when that is reached, a survey is made all around to see that no danger threatens. Then, without ascending the tree, off he starts to the next. If pursued, the Squirrel does not seek refuge in the nearest tree if it be small, but pushes on to a larger. At times, however, he would seem to be more venturesome, for one was brought to me by a person who killed it out on a hill. If hunted from tree to tree, some notable leaps are taken from the point of one branch to another; and I

remember to have seen one jump from the summit of a tree to the ground, a height of about forty feet. It was not in the least stunned, as might have been expected, but ran off at once along the ground.

A very pleasing exhibition of parental affection and instinct of the Squirrel on behalf of its young came under my notice a few years ago. While proceeding along a footpath which led through a wood, I observed one coming along the ground towards the path a short distance in front of me. By its peculiar motion and slow pace, I saw that there was an interruption to its progress, which became manifest when it emerged from the grass and crossed the path. It was carrying a young Squirrel in its mouth. Arriving at the base of a good-sized tree, it began to ascend; but to do so while thus encumbered proved to be no easy matter. The difficulty was, however, surmounted; for when I got up to the tree and obtained a near view of the pair, the old Squirrel had quitted its hold, and the young one, with its fore-legs round its parent's neck, clung closely to its breast. Thus relieved, the heroic creature very soon reached the summit of the tree, crossed by leaps to several others, and finally settled in a large Spruce Fir. A high wind, which was blowing at the time, had most probably shaken the young Squirrel from its nest. On another occasion, after a gale in winter, a nest was found one morning on the ground, blown from a tree, and on its being overturned a Squirrel bolted from it. It may be imagined that the poor Squirrel was greatly dismayed at the downfall of his habitation, but he showed commendable coolness in retaining the benefit of its shelter as long as he could.

Enjoying comparative immunity from attacks of predatory birds and animals, having generally at all times a supply of food at hand to meet his wants, and possessing powers which enable him to roam and gambol at ease in his own peculiar haunts, the Squirrel seems to pass a happy, joyous existence. Each creature has been providentially and benevolently endowed with instincts which are in sympathy with its mode of life, but all have not capabilities alike to enjoy the latter. In this respect the Squirrel seems to stand on a higher pinnacle than many others.

At this meeting Mr Grieve made a few extempore remarks on the occurrence of the Pine-marten in Scotland.

MEETINGS OF MICROSCOPIC SECTION.

Six meetings for practical work with the microscope were held during the Session under the presidency of Dr J. M. Macfarlane, all of which were numerously attended.

At the first meeting (6th November 1884) a demonstration on the structure and mode of preparation of the glands of Nepenthes was given by Dr Macfarlane and Mr A. D. Richardson. The second meeting (5th December 1884) was devoted to a description of various forms of microtomes, with a demonstration of the methods of cutting sections, by Mr Alexander Frazer, M.A., optician. The following is a brief notice of improved forms of ether and imbedding microtomes, as submitted by Mr Frazer :—

IMPROVED FORMS OF ETHER AND IMBEDDING MICROTOMES.

The appliance illustrated in fig. 1 is part of a microtome in which the Cathcart method of freezing is adopted, and by which sections are cut by the knife of Williams' (Swift's) microtome. Experience having shown that the Williams' knife is an exceedingly good form of section-cutter, and that the Cathcart method of freezing is very convenient, the present instrument has been

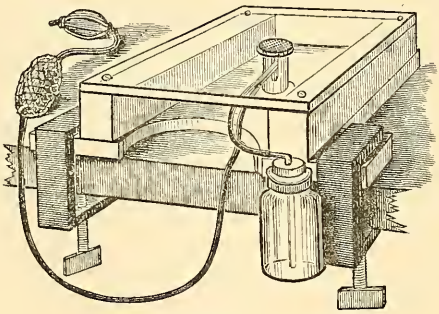

Fig. 1.

designed to combine the advantages of the knife and the method of freezing already mentioned. A detailed explanation of the instrument is hardly necessary. A stout brass tube is fixed to the frame, which is the body of the instrument, and which supports a small insulated zinc plate, upon the under side of which a spray of ether impinges as in the Cathcart microtome. The frame also supports a glass plate, which is slightly below the level of the zinc freezing-plate, and upon this glass plate the Williams' tripod

knife slides in the usual manner. The knife is not shown in the figure. The microtome shown in fig. 2 is designed for objects which are imbedded in paraffin or other medium previous to cutting. The instrument consists of the usual cylinder, piston, and

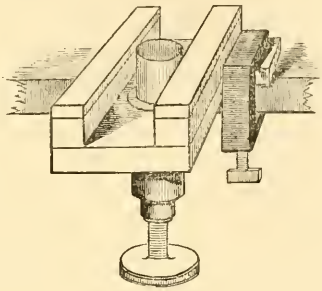

Fig. 2.

screw—the novel point in its construction being, that the upper part on which the section-knife slides is provided with glass rails similar to those used in the Cathcart microtome, and that the instrument is made to be fixed to the table by a separate clamp, and not by means of a screw which presses one part of the microtome from the other when binding it to its support.

At the third meeting (9th January 1885) a lecture was delivered by Mr A. N. MacAlpine, B.Sc., on "The Woody Tissue of Plants: its Arrangement in Root, Stem, and Leaf, and its Detection"—the lecture being illustrated by the lantern. At the fourth meeting (5th February 1885) Mr Alexander Frazer drew the attention of members to the construction of Brooke's double nose-piece for the microscope, and explained the adjustment of the same; while Mr A. D. Richardson gave a demonstration on double-staining, which was much appreciated by the members, and furnished matter for some discussion. At the fifth meeting (6th March 1885) a further explanation of double-staining, with an exhibition of double-stained objects, was made by Messrs Richardson and Henderson; while Dr Macfarlane made a communication on "Recent Advances in the History of Cell-Formation." The sixth and concluding meeting (6th April 1885) was occupied by a demonstration on Photo-Micrography, by Mr William Forgan. The following is Mr Forgan's explanation of the process:—

PHOTO-MICROGRAPHY.

The term Photo-micrography means the production of enlarged photographic pictures of microscopic objects by means of a micro-

scope and a photographic camera. Another term, Micro-photography, has a different meaning, and is applied to the production of photographic pictures of large objects on a microscopic scale,—small enough, in fact, to enable a microscopic object-glass of medium power to see the whole of the picture in the field of the microscope at one time. It is, however, only with Photo-micrography, the first of the above terms, that I am to deal just now.

Three things are essentially necessary to enable any one to produce good Photo-micrographs. These are—(1) A competent knowledge of photography; (2) a considerable knowledge of microscopic manipulation; and (3) good apparatus, especially good microscope object-glasses. As to the first of these, I have had an experience of over a dozen years, more or less. As to the second, I have had a large and varied experience with the microscope for over thirty years, and during that period I have seen and handled object-glasses by nearly every European maker of any note. As to the third, I have at present a very excellent series of glasses, about eighteen in number, extending from a four-inch up to Powell & Lealand's famous water-immersion one-eighth. I merely mention these facts to show that I am not a novice in the management of the apparatus I am about to show you.

In the production of Photo-micrographs, the first thing to do is to have the camera and the microscope both firmly mounted on a board. That now before you is about 3 feet 6 inches long, and about 10 inches broad, by an inch thick to give it strength and stability. It might with advantage be longer and a little broader. The small camera, you will notice, is mounted at one end of the board, on a platform raised about two inches above it. This is done to cause the centre of the focusing screen of the camera to coincide with the optical axis of the microscope when the latter is bent back to allow its tube to enter the camera. The camera before you is that known as quarter-plate size—that is, the size of the sensitive-plate is $4\frac{1}{4}$ inches by $3\frac{1}{4}$. This plate is generally large enough for the purpose. If larger pictures than can be had in this way are wanted, it is only necessary to have enlarged pictures printed direct from negatives of that size. The camera has a pretty long bellows, enabling it to be drawn out about 18 inches. The microscope used is a plain one, with a very delicate fine adjustment, and rack-and-pinion coarse adjustment. This latter is almost an essential requisite in Photo-micrography, if ease and comfort in manipulation are desired. The microscope used has a very large tube, more than $1\frac{1}{4}$ inch in diameter. This gives, with the length of camera used, a large field, and enables the light to fill the whole of the plate except the corners. The microscope is connected with the camera by means of a conical hood of double thickness of black calico, which is attached to the camera at the

larger end—the smaller end being drawn over the end of the microscope tube and tied with a string. Both the camera and the microscope are attached to the board by means of small brass bolts and screws, and both can be shifted along the board either way by means of a narrow central opening,—the opening for the microscope being on the board itself, and that for the camera in the top of the platform on which it stands.

The lamp I use is a small microscope lamp, with a half-inch wick. I find this lamp gives sufficient illumination, even for very high powers. For powers up to half-inch, the ordinary bull's-eye condenser in front of the lamp gives quite enough light to enable one to work with short exposures; and when using higher powers, an achromatic condenser is used to further concentrate the light. I never use the microscope with the eye-piece in. Without the eye-piece I get a sharper, better-lighted picture, and therefore a quicker exposure. Of course, the magnification in the camera is correspondingly less. With this camera, for instance, fully drawn out, the magnifying power, tested with Smith & Beck's micrometer and Zeiss's quarter-inch objective, is only 125. The image on the sensitive plate is, however, without the eye-piece, much finer and sharper. When you have few object-glasses, it may be necessary sometimes to use an eye-piece to bring up the power to what you want; but it is much better to do without the eye-piece, if possible.

A great deal has been said and written about the non-coincidence of the chemical or actinic and the visual foci of microscopic object-glasses. I do not find in practice that I experience any difficulty on that ground. My glasses were all chosen for their good qualities as microscopic objectives simply, and with no view whatever to their use for photography. I have never required with any of them to apply any correction for the actinic focus. I simply get as sharp a focus on the camera screen as I can with powerful magnifiers, and I can be absolutely certain that I shall get a correspondingly sharp photographic negative. This will not apply, however, to object-glasses with only one combination. My experience is, that glasses of that description do require correction for the chemical focus.

I use an ordinary piece of ground-glass to focus the image of the object in the camera in the first instance, and to get the light nicely in the centre of the screen; but this is far too coarse for the final adjustment, and when finally adjusting the focus I put in a screen formed of a piece of plain glass, one side of which has been daubed slightly over with glazier's putty, and then spread over the glass with long strokes by the forefinger; or a similar piece of glass which has been rubbed over slightly with virgin-wax, —then the glass is slightly heated to melt the wax, and rubbed in

the same way to spread it over the glass. The film in both cases must be very thin, and just sufficient left on the glass to see that it is there and no more.

With microscopic objects that polarise well, polarised light is of very great assistance in Photo-micrography. It brings the various markings into greater contrast—differentiating them in such a way that they are much more easily photographed, and give better results. The exposure in such a case is, however, much more prolonged. What would require, with transmitted light, say fifteen seconds, with polarised light requires five minutes.

The demonstration I propose to give you to-night is to photo-micrograph the palate of the Whelk, and to do so by polarised light. After placing the slide on the stage of the microscope, and fixing it in the position I wish it to be, I place the lamp in position,—and this must be carefully adjusted as to the height of the flame, as it also must be placed in the optical axis of the object-glass, or as nearly so as may be. I then place the bull's-eye condenser at the distance of its own focus from the lamp, and between it and the stage. I place the polarising prism under the stage, and on the top of the prism I place a selenite, giving a blue tint, as I wish to produce a strong colour in the object. The analysing prism is, of course, placed over the object-glass. The glass I shall use is a Zeiss's "aa,"—what is termed on the glass itself a $\frac{5}{4}$th. It gives one of the flattest fields I have ever seen in any glass, and the most beautiful definition to the very margin of the field. I place the microscope-tube in the hood in the front of the camera, and tie it on. I should perhaps have mentioned before that the tube should either be lined with black velvet or receive a coating of dead black by mixing lamp-black in lacquer and painting the inside of the tube with one coat and setting fire to the spirit. One coat is enough if the mixture is thick enough. This leaves a fine dead black surface, and not a glossy one as when more than one coat is given. The only thing now to do is to see that the illumination is exactly in the centre of the optic axis. To do this, remove the focusing screen and look through the camera and microscope tube. If the image of the flame is seen in the centre of the tube, all is well; but if not, the lamp must be altered in such a way as to accomplish this end. No pains must be spared in doing this, as upon it depends entirely whether your negative will be a success or a failure. It is very easy to do with low powers, but when using high powers and an achromatic condenser, it is sometimes a matter of ten minutes' work to get the light right in the optic axis. When that is accomplished, and the apparatus firmly secured to the board, and the light fairly in the centre of the screen, you may at once proceed to expose the plate. As I am using now polarised light, I shall give this object—although

I use a low power—an exposure of five minutes. [The plate was then exposed and developed in the presence of the meeting; and, although it was not carried so far as printing density, turned out a perfect success.]

I think the above explanation affords all the necessary and essential information to enable any of the members who wish to try it to start work. Yet to every beginner there are innumerable difficulties starting up before they acquire the necessary skill and dexterity from practice. If any such are members of this Society, I only add that I shall be too pleased to give them every help and advice they may require, so far as in my power.

At the meetings several members exhibited interesting micro-objects; Mr Forgan distributed a number of beautiful photo-micrographs; and unmounted preparations were given to the members present to be mounted at home—the proper methods to be followed in mounting being in each case indicated. The objects distributed included preparations from the following:—

VEGETABLE.

Aërial root of Orchis.
Bryopsis plumosa, with Diatoms *in situ*.
Stem of Selaginella cæsia.
Petiole of Nymphæa alba.
Stem of Pinus sylvestris (double-stained).
Leaf and stem of Hoya carnosa.
Stem of Xanthochymus.
Root of Pandanus graminifolius.
Peziza tectoria.
Stemonitis fusca.
Fucus vesiculosus.
Callithamnion Rothii.

ANIMAL.

Kidney, liver, and tongue—human and other—stained and double-injected.

The Annual Conversazione on 17th April took largely the form of a microscopic exhibition; and as an interesting record of what was then shown, a copy of the Programme distributed on that evening will be found at the end.

ANNUAL BUSINESS MEETINGS.

The Annual Business Meeting of the Club for Session 1884-85 was held on the evening of the 24th October 1884. The Secretary and Treasurer submitted his Statements, which were approved of. At this meeting an alteration of the Laws was made, to the effect that there shall be *three* Vice-Presidents, instead of *one*

as formerly. The various Office-bearers having been elected, the list for 1884-85 stood as under, viz.:—

President.—A. B. Herbert.

Vice-Presidents.

P. B. Gibb, M.A. | T. B. Sprague, M.A., F.R.S.E. | J. M. Macfarlane, D.Sc.

Council.

Robert Thomson.	John Walcot.	John Rattray, M.A. B.Sc.
George Bird.	Symington Grieve.	Archibald Craig., Jun.
Robert Stewart.	George L. Brown.	W. I. MacAdam, F.C.S., F.I.C.
Dr L. Dobbin.	Charles Fraser.	Alexander Frazer, M.A.

Honorary Secretary and Treasurer.—Andrew Moffat.

Auditors.—Alex. Matheson, M.A., W.S.; J. A. Brodie.

The Financial Statement showed an income, including balance from previous account, of £69, 13s. 5½d., and an expenditure of £44, 2s. 4½d., leaving a balance of £25, 11s. 1d. in favour of the Club.

During the past Session there had been held 32 meetings, of which 12 were indoor meetings and 20 were field meetings, with an average attendance of 50. The following is a detailed list of the meetings—viz.: *Ordinary Evening Meetings*, 1883—26th Oct., 29th Nov., 27th Dec.; 1884—24th Jan., 28th Feb., and 27th March. *Microscopic Meetings*, 1883—6th Dec.; 1884—3d Jan., 31st Jan., 6th March, and 3d April. *Conversazione*—8th April, 1884. *Field Meetings*, 1884—23d Feb., Arniston; 15th March, Arthur Seat; 22d March, Shore at Granton; 29th March, Hailes Quarry; 3d May, Sections on Suburban Railway; 10th May, North Berwick; 17th May, Sections on Suburban Railway (second excursion); 24th May, South Ferry and Forth Bridge Works; 31st May, Crichton to Tynehead; 7th June, Caribber Glen; 11th June, Restalrig Church and Neighbourhood; 14th June, Dolphinton to West Linton; 21st June, Gosford; 25th June, Duddingston; 28th June, Cockburnspath for Pease Dene; 5th July, Balerno; 12th July, Inchcolm; 19th July, Colinton and the Pentlands; 26th July, Currie and the Pentlands; 6th Sept., Joppa Quarry.

During Session 1883-84, 16 names of members were withdrawn from the roll, and 60 new members added, making a net increase of 44 and a total ordinary membership of 190.

[It having been thought advisable to bring the record of the proceedings of the Club up to the present date (October 1885), the Statement embodying these, read at the Annual Business Meeting for Session 1885-86, is here given.]

The Annual Business Meeting of the Club was held on the evening of October 23, 1885—Mr A. B. Herbert occupying the chair. The usual Statements by the Secretary and Treasurer were laid before the meeting, and unanimously approved of. By the Financial Statement, it was shown that the total income for Session 1884-85, including a balance from last account, was £81, 2s., and that the expenditure was £51, 3s. 5d., thus leaving a surplus at that date in favour of the Club of £29, 18s. 7d. The meetings held during the Session were 30 in number—13 of these being indoor meetings, and 17 field meetings, with an average attendance at all the meetings of 54. The following list gives the dates of the indoor meetings, and the dates and localities of the field meetings, viz.:—

Indoor Meetings: (1) *Ordinary Evening Meetings*, 1884—Oct. 24, Nov. 27, Dec. 26; 1885—Jan. 29, Feb. 26, March 26. (2) *Microscopic Meetings*, 1884—Nov. 6, Dec. 5; 1885—Jan. 9, Feb. 5, March 6, April 2. (3) *Annual Conversazione*—April 17, 1885.

Field Meetings, 1885: Feb. 21, Arniston; May 2, Scottish Marine Station, Granton; May 9, North Berwick; May 16, Hawthornden and Roslin; May 23, Dalhousie; May 30, Dysart and Wemyss; June 3, Blackford Hill; June 6, Midcalder; June 13, North Queensferry; June 17, Craigmillar; June 20, West Linton; June 27, Caribber Glen; July 1, Union Canal; July 4, Inchkeith (with Dredging in Forth); July 11, Aberlady; July 25, Balerno; Sept. 26 ("Fungus foray"), Roslin.

The election of Office-bearers for Session 1885-86 was next proceeded with, and the following is the complete list, as then adjusted, viz.:—

President.—Symington Grieve.

Vice-Presidents.

T. B. Sprague, M.A., F.R.S.E. | J. M. Macfarlane, D.Sc. | A. Frazer, M.A.

Council.

John Walcot.	John Rattray, M.A., B.Sc.	William Forgan.
John Allan.	Archibald Craig, Jun.	William Bonnar.
George L. Brown.	W. I. MacAdam, F.C.S., F.I.C.	John Henderson.
Charles Fraser.	A. D. Richardson.	A. B. Steele.

Honorary Secretary and Treasurer.—Andrew Moffat.

Auditors.—John A. Marshall, C.A.; Hugh H. Pillans.

The membership of the Club for Session 1884-85 stood at the close as follows: 26 names were withdrawn from the roll, and 50 new members were admitted, giving a net increase of 24—which, added to the ordinary membership of 190 for the previous Session, makes a total at the present date of 214. Owing to the steady

increase in the membership of the Club, it had become imperative to leave the old place of meeting at No. 5 St Andrew Square, and to find more commodious rooms, which have now been secured at No. 20 George Street. After the disposal of the business, several members threw out various hints for the better conduct and greater efficiency of the Club, in view of the new departure which had thus been made. The meeting closed with a hearty and unanimous vote of thanks, on the motion of Dr Macfarlane, to the retiring President, Mr A. B. Herbert, for the keen interest he had taken in all the affairs of the Club during the three years he had been in office, as well as for the valuable contributions he had made to its 'Transactions' in the very interesting papers read from time to time.

ERRATA ON ART., "THE HYMENOMYCETES."

The following list of errata was received too late for correcting the text of the above-named paper—viz.:

Page 212, line 28, *for* "colour" *read* "odour."
,, 214, ,, 30, *for* "comestus" *read* "comatus."
,, 214, ,, 37, *for* "cortiles" *read* "tortilis."
,, 214, ,, 38, *for* "aliamentarius" *read* "atramentarius."
,, 215, ,, 17, *for* "volunum" *read* "volemus."
,, 215, ,, 26, *for* "*Smilus*" *read* "*Suillus.*"
,, 215, ,, 39, *for* "Vittælini" *read* "Vittellini."
,, 217, ,, 14, *for* "Monkhamorr" *read* "Moukhamorr."
,, 217, ,, 20, *for* "Meruleus" *read* "Merulius."

I.—OPENING ADDRESS.

By Mr SYMINGTON GRIEVE, President.

(*Read Nov.* 20, 1885.)

The first duty I have to perform is to express my thanks for the honour you have conferred upon me, in making me your President for the coming year. I feel deeply that you have placed me in a position of considerable difficulty, as I cannot expect to fulfil the duties of President in the same satisfactory way they have been done by the accomplished Naturalist whose term of office has just expired. I am sure each of you will join with me in expressing to him our grateful thanks for the manner in which he has striven to promote the interests of the Club, which has progressed in membership and usefulness by strides and bounds during the last three years. I hope he, and other past Presidents, may long be spared to attend our meetings, and to manifest the interest they have ever shown in the welfare and prosperity of the Club.

Having elected me to the honourable position of presiding at your meetings, it will be my earnest desire to try and increase their usefulness. I think it is possible that we may devise a more systematic way of working, so that in all we do, it may be with the object of studying some special subject or subjects in a more thorough and searching way than we have done in the years gone by. You will notice I use the word "we," for unless you are, each of you, willing to unite earnestly in doing your best to aid the Council in trying to inaugurate more systematic modes of investigation, they cannot hope or expect to attain the satisfactory results they would like. We must rely upon each of you feeling an individual responsibility, and doing your utmost to make our meetings and publication a success.

With the advantages we now possess, it will be a shame to us if we allow our powers to lie dormant, and the opportunity to pass without striking out into new branches of study. To some extent the Council have provided for the occasion, and have agreed to relieve our able Secretary of the arduous task of arranging for the papers to be brought before our meetings. However, it seems to me that this is only a beginning; for it must now devolve to a great extent upon the members of the Club to keep up a continual supply of material in the way of papers for the Council to choose from. I trust the time is not far distant when you will emulate

each other as to whose contributions will prove most worthy of being read, and that each will covet the honour, and that it will be accepted as a token of no small attainments when a paper is selected for our meetings.

For systematic work, we must appoint standing committees for each of the following subjects—namely, Fauna, Flora, Geology, Archæology, and Microscopy; and it will be the duty of the members of such standing committees to find out the subjects on which each member of the Club has special knowledge, or which they propose to study. Having found out this, it will be the effort of each committee to direct, aid, and encourage members in their studies, so that in time they may write papers for the meetings of the Society. I feel sure if each of these committees was started under the care of an energetic convener, they would together do splendid work, and promote our best interests as a scientific Club. From my own standpoint, I think the sooner they are started the better for the Club. We have good proof of this in the success that has attended the meetings of the Microscopic section under the presidency of Dr Macfarlane, and I trust we are only at the beginning of that success. It has long been my belief that nothing would do more to popularise and make the work of this section even more interesting than it has been, than the reflection of magnified living organisms upon a screen, when the life-history, structure, and habits of such organisms could be studied and explained. I can conceive of no more profitable lessons from the book of Nature than we might thus receive in this hall. I understand there are certain difficulties in the way of minute objects being clearly reflected upon canvas; but from what I have seen at our meetings, I think sufficient success has been attained to enable us to use this mode of illustrating a subject with great advantage, even though every detail of the picture is not brought out as clearly as we would like. Besides, when such difficulties cross our path, it should inspire us with a fresh resolution to do our best to overcome them; and in a Club like this, we have an opportunity of illustrating the old adage that "two heads are better than one." I hope these difficulties will soon be satisfactorily solved, and that we shall then acquire microscopic apparatus that will enable us to enhance the attractiveness of our meetings, and open up some pages of what is to a large extent, to many of us, a sealed book.

The Field Club, to be of real use to its members, must be an educational institution, and we must always have many schemes at work, so as to develop the enthusiasm of every member in a greater or less degree. Without enthusiasm, the Club will gradually decay and die. When I think of the thorough training and splendid equipment that some of you possess, combined with first-class opportunities, I almost feel ashamed thus to address you. But I

cannot shut my eyes to the fact that it is you who are thus equipped who must bear in the future, as you have done in the past, the burden of working the Club so as to make it a success. It is to you that those of us who have been less fortunate in our opportunities or training look for assistance, encouragement, and help. The younger members expect you to take them by the hand, and trust to your kindness to point out to them those special subjects that they may study with advantage; and no one knows better than I do how well and earnestly you have been endeavouring to afford this aid. Let me say to those of you who have abstained from joining our active work, that if you desire special knowledge you must not hesitate to ask questions, and ever be ready to supply us with information when you can. I feel sure I am asserting a fact when I say there is no one in this room without some special knowledge or experience that would be valued by us, if we could only discover it. I suppose there is no way to find out these things except by getting each member to volunteer information for our meetings. Long papers with elaborate details will be quite unnecessary; the narration of daily experiences or observations, stated as simple facts, is all that is required.

So much for our Winter Meetings: but need I remind you that these are only auxiliaries to our actual Club work, and should be used for recording the observations and discoveries that have been made in the field. The name "Naturalists' Field Club" makes my mind stretch in fancy from these stone walls to breezy braes with wimpling burns, or to rugged mountain-sides with their wild cascades. In our cities we live like caged birds, hedged in with the anxieties, worries, and cares of the struggle for existence. Can any one wonder that sometimes the tired-out machinery of our nature requires to be reinvigorated by breathing the pure air of heaven; or that the aspirations of the sons of freedom rise within us, and, as Scotia's children, make us seek for health upon the heaths and mountains of our native land. Alas! neglect, languor, and want of determination are rapidly performing their work; and unless we are up and doing to claim and protect our rights, we will lose our privileges. From time immemorial our heaths and hills have been the happy hunting-grounds for health for all our citizens; but for years past, gradually one part and then another of our moorlands have been closed to the public, and ere long we may find that nothing but the dusty roads are left to us. It is time we were moving in this matter; if we delay much longer it will be too late. Fortunately Professor Bryce, a countryman of our own, has become alive to the dangers of losing the Scottish mountains and heaths as a sanatorium for Britain, and for some years has been endeavouring to get Parliament to pass his "Scottish Mountains Access Bill." He has had to fight most of the battle

himself, and I for one feel that he has been fighting for us. I say then, let us help him, and in every possible way give him our support. I think I hear some of you say in amazement, "What can *we* do?" Well, my view is, we can do a great deal. In the first place, we can stir up public opinion as a Club; we can try to interest every Field Club and Natural History Society in Britain, and do our best to get them to combine to support Professor Bryce. But, what is more, we have over two hundred members who can influence their friends in favour of this Bill, and the effect of such efforts will be great in stirring up a healthy agitation to promote the end in view. We wish to invade no man's privacy; and to do damage to property is the last thing we desire. In Scotland there is no law of trespass, and I trust never will be. We must respect the lawful rights of others as we value our own, but we must have our heritage. During the past summer I had the privilege of forming one of a party of members of the Botanical Society who visited the mountains at the head of Glen Lyon, and I wish I could only express to you the enjoyment we all had. Might it not be possible to inaugurate such excursions in connection with our Club? It is a matter for the consideration of the Council, as it would enable our members to get wider experience than can be obtained by merely working in the neighbourhood of Edinburgh. It would also help to bind us together in closer friendship, and tend to promote and encourage united investigation.

And now regarding next summer's excursions, may I suggest that each of you should think over the subject during the coming winter, and be ready to propose places for the Club to visit next season. For several years a number of lists with the names of places were sent in, but these have gradually been dwindling in numbers, with the result that the work of drawing up the list of excursions has of late mostly devolved upon the Council. It would be a decided advantage if places could be visited to which as a Club we have not yet been. We might perhaps attempt excursions that would enable those interested in the various branches of study we take up to thoroughly enjoy themselves in their own particular investigations. Some might require to take long walks, others again might find all they required within a short distance of the starting-point; but one feature of our excursions might be, to have each day a fixed rendezvous at which we could all meet in the evening. The longer walks would enable our members to become acquainted with all the "rights of way" within a considerable radius of the Modern Athens, and thus help to preserve them as public paths. There is upon the table a little book with a red cover that I trust may place on record for all time coming what are at present undisputed rights of way over the Pentland Hills. It has been written by our fellow-townsman Mr W. A. Smith, and

the map supplied gratuitously by another of our citizens, Mr Bartholomew.

In conclusion, let me urge upon you all to use your best efforts to proclaim from one end of the city to the other, and if possible far beyond its boundary, the advantages to be derived from the membership of the Field Club. With more members we would have greater resources, be able to make our meetings more attractive, and do better work. The measure of prosperity that has attended the Club within the last few years may well encourage us for the future; and need I remind you that "nothing succeeds like success."

II.—THE ORGANIC CAUSES OF THE COLORATION OF WATER, ETC.

By Mr JOHN RATTRAY, M.A., B.Sc.

(*Read Nov.* 20, 1885.)

The explanations that have been given of unusual colours of water, snow, hail, &c., may be arranged in four periods, more or less distinct from and independent of one another—viz.: (1) The theocratic, or period of wonder; (2) the hippocratic, or period of doubt; (3) the naturalistic period; (4) the cosmic period. To the first of these periods must be assigned the opinions held by the ancient Greek and Roman classics, who, from the time of Homer, referred such phenomena as are now familiarly known as blood-rain to the direct intervention of the gods, in modifying the ordinary course of the laws of nature. To the second Cicero probably belongs, as by him supernatural interference was, for the first time, doubted, and an attempt was made to obtain a physical explanation. Peiresc founded the third period, and Cladni the fourth.

Prior to Cladni, various remarkable occurrences had taken place; but in not a few cases precision is not to be found in the stories that have been recorded. Thus, rivers had suddenly become red *without* previous red rain—*e.g.*, in Picenum, 323 B.C. In the summer of 586 A.D., a similar event occurred in the Gulf of Venice; while Pliny records that a lake in Babylon remained red for eleven days. Dew, rain, snow, and hail had been observed to fall of a red colour; a blood-like moisture, according to Livy, had covered the statues even of the gods and of implements of war. Red snow and hail had fallen, and instances of the occurrence of places suddenly covered with a blood-like mucilage were not unknown. But in all

these cases the fall from the atmosphere had taken place *before* the observations were made; and no evidence existed that the appearances were atmospheric, and not terrestrial. On the other hand, on several occasions the atmosphere had previously been observed to be filled with red-dust particles before the red rain fell—for example, at Bagdad in 929, and at Rome in 1222.

But it was not till the beginning of the seventeenth century that true interpretations began to be forthcoming. A shower of blood-rain occurred at Aix in 1608, which greatly alarmed the people, whose frenzy was still further increased by the clergy. Peiresc, however, soon offered a simple explanation. He had observed that Butterflies were then very abundant, and that after the escape of the imago from the pupa state a droplet of red juice remained, and produced a red speck. These specks were found to occur in places accessible to Butterflies, but where no rain had fallen, and inquiry revealed that occurrences reported earlier might be similarly interpreted. The explanation became generally accepted; and for the first time insects were looked upon as possessing a new and peculiar property.

Swammerdam, while journeying in France about the middle of the seventeenth century, also observed, and was alarmed at, certain blood-coloured water which he met with. He examined it, however, and found the cause to be the presence of a small Water-flea (*Daphnia pulex*). Schuyl[1] similarly explained a similar phenomenon which had excited the inhabitants of Leyden.

The observations thus instituted during the seventeenth century were continued with still greater zeal during the eighteenth. In 1700, Romberg directed attention to the reddening produced by the cases of Bees in the vicinity of bee-hives; and in 1711, Hildebrandt, from observations made in Sweden, corroborated the influence exerted by insects. Westphal, in 1716, observed red spots on plant-leaves in the vicinity of Delitzsch and Wittenberg; and not being able to regard these as due to insect products, he laid himself open to the charge of being occupied with alchemist experimental theories, by asserting that the appearance was the result of dew, coloured red by the presence of sulphurous matter.

In 1746, a phenomenon on a larger scale, and one demanding a new explanation, was recorded by Gonsag in California. He believed that springs occurred in the sea, as at flood-tide the water, for an extent of half a mile, was of a bluish-red hue. A chemical action was here believed to be taking place between the spring and sea water. Linnæus attributed blood-rain to the presence of a small animalcule, *Monoculus pulex*, which was similar to the *Cyclops quadricornis* found in similar conditions in Sweden by Agardh.

So early as 1646, a chemical examination of red rain had been

[1] 'Bibel der Natur,' p. 40.

made at Brussels; but Dr Rau made another such research at Ulm in 1755, and his results entirely disproved the sulphur theory, and established the presence of organic bodies. It is also important to note that instances have been recorded of red water resulting from the fine dust emitted during volcanic activity; and that, at sea, the bleeding of large animals, such as Sharks and Sword-fish, may cause red discoloration. De Saussure,[1] in 1760, found the cause of the colour of red rivers to be sometimes pollen; while in France, in 1797, Girod Chantran found a pond filled with water of a carmine colour, which he attributed to the presence of a species of Volvox (*V. lacustris*)—an infusor, which he has named, but not described.

During the nineteenth century, the investigation of this curious subject was still prosecuted with zeal. Persoon, in 1801, examined certain red mucilaginous specks observed on damp ground, and found the cause to be a fungus, which he described as *Thelephora sanguinea*, and which was later described by Fries as *Phylacteria crustacea*, and still later, by Agardh, as an alga, *Palmella cruenta*.

Andreossy, in Lower Egypt, and Ehrenberg, in the Astrakhan Steppe, found a red-coloured "Salz-lage,"—the colouring matter being in the salt, and fading on drying.

In 1815, the inhabitants of South Prussia were, like the ancient classics, astonished by the presence of red, violet, and green patches in the water of the lake of Lulotin; and, in consequence of the unusual occurrence, were not slow to predict misfortunes soon to come. Klaproth[2] examined this water chemically, and found the cause to be an albuminoid-like vegetable mucilage, peculiarly tinged by an indigo dye, and attributable to the decomposition of vegetables during harvest. The transition from green to violet was caused by the presence of more or less oxygen.

Scoresby,[3] in 1820, noted the occurrence of green and blue stripes in the sea around Greenland, and covering about one-fourth of its surface. These he attributed to the presence of small animals (= small medusoid spherules, $\frac{1}{3}$ to $\frac{2}{3}$ inch long), of which he calculated 64 to be in a cubic inch.

About the same time, Captain Ross was engaged in the study of red snow, which he found very abundantly in the mountains of Baffin's Bay. This colouring substance, which had been ascribed to the ejectamenta of birds, was examined by Bauer, Wollaston, Thénard, Brown, Hooker, Sprengel, Agardh, De Candolle, Cladni, and others; and by all, save Cladni, it was declared to be of a vegetable nature. The systematic position—whether algoid or fungoid—of this new organism was uncertain, and various

[1] 'Voyage dans les Alpes.'
[2] 'Beitrage z. chem. Kenntniss d. Min.,' vol. vi. p. 96.
[3] 'Account of the Arctic Regions,' vol. i.

synonyms were given for it, such as *Uredo nivalis* (Bauer), *Palmella nivalis* (Hooker), *Protococcus kermesinus* (Agardh), *Sphærella nivalis* (Sommerfeld), *Lepraria kermesina* (Wrangel), &c. Fantastic explanations of the origin of these bodies were soon forthcoming. By some the sun was supposed to contribute a peculiar life-giving principle to the snow; while by others the red bodies were regarded as foreign, and as being, in the first instance, collected on its surface by the wind, and then further aggregated by the melting of the snow. That each of these bodies could develop further on the surface of the snow was regarded as very probable. By others, again, the "so schwer zu erweisende *Generatio primitiva*" was maintained; while by yet others their fungoid rather than their algoid nature was regarded as the more probable.

The account thus given, from a naturalist's point of view, was combated in 1819 by Cladni, who ascribed the redness of snow to the presence of meteoric dust, and who deprecated the manner in which this had been overlooked by Bauer and others. Cladni even believed that in red snow from South Switzerland he detected pyroxene, or augite-like substances.

The orange-coloured snow which Scoresby had seen in the neighbourhood of Greenland was regarded by him as not unlikely of specific difference from the red snow noticed by Captain Ross. In the green sea-water, red spots which seemed to correspond with appearances of a similar kind in various places inshore were seen. These spots were believed to be caused by the presence of very many small acephalæ—which, however, seemed to be devoid of swimming organs—and to these the redness of the snow was ascribed;[1] but no further investigations were made in connection with them.

In the province of Padua, in Italy, the presence of blood-coloured spots excited much curiosity about the year 1824. Sette investigated the cause of these, and found it to be the presence of a red filamentous fungus, which he named *Zoogalactina inebrosa*, and referred to as a hitherto unknown genus. Only a year later De Candolle made further observations on the red colour of a lake in South Switzerland, the unusual hue being well known to the fishermen in that neighbourhood. Engelhardt, Haller, and others had also observed the appearance, and arrangements had been made to prosecute a chemical analysis. De Candolle found the colour to be due to the presence of a yet undescribed species of Oscillatoria, which was described as *O. rubescens;* while the chemical analysis revealed the presence, among other things, of red and green resinous materials, mucilage, an alkali, and iron-oxide. With respect to the Oscillatoriæ, an interesting observation was made, namely, that during sunshine they rose to the surface of the water, while

[1] 'Edin. New Phil. Jour.,' 1828; 'Ann. d. Sci. Nat.,' 1829, p. 218.

at sunset they sank, and it was suggested that the evolution of gas might have something to do with the movement.[1]

As a result of a chemical examination of meteoric masses carried out by Zimmermann in 1821, after an appearance of blood-rain, the coloration was ascribed to a peculiar substance of doubtful nature, which was named Pyrrhin. The importance of the red colour produced by adding silver nitrate to amber containing organic matter was also pointed out by physicists; while Hermbstädt and Berzelius were inclined to recognise the existence of a transitory substance in sea-water, produced by the decomposition of organic bodies. Witting,[2] on the other hand, regarded the redness to be the result of the union of carbo-hydrates with water.

To G. von Esenbeck the somewhat poetical idea held by some, that in the atmosphere a workshop of living forms was to be met with, appeared trivial; while the operation of certain physical factors referred to by others was to be kept under due bounds. All the blood-like appearances were to be looked upon as due to siliceous earth, or even oxide, or to grains of pyroxene and augite.

F. von Esenbeck, brother of the observer last noted, again recognised the part played by infusoria in producing the red colour of water, and the organism believed to be the direct cause was named *Enchelys sanguinea.* Its colour was due to the presence of an internal, brownish-red, granular mass; the ends of its body were transparent, the anterior being truncated and the posterior pointed.

Ehrenberg now recorded the effect produced by *Oscillatoria major*, or a nearly allied species, in colouring water; while Bory sometimes observed, by aid of the microscope, a circulation of the colouring matter in the filaments. At Cairo, in Egypt, Ehrenberg, in 1823, found red spots which he ascribed to a fungus, *Sarcoderma sanguineum;* while the small fungus, *Geocharis nilotica*, was also found in a highly coloured condition on the banks of the Nile. At Siut, in Upper Egypt, in 1821, stagnant water was found to be coloured red by *Sphæroplea annulina*, Ag. While in 1823, the Red Sea, near Tor, was tinged by, for the most part, dark-red organisms, which proved to be Oscillatoriæ enclosed in mucilage, and were named *Trichodesmium erythræum.* Again, in Siberia, in 1829, Ehrenberg found a marsh coloured red by the presence of an infusor, *Cercaria viridis* (Müller).

In the sea, especially in tropical or subtropical localities, the existence in clear blue water of streaks of green or brownish-red colour occurring in the same locality are not unfrequent. The existence of floating masses of living Diatoms especially bring about this appearance—*e.g.*, Rhizosoleniæ, Chætocerotidæ, and

[1] 'Mem. de la Soc. de Phys. et d'Hist. nat. Genève,' vol. iii. p. 30; Ehrenberg in 'Poggend. Ann d. Phys. et Chemie,' p. 130.

[2] 'Archiv. d. Apothek. Vereins in nordl. Deutschl.,' Bd. ix., p. 215.

Coscinodisci; while it cannot be doubted that the presence of often brilliantly coloured crustacean larvæ aid in producing the same result. The fact is no less significant, that although these streaks are often apparently on the very surface in daylight, careful appliances will fail to collect them. If, however, the collecting-net be sunk some fathoms, an abundance of material of the desired kind will be procured. It is also important that, with due precautions, these floating masses may—for example, in the vicinity of an isolated rock—be made the means of arriving at an approximate idea of the velocity of ocean currents, about which so little, it must be acknowledged, is yet known with precision.

III.—THE RED DEER (CERVUS ELAPHUS).

By Mr SYMINGTON GRIEVE, President.

(*Read Nov.* 20, 1885.)

It has been most difficult for me to decide upon a subject for my address to you to-night. I am well aware that you naturally expect me to discourse to you upon some theme that will prove of general interest, and it has been in that very fact that my principal difficulty has arisen. Most of the localities at which I have carried on investigations are so distant from Edinburgh, that I suppose very few of you have visited them; and without having been there, it can hardly be expected that you should have that special interest which makes one an enthusiastic listener even when a subject is somewhat dry. It is therefore not without considerable doubt in my own mind that I have resolved to read to you to-night some notes on Red Deer, suggested by incidents and observations made during a trip to the Deer-forest of the island of Rum, one of the Hebrides, in July 1884. I need not tell you of our voyage to Rum in the good steamer Hebridean, as many a voyage of greater length, and accompanied by more stirring adventures, has been told before. Suffice it to say we arrived at Loch Screresort early one morning, and were soon landed at a substantial stone quay, from which we found our way to Kinloch, the proprietor's house, situated about half a mile distant, at the head of the loch. When we got time to look about us, we found that Kinloch was situated at the entrance to a valley that stretched away westwards for some miles. To the south the cluster of grand mountains that make Rum such a conspicuous object in the landscape from most points of the western mainland and islands, reared up their heads to

heaven. It is this south-eastern corner of Rum that is the Deer-forest, though the Deer find their way more or less all over the island. The greater part of Rum is let as a sheep-farm, and during the summer the proprietor puts a number of sheep also into the forest, as there is sufficient grazing for both them and the Deer; but in the winter time the sheep are withdrawn. I was several days on the island, climbing the mountains and wandering over the Deer-forest, without having seen even one of these animals; and I naturally began to think that there must be some mistake about the Deer. I mentioned my doubts to some of the inhabitants, who assured me that I would yet see plenty of the big game, and added that I must have been near many of them without having discovered their presence. On the sixth day after landing I arranged with a shepherd to ascend Aisge-meal (pronounced *Askival*), the highest and most inaccessible peak of Rum. We attempted the ascent from the eastern side, a point from which the shepherd had never reached the summit before; but by assisting each other from ledge to ledge, we at last found ourselves at the top. We were taking a rest on the sharp ridge after our climb, and were scanning the depths of the vast corrie that lies immediately to the west of Halival and Aisge-meal. I expressed to my companion the intense joy I felt at having an opportunity of looking on such rugged grandeur, and casually remarked on the absence of Deer in such a likely spot for them to frequent. He at once said, "I am sure there are plenty of Deer in the corrie, but they will be lying down." He then began to halloo at the top of his voice, and in a minute or so said to me, "See, there they go!" But though I looked in the direction he pointed out, I at first could see nothing but the rugged mountain-side, with patches of verdure and masses of broken rock. At last I saw one Stag spring up from the ground, and, watching him closely, observed that he joined some others, and then I noticed in front of them quite a procession of Hinds. This was my first view of the wild Deer of Rum. It was a distant one, however, as we were at an altitude of 2659 feet, while the Deer were at least half a mile off, and were on ground not more than 500 feet above sea-level. The next day I had a much closer acquaintance with one of the monarchs of the forest, and I cannot say I felt quite at ease when we met. I had been fishing one of the numerous tarns, and, with the intention of testing the fishing capabilities of another, had just started to cross an intervening ridge of rising ground. I had only got a short distance on my way when suddenly there sprang up, from a slight hollow in front of some rocks, a splendid Stag with antlered head. The wind was rather high, and was blowing in my face, so the Stag had neither heard nor scented my approach until I was almost upon it. When it first rose it turned its head to-

wards me; then instinctively it put itself in an attitude of defence, and stood at bay. I made a slight advance, waving my fishing-rod in front of me, but instead of running away the brute seemed rather inclined to advance, and I expected the next moment to have a fight for life. If it did charge, I felt the mounted fishing-rod would be next to useless as a weapon of defence; and as the antlers of the deer were free of velvet, I knew the consequences might be rather serious for me. To run was out of the question, so I stood my ground and kept waving the fishing-rod in front of me. Gradually this had the desired effect, for the Stag moved slowly off to the left a few yards, stopped, had another look at me, then leisurely scrambled up the rugged ascent a short distance, and turned round once more. Something about my appearance seemed to make him decide not to prolong our meeting, and to my intense relief he made a sudden dash over the crest of the hill, and was out of sight. I followed, and presently caught sight of him rushing down the glen with several Hinds in his company. After this I had no unpleasant *rencontres* with the Deer, but saw numbers of them every day during my excursions.

Pennant, who visited Rum in July 1769, mentions that the Stags are sometimes attacked by Eagles and killed. He says: "These animals [the Red Deer] once abounded here, but they are now reduced to eighty by the Eagles, who not only kill the Fawns but the old Deer, seizing them between the horns and terrifying them till they fall down some precipice and become their prey."[1] One would almost doubt the accuracy of such a statement were it unsupported, even though Pennant is such a trustworthy authority; but the following notice of an attack upon a Stag by an Eagle which appeared in the 'Scotsman' newspaper for 11th December 1884, seems to my mind to give the best possible reason for crediting Pennant's statement. A Strathglass correspondent says:—

"A few days ago a singular struggle was witnessed on the lower portion of Corrie-Mor, at a short distance above Glassburn House, between a large and powerful Eagle and a finely antlered Stag. The king of birds was watched for some time as he hovered about on high above a herd of Deer, which appeared to possess particular attractions for him. The noble bird was slowly descending as he majestically sailed round in his aerial circles, and by degrees getting nearer to his coveted quarry. At last reaching the striking distance, he suddenly came to a halt in mid air, and, poising himself on outspread wings, he seemed for a few seconds perfectly motionless. Then, like a bullet from a rifle, he swooped down, and in an instant his powerful talons were firmly fixed in the back of a fine large Stag. The monarch of the glen plunged about in the wildest possible manner, evidently in great terror and pain, the Eagle holding on grimly, belabouring the Stag's sides all the while with heavy blows from its wings, and, when opportunity offered, making

[1] 'A General Collection of Voyages and Travels.' By Thomas Pennant, Esq. London: 1772. Vol. iii., p. 313.

desperate darts with its beak at the eyes of the frightened Deer. By this time the poor Stag's brown sides were red and gory, and, notwithstanding its frantic efforts, he could not disengage himself from his strong and cruel foe. At last, seeming to discover that his antlers could reach his savage enemy, he commenced raking fore and aft with them in the most vigorous manner, until he managed to send the Eagle sprawling in the heather. The Stag had gallantly freed himself; but he had not bounded far when his fierce assailant, recovering from his discomfiture, was again on the wing, and in full chase, and in a few seconds down he came again, and firmly fixed his powerful claws in the Deer's haunches, so far back as to be out of reach of the antlers. Again the struggle was renewed, the Eagle meanwhile tearing at the victim's flesh with his strong bill, and burying his talons still deeper into his haunches. The poor Stag was now very much exhausted, and was evidently getting the worst of it, as he could not touch the Eagle with his antlers. At this juncture, as if in despair, the Stag commenced to tumble about, throwing himself on the ground, and rolling over down-hill; but still the Eagle seemed incapable of letting go its tenacious grip. The Stag then put his head down between his fore-legs, throwing himself clean over—heels over head—several times. It was indeed a wild, a wonderful, and a most unusual sight. The Stag's efforts were at last successful, and getting clear of his murderous enemy, he galloped off.

"The Eagle was, however, speedily up again and in full chase; but his intended victim made his escape sure, by rushing full speed down the hill into the Glassburn woods. The Eagle, rather ruffled in his plumage, and no doubt much ruffled in his temper, soared aloft to look for his dinner elsewhere. It was a hard and well-fought battle, worthy of being delineated by the pencil of a Landseer. The Eagle was a splendid specimen of its kind, and of unusual size. He appeared to be much larger than the Glen Strathfarrar Eagles, and is supposed to be a poacher from the North or West. His plumage was dark brown, with some white or grey on the surface of the tail feathers; the crown of the head was tawny, the legs and beak yellow, and the claws black."

It is no unusual thing for the Red Deer to endeavour to swim across the ocean channel that separates Rum from Skye, a distance of at least seven miles. It is possible they may sometimes succeed, but frequently they are drowned in the attempt, though they are splendid swimmers, especially when in good condition—their fat contributing to their buoyancy. During the winter of 1883, the dead bodies of six Deer were washed up on the south shore of Skye, which, we were told by the inhabitants, had been drowned through a storm coming on while they were crossing from Rum. That this is true seems probable, as Deer are said to have been seen crossing by the occupants of boats and passing ships, swimming hard far out in the channel. The nearest point on Rum to Skye is distant about seven miles. The distance between the nearest point on Rum and Eilean Soa is fully six miles; and the distance across the channel between Eilean Soa and Skye at the narrowest part is about one mile. In the 'Zoologist' for 1860, at page 6913, there is the following interesting account, which in all likelihood refers to a Stag from the island of Rum. The communication originally was sent to the 'Field' by Mr William Robertson, Kinloch-Moidart, Inverness-shire. He says:—

"On the 27th October last (1859), a Red-Deer Stag of four points landed on the north side of the island of Muck, one of the Inner Hebrides, belonging to H. Swinbourne, Esq., R.N. The shepherd's family were startled by his bellowing. Unfortunately his dogs broke out, and chased the poor animal all night. In the morning he was found dead, though warm, his gallant heart being, as it was expressed, broken. He must indeed have been a noble animal to face the swim he so successfully though unfortunately accomplished. The nearest places on which Red Deer are kept are the island of Rum, belonging to the Marquis of Salisbury,[1] about ten miles distant, and Arisaig, belonging to Mr Astley, about twelve miles distant. There are also Red Deer in the island of Mull, more than twelve miles distant, but he could not have come from thence, as there was a strong wind right against him. From either Rum or Arisaig he might have shortened the distance by landing on the island of Eigg; but Muck is two miles from Eigg, and Eigg is six miles from Rum and eight from Arisaig, and from either he must at all times have had a strong side-tide against him. The distances are local estimates, the existing charts being considered incorrect, and since hearing of the above I have had no opportunity of consulting them.[2] . . . The late Colin Campbell of Jura mentioned to me that he believed there was a well-authenticated tradition of a Stag having swum from Jura to the mainland, a distance of seven miles."

So far the correspondent of the 'Field'; but I have been informed by a Mr M'Kechnie, who was brought up at Ardlussa, at the north end of Jura, that he recollects well when a lad (probably about the years 1852 to 1855), that one autumn a tame Hind swam from Ardlussa to a point on the mainland opposite, where it was observed by a fisherman to land in the early morning. This Hind was easily recaptured, being tame, and was returned to Ardlussa in a boat. The distance across the channel here appears, from the maps at my disposal, to be a little over five miles. From these accounts you can form some idea of the swimming feats of the Red Deer; and it indicates to us pretty clearly the way in which in past times these animals managed to reach some of the islands, such as Colonsay and Oronsay, from which they have long disappeared. That they at one time were plentiful on the two islands just mentioned is easily understood, when we remember the frequency with which fragments of their bones and antlers are found in the kitchen-middens of the ancient inhabitants. It is difficult to say what may be the causes that prompt the Deer thus to seek a new home. Perhaps it is sometimes the desire to find richer pastures; but it seems probable that more frequently the young Stags, after those fierce fights for supremacy, when defeated, think

[1] The late proprietor, Farquhar Campbell, Esq. of Oronsay, offered the island at public sale in June 1886, without getting a purchaser. He died during the following August.

[2] The nearest point of Rum to Muck is about six miles; from Arisaig to Muck, about thirteen miles; from Arisaig to Eigg, about seven miles; the nearest point on Eigg to Rum, about four miles; and the nearest point on Eigg to Muck, about three miles.

it prudent to retire from the neighbourhood of their defeat and from the presence of their conqueror.

While speaking about the Red Deer, let me say a few words about its antlers. In the first place, one often hears people talking of Deer's horns. This mode of expression has become so common, that it is now indulged in as "use and wont," but properly we should say a Deer's *antlers*, and not *horns*. There is a striking difference in the structure of a Deer's antler and a Bull's horn, and it seems as well to express that difference when we have words for the purpose.

During the first two years of a Stag's life, before the antlers begin to branch, some writers on Natural History call the bony protuberances from its head *horns*. As you are doubtless well aware, the hinds of the Red Deer do not possess antlers. The antlers when formed are of a hard bony substance, and differ in this respect from the horns of the Antelope, which are hollow and persistent, while the antlers of the Red Deer are caducous—in other words, fall off early each year. The power of renewing these enormous bony appendages appears to increase with the age of the animal, so the largest antlers are generally found on the oldest Stags. The following is a rough outline of a Stag's life-history as regards its antlers: The first year after birth it has, properly speaking, none—only two bony excrescences, short, rough, and covered with a thin hairy skin. The second year two straight prong-like antlers appear. The third year the place of these is taken by antlers with two branches; the fourth year there are three; the fifth, four; and the sixth, five. From this time onwards the antlers do not always become more branched, but sometimes they increase to double that number. When a Stag's antlers possess twelve tines, it becomes a "royal," but Deer with such fine heads are rather scarce in Britain. During last September, out of eighty-one stags killed in the Kingussie district, only four were "royals." On the 24th of the same month I noticed from the newspapers that Lord Lovat was said to have shot a Stag near Beaufort Castle which had antlers upwards of three feet in length, with fourteen points, the animal weighing twenty-four stones. This, however, appears to be quite unusual.[1] The Stag's age is generally estimated rather from the thickness of the base of the antler from which the branches spring, than from the number of the tines or

[1] Since the above was written, I have been favoured with the following communication from Henry Evans, Esq., Jura forest, dated 24th October 1885. He says: "The heaviest Red-Deer Stag ever killed and recorded here was 26 stone 9 lb., but it was a wood Deer, and no doubt got a bite from the crops. The average weight killed here now, clean (*i.e.*, without heart, liver, lights, and throttle), is about 14 stone 2 lb. to 14 stone 4 lb. The average of all Scotch forests is less than that. Most island Deer are small—*e.g.*, Skye, Lewis, Harris. The Reay averaged over 16

points. It frequently happens that there are more tines on the antler on one side of the head than the other, and the angles of curvature, length, and direction on different heads vary considerably. As the antlers become larger, the superficial furrows become more marked, and the burr is more projecting. The average full-grown Stag has antlers that probably weigh about 24 lb., and this enormous mass of bone drops off annually in the spring, and is replaced by at least an equally large mass of bone in the succeeding three months. The remarkable provision of nature by which this rapid growth takes place, and is transformed into bone, I will now refer to. Towards the end of spring the branches of the external carotid arteries, which perform the office of secreting this new bone, become enlarged, and there is an increased flow of blood to the Stag's head, as a large supply of blood is necessary for this rapid formation. The new antlers immediately begin to grow, but are covered with a hairy skin called the velvet, which is rich in blood-vessels. The antlers are at this time quite soft and vascular, and if pricked, blood flows from the wound. They are warm to the touch, and extremely sensitive. When the process of growth has been completed, the supply of blood is gradually curtailed by the burr which forms the base of the antlers. The antlers being fully formed, the velvet peels off. The antlers are now no longer sensitive, but are hard bony formations, ornamental to the animal, and weapons with which it can wage war upon its brethren for possession of the Hinds. The average period occupied by this growth is about ten weeks. During this time the Stags retire from the herd into solitude, as if they were aware of their defenceless state. When the rutting season comes on, about August, the Stags of the Red Deer are formidable animals; and though in their wild state they are said not to attack man, still I would not like to trust them much, if suddenly surprised, especially in situations where they had no means of easily retreating. It is not within my knowledge whether there are any well-authenticated instances of such attacks in this country, but in Asia the Red Deer will fight with other wild animals. I have heard of an instance in which a Stag is said to have beaten off a Tiger with its antlers. Though it may be doubtful whether wild Red Deer will attack human beings, it is well known that when confined in a park, or in a supposed tame state, they frequently become exceedingly dangerous, and will attack even those who attend to them.

stone last year, which is amazing. Very few people tell the truth about weights. We have "crounie" heads here, horns leaning backwards, and I believe these are seldom if ever found elsewhere. I believe wild Scotch Stags are at their best when twelve years old. I have paid a good deal of attention to them. I know little as to how far Stags swim. They swim well; they have crossed from Jura to Islay, but it is but half a mile at the ferry."

In the spring of each year the antlers, which have become gradually loosened, drop off. We might expect to find great numbers of those head-ornaments scattered throughout Deer-forests, but in this country the Deer appear invariably to eat them. This curious habit has puzzled numbers of naturalists, but I think there can be no doubt upon the question, as Hinds have been seen gnawing at the cast-off antlers; and a case is mentioned where one was found dead by a late Duke of Athole, which had been choked while trying to swallow part of an antler. One thing is certain, and that is, that any one may wander for days over Deer-forests, both on the mainland of Scotland and Western Isles, without finding even a scrap of an antler. I once was fortunate enough to make such a find in the Rannoch district, and the fragment is before you on the table. You will observe that it exhibits signs of having been gnawed at one end, and perhaps the Deer had been frightened in some way while busy eating, and did not return to complete its meal. If you ask any gillie, he will tell you that the Deer eat their antlers; and though he may never have seen the animals engaged in the operation himself, still you will find he has not the least doubt that they thus dispose of these cast-off appendages. The statements we have seen regarding Red Deer having been noticed eating their antlers only mention Hinds having been observed thus engaged. This seems rather curious, and it would be interesting to have fuller information upon this point, as it is difficult to suggest any advantage likely to accrue to the Hinds from eating these antlers; while if the Stags themselves were known to eat these bones, it might be offered as a possible suggestion that they were storing up material to aid the formation of the antlers of the following year. However, as far as the evidence at our disposal goes, it prevents the adoption of this theory. That large quantities of Deer antlers are obtainable from some source is evident, when one thinks of the vast quantities of this material used for the handles of cutlery. Probably the greater portion is obtained, not from the Red Deer, but from some allied species, such as the Reindeer. Both male and female of this variety of Deer have antlers; and as immense herds are domesticated, it is comparatively easy for the owners of these herds to collect the antlers before the animals have time to destroy them. With the wild Deer it is, however, entirely different. We find from a paper in 'Science Gleanings,' written by Mr John Gibson of the Museum of Science and Art, that "about four hundred tons weight of antlers are said to be annually imported into Britain from India and Ceylon, and one hundred tons from the continent of Europe, while Greenland supplies a very large quantity."

It has been observed in North America that Deer seem to visit certain localities to shed their antlers, and in these circumstances

do not appear to eat them. In such localities as those referred to, vast accumulations of shed antlers have been discovered. However, such a habit appears to be exceptional, as hunters in those parts of the North American continent where the cervine family are most plentiful have remarked the scarcity of shed antlers, in the same way that has been noticed in our own country. The peculiar habit of the Red Deer of visiting a particular place to shed its antlers—generally a place where there is good pasture—has also been observed in Scotland, and may be much more common than is generally supposed. During a recent visit to the Applecross Deer-forest, I was informed by Mr Macrae, one of the gamekeepers, that close to the house of another gamekeeper in the forest, near Kishorn, is a field to which the Deer resort to shed their antlers, and this keeper gathers them regularly each morning in the spring months. I could not ascertain that there appeared to have been any attempt by the Deer to eat these cast-off antlers. From all I could learn, they were found just as they were when they became detached. They are purchased by the agent of a Glasgow merchant at the price of about sixpence per pound weight.

IV.—ON THE STRUCTURE AND POLLINATION OF THE FLOWERS OF SARRACENIA.

By J. M. MACFARLANE, D.Sc., F.R.S.E.

(*Read Dec.* 18, 1885.)

The structure of the flowers of Sarracenia in relation to their pollination has not hitherto been explained, though the peculiarities of the pistil have frequently been noticed.

The flowers are produced singly at the extremity of long peduncles, and, owing to bending of the upper part of the peduncle, they droop in a graceful manner. Each flower consists externally of three small bracteoles and five large spreading sepals, these being all abundantly studded with honey-secreting glands, resembling those found on the outside of the tubular leaf and its inner lid-surface. Though I have only occasionally observed honey secreted by these, it cannot be doubted but that they attract insects to the inner flower-parts. The petals in the different species agree in shape and general arrangement, but differ considerably in size and colour. In *S. variolaris* they are yellowish-green, and relatively small; in *S. flava* they are pale yellow,

and of large size; while in *S. Drummondii*, *S. rubra*, *S. purpurea*, and *S. psittacina*, they are of a greenish crimson or crimson colour.

Each petal, springing from the receptacle, grows outward and downward (in drooping position), till it abuts against the upturned edge of the umbrelloid style, over which it spreads, and then hangs down as a broad free flap. In adjacent petals, between the point of origin and abutment against the style, a space is left through which insects can crawl into the interior; and in doing this, they, in almost all cases, must rub against one of the minute stigmatic knobs. The stamens develop an abundance of pollen, which escapes by apical, and eventually by longitudinal, dehiscence of the anthers, on the opening of the flower, or, at most, a day after.

The outer wall of the ovary is covered by large, compound, wart-like honey-glands, differing completely in structure and appearance from the other glands of Sarracenia, and from these an enormous quantity of nectar distils. From the position of the ovary, this trickles down among the filaments, and, washing down the pollen, falls in drops on the inner umbrelloid cavity of the style-head.

Insects, tempted doubtless to the flowers by the external bracteolar and sepaline nectar, and, to a greater or less degree, by the colour of the petals, push through the gap between each pair of the latter, and enter the umbrelloid cavity. In sipping the abundant nectar, they simultaneously get smeared with pollen. I have been unable to ascertain exactly the period of ripening of the stigmatic knobs; but insects in leaving the flowers can do so readily by pushing up the flap of the petals, or by passing out the way they entered without touching the stigma, since in the latter case they most easily escape by emerging on one side of the stigmatic part of the style process. Judging from analogy with other bright-coloured flowers, one would expect a protandrous condition in ripening of the stamens and pistil, and I incline to think, from all I have observed, that a considerable period may intervene between shedding of the pollen and ripening of the stigmas. This may, in fact, explain why gardeners consider it difficult to obtain seed-capsules either from self- or cross-fertilised flowers. An interesting relation might doubtless be traced between the varying colour of the flowers of the different species and the particular insect which visits each, if these were watched in their native haunts—the swamps of central and eastern N. America.

It may only be noted further that, in several of the species, hairs are present on the outside and inside of the umbrelloid style, which will guide insects into the interior as powerfully as the similarly arranged hairs on the interior of the leaf-tube.

V.—THE RARER BIRDS OF STOBO.

By Mr JOHN THOMSON, Stobo.

(*Communicated by* The Secretary, *Dec.* 18, 1885.)

In passing through the country, an observer of birds, as he reaches a district well watered by streams, and largely interspersed with trees, sheltered by surrounding hills which form a pleasing contrast to the portions of land under cultivation,—as he descries a "pleasant valley" like this, discovers, in addition to the natural beauty of the landscape, a favourite haunt of his feathered friends. If, on closer inspection, the locality boasts of a great diversity of trees, in various stages of growth, from the tender sapling to those of maturer age, the situation is on that account all the more attractive as a bird resort. Such characteristics as the foregoing are at the present time exhibited by the parish of Stobo, and they do not fail to attract a correspondingly large number and variety of the feathered fauna. The parish lies 3½ miles west from the town of Peebles, in the county of same name, and includes an area of 10,373 acres. The banks of the river Tweed which runs through the valley, and is fed in its course by many tributary burns, attain to an elevation of nearly 600 feet above sea-level; whilst the neighbouring hills, which in a measure surround the finer and consequently more fertile portions of land pertaining to it, attain to heights varying from 1500 to 2347 feet. The name of the parish was written in remote times "Stobhow," "Stubbehok," &c., which signifies "the hollow of stumps," and thus indicates that in those days, or at an earlier period, the district was covered with wood. When the name was originally created, however, it was perhaps intended to have a wider significance, and to be descriptive of the main natural features of the neighbourhood, in which case the interpretation would be "a hollow covered with wood." With this slight introduction I will now proceed to the matter in point.

During a period of sixteen years, in which I have given a good deal of attention to the ornithology of Stobo, I have noted upwards of ninety different species of birds within its bounds. I am well aware, however, that this number is capable of being considerably supplemented, and that various species, particularly migrants, though hitherto undetected, may yet be discovered, as visitants to this part in small numbers year by year. Indeed, judging from past experience in adding new names to the list, and considering how numerous the possibilities are of the presence of many being

overlooked—especially in the season of the dense summer foliage —I feel that a more thorough investigation than that which has been made would be requisite, in order to obtain an approximately complete list of the birds of the district. That it has often been the temporary abode of many a *rara avis* in Scotland is very probable, as, from the numerous sheltered nooks and hollows which it contains, and the inducements which are offered by the protection and food-products of an abundance of trees dispersed over its surface, it presents a very tempting halting-place, or even temporary residence, for a wayfaring bird. Of those to be noticed, the rarer, and therefore the more interesting, only have been selected about which to offer the few following remarks, which latter are mainly the result of observations made during the sojourn of the several species in the district.

The Grey Shrike (*Lanius excubitor*) may be first mentioned. Possessed of qualities which entitle it to rank among predatory birds (which by common consent take precedence in classification), its occurrence is deserving of something better than the slight notice afforded by the limits of a short paper like this. It has only come under my own observation once, though of late years it seems to have visited the country not unfrequently. My attention was drawn to the individual example indicated, by the noisy alarm which its presence created among a large number of small birds, chiefly Chaffinches, who seemed to dread it as much as they would a Sparrow-hawk (*Accipiter nisus*). It was perched on the top of a tall tree, from which, darting forth, it came into close proximity with a passing Chaffinch, and at once gave chase, pursuing it eagerly for a considerable distance—happily, however, without success. Resuming the line of flight from which it had deviated, it came sufficiently near to admit of no dubiety as to its identification. Its flight is rapid; quick beats of the wings are repeated continuously until a considerable space is covered, when a short intermission is made, which, combined with the succeeding stroke, produces a slightly zigzag movement. Proceeding onwards, the Shrike made a long downward swoop in the direction of a group of large trees, and was lost to view. This occurred in February 1883. Three specimens were shot at Biggar, about eight miles distant, in October and November 1882. Two of these which I dissected had the fur and bones of mice in their stomachs, and the third one had just been making a meal of one of these quadrupeds, when it was shot. The mouse was twisted round a spiked twig of a hawthorn tree, and fixed so securely as to preclude entirely its removal, save by the process of pulling it in pieces.

The Pied Flycatcher (*Muscicapa atricapilla*) next claims our attention. Like many others of our rarer visitants, it would seem recently to have appeared in greater numbers in Scotland, as is

proved by the circumstance of so many having been noted during the past summer. Some allowance must no doubt be made for the fact that there are now many more accurate observers of bird-life than formerly, therefore much valuable information is brought to light that previously was lost from want of the requisite attention being paid to such subjects; but still this does not militate against the probability that by breeding in the country (as the birds have been lately known to do, and returning with their broods to their old haunts), they may be gradually increasing in numbers. It therefore behoves all who may chance to come in contact with the species to give it whatever protection they can, and so tend to enhance the prospect of its yet becoming one of our familiar summer birds of passage. On the 15th of May last I saw two of these birds in the parish, mated and evidently looking out for a nesting-place. Operations were not, however, begun at this spot, and, the birds disappearing on the following day, I failed to find any trace of them until the 9th of June, when, a short distance off, I discovered, in the hole of an Alder tree, a nest with eggs, on which the hen-bird was sitting. Her male associate, nevertheless, did not look such a fine specimen as the one first noticed. But next day (10th) I observed a very superior plumaged cock, and so concluded that two pairs were in the neighbourhood. In the hope that another nest might not be far off, the bird's movements were closely watched until a little patience produced the desired result. This second nest was in the hole of a Rowan tree, and only about 100 yards distant from the other. It also contained eggs. The one first found was deserted by the birds before the eggs were hatched, owing probably to an act of molestation; but the other pair hatched out a young brood which were fledged on 8th July, having remained in the nest about seventeen days. The habits of this bird bear a considerable similarity to those of its congener, the Spotted Flycatcher (*Muscicapa grisola*), insects seeming to constitute its principal food-supply. The mode of feeding is to remain quietly perched until it espies an insect, when off it darts to secure the same. While, however, the Spotted species usually sits on the outermost branches of trees, or on some prominent object, directing its gaze to insects that are passing on the wing, the Pied Flycatcher turns its attention mainly to what is stirring amidst the trees, capturing the most of its prey off the leaves and branches. Occasional outward sallies are also made after passing insects, when a snap of the bill may be heard at the moment of seizure, and descents are made also to those on, and in proximity to, the ground. During the period of incubation the male feeds his partner very frequently, both when in the nest and out of it, but does not, so far as I could ascertain, assist in hatching. When a person approaches close to their nest they show little concern,

so long as it does not contain young birds; but for these latter they evince much solicitude, alighting quite near to an intruder and manifesting distress by their gestures and the rapid utterance of a note which is somewhat like "veet." Another note—"chuck-tuck"—is used by turns on these occasions. When sitting quiet, the male may be heard to utter a low, plaintive note, resembling the ordinary call of the Bullfinch (*Pyrrhula europæa*) as it is heard at a distance; and its song, which is audible some way off, is not unlike that of the Cole Tit (*Parus ater*). They are courageous birds, and will sometimes drive another species away from their nest. A male Pied Flycatcher was shot in the grounds of Stobo Castle on May 22, 1879, and is now in my possession.

The Raven (*Corvus corax*) has now become a stranger in the district, insomuch that his once familiar name of "Corbie" is rarely used except by the older residents. For many years back his appearances have unfortunately been few, and his stay of short duration. Two or three were observed on the hills in the autumn of 1882, and one was shot at that time in the neighbouring parish of Lyne. Last autumn one again appeared on the hills for a short period, its presence being much resented by the Carrion Crows (*Corvus corone*), which flew around and buffeted him in his flight. I am informed that a pair bred this year in a rocky precipice called "Bitch Craig," in the adjoining parish of Manor, but the young were harried from the nest to be tamed, and kept as interesting pets. Last year another nest was built at the same place, which also suffered spoliation; and thus the birds have been twice frustrated in their attempts to maintain the existence of the small remnant now left in the Lowlands of Scotland.

Two very beautiful Waxwings (*Bombycilla garrula*) were shot by a labourer near the Manse of Stobo on 26th January 1882. They were feeding at the time on the berries of the Hawthorn, which they seem to pick off and swallow entire. The pair showed little distrust when approached, admitting a close inspection, so that the quiet demeanour of the bird would seem to be expressive of its disposition. Upwards of twenty years ago one was shot out of a small flock near the same place, the numerous Hawthorn trees in the vicinity having then also been the attraction.

Next on the list is the Red-throated Pipit (*Anthus cervinus*). I have never had an opportunity of handling a specimen of this species, but after a careful scrutiny of the coloured plate and perusal of the accompanying description in Morris's 'British Birds,' I feel quite assured that I once saw a flock of eight or ten in the parish. They were feeding on a bank of short turf, near a road which ran close to one of the larger burns in this neighbourhood. It was a spot where Meadow Pipits (*Anthus pratensis*) are frequently seen, and at the first sight of their graceful running mo-

tions I concluded they must be these birds; but, stealing up to within fifteen yards of them, I saw their colour quite distinctly, and was convinced that I had never identified any such species before. The males and females could easily be distinguished—the rose-coloured red on the breast and forepart of neck being very visible on some of the birds, presumably the former, whilst on others it was nearly or entirely awanting. Saving on that one occasion, I never saw them before nor since.

The Crossbill (*Loxia curvirostra*) is a more assured visitor to Stobo than the preceding species. The first occasion on which it came under my notice was towards the end of August in 1873, when a few small parties appeared and attracted attention by their peculiar and far-sounding note. One or two being shot, their identity was proved beyond doubt, and shortly thereafter I became aware that large numbers had arrived in the district. Almost any day one or more flocks might be seen composed of from six to twelve individuals, and sometimes the numbers reached to upwards of twenty. Most extensive feeding-grounds were at their disposal in the large Pine woods; but the birds showed a decided preference for the smaller plantations, clumps, and straggling trees. The Larch was at first almost exclusively resorted to, the seeds from the cones near the top of the tree being always preferred. An instance of their acuteness in distinguishing these trees from others once came before me. A flock flew past at their usual rapid rate, and, going in a straight line, would soon have disappeared; but suddenly they turned at right angles and flew straight to a single Larch, which they had espied in the midst of other trees many hundred yards away. Their flight, except for its superior swiftness, is very much like that of the Greenfinch (*Coccothraustes chloris*), and while on the wing their call-note is repeated almost incessantly. This latter is not easily described, but has somewhat of a ringing clearness about it,—the words "clink-a-link" pronounced quickly may perhaps convey a slight idea of the sound. On a quiet day the united voices of a flock are audible five hundred yards off, consequently they are often heard when not seen. All through the winter of 1873 and during the following spring the Crossbills remained in the locality. A number probably shifted their quarters early in spring, as they were not noticed so frequently towards the end of the season. One was shot from a flock of six or seven on 23d April, and I observed two in May; they were male and female, and the former was feeding the latter, which is an act I am inclined to believe they perform to a certain extent throughout the year, as during their stay I remarked the operation several times. No nest was found, though it is very probable that a few might have been built; and it seemed to me rather remarkable that those birds which remained all spring were invariably

herded together in flocks. They are described as breeding early in foreign countries, as well as in other quarters of Great Britain; but many certainly did not incubate on the occasion of their notable visit to Stobo. The winter of their sojourn was unusually mild, snow not lying on the ground until February and March, and then only to a slight extent. Other parts of Peeblesshire were also visited by the birds at that period. In 1879, on 14th September, I again saw a band of seven Crossbills; and towards the end of 1883 these birds appeared twice or thrice during winter.

The Water Rail (*Rallus aquaticus*) is very seldom met with in Stobo. Its sombre colours, assimilating well with its habitats, may perchance enable it to elude more frequent notice. One which was shot by a burn-side at the foot of the hills, not far from here, is now in my collection.

The Goosander (*Mergus merganser*) is seen occasionally on the Tweed in winter. Two were shot in the district, out of a small flock, on February 8, 1877, one having in his mouth a newly caught minnow, which he evidently intended for a *bonne bouche*—a laudable desire never to be consummated, as death overtook him ere he could swallow his victim.

The Oyster-Catcher (*Hæmatopus ostralegus*), although not actually obtained in the parish, has been known to pass through it on its way up and down the course of the Tweed, and one was shot in July 1876 just outside the boundary.

With the mere mention of the lovely plumaged Kingfisher (*Alcedo ispida*), which visits us at rare intervals, this completes the list of species selected for remark.

The acquisition of the material from which these notes have been culled afforded me very great delight. Indeed, how few keener pleasures are there than those which attend the discovery of a rare bird? But in addition to this pleasing excitement, the study of ornithology is one in every way calculated to lead us to higher thoughts of the Great Author of Nature, who, in the variety and beauty of the feathered creation, as much as in any other of His works, has made abundant provision for the enjoyment of mankind.

List of Species identified at Stobo.

Common Buzzard, *Buteo vulgaris.*
Rough-legged Buzzard, *Buteo lagopus.*
Merlin, *Falco æsalon.*
Sparrow-Hawk, *Accipiter nisus.*
Kestrel, *Falco tinnunculus.*
Tawny Owl, *Strix aluco.*
Long-eared Owl, *Asio otus.*
Grey Shrike, *Lanius excubitor.*
Blue Tit, *Parus cæruleus.*
Great Tit, *Parus major.*
Cole Tit, *Parus ater.*
Long-tailed Tit, *Acredula caudata.*
Spotted Flycatcher, *Muscicapa grisola.*
Pied Flycatcher, *Muscicapa atricapilla.*
Kingfisher, *Alcedo ispida.*
Raven, *Corvus corax.*

Carrion Crow, *Corvus corone.*
Rook, *Corvus frugilegus.*
Jackdaw, *Corvus monedula.*
Magpie, *Pica rustica.*
Waxwing, *Bombycilla garrula.*
Creeper, *Certhia familiaris.*
Cuckoo, *Cuculus canorus.*
Nightjar, *Caprimulgus europæus.*
Swift, *Cypselus apus.*
Chimney Swallow, *Hirundo rustica.*
House-Martin, *Chelidon urbica.*
Sand-Martin, *Cotile riparia.*
Pied Wagtail, *Motacilla lugubris.*
Grey Wagtail, *Motacilla sulphurea.*
Titlark, *Anthus pratensis.*
Tree Pipit, *Anthus trivialis.*
Red-throated Pipit, *Anthus cervinus.*
Skylark, *Alauda arvensis.*
Corn Bunting, *Emberiza miliaria.*
Yellow Bunting, *Emberiza citrinella.*
Snow Bunting, *Plectrophanes nivalis.*
Reed Bunting, *Emberiza schœniclus.*
Chaffinch, *Fringilla cœlebs.*
Mountain Finch, *Fringilla montifringilla.*
Sparrow, *Passer domesticus.*
Greenfinch, *Coccothraustes chloris.*
Siskin, *Carduelis spinus.*
Redpole, *Linota rufescens.*
Bullfinch, *Pyrrhula europæa.*
Crossbill, *Loxia curvirostra.*
Starling, *Sturnus vulgaris.*
Water-Ousel, *Cinclus aquaticus.*
Missel Thrush, *Turdus viscivorus.*
Mavis, *Turdus musicus.*
Fieldfare, *Turdus pilaris.*
Redwing, *Turdus iliacus.*
Blackbird, *Turdus merula.*
Ring-Ousel, *Turdus torquatus.*
Hedge-Sparrow, *Accentor modularis.*
Robin, *Erithacus rubecula.*
Redstart, *Ruticilla phœnicurus.*
Wheatear, *Saxicola œnanthe.*
Whinchat, *Saxicola rubetra.*
Sedge Warbler, *Salicaria phragmitis.*
Blackcap, *Sylvia atricapilla.*
Garden Warbler, *Sylvia salicaria.*
Whitethroat, *Sylvia rufa.*
Wood Warbler, *Phylloscopus sibilatrix.*
Willow Warbler, *Phylloscopus trochilus.*
Wren, *Troglodytes parvulus.*
Goldcrest, *Regulus cristatus.*
Wood Pigeon, *Columba columbus.*
Pheasant, *Phasianus colchicus.*
Black Grouse, *Tetrao tetrix.*
Red Grouse, *Lagopus scoticus.*
Partridge, *Perdix cinerea.*
Golden Plover, *Charadrius pluvialis.*
Peewit, *Vanellus cristatus.*
Oyster-Catcher, *Hæmatopus ostralegus.*
Heron, *Ardea cinerea.*
Curlew, *Numenius arquata.*
Common Sandpiper, *Totanus hypoleucos.*
Woodcock, *Scolopax rusticola.*
Snipe, *Scolopax gallinago.*
Land-Rail, *Crex pratensis.*
Water-Rail, *Rallus aquaticus.*
Moor-Hen, *Gallinula chloropus.*
Coot, *Fulica atra.*
Teal, *Anas crecca.*
Mallard, *Anas boschas.*
Goosander, *Mergus merganser.*
Little Grebe, *Podiceps minor.*
Common Gull, *Larus canus.*
Black-headed Gull, *Larus ridibundus.*
Herring Gull, *Larus argentatus.*
Barn or White Owl, *Aluco flammeus.*

VI.—THE FUNGUS FORAY IN ROSLIN GLEN.

By Mr A. B. STEELE.

(*Read Dec.* 18, 1885.)

The first "Fungus Foray" of the Club took place last summer on the last Saturday of September. In the morning the weather was unfortunately unfavourable, and prevented many members from joining the excursion. With a muster of about twenty

members, including a few ladies, we started for Roslin with the afternoon train, and walked through Roslin Glen to Polton. Our first find was in the small cemetery near Roslin Castle. It was the commonest of the Agarics—Agaricus fascicularis—with its yellow umbonate pileus, adnate gills turning green, hollow stem, and black vanishing veil. It grows abundantly in tufts at the foot of old trees and gate-posts. It resembles slightly Agaricus mutabilis, which was found in almost as great quantity when we got fairly into the woods. Its habitat is the same. The gills, however, are subdecurrent and reddish brown, with stuffed stem. In the pasture-ground below the chapel was found, growing in large rings, the Sooty Agaric—Agaricus grammopodius—with its dark slightly umbonate cap, gills adnate dirty white, and furrowed solid stem. Several specimens of the large Scorched Agaric—Agaricus adustus—were collected, the pileus of which is ash colour, olive and at length dark as if burnt, from which it takes its specific name. The gills are white, and the stem when cut transversely is of a sponge-like texture. A variety of this Agaric —Agaricus elephantinus, *Sow.*—which has the cup brownish-yellow, gills yellowish-white, and stem solid, was also got, but not identified at the time. Three very common Agarics—Agaricus laccatus, A. rimosus, and A. fœnisecii — were found in large quantities all through the glen; but we only once observed the very common Agaric, Agaricus micaceus. It was growing in large clusters on a fallen and decaying tree. It has the pileus slightly furrowed and brownish, pale and at length black gills, and slender stem. It takes its specific name from the effect caused by the young plant, which shines in the sun as if covered with particles of mica. An allied species, Agaricus atramentarius, was found near the same spot, but not so plentifully. Like its relative, it grows in tufts; and they are both species, says Greville, of a striking group, whose very singular property it is to dissolve in decay, and almost entirely to disappear in an inky fluid. Two other species, Agaricus conicus and A. dealbatus—the latter said to be edible—were also collected in the same spot. A specimen or two of Agaricus variabilis, made famous by the researches of Professor Oersted, were found growing on dead branches. Though not uncommon, it is interesting by its resupinate and afterwards reflexed pileus, and the absence of a stem. About this spot the President, a keen observer, picked up a tiny Agaric growing among moss. I was not able to name it at the time, but I afterwards identified it as a very small specimen of the Black-stemmed Agaric —Agaricus androsaceus. The only rare species among the Agarics collected that day were Agaricus rubescens, *With.*, having a polished reddish-brown pileus, rufous gills, and solid stem; and Agaricus virescens, *Fries*, with a roughish

green cap, unequal forked gills, and white, solid, almost smooth stem. The former is of a highly poisonous nature, while the latter, on the authority of Berkeley and Mrs Hussey, is one of the edible species. Among the Auricularini we got Auricula reflexa, now classed among the Polypori, and called Polyporus versicolor, with a buff, yellow, or brown, smooth hymenium, and reflexed zoned pileus, exceedingly common on dead trunks and branches of trees throughout the whole year. Three other Polypori or Sap-balls were collected—one a tolerably large specimen of Polyporus squamosus, the largest species of our British Fungi. It was detached from its habitat, but was too moist and decayed to be carried away. It is known by its scaly fleshy pileus and sublateral stem, and grows on stumps of decaying trees, chiefly those of the Ash. The other species were Polyporus ulmarius and P. vulgaris. What I called a Clavaria—the Clavaria hypoxylon of Withering—is now grouped among the Ascomycetes, and called Xylaria hypoxylon, *Sow.* The hymenium is branched like the horns of a Reindeer, downy at the base, and black and white towards the apex. The only Puff-ball collected was found by a lady, and was a young plant of Lycoperdon verrucosum, with a warty yellowish-brown peridium, and when full grown has a large lacunose stem, thickened at the base, the peridium bursting at the apex. Among Pezizæ three species were found—Peziza virginea, with a longish stipes and hemispherical subpatulate pileus; P. hirsuta, with a sessile sub-hemispherical cupule, an inflexed margin, and vermilion-coloured inside; and P. aurantia, with cupule nearly sessile, irregular, oblique, orange, whitish externally, and somewhat pruinose. We collected altogether about twenty-five different species; and had the season been more propitious to the growth of these plants, I have no doubt that double that number would have been got in a locality so favourable to fungoid growth. A week or two after our excursion, our fellow-member, Mr James Monteith, went over the same ground, and sent me a small box containing a dozen species collected by himself, seven of which were not found on the day of the excursion. These were—Agaricus fimiputris, A. velutipes, A. umbelliferus, and A. varius; Dædalea quercina, Peziza tuba, and Nectria cinnabarina.

VII.—DISCOVERY OF THE WATER-SPIDER (ARGYRONETA AQUATICA) NEAR BALERNO.

By Mr A. B. HERBERT.

(*Read Dec.* 18, 1885.)

When the Club visited the bog at Bavelaw last summer, we had not sufficient time to thoroughly investigate the locality; so on the 4th August, a bright and warm day, I went with some of my children for a further search, both for wild plants and also objects for a fresh-water aquarium. The peat-pits on the bog contain thousands of Frogs and Tadpoles in the early spring. The Dytiscus marginalis we have also found there, and the larvæ of the large Dragon-fly; and it was while searching for the latter, by drawing out some Myriophyllum from one of the pits, that I saw a Spider creeping on the moss, which I at once recognised as the Argyroneta aquatica. Further investigation brought to light many specimens, in various stages of growth, of this peculiar species of the Arachnidæ; and on the surface of one of the pits, floating on the Myriophyllum, we observed several white silken bags, about the size of a filbert, which proved to be the Water-spiders' nests, and full of very minute young ones. These, in this early stage of life, are quite white. Three of the full-grown Spiders I sent by post to a scientific friend in London, who informed me they were all females. At home I at once established, at a cost of tenpence, a small Spider aquarium, consisting of a confectioner's glass, 9 inches high by 4 inches in diameter, with perforated zinc top, in which I placed a few sprigs of Anacharis from the Canal, and the Spiders have lived in this jar from the 4th August to the present time. My difficulty with the Spiders was not knowing their natural food. There were among the Anacharis many minute forms of animal life, such as small Crustacea and Coleoptera, but I cannot be certain that the Spiders ever fed upon these. My first attempt at feeding was with a Blue-bottle fly; and the Spider's proceeding with this was interesting to watch. He placed the fly down among the weed, then spun a single thread of web to the surface, and, running up this, he brought down a bubble of air and fixed it in the weed; then up again for another supply of air to add to the first—these journeys, voyages, or divings being repeated till the air-bubble was of considerable size, and dome-shaped. He then fetched the fly and pushed it up from below into the air-bubble, and then, placing himself inside with the fly, remained quiescent for some time, no doubt feeding on his prey. The Spiders, I find, will eat flies, gnats, and ear-wigs, but are not very partial to the last. They seem to lie

almost dormant at this time of the year. They are interesting subjects for observation; and the globule of air, which envelopes the whole of the body except the head and thorax, gives them the brilliant appearance of being coated with quicksilver—and this silvery aspect is, no doubt, the reason for their scientific name of Argyroneta.

Our fellow-member, Mr Archibald Gray, was the first to discover these Arachnidæ at Luffness, a considerable distance to the east of Edinburgh; and we now know that they are in no small numbers seven miles to the west. We may therefore, I think, conclude that they are not so very rare in this neighbourhood; and it is extremely probable we may hear of them in other clear-water pools near Edinburgh.

I may remark that I believe Snipes breed on the Bavelaw bog, for I flushed one, which seemed very reluctant to leave, and pitched again within a few yards; and this occurred on two occasions on different days. I may also mention that while at Bavelaw, on the 4th August, I took the opportunity of transplanting some of the Linnæa borealis to other suitable localities in the Fir-wood, selecting those places where the soil was of a similar character to that where the plant now grows,—as it is, and I trust ever will be, the object of our Club to disseminate rather than extirpate all our rarer indigenous plants.

VIII.—LIST OF THE LESS COMMON PLANTS GATHERED AT THE EXCURSIONS DURING 1885, WITH LOCALITIES.

By Mr ANDREW MOFFAT, Secretary.

(*Read Jan.* 22, 1886.)

The plants included in the following list were those gathered at the Club's excursions during 1885, so far as they differ from those gathered in 1884 (*vide* p. 254 *et seq.*) Plants when once noted are not repeated, unless recorded from different localities.

Brassica nigra, Boiss. Inchkeith. Very abundant.

Cerastium arvense, L. Queen's Park, near Echoing Rock.

Although this plant was not gathered at a Club excursion, I take this opportunity of recording its occurrence in this locality. Seven or eight years ago I got it here, but was never again able to gather it till May 1885.

Viola lutea, Huds. Blackford Hill.

Dianthus deltoides, L. Same locality.

Geranium pyrenaicum, L. Craigmillar Castle and vicinity.
Geranium dissectum, L. Same locality.
Geranium lucidum, L. Same locality.
Geranium Phæum, L. Woods around Dysart House. A garden escape—naturalised.
Potentilla reptans, L. By the roadside leading from Duddingston Station to Craigmillar Castle.

Notwithstanding the various changes in this locality, the above station is identical with that referred to by Dr Greville in his 'Flora Edinensis,' published in 1824.

Smyrnium Olusatrum, L. Craigmillar Castle.

This plant, having been formerly cultivated as a pot-herb, has most probably been introduced into this locality.

Ligusticum scoticum, L. Inchkeith.
Erythræa pulchella, Fries. Gullane Links.
Anchusa sempervirens, L. Craigmillar Castle.
Hyoscyamus niger, L. Gullane Links.
Mimulus luteus, L. In ditches near Dysart House. Naturalised from North America.
Lathræa squamaria, L. Roslin Woods.
Utricularia vulgaris, L. Gullane Links.
Anagallis tenella, L. Gullane Links.
Rumex scutatus, L.

This, the French or Garden Sorrel, introduced from France in 1596, is naturalised on the walls of Craigmillar Castle.

Lepturus filiformis, Trin. Aberlady.
Asplenium septentrionale, Hull. Blackford Hill.

IX.—ON THE OBJECTS AND METHODS OF METEOROLOGY.

By Mr ALEX. FRAZER, M.A.

(*Jan.* 22, 1886.)

At the request of the Council, Mr Alex. Frazer, M.A., delivered a lecture to the members of the Club "On the Objects and Methods of Meteorology." The lecture was of a practical nature throughout, describing in detail the mechanism of such "weather-instruments" as the thermometer, barometer, and anemometer, and the various improvements effected from time to time on their construction. Particular attention was given to wind-storms, and the

different modes of calculating their velocity—the lecturer describing an anemometer designed and constructed by himself for this purpose. The lecture was illustrated by specimens of the several instruments described, as well as by a series of wall-diagrams.

X.—*VERONICAS IN THE NEIGHBOURHOOD OF EDINBURGH.*

By Mr MARK KING.

(*Read Jan.* 22, 1886.)

In one of those charming little books on Natural History by John Burroughs, that genial and enthusiastic American naturalist thus speaks of the Veronicas or Speedwells, which soon arrested his attention on his first visit to this country. "The prettiest of all humble roadside flowers I saw," he says, "was the little blue Speedwell. I was seldom out of sight of it anywhere in my walks till near the end of June; while its little bands and assemblages of deep-blue flowers in the grass by the roadside, turning a host of infantile faces up to the sun, often made me pause and admire." [1] And truly none of our early summer flowers are more worthy of observation. The Speedwell is pre-eminently a poet's flower, and there are many beautiful and tempting allusions to it in our poetical literature. But I would pass by all these for the present, desiring rather to give a few descriptive hints which may be of use to some of our younger members, or to those only beginning the study of British plants, in enabling them to identify the various commoner species, which may nearly all, without much trouble, be met with in short excursions round our own city. Veronicas, amongst other plants, have occupied my attention for many years, and they have been to me an ever-increasing source of delight. If I can enlist any to begin their field-work with them, I would fain believe that an interest will thus be evoked which will not stop short until the whole of Flora's domain has been investigated.

Veronicas differ in habit—some being weak and trailing, while others are firm and erect; and their habitats are likewise various—some loving the marsh or the river-bank, while others flourish in the ploughed field, or the shady wood, or by the dusty roadside. Yet a Veronica need never be mistaken for any other British plant, from the characteristics of possessing *two* stamens and having a rotate corolla. These constant features are a sufficient guide to

[1] 'Fresh Fields'—"A Glance at British Wild Flowers." By John Burroughs.

the identification of the whole family. Other marks of our British species are, that their blossoms are arranged either in axillary or terminal racemes, which are usually blue, but occasionally white, or some shade of lilac. The transition of leaves into bracts is also very abrupt, these latter becoming large and leaf-like. In treating of Veronicas, their duration as annuals or perennials furnishes a simple and natural mode of grouping, and other points can be noted as we proceed. Twelve species have been admitted into the Edinburgh Flora, but of these one at least has probably been introduced. Of these twelve species, seven are perennials and five annuals. Taking the perennials first, we find that all of them have stoutish, more or less upright stems; and all but *one* (V. serpyllifolia) have spikes or racemes of flowers proceeding from the *axils* of the leaves. V. Beccabunga grows in streams or ditches, and is a very handsome species, with a thick smooth stem and opposite bright-green leaves, which are sometimes eaten as a salad. The flowering period extends from May to August, and the little bright-blue flowers are sometimes called Forget-me-nots. Another Veronica frequenting the borders of ditches and watery places is V. Anagallis, or the Water Speedwell, which may be easily recognised by its tall, thick, *hollow* stem, and its smooth, *stalkless*, and lance-shaped leaves, which clasp the stem. As its common name implies, this Speedwell prefers damp situations, though not absolutely requiring such a locality, for I have found it by the margin of Duddingston Loch, in the hardened mud, yet flowering and fruiting abundantly. Another water-loving species is V. scutellata, or the Marsh Speedwell, with leaves very like the last named, but smaller, and faintly toothed, while the pale-blue or flesh-coloured blossoms are a little larger than V. Anagallis. I have found this plant not so abundant as its neighbour, the Water Speedwell: perhaps, from its smaller leaves and more straggling habit, it may be apt to be overlooked. Leaving now the marsh for the dry ground, our next example is V. Chamædrys, or the Germander Speedwell—one of the prettiest of our wayside flowers, its spikes of bright-blue blossoms peeping out from dry banks and hedgerows from early May to the end of June. This flower, with its alternate pairs of leaves, and its *two rows of hairs* changing sides with each pair, is familiar to all of us in our walks round the outskirts of the city. A mere catalogue of its uses in rustic medicines in former times would take up far more space than the subject is worth. For instance, as a cure for gout and in cancer, it is recommended by old Gerard in "good broth of a hen"; and another old herbalist urges its use "for all diseases of the brain." In dry banks and pastures, as well as in woods, you will find the Common Speedwell (V. officinalis). It may at once be identified by its hairy stem, egg-shaped leaves on *short* stalks, and small, very pale blue or lilac

flowers, borne in long spikes. The astringent leaves were at one time used in this country for tea, and are still so used in France. With V. montana I have never yet had the good fortune to meet in a growing state, but I exhibit a dried specimen from the south of England. Its chief features are the very pale green of the leaves, with their *long* hairy footstalks. The last of the perennial species is V. serpyllifolia, or the Thyme-leaved Speedwell. This is a very common species, found on dry banks and waste places. It grows to a height of about four inches, and has small whitish flowers with blue veins, and narrow leaves not unlike those of the plant whose name it has adopted.

We now pass on to the commoner annual species. As already said, these may be reckoned as five in number; and four of them are weak trailing plants, with flowers borne singly in the axils of the leaves. The fifth (V. arvensis) has an upright stem, and the flowers are borne in a terminal spike, like V. serpyllifolia amongst the perennials. Of the trailers, we may take first in order V. hederæfolia, or the Ivy-leaved Speedwell, with very pale-blue flowers, which appear in succession as the branch lengthens, and the cells of the capsule containing one or two seeds. This species is one of the first to flower of all the Speedwells, being sometimes found in January, and with the advancing year it straggles more and more, becoming visibly weaker. Our next species, known as Buxbaum's Speedwell (V. Buxbaumii), is considered by some of our best botanists as a doubtful native of Britain. As far as my experience goes, it is somewhat rare in the Edinburgh Flora, though very abundant where it does occur. Its first appearance in Scotland was in Berwickshire, where it was noticed in 1850 by Dr George Johnston, and figured and described by him in his elegant work, the 'Botany of the Eastern Borders.' It must be admitted the honour of being by far the handsomest of the annual forms, with its large bright-blue blossoms—though the small lobe of the corolla is always lighter in colour, sometimes nearly white. Its leaves are oblong, dark-green in colour, and deeply serrated. V. arvensis, or the Field Speedwell, is a misnomer, for it no more grows in fields than V. montana is to be found on elevations. It must be looked for on dry old wall-tops, or even by the dusty roadside, where it will be found with a stem three or four inches long; but when growing on a moist bank, as it may occasionally be found, the stem may have increased to eighteen inches. But it is pre-eminently a wall plant; and though the flowers are very small, seldom exceeding one-eighth of an inch in diameter, yet growing as it does in patches, its pale-blue corolla and little white eye form a very pleasing object. Its petioled lower leaves and alternate bracts, together with its flattened seed-vessels, furnish further marks for identification. Our fourth annual species is V. agrestis, or the Green Field Speedwell.

This plant is well known in every field and garden, and may perhaps be characterised by some irate farmer or gardener as "a pernicious weed," seeing it has a decided preference for cultivated ground, and when it has obtained a footing it is very difficult to eradicate. It has a white corolla, sometimes tinged with blue. Its leaves are small, pale-green in colour, with regular serratures; and it continues to flower till killed off by frost. In mild winters it survives, and flowers the next summer, thus becoming a biennial. The last of our annual forms—V. polita, or the Grey Field Speedwell—is by some considered as merely a variety of V. agrestis. But its flowers are *larger*, and *wholly* blue; and the serratures of the leaves are *deeper*, and not so regular. By these marks it may be readily distinguished.

It may be interesting to compare the occurrence of some of the Veronicas above mentioned, near our own city, with their presence in the West. Mr Turner, of the Glasgow Natural History Society, informs me, for instance, that V. Buxbaumii "occurs in some abundance about Loch Lomond and elsewhere in the West, but is very rare in the immediate neighbourhood of Glasgow"—just as in the neighbourhood of our own city. "It is a weed, however," he adds, "that appears to be spreading, so that it may probably be too common before long." Again, as regards V. Anagallis, which is found at Duddingston and some other places with us, Mr Turner says it "is very rare in the district, though it occurs in a few coast stations. There is only one inland station recorded for it,—'near Flenders, beyond Busby.'" V. scutellata and V. montana, which are both rare with us, the latter especially, Mr Turner adds "are both frequent in the neighbourhood of the city,—the former growing in boggy places, and the latter in woods and shady places."

A word or two in conclusion as to the drying of Veronicas. My own experience is, I daresay, similar to that of most who have tried thus to preserve them—namely, that they are "eminently unsatisfactory." The gamopetalous corolla falls off generally soon after the plants are gathered; while in the process of drying, a sad change of colour frequently takes place,—what was before so bright and beautiful becoming a mass of dirty black. In order to obviate these untoward conditions as far as possible, the plants should be transferred to bibulous paper as soon as gathered, and submitted to pressure by strapping. On reaching home they should be placed between fresh sheets of paper, and a warm iron passed over them. By these means there is *some* chance that the blossoms may be preserved, and the colour to some extent remain intact. But if any of the members of the Field Club know of a better method of preserving these beautiful, humble wayside flowers, I for one shall feel very glad indeed to hear of it.

XI.—THE RING AND WATER OUSELS: THEIR HOMES AND HABITS.

By Mr ARCH. CRAIG, Jun.

(*Read Feb.* 19, 1886.)

The two species which are the subject of the ensuing remarks have been selected, not because of their rarity, as they are far from uncommon, but for various other reasons which seem to me sufficiently valid to create more than a momentary interest, and repay the slight trouble and time expended upon their examination. The rare bird is not of necessity the most interesting, as, considering the fact that such may only be observed once or twice in a lifetime, and then possibly only for a few minutes, no opportunity of studying its habits is attainable. It is quite otherwise, however, with our common species, whose sojourn in this country, even if migratory, is of sufficient length to permit of comparatively close watching; and consequently many little traits and pleasing actions may be marked, that add greatly to our knowledge and increase our pleasure at the same time.

Briefly stated, the following are a few of the reasons which I have thought potent enough to warrant this selection: First, the two, although bearing the same popular name, are of different genera—the Ring-Ousel (*Turdus torquatus*) belonging to the family of Turdidæ or Thrushes, and the Water-Ousel (*Cinclus aquaticus*) being the sole representative, in Scotland, of the genus Cinclidæ. Second, they serve as illustrations of two classes of feathered fauna —the former being a migrant, and the latter a constant resident. Third, the plumage of both, besides bearing a certain similarity, is peculiar, and almost unique, among our native land-birds—the distinct contrast between the black and white giving to both a cleanly, sprightly appearance, which more brilliantly attired species do not possess. Fourth, both are solitary in disposition, and frequent equally those lonely situations where other bird-life is not abundant. Fifth—and this is applicable to one only—notwithstanding its comparative harmlessness, the Water-Ousel is an example of that ignorant prejudice which is the origin of the phrase, "Give a dog a bad name," &c.—as for long it has been subject to constant senseless persecution at the hands of salmon-fishers and their too ready satellites, the motives for which cruelty will be adverted to more fully later on. Sixth, and lastly—although the reasons might be multiplied considerably, and I fear you will consider this one the weakest of all—these species have always been especial favourites of my own; and as an easy day's walk from town during the

summer months will bring one in contact with both, I can only express the hope that some members of the Club will next season take the trouble to make their acquaintance.

Take first the Ring-Ousel. As already indicated, it is a migrant, arriving in Scotland about April and departing southwards again in September or October. It seems to return to its old nesting-ground with marked regularity; yet, what appears somewhat strange, the numbers of the species show no perceptible increase in any one locality, and this is all the more wonderful as each pair rear at least four or five young every season. We are therefore inclined to think that the entire brood, even taken for granted that they still exist, do not accompany their parents on the return journey in spring; or, if they do, they are not permitted to nest near at hand, but scatter over likely localities in the neighbourhood, where they supply the place of those whom accident or other causes have prevented from migrating. Occasional specimens may be noticed in winter, but these are clearly exceptions to the general rule. In Glen Urquhart, Inverness-shire, where as great numbers may be observed as in any other part of Scotland, certain definite localities are selected for their residence, and year after year these are occupied by single pairs—there always being a considerable distance between each couple. This would lead to the belief that each pair monopolise a certain tract, and during the incubating period, until the young have flown at any rate, they adhere very closely to the same spot. There is one particular portion of a mountain-burn in the aforementioned glen where, within a radius of a few hundred yards, a pair of these birds (not, of course, the same pair) have nested for a greater number of years than can be authenticated even by the accommodating memory of that venerable and often-quoted impostor, "the oldest inhabitant." As a sequel to this affection for the same spots, it may be as well to indicate shortly the class of country frequented by the species. On arriving in Britain it immediately hies to the wilder and more mountainous regions, shunning the lowland, wooded, and cultivated parts. Rocky hillsides, where scattered clumps of juniper and whin bushes break up the bare monotony of the scenery; the banks of mountain-burns, which, in the course of centuries, have worn for themselves deep and rugged channels; high-lying Fir plantations,—all these are favourite resorts. In the Highlands particularly, the home of the Ring-Ousel is associated with scenes of the wildest and most picturesque grandeur; and it is no unusual circumstance, when resting by the side of one of those lovely ravines that occur in such numbers among the muirland solitudes, to be startled by the sudden sharp "tuk-tuk" of this bird, who, by his gestures as well as his voice, seems to resent intrusion into his haunts.

Perhaps no inland species has better opportunities for rearing its young in safety than this, the very isolated nature of its dwelling being sufficient safeguard against interference. The nest is commonly placed in a juniper or whin bush, or, where such a site is impracticable, under shelter of the heather or overhanging rock; and when in either of those two latter situations, it is matter of no small difficulty to detect the same, the general appearance and colour assimilating so well with surrounding objects. One which came under my notice lay in a hollow of the bare rock without any sheltering cover whatever; but so admirably did it resemble the hue of the lichen-covered stones around, that it might have been passed a dozen times without detection. In appearance it strongly resembles the habitation of the Blackbird, as do also the eggs—in fact, in many ways the family likeness between the two is remarkably strong, hence the origin of three at least of its popular cognomens, the Mountain, Muir, and Ringed Blackbird. It is possessed of the same kindred *penchant* for skulking under bushes as our more familiar friend, and flies off with a similar succession of indignant notes when it conceives that hiding is of no further avail. Its very song has a distant relationship to that of *Turdus merula*, but with this difference,—it lacks the beautiful musical modulations and variety that are such well known and appreciated features of our everyday acquaintance. If you can imagine the loud clear whistle of the Blackbird reiterated several times in succession with laudable persistency and no attempt at diversity, you have some idea of the Ring-Ousel's song. In itself by no means charming, it requires all the wildness of the environs to counterbalance its musical defects; but still, in spite of that, it possesses a certain charm that somehow conveys a sense of pleasure to the hearer, and is quite congenial to the locality where it nests. The time *par excellence* to hear it is the early morning, between five and eight o'clock, in the clear bright weather of the month of May. Although it sings more or less all day, and lustily towards evening, it seems to put more pith and energy into its song at that early hour: perhaps, however, the quietness all around and the sharp atmosphere have something to do with the intensity of its pipe. The first time it was my good fortune to hear it was in Inverness-shire many years ago, about 6 A.M. in the beginning of summer. Climbing up a steep hill, when fully three-quarters of a mile distant the notes sounded as clearly as if the bird were within a hundred yards. The strain was quite new to me, so I followed it up and traced it to a rocky eminence which rose high above the adjacent muirland. Once having located the song, as it were, it was not such an easy matter to discover the songster. Fully fifteen minutes of judicious sneaking about elapsed ere a sight of his white collar was caught, the wearer of which was perched right

on the summit of the rock, from which coign of vantage he had no doubt been watching all the time, with a jealous eye, the intruder upon his haunts.

It is rather curious, when we turn our thoughts upon the subject, how so many birds and animals resemble, in a general sense, the hues of surrounding objects; and yet if the shades of their feathers or other outside covering are compared with the colourings that pervade the material objects in the immediate vicinity, they are quite dissimilar. It seems to me that this can be accounted for easily enough in the following manner. If you take a bird itself whose plumage is not marked by violent contrasts—such as pure black and white, or other opposite characteristics—you will find on close examination that its feathers are composed of various tones and shades of colour; yet when we retire to a short distance these blend together, and the owner thereof seems to be of one uniform shade. Very much the same effect is produced when an ordinarily dull-plumaged bird sits upon the ground: the rocks, the soil, the grass, the heather, and the bird are all different when taken separately—but collectively, a general similarity of hue affects the whole, and the latter merges, so to speak, into the general tone, and is lost. This, of course, is purely theoretical, and to some of you it may appear a very questionable theory indeed. The plumage is not unlike that of the Blackbird, with this difference, that the feathers of the male are not so jetty black, and the margins are more or less edged with grey: the white gorget, again, is a distinguishing feature; the bill also is not so brilliant in the orange, and the point of it is black. The female is browner in shade, like the corresponding sex of the Blackbird; the points of the feathers have a tendency to be greyer than those of the male; the white neckcloth is not so wide, and is mingled largely with brownish feathers, which detract from the pure white. At first the young have no white across the breast, but in a short time the cocks begin to show a faint indication that some day it will appear more prominently; but in the young hens there is no trace of it for a long time after they are fledged. Before the brood is hatched it would be hard to find a shyer species, or one more difficult to approach. The open nature of the ground frequented gives it such admirable opportunities for keeping a look-out and acting on the defensive, that once it observes you are bent upon following it up, it will lead you such a dance that in the long-run, after hours of hunting, you are forced from very weariness to give up the chase; and if you are human at all, your stock of patience will have long ere that issue flown to the winds along with your temper. It will sit upon a knoll or rock, out of gunshot, however, giving vent to an angry chuckling note, and as you close up, off it flies to another. You follow, and away it starts

again, sometimes, by way of variation, taking a clear flight of half a mile to a mile before settling. I myself stalked one for three days over a wide trackless muir, and for all I know he may be there yet, unless he has in the interim fallen a victim to some more fortunate enthusiast. When the young have flown, a great deal of this shyness of disposition disappears, and the bird does not seem to place such value on its personal safety, as at that period you can approach comparatively close without exciting alarm. It may be as well to state at this juncture, to prevent misapprehension, that even at the nesting-time, so long as you make no attempt to hunt it, the bird will sometimes alight quite close to where you are sitting; but on the slightest signs of hostile intentions it is on the *qui vive* at once, self-preservation being its predominating tendency on these occasions. To enumerate all the localities in Scotland which this bird frequents would be a rather serious task; suffice to say that it is distributed pretty evenly all over the Highlands and the mountainous districts of the Lowlands, including our own Pentlands and Lammermuirs. There is one particular glen in the first-named range of hills where considerable numbers may be noticed, and perhaps I may be permitted to refer shortly to that habitat. One of the old tracks, now marked out by posts erected at the instance of the Scottish Rights of Way Association, extends from Bavelaw Castle, above Balerno, to Logan Lea Reservoir, where the regular Water Company's road commences. This is as pretty and romantic a spot as any in the Pentlands, and well worthy the attention of members of the Naturalists' Field Club. From Balerno, four hours' smart walking will bring the pedestrian to Glencorse Station at Greenlaw Barracks, so that it forms an easy and pleasant afternoon's excursion. The path, barely distinguishable at several points, runs for a few miles through a deep valley, from which the hills rise abruptly, the sides being in many parts composed of masses of loose stone and jagged rock, attaining almost to the precipitous—a veritable Highland glen in miniature. Its solitary wild nature offers great attractions to the Ring-Ousels, and during summer it is taken advantage of by sundry pairs, who are here permitted to bring forth their broods in peace. In addition to this species, the following are certain to be seen or heard:—

Grouse, *Lagopus scoticus.*
Curlew, *Numenius arquata.*
Peewit, *Vanellus cristatus.*
Cuckoo, *Cuculus canorus.*
Wheatear, *Saxicola œnanthe.*
Common Sandpiper, *Totanus hypoleucos.*
Whinchat, *Saxicola rubetra.*
Titlark, *Anthus pratensis.*
Water-Ousel, *Cinclus aquaticus.*

Occasionally, too, we get a glimpse of that most persecuted of the persecuted, the Magpie (*Pica rustica*); and when we include

all the numerous smaller fry, such as Warblers, Titmice, and the like, that swarm in the woods both at the Balerno and Glencorse ends of the road, it is extremely doubtful if any walk of similar duration in the vicinity of Edinburgh can show up to such advantage in the matter of ornithological varieties. The two Ousels are by no means confined to this part of the Pentlands, as both are fairly numerous all over the range, and the water species may be observed even at present so close to town as the Braid Burn, although unhappily banished for ever from the banks of that pellucid stream, the Pow. In autumn, prior to migration, the Ring-Ousels often descend to the low grounds, and assist their congeners the Blackbird and Mavis to clear off the rowan-berries from the trees; and as this happens in many seasons immediately before they depart, they may almost be said to carry a taste of the wild north-land along with them to the sunnier climes of the south. Leaving them *en route*, therefore, let us turn for a few minutes to cultivate the acquaintance of our stay-at-home species, the Water-Ousel.

The Water-Ousel is seldom or never seen far away from the side of a stream or loch, and unfrequently even in the vicinity of the latter—the clear mountain-burn or rapid-running rivers, such as the Tummel, Tweed, &c., being its favourite resorts. Every one who has wandered by the sides of the last named, or fished any of the upland rivulets, must be familiar with its snow-white waistcoat and curious bobbing motion,—an action which strongly reminds one of the custom, now gradually becoming extinct but at one time very prevalent, of little girls curtseying to strangers as they passed through country villages—a species of servile politeness which does not recommend itself to the present practical and radical generation. When it alights, usually upon a stone or rock that rises out of the stream, it flirts its tail and dips up and down in rather comical style, very often accompanying this motion with a restless turning about, so that at one moment its head faces you, and at another its tail is presented. This practice has acquired for it the common English name of Dipper,—not by any means an inappropriate term, as is so often the case with the local nomenclature of birds. As already mentioned, it rarely ever leaves the course of the running water; in fact, even if chased, it can hardly be persuaded to venture to any distance from the same, and when pressed hard, it merely takes a higher flight overhead than usual, only to return to the bed of the burn at a point where it conceives itself safe. It is amphibious in the sense that it spends a considerable portion of its existence under the watery element, and this faculty has given rise to a very great amount of controversy, assertion, and counter-assertion, bordering sometimes upon the vituperative, among naturalists, some of whom maintain that it

can walk as easily upon the bed of a river under water as it can on dry land; while others, again, scout the idea as nonsensical and contrary to reason. One authority is ready to make oath that it possesses the former power, and asserts that he has ocular demonstration to prove it; another argues to his own satisfaction that this is impossible, as its specific gravity is not sufficient to keep it at the bottom. Both disputants agree, however, upon this, that it can dive and swim beneath the surface to perfection: in reality, it actually flies through the water—using its wings for that purpose precisely in the same manner as it does when skimming through the atmosphere. About this latter fact there can be no doubt, but its walking on the bed is quite another matter. It would be presumptuous on my part to offer an opinion upon the vexed question, although I am bound to confess that my own ideas on the point are strongly in favour of its inability to perform the feat. It is just possible, nevertheless, that the exponents of the former theory may be right to a certain extent, as its feet are well adapted for clutching firmly, *ergo* it may be able to hold on for a short space to one spot: but that it can continue to walk will require more substantial evidence than has as yet been adduced in support of the hypothesis. This amphibious habit renders the species an attractive one to naturalists; but it has also developed an interest of a totally different character in the minds of another class, whose feelings towards it are akin to those which Baillie Nicol Jarvie imputes to Helen Macgregor, when he remarks that her reception of him was "on the north side o' freendly." The class referred to are Salmon and Trout preservers, who used to—and do even yet to a considerable extent—wage a war of extermination against this harmless creature. The reason for this hostility is by no means satisfactory, especially in this, as we are accustomed to consider, enlightened age.

The bird is accused of devouring immense quantities of Salmon and Trout ova, and, as a natural consequence, of destroying the breed of these fish. Now it is notorious that many of its maligners have never taken the trouble to investigate for themselves the truth of this accusation, but are content to go on killing the species simply because the belief that it is detrimental to fish-culture has been taken for granted for such a length of time, that now it almost forms part of the creed of an angler. That it may eat ova occasionally is admitted; but that it makes a practice of this, or destroys large quantities, is a statement denied by our most eminent ornithologists, many of whom have made this bird a special study. Such authorities as Sir William Jardine, M'Gillivray, Yarrell, and in our own day Professor Newton, Thomas Edward of Banff, and many others, have expressed themselves more or less emphatically against this imputation; and I venture

to think their testimony is of more value than that of lessees of fishings, keepers, and similar fishing enthusiasts, who in too many instances will not take the trouble to discover if the bird be guilty or not before continuing the work of destruction. What the species really feeds upon are fresh-water molluscs, larvæ of flies, various aquatic insects, such as beetles, &c., with an occasional small fish or two. It has been satisfactorily proved by entomologists that certain kinds of water-beetles are very hurtful to fish ova; yet this bird, who feeds upon these, is slaughtered in order to preserve what these same insects are doing their best to destroy. If this mode of reasoning were carried out in other spheres, it would necessarily follow that the best plan to get rid of mice in a house would be to kill the cat. Under these conditions, then, one may perhaps be excused from applying the mild term "absurd" to the policy of pisciculturists. A good deal more might be said upon this subject; but as time would not permit, I will merely mention a statement made to me by a practical taxidermist of forty years' standing, that during the whole course of his bird-stuffing career, in which time he had dissected large numbers of Water-Ousels—upwards of 100—he had never on any single occasion discovered the slightest trace of fish ova in their stomachs. This, I fancy, you will believe to be as conclusive evidence against the random assertions of its enemies as could possibly be obtained.

The nest of this bird is almost as curious as itself, in so far as the extraordinary size is concerned. It measures nearly a foot in length, and about six to eight inches in depth, by as many in thickness; is composed of moss platted strongly together, the interior being lined with dead, dry leaves; and instead of being open at the top like most other nests, it is domed, and an entrance-hole is left in the front very nearly in the centre of the mass. In fact, to use a rather homely simile, it is uncommonly like a huge haggis with a large hole cut in the side. This unusual structure is found in various situations, but always close to water, under overhanging rocks or concealed in the banks at the side of a stream, and not unusually upon the flat iron beams that support small railway-bridges. By Tweed-side I have found it frequently in this latter position. The plumage is brownish-black on the upper parts, white on the breast, and chestnut-red beneath. The female is similar to the male, but barely so decided in the colours; and the young, although not so clearly marked, have sufficient of the parental plumage to prevent their being confused with any other species. Its song is very pretty, and, although not of long duration, is always welcome, more particularly as it commences very early in the season, when most birds are mute.

So far as these two species are concerned, this concludes my remarks, which have been very imperfect and far from scientific.

This latter qualification I make no pretensions to whatever; but my excuse for that deficiency must be, that if an interest in Ornithology is to be aroused among the members of our Club, it must be done, in the first instance, by simple description, and not by dry details or wearisome statistics. To myself personally, it would be a source of gratification if more of our members showed a desire to become acquainted with bird-life. It only needs a beginning to prove how fascinating the subject really is. Of all the lower animate creatures on this earth, surely birds are the fairest of God's handiwork; and we need never suppose, as the ignorant are too prone to do, that time spent upon the acquisition of knowledge is lost, as nothing can be more enjoyable, or more calculated to elevate our minds above the dull and sordid cares of everyday life, than the study of Natural History in its various branches.

XII.—NOTES ON MARINE EXCURSIONS.

(*Read Feb.* 19, 1886.)

I. GRANTON.

By Mr JOHN LINDSAY.

On a raw, cold day of last month—Saturday, Jan. 16—a small but enthusiastic band, representing the Biological section of the Club, found their way to Granton. Our destination was a reef of rock, not far from the shore, near Caroline Park, and covered by the tide at high water. This reef, we had good reason to believe, would prove a fair "hunting-ground" for marine specimens, and in this hope we were not disappointed. It must be stated, however, at the outset, that nothing which could possibly be called "rare" was found; and the design of the following brief remarks is simply to record the varied forms of life that may be observed in such a situation, and in a comparatively small compass, both of time and space; and to furnish, perhaps, some guidance to others who may follow in the same work.

The Mollusca may first be noted. We gathered the ten following species and varieties—viz., the Common Limpet (*Patella vulgata*), the Tortoise-shell Limpet (*Acmæa testudinalis*), the Common Whelk (*Buccinum undatum*), the Common Periwinkles (*Littorina littorea* and *L. rudis*), the Dog Whelk (*Purpura lapillus*), the Spindle-Shell or "Buckie" (*Fusus antiquus*), the Grey Top-Shell (*Trochus cinereus*), the Common Scallop-Shell (*Pecten opercularis*), and the Edible Mussel (*Mytilus edulis*). The popular names of com-

mon shells are in as great a state of confusion as those of familiar wild plants, therefore the use of the scientific names becomes a necessity when precision is desired. The palates of a few of the univalve Molluscs were extracted in the Club-room the same evening, and several specimens are now shown under the microscope by polarised light. The acephalous or headless Molluscs, corresponding generally to the bivalves, have, of course, no dental apparatus. The palate of the Limpet is very easily extracted, all that is necessary being to make an incision at the head in order to get a hold of the end of the "lingual ribbon," when a gentle pull brings it away gradually in a long roll. Some specimens of the palate of the Limpet were got in this manner nearly three inches in length. When it is noted that the lingual ribbon of the Limpet has 12 rows of teeth, with 160 teeth in each row, or 1920 in all, it will be evident that the work done by this chain-saw-like rasping organ must be considerable. The palates of the Whelk and "Buckie" are rather difficult subjects to manipulate, being enclosed in a fleshy tube: this tube must first be extracted, and the integuments of which it is composed carefully cut through with a sharp instrument, before the lingual ribbon can be got at.

The Crustaceans noticed were tiny specimens of the Common Shore-Crab (*Carcinus mœnas*), the Hermit Crab (*Pagurus Bernhardus*), and the Acorn-shell (*Balanus balanoides*). The Hermit-Crab, as is well known, never forms a shell for itself, but appropriates that of some Mollusc, changing from one to another to suit the requirements of its own growth, and often ending with the Whelk. Whether it simply appropriates an empty habitation, or coolly makes a meal of the rightful tenant, does not seem to be very clear, although the latter is the more likely method of "taking possession." The Acorn-shells were formerly classed amongst the Molluscs, but now rank with the Barnacles in the class Crustacea, sub-class Cirripedia,—differing from the latter, however, in being sessile, while the Barnacles are stalked. The larva of the Acorn-shell, like that, *e.g.*, of the Sponges, is free-swimming; but the adult undergoes a process of degradation, fixing itself by the head to rocks or other foreign bodies, and then elaborating a calcareous segmented shell, capable of opening at the top for the protrusion of the so-called "hand"—though "foot" would be an equally descriptive term. This foot bears generally six pairs of jointed limbs studded with bristles, and giving the name Cirripedia, or "curl-feet," to the sub-class. The function of the foot is to set up currents in the water by agitating it: food is thus brought within reach, then laid hold of, and conveyed to the interior. A specimen of this interesting organ, by which, as Professor Huxley says, the animal "kicks its food into its mouth," is shown under the microscope. Rocks, stones, and Molluscs—principally Limpets—were covered by these

familiar Acorn-shells, their crusted surfaces suggesting some violent eruptive disorder.[1]

The only Sponge noticed was Halichondria silicea, and of this a few good specimens were got. A transverse section through one of the exhalant apertures, with the rod-shaped spicules *in situ*, is shown under the microscope. The Common Sea-Anemone or "Beadlet" (*Actinia mesembryanthemum*) was seen in the rock-pools. Of the Annelids, there were observed Serpula vermicularis and Spirorbis communis. The calcareous tube of the Serpula is fixed by the apex to rocks or stones, while that of Spirorbis adheres by the side to Fuci and other Seaweeds. Spirorbis was common: minute forms of the tube make a very good slide for the microscope, mounted as an opaque object. The Hydroids found were Obelia geniculata and Sertularia pumila; while the representatives of the Polyzoa were Flustra foliacea and Membranipora membranacea. These Zoophytes are familiar to most sea-side visitors, and are well worth examination, especially in the living state. The Polyzoa are a distinct advance on the Hydroida, inasmuch as they possess a nervous system, which is wholly wanting in the latter. Obelia geniculata is shown under the microscope by Mr Allan, with the polypes in their cells or polypidoms. In order to procure this object, the Zoophyte must be got in the living condition, and put into a shallow vessel with sea-water. On pouring in a few drops of spirit, the Polypes may be seen, by the aid of a hand-magnifier, in a very active, not to say hilarious condition; then suddenly coming to a dead stop—killed off by alcoholic excess! In the early days of science these colonies of living beings, as well as Sertularians, Sea-Anemones, and similar forms, were classed amongst plants. A square inch of Flustra foliacea, with its cells on both upper and under surfaces, has been calculated to contain 1800 cells in all, housing as many zooids. The specimens found on the beach are always empty, and living forms must be dredged for. The only two Star-fishes noticed were the common "Five-fingers" (*Asterias rubens*) and the Sun-star (*Solaster papposa*).

The Seaweeds fall now to be shortly mentioned. Of Fuci, the four common forms were observed, all within a few yards—viz., the Channelled Wrack (*Fucus canaliculatus*), the Knobbed Wrack (*F. nodosus*), the Bladder Wrack (*F. vesiculosus*), and the Saw-shaped Wrack (*F. serratus*). There were found, besides, the following: Cladophora rupestris, Porphyra vulgaris, Ulva latissima and U. linza, Halidrys siliquosa (in large quantities), Laminaria digitata, Callithamnion polyspermum, Ceramium rubrum and C. acantho-

[1] An interesting note on the life-history of the Acorn-shell, with an illustration, will be found in the 'Journal of Microscopy and Natural Science' for January 1886—art. "Half-an-hour at the Microscope with Mr Tuffen West, F.L.S., F.R.M.S., &c."

notum, Corallina officinalis (growing abundantly in rock-pools—a beautiful object), Polysiphonia nigrescens and P. fastigiata. The larger Seaweeds, as Fucus and Laminaria, will always repay investigation, for attached to them are frequently found various forms of Zoophytes and minute Mollusca, as well as epiphytic Algæ; while under their heavy drapery many of the finer Seaweeds love to luxuriate. On the sides of pools, and overhung by these larger forms, there were found numerous patches of microscopic Algæ, bearing Diatoms in great abundance. The tufts gathered, when examined under the microscope, were found to be mostly Polysiphonia nigrescens and Ceramium rubrum, covered with such Diatoms as Schizonema Grevillei and Synedra gracilis. Specimens of these are shown under the microscope.

We had now been occupied for about two hours in our investigations, and had we waited a little longer, the ebbing tide would have permitted an examination of the rock-pools on the seaward portion of the reef, where other treasures would doubtless have been found. But snow coming on, and darkness beginning to fall, we turned our faces homeward, carrying away sufficient material for several instructive "evenings at home with the microscope."

II. JOPPA.

By Mr JOHN ALLAN.

A contingent of the Club visited Joppa rocks on the afternoon of Saturday, 30th January, and met with very much the same "finds" as on the Granton excursion. The only shell-fish observed, in addition to those got at Granton, were Chiton marginatus and Pholas dactylus. The latter burrows so deeply in the rock, that only the mouth of the circular hole it makes can be seen, and any attempt to dig it out simply results in its breaking to pieces. It has long been a mystery how so frail an animal can bore through rock and other hard substances, just as it is equally puzzling how a soft Sponge (*Clione celata*) can drill holes through Oysters and other thick shells.[1] Empty shells of Cockle, Pecten, Solen, and Turri-

[1] The Pholas is not the only boring Mollusc, although it is the one regarding which, probably, most has been written. Various theories have been put forward to account for its boring powers,—such as the elaboration of an acid secretion, and the presence of flinty spicules on the "foot." But the true *modus operandi* has in all likelihood been now discovered, from keeping specimens in marine aquaria and watching them at work. By means of the fleshy "foot," the extremely hard shell is pulled constantly backwards and forwards, thus acting as a rasp or file; while the siphon-tube at the opposite extremity ejects a continuous stream of water, which keeps the "tunnel" that is being hollowed out always damp, and at the same time carries away the abraded material.

tella were picked up. Several masses of Sponge (*Halichondria*) were found growing in rock-pools, one of them very large, measuring fully six inches by four inches, and two inches high. The egg-capsules of both the Common Whelk and the Dog Whelk were observed to be very abundant. A white membranous substance, not known to any of those present, was found attached to a rock at the bottom of a pool. It was shaped like an inverted bell-glass, and measured not quite two inches in circumference, and three-fourths of an inch deep; it was very elastic in consistence. One or two other specimens were afterwards observed. On being examined under the microscope, it was found to contain a mass of eggs, and an attempt is being made to hatch these. I may here incidentally remark that I made another visit to the same pools a few days ago, and found one or two similar patches of eggs, and sitting close beside one patch, apparently engaged in depositing the eggs, I found the animal which I now exhibit—viz., a Doris, one of the Nudibranchiata. Several specimens of the Sand-star (*Ophiura texturata*) were found, and also one of the Polyzoa (*Membranipora pilosa*), which we did not observe at Granton.

No attention was given to Algæ on this occasion, but it may be incidentally mentioned that Joppa is one of the best stations for Algæ on the Firth of Forth. Mr G. W. Traill, Joppa, who is an authority on this subject, records over 120 different Seaweeds as having been found growing on the rocks or in the pools there. Mr Traill has spent several years on this study, has carefully noted the various periods of the year at which Algæ are to be found in fruit, and has in several other ways added to our knowledge on this subject.

It may be worth while to say a few words as to the habitats of some of the shell-fish we gathered. The Mussel and the Whelk are to be found adhering to rocks between tide-marks — the former anchored firmly to the rock by silken threads of great strength, spun by means of its foot, and affixed to the rock and to its neighbour Mussels. The Periwinkle is to be found either on rocks or browsing on Algæ, such as Fucus; while the Pearly-top is got generally on the under side of the larger stones, in pools where the water always remains. In searching for them, therefore, as well as for many other marine objects, no stone should be left unturned! The Chiton is generally found adhering to rocks near low-water mark, and when taken from its resting-place, rolls itself up after the manner of a hedgehog. The Limpet was got of all sizes, and adhering to rocks, some literally covered with Acorn-shells; while the Tortoise-shell Limpet, of which we secured only a few small specimens, was got on the perpendicular sides of pools near low-water mark.

Marine botany and zoology, I would remark in conclusion, have

not hitherto received that attention from the Club which these subjects deserve. Possessing, as we do, a stretch of coast-line at many points not far distant from the city, a series of short excursions at various intervals throughout the year might be arranged, in order to investigate the countless forms of life to be found at the sea-shore.

XIII.—NATURAL ENDO-SKELETON AND EXO-SKELETON OF AMERICAN BULL-FROG (CERATOPHRYS CORNUTA).

PREPARED AND EXHIBITED BY

MR DONALD KNIGHT.

(*Feb.* 19, 1886.)

THE skeleton which forms the hard internal part of the Frog is composed partly of cartilage and partly of bone. Cartilage is formed in the embryo, and is absorbed by the blood-vessels. It presents under the microscope a clear, slightly granular substance, with nucleated corpuscles imbedded in it,—in order of development, at first represented by the notochord alone. Bone consists of a dense, fibrillous, intercellular substance or matrix, in which are imbedded cells that lie in cavities connected with one another by fine branching canals. Bones developed independently of cartilage are very rare. In the skull the original cartilage is not so completely replaced by bone as in the vertebral column, large tracts of unossified cartilage persisting in the adult. Besides the cartilage bones, the skull is strengthened by numerous membrane bones. The vertebral column is the first part of the skeleton which is developed in the embryo, then the head and limbs. All amphibia possess a fenestra ovalis, with a cartilaginous or osseous columelliform stapes, the expanded proximal end of which is fixed to the membrane of the fenestra. In many batrachia, if not in all, there is a fenestra rotunda, though the presence of a distinct cochlea has not been ascertained. The nerve of hearing arises from the side of the medulla, immediately behind and close to the root of the facial nerve. It enters the audit capsule, and ends in the internal ear.

I prepared a considerable number of skeletons of the common American Bull-frog a few years ago, but found no exo-skeleton plates present. The Ceratophrys cornuta is the only Bull-frog on which I have found these plates; and, so far as known to me, they

have never before been described. The whole dorsal surface of the body, in the natural skeleton now exhibited, is covered with distinct, ossified, exo-skeleton plates, eleven in number, the two outer ones measuring fully $\frac{3}{4}$ in. across and $\frac{1}{32}$ in. thick. This Frog is evidently an aged specimen, as all the bones of the skull are anchylosed or fused together; and they are also rough and pitted, like the reptilian, excepting the premaxillæ and mandibles, which are smooth and free. The skin was so very thin on the dorsal surface of the body, that I could only get it parted from the bony plates by diligent scraping. The plates are attached to each other by sutures, and are very apt to be regarded by a casual observer merely as a thickened and hardened portion of the skin. The inner plates resemble very much in shape the bones of the carapace of the Chelonia. They are of a reptilian type, rough and pitted on the upper surface, not unlike the skull-bones of the Crocodiles, and are quite flat and smooth on the under surface, forming a protection to the soft parts of the animal. Further, they are not attached to any of the vertebræ, as in Ceratophrys dorsata, but are quite free, and cover the whole back. In the various museums of England, Scotland, and Ireland that I have visited, I have never seen a specimen of the Frog skeleton showing such exo-skeleton plates. Bhron, the eminent German scientist, has a skeleton figured in his valuable work which exactly corresponds with this one, but shows no exo-skeleton plates.

XIV.—ABNORMAL GROWTHS ON ROOT OF TAXODIUM DISTICHUM.

By Mr HUGH FRASER.

(*March* 19, 1886.)

Mr Hugh Fraser, manager, Leith Walk Nurseries, exhibited a specimen of the protuberances on the root of Taxodium distichum—the deciduous Cypress of North America—which he had obtained from a tree of about 30 feet high, growing on the margin of a pond in Surrey. It was one of some thirty or forty from the same tree, and measured 16 inches in height, with a breadth of 8 inches, as sawn from the surface of the turf. In the course of a few remarks, Mr Fraser stated that this tree is found native in Florida and on the Delaware and Mississippi—attaining heights of from 100 feet to 150 feet when growing on swampy ground. It is, particularly in the southern districts of Britain, perfectly hardy; but

though introduced more than 200 years ago, it is yet comparatively little known. Few of our deciduous trees, however, were more graceful in foliage, which was suggestive of the most delicate Ferns; or in general appearance, its spring and summer greenery being always most attractive. The protuberances on the root, when growing in its native marshes, are commonly from 1½ to 2 feet high, and sometimes from 4 feet to 5 feet in thickness. Michaux says that "no cause can be assigned for their existence; they are peculiar to the deciduous Cypress, and begin to appear when it is only 20 to 25 feet high." Another writer has suggested that the absorption of air is the probable purpose for which the knobs protrude above the water. According to Loudon, these protuberances are made use of by the Indians for bee-hives. The wood is universally employed throughout the United States for the best kind of shingle; and in Louisiana it is also used for almost every other purpose to which timber is applied.

MEETINGS OF MICROSCOPIC SECTION.

During the past session six meetings in connection with the work of the Microscopic Section were held, under the presidency of Dr J. M. Macfarlane. The session was inaugurated with an address by the President, delivered on Nov. 6, 1885, as follows:—

ON THE PROGRESS OF MICROSCOPICAL RESEARCH.

When requested by the Council of the Society to open its Microscopic Section with an Address, I consented with considerable trepidation. Composed, as our Club is, of members most of whom are not scientific specialists, I felt that to deal with a purely scientific subject might promote its advancement less than if I briefly reviewed the grand progressive lines of microscopic research. I propose therefore to trace shortly, and, I fear, very imperfectly, the history of the evolution of our present microscopic organisation.

In the biological world the oldest plants and animals appear to have been extremely simple in structure, and the life functions exhibited by them were correspondingly simple. But in time higher forms appeared, which exhibited in their structural or mechanical details more complexity of organisation, and this was linked with a similar advance in function. At length we reach, in comparatively recent time, the highest types of mechanical arrangement in the richly coloured flowering-plant of the vegetable world,

and the equally beautiful bird amongst animals, these exhibiting at the same time a minute intricacy of functional action which often baffles the most ardent physiologist to understand. In the organic world, therefore, we have a gradual advance in structural or mechanical details, coupled with a similar advance in the effects or results produced by the mechanism.

Exactly the same principle applies in the evolution of microscopic research. On the one hand are the mechanical arrangements which we call microscopes, and on the other these have, as their desired result or function, the unfolding to us of the secrets locked up in the living things around us. A single lens of glass fitted into a handle was all that the fathers of microscopy had, and we need not wonder, therefore, that the results achieved by them were comparatively simple. But as, according to the principles of organic evolution, the necessity for providing a food-supply, for warding off the attack of enemies, and for becoming better fitted to their surroundings, all conspired to raise animals in the scale of existence; so, as new wonders were presented to the eye of the early microscopists, the determination possessed them to perfect their instruments, and become yet more familiar with the hidden things around,—in other words, to obtain a knowledge of, and suit themselves to, their environment.

Let us see then how, side by side, gradual but sure progress has been made in the perfection of instruments of research, and our knowledge of the organisms to which these instruments are applied. In doing so, we must equally take account of the botanical and zoological records, for they have expanded in nearly the same ratio. We must bear in mind also, that till two centuries ago, naturalists were content (and perhaps were serving their day well) when they looked only at external naked-eye appearances—noting shape, colour, size, and outside structural details, for it made them thoroughly familiar with the stones, so to speak, with the aid of which the future edifice of exact science was to be built.

A mere surface knowledge, however, did not long suffice, for some of the more speculative spirits began to inquire, "What is the size of the smallest living thing?"—while others asked, "What is the explanation of all that we find beneath the surface in those plants and animals that we *can* see?" Questions such as these brought to the front two worthy pioneers—Robert Hooke in our own country, and Leeuwenhoek in Holland. The former published in 1665 an account of what he had been able to discover by aid of a simple magnifying-glass, of a water-microscope, and a very primitive compound microscope, his work being entitled 'Micrographia.' Looking over it, a student of the present day scarcely knows whether to admire most the difficulties he had to overcome or the wonderful results he achieved. Dedicated to King Charles II.,

the author says, "I do here most humbly lay this small present at your Majesty's royal feet. And though it comes accompanied with two disadvantages, the meanness of the author and of the subject, yet in both I am encouraged by the greatness of your mercy and your knowledge. By the one I am taught that you can forgive the most presumptuous of offenders, and by the other that you will not esteem the least work of Nature or Art unworthy your observation." Such were the relations between Robert Hooke, F.R.S., and King Charles II. Looking back 200 years, I think we may now fairly regard Robert Hooke as king and Charles as subject, if the true advancement of our race is considered.

In treating of his subject, this father of microscopy proceeds in a most methodical way from the known to the unknown. He first describes and figures carefully a needle-point, magnified about thirty times; and after drawing some sage conclusions, he proceeds to expatiate on "the sharp edge of a razor"—his conclusion about it being, "This edge and piece of a razor, if it had been really such as it appeared through the microscope, would scarcely have served to cleave wood, much less to have cut off the hair of beards, unless it were after the manner that Lucian merrily relates Charon to have made use of, when, with a carpenter's axe, he chopped off the beard of a sage philosopher, whose gravity he very cautiously feared would endanger the oversetting of his wherry." He next examined fine lawn, tabby, and watered silks—the last of which, our lady members may be interested to know, struck him as showing "the great *un*accurateness of artificial works."

Glass drops, fantastical colours, metalline colours, fungus moulds, moss, seaweed, the stinging-point of a nettle, and many other common and original objects, were reviewed in succession, as leading gradually up to the most interesting and complex of all—entire animals of minute size, or parts of them. Human hair, scales of sole, sting of bee, peacock's feathers, head of fly, teeth of snail, eggs of silkworm, spiders, &c., succeed each other with a panoramic effect, alike of description and figure.

The chapter he devotes to a certain little insect well known to most by repute, if not by experience, as sometimes detracting from man's crown of glory, is so unique that you will pardon my quoting at length. The description, I think, is scientifically correct. "This," he says, "is a creature so officious that 'twill be known to every one at one time or other—so busie and so impudent that it will be intruding itself in every one's company, and so proud and aspiring withal that it fears not to trample on the best, and affects nothing so much as a crown; feeds and lives very high, and that makes it so saucy as to pull any one by the ears that comes in its way, and will never be quiet till it has drawn blood. It is troubled at nothing so much as at a man that scratches his head, as know-

ing that man is plotting and contriving some mischief against it, and that makes it oftentimes skulk into some meaner and lower place, and run behind a man's back, though it go very much against the hair; which ill conditions of it having made it better known than trusted, would exempt me from making any further description of it, did not my faithful Mercury, my microscope, bring me other information of it. For this has discovered to me, by means of a very bright light cast on it, that it is a creature of a very odd shape: it has a head shaped like that exprest in 35 Scheme marked with A [referring to the accompanying plate], which seems almost conical, but is a little flattened on the upper and under sides, at the biggest part of which, on either side behind the head (as it were, being the place where other creatures' ears stand), are placed its two black shining goggle-eyes, *b b*, looking backwards, and fenced round with several small cilia or hairs that incompass it, so that it seems this creature has no very good foresight. It does not seem to have any eyelids, and therefore perhaps its eyes were so placed that it might the better cleanse them with its fore-legs—and perhaps this may be the reason why they so much avoid and run from the light behind them; for being made to live in the shady and dark recesses of the hair, and thence probably their eye having a great aperture, the open and clear light, especially that of the sun, must needs very much offend them. To secure these eyes from receiving any injury from the hairs through which it passes, it has two horns that grow before it, in the place where one would have thought the eyes should be." Our immortal national bard must surely have read "Hooke" before giving the finishing touches to his well-known poem.

Proceeding to an allied group, our philosopher observes: "The least of reptiles I have hitherto met with is a mite,—a creature whereof there are some so very small that the sharpest sight, unassisted with glasses, is not able to discern them, though, being white of themselves, they move on a black and smooth surface; and the eggs out of which these creatures seem to be hatched are yet smaller, those being usually not above a four- or five-hundredth part of a well-grown mite, and those well-grown mites not much above one-hundredth of an inch in thickness; so that, according to this reckoning, there may be no less than a million of well-grown mites contained in a cubic inch, and five hundred times as many eggs."

To the microscopic sages of the present day, many of Hooke's observations may look like the vagaries of a weakling; but the seeds of truth sown by him in weakness are now grown into trees of knowledge whose fruit satisfies our intellect, enhances our happiness, and increases our comforts. Let us not despise the day of small things.

Leeuwenhoek published his observations also in the 'Philosophical Transactions' a few years after Hooke. He devoted a separate microscope to every object he examined, so that he was the happy possessor of two or three hundred instruments.

The figures who next stand forth conspicuously are Dr Nehemiah Grew,—like Hooke, a Fellow of the Royal Society,—and Marcelli Malpighi, Professor at Bonn. Advancing and improving on the work of their predecessors, they made an enormous addition to our store of permanent scientific truth. Grew, who published in 1682, devoted special attention to the minute anatomy and physiology of plants. I am glad to be able, through the kindness of Professor Dickson, to exhibit the original publication; for one is greatly struck not only with the accurate and advanced views he propounds, but with the crisp beauty and correctness of his microscopic drawings, specially those of stems and roots. The secret of his success is discoverable in the closing words of an early chapter: "What we obtain of Nature we must not do it by commanding but by courting of her."

Malpighi's work, issued in 1687, can only doubtfully be called *parvus liber*, but it certainly is *magnum opus*, for taking up botanical, medical, and anatomical studies, it discusses these in a most original and accurate manner. Well may we term him "the Father of animal physiology." Enthusiastic workers such as these succeeding each other, and not only inheriting but adding to the wealth left by their predecessors, soon called forth, both in this country and abroad, others who devoted their time to improving the microscope, or enlarging our field of knowledge by aid of it. To the latter class belongs one who probably more than any other excited a strong popular interest in minute living things. M. Trembley of Geneva gave to the world, about 1740, the result of his studies on the common fresh-water Hydra; and if the account of the discoveries and experiments on Ants of his illustrious fellow-townsman, Huber, published about fifty years after, were looked on as the ravings of one insane, even more incredible were those of Trembley regarded. That a true animal could be turned outside in and yet arrange its digestive functions to suit the altered conditions; that it could be cut either lengthways from head to foot or transversely, and each half develop as a new Hydra; nay, that it might be cut into small pieces, and yet each grow into an adult,—seemed so opposed to all the canons of animal life, that we scarcely wonder at the incredulity with which the announcement was received. It whetted, however, most powerfully the desire for further discovery, and resulted in our countryman Ellis showing that all the Corallines, so-called, were only colonies of such animals. Previous to and about this time, also, great improvements were effected in the construction of the microscope, resulting in new

and separate lines of inquiry being pursued, so that if we again borrow an illustration from biology,—just as plants or animals may, when looked at as a whole, be likened to a tree having a common root in the soil, and a common trunk rising into the air from which many specialised branches are given off, so the Hookes, Leeuwenhoeks, and Malpighis may be venerated as the great trunks from whom many have branched off, each to pursue his special investigations. How numerous now these branches have become!

From the year 1800 onwards, many illustrious names cluster round our instrument as helping to perfect it. Chief among these may be noted Wollaston, Frauenhofer, Biot, Amici, Chevalier, Brewster, Airy, Ross, Lister, and Coddington. But the discoveries made within the same period have been, I may say, unexampled in the history of any science. Muller, Ehrenberg (whose 'Infusoria' will ever be a landmark in microscopy), Vaucher, Brown, and Von Mohl, have laid succeeding generations under a permanent debt of gratitude; but with the appearance, in 1837, of Schleiden's classic paper on cell-structure, may be said to have commenced the dawn of Botany as a science. When he enunciated the law that all plants are composed of one or more little vesicles or cells, of definite structure and history, and that every cell springs from a pre-existing cell, a broad and solid basis was laid for a mighty superstructure of scientific histology. Since his day botanists have been largely concerned in developing and amplifying his generalisations.

Considering the greater difficulty in examining animal tissues, it need scarcely be wondered that several years elapsed ere Schwann propounded for the animal kingdom a law identical with that of Schleiden's for the vegetable. And here again the great mass of investigation of recent times is simply an explication of the arrangement, work, nature, and history of animal cells in health and disease. Edinburgh can hold it as a sacred tradition that the man of her own intellectual upbringing, the late Professor Goodsir, first proved clearly that all disease is due to alterations in the normal condition of cell life.

We now ask, What part did societies and individuals play in the advancement of our favourite work? If we reply that little interest was shown outside the circle of pure science, it must be borne in mind that the bulk of mankind require strong and convincing proofs of the value or charm of any study, before they incline to patronise and cultivate it. Has the day come when such proofs are forthcoming, and the value of the study is recognised? I take it that this meeting to-night shows that we are all animated with the idea of stimulating others by our sympathy, or of helping each other practically in all that pertains to the microscope. We have

come to recognise the beauty and interest and instruction—nay, even the utility—there is in the study of little things. I have often thought that the most appropriate epitaph on the tomb of Charles Darwin would be, "He showed the power of little things." Let this motto be the watchword of each of us; and though we may not all be able to devote hours to patient study in the company of our "Mercury," yet we may do much by interesting those around us. Friend may encourage friend, parents may direct their children, teachers their pupils. The cry is raised at the present time, and justly too, that in our system of education no provision is made for teaching the young to use their hands neatly and well. Now, I think it may be accepted as a general axiom that the man or woman who can use well the hands, will not be lacking in qualities of the head. I know of no teaching which would so thoroughly train our youth to cultivate habits of neat-handedness, observation, reflection, and expression, as a course of practical microscopic study. If for our young ladies pianos are provided at a cost of from twenty to sixty guineas, to cultivate a minor part of their nature, surely for them, and for boys also, microscopes of two or three guineas in value could be got. I do not consider that I am too sanguine when I expect that within the next twenty years a complete course of the nature indicated will be provided in our schools. No work so well combines manual and mental training, capable of being carried out in limited space. It will bring our youth also face to face with the beauties and deep things of Nature—a pleasure which has too long been denied them by the bigotry and prejudice of hide-bound dominies and their patrons.

And now let me say a few words on the past success, present aims, and future prospects of our own Society. First, I may be allowed to congratulate those members who were the originators of our microscopic department. Most of them are quiet workers, but I trust that equal success may attend the labours of all quiet workers. We are now entering on the third series of meetings; the programme, as partially drafted out, promises to be even more attractive and instructive than those of the past; new members are joining us, and new departures are being made to interest and help those already with us. Chief amongst these, I may note the formation of a Slide-cabinet, the contents of which will be given out at stated periods for home examination. Already a considerable collection of slides has been made, and further donations are requested from all. I hope that by the close of the session the Society may boast the possession of a large series of preparations.

Well, in order that such valuable possessions may be properly accommodated, it is absolutely necessary that we should have "a local habitation" as well as "a name." I am greatly pleased to announce that in this building such has been got; and it is proposed

that all who care may come together of an evening, or at any other time, and give mutual help in the examination and permanent preservation of special objects. With such advantages and opportunities in the immediate future, we may surely expect that our prosperity and influence will enormously increase.

[The Chairman then indicated to the members lines of study and investigation which might profitably be engaged in, and closed by inviting them to work vigorously together for the advancement of the Society.]

At the second meeting (Dec. 4, 1885), Mr William Forgan made the following valuable observations on microscope objectives :—

NOTES ON MICROSCOPE OBJECTIVES.

Every one who uses a microscope should know a good deal about the construction of the instrument, particularly the optical part. This can readily be learned from the ordinary text-books, but there are many points of importance in connection with the subject which are apt to be overlooked unless the reader's attention is directed to them in a special way. In the following notes, space will not permit of a great deal being said. I can only refer to a few of the more prominent and striking facts.

Microscopes are usually divided into two classes—viz., simple and compound. The simple microscope is that in which the magnifying power is obtained by the use of a single lens, or, it may be, two or three lenses placed together—the eye being placed immediately behind them. I need not here enter upon the question of how an object is apparently enlarged by viewing it through a lens of short focus. That is explained fully in every book on the microscope. I need only say that the enlargement arises from the fact, that by means of the lens the object is viewed at a greater angle, and hence appears larger to the eye. The simple microscope remained for a long time without much improvement. Lenses had been made of precious stones, which, having greater density than glass, allowed the use of shallower curves with the same magnifying power. It was only, however, when Dr Wollaston invented his doublet that any advance was made. This enabled them to pass a larger angular pencil of light through the objective for the simple microscope, and hence gave much clearer and brighter definition of the object. Simple microscopes have one quality which renders them useful where low powers only are required—they do not reverse the image. Their use nowadays is very limited, as the recent gigantic strides in the improvement of the compound microscope have quite superseded them. The compound microscope, previous to the invention of the principle of

achromatism, and for long after, made little progress. Who has not seen a compound non-achromatic microscope as constructed about the beginning of this century, with its huge tube and wheel of small lenses forming a multiple "nose-piece," upon turning which each lens in succession gave a different power? Any one who has examined an object with one of these glasses, and contrasted it with a modern objective, must be astonished that they could even be tolerated, and yet they are bought and sold at the present day. The invention and perfection of the achromatic microscope objective has advanced with such leaps and bounds, that it may well rival the steam-engine, with the rapid improvement of which it has been almost a contemporary. The principle of achromatism was applied successfully to the telescope just about 100 years ago. It was not, however, until the 5th April 1824 that M. Chevalier successfully made an achromatic microscope objective, which was exhibited to the French Academy. This was, no doubt, the date of the birth of the present compound achromatic microscope, and worthy of remembrance. About the same time Mr Tulley, in England, made one for Dr Goring of nine-tenths of an inch in focal length.

There are two, and only two, special difficulties to be overcome in the construction of objectives. I cannot give here any explanation of them, but merely name them—(1) Spherical aberration; (2) Chromatic aberration. Both these are fully explained in the text-books, but they are of such a nature that the very highest skill and talent are necessary to overcome them to an extent necessary to make an objective. Neither in the one case nor the other, however, can they be, or are they ever fully eliminated. An objective is said to be aplanatic, or have a flat field, when the spherical aberration is destroyed to a certain extent; and it is said to be achromatic when the image it gives is free from colour. Now when objectives were first made, it was found by placing two or three lenses, all of which were achromatic, above one another, that the spherical aberration was cured or destroyed to a large extent, and this system has been followed in their construction. The French make a large number of lenses all of like foci, and by a method of selection of the best, or those best matched to each, they construct a tolerably good objective. This is said to be "marrying" them. Objectives of this kind, however, have invariably a small angle, admit little light, and are not adapted for the finest definition constantly required by the microscopist. It is somewhat strange that although the initiatory steps in the perfecting of the microscope are nearly all due to foreigners, it is to our own countrymen that the real advances are mostly owing. After it was once seen to be possible to construct achromatic micro object-glasses, improvements went on very rapidly. The

greatest of these are undoubtedly due to Mr Joseph Jackson Lister, the father of Sir Joseph Lister. From many experiments made by him with combinations of glasses, he was able to devise certain forms for low- and high-power glasses, which gave very flat fields, splendid definition, and wide angles. These formulæ he communicated to the three principal London makers, and I believe that glasses are still made by them upon these formulæ without alteration. Besides Mr Lister, Andrew Ross, who has been termed the father of the microscope, was one of the earliest experimenters in regard to the perfecting of the instrument. By confining his methods to these three firms, Mr. Lister certainly insured the manufacture of good glasses, but it became, and was for long, a real monopoly. The prices charged were very high, and after-experience of other makers has shown that they were excessively so. However, this enabled them to be manufactured with a high standard of excellence and progressive improvement. Mr Thomas Ross made an important alteration on the lower powers, by separating the two lenses of which these are constructed, and placing them about an inch apart, thus flattening the field considerably, and improving the definition. Andrew Ross was, I believe, the first to increase the usefulness of the higher powers by widening their angle, and thus increasing their light. A steady advance in this respect, which began about the end of the third decade of the present century, was continued for many years, when for a considerable time the improvements seemed to stand still. At last, Professor Amici of Modena startled microscopists by introducing the principle of water-immersion. By a glass constructed on this principle, he was able to resolve with ease a Diatom, the striæ of which had not been seen before—viz., Navicula rhomboides, or, as it has been named after him, the Amician test. The principle was rapidly adopted on the Continent, Hartnack having made water-immersion glasses by which he was enabled to resolve a more difficult test—viz., Surirella gemma. As in other things in this country, we were slow to adopt the improvement; and it was only after a comparison of glasses in the first French Exhibition showed our inferiority in their manufacture, that our leading firms began to make them. It was not so with the principle of oil-immersion, the last and greatest of all the improvements in the microscope. We owe this to the suggestion of an Englishman, Mr J. W. Stephenson, but he could only get his idea carried out in practice by a foreigner—Dr Zeiss of Jena. There is one Englishman still alive whose name I must mention in connection with the improvements of microscope object-glasses—viz., Mr F. H. Wenham. He has done more, perhaps, than any other after Mr Lister, to improve the microscope. To Mr Lister we owe, I believe, the triple back, but to Mr Wenham we owe the single

front—two of the most important improvements in object-glass construction.

Our English microscopes are usually sold with a 1-inch and a $\frac{1}{4}$-inch object-glass. Where expense will not admit of a purchaser buying more glasses, these are generally sufficient to show everything which a microscopist wishes to see, except fine tests; but both a lower power and a higher one are desirable. When a lower power is desired, one of 2 inches focus should be got; and for a higher, a water-immersion of about $\frac{1}{10}$ of an inch focus. English low powers by the leading makers are unrivalled. Continental makers, as a rule, do not make good low powers—the very powers with which the most of microscopic work is done. I, of course, except Dr Zeiss from this statement, as his glasses, from the 1-inch upwards, are unrivalled. Foreign microscopes generally have a considerably higher power than a $\frac{1}{4}$ of an inch glass for the high power, and this is certainly an advantage they possess over our English quarter. English opticians have devoted far too much attention to the perfection of the brass work of the instrument, and not enough to the optical part. At the present time, however, we have one English optician whose work in the higher powers has not yet been equalled—viz., Mr Hugh Powell.

There is no hard-and-fast rule which can be given to a purchaser of a microscope. Experience must be one's only guide—either one's own or that of a friend. Buying a microscope depends very much upon what one is able to give. But there is one advice which every one ought to follow, which is, Whatever you buy, buy something good. If object-glasses, get one good one to begin with, rather than two bad cheap ones. Microscopes never can be very cheap if good; but it is much better to build a good one up by degrees, as it can be afforded, than to buy what after-experience will show you is unable to give you satisfaction. At the present day I should say that every article made by Dr Zeiss may thoroughly be depended upon: the stand is good, the glasses are good, and the prices are reasonable.

At the same meeting Mr Allan exhibited and described a slide showing the fructification of Delesseria alata—an Alga which he found on the shore between North Berwick and Tantallon Castle, when the Club visited that place last summer. The fruit, which was in the form of tetraspores imbedded in the margins of the leaflets, was in fine condition; and the slide was of interest from the fact that this Alga is rarely found in fruit. He also exhibited several other slides of Algæ in various forms of fructification.

At the third meeting (Jan. 8, 1886), a lecture was delivered by G. Sims Woodhead, M.D., F.R.C.P.E., on "The *Rôle* of Micro-organisms." The lecture was of a highly interesting character,

describing the nature of various kinds of bacilli, and the artificial means adopted for propagating these organisms. Their presence in several forms of disease, as phthisis, small-pox, splenic fever, &c., was further demonstrated by means of the magic-lantern; and the treatment adopted for combating such diseases by inoculation was explained.

At the fourth meeting (Feb. 5, 1886), Mr F. G. Pearcey, of H.M. Challenger Commission, delivered a lecture on the Foraminifera, which was illustrated by an extensive series of named specimens, shown under the microscope, as well as by a large number of beautiful diagrams. The lecturer enumerated the various classifications of these minute organisms, from that of d'Orbigny, in 1826, to the recent investigations of the Challenger Commission, which have been wrought out and tabulated by Mr H. B. Brady. The structure and life-history of the pelagic forms were then taken up, with their distribution in the ocean-depths, and the ultimate reduction of the lime composing their tests to a bicarbonate of lime, which was carried away in solution, to be again elaborated into varied and beautiful living forms. The formation of coral-reefs and coral-islands was then explained, especially the part played by the Foraminifera in laying the foundation on which coral is built up. Lastly, the importance of the fossil Foraminifera in the formation of the earth's crust was dwelt upon.

At the same meeting, Mr J. D. Murray made the following communication on the tongue of the Blow-fly:—

THE TONGUE OF THE BLOW-FLY IN RELATION TO ITS FOOD.

Most microscopists are familiar with that well-known object, the tongue of the Blow-fly (*Musca vomitoria*). This fly secretes large quantities of saliva from two glands situated one upon each side of the thorax, and the consumption of its food has been very generally ascribed to the solvent action of this saliva alone. Jabez Hogg, in the fourth edition of his valuable work, 'The Microscope,' quoting from a book called 'Episodes of Insect Life,' says that "a magnifier will solve the difficulty, and show how the fly dissolves its rock, Hannibal fashion, by a diluent or salivary fluid passing down through the same pipe which returns the sugar melted into syrup." Mr Lowne also, in his admirable monograph on the 'Anatomy and Physiology of the Blow-fly,' states that "no solid food is taken by the fly, as it lives entirely upon juices or such substances as can be dissolved by its copious saliva;" while a recent writer in the 'Naturalists' World' further informs us that "when flies want to eat hard substances, such as sugar, they emit a drop of water, which renders the soluble substances liquid." On the other hand,

as far back as 1869 Mr Suffolk ascribed the consumption of the food to the rasping action of the pseudo-tracheæ, which he figured and described in the 'Monthly Microscopical Journal' of that year. His views, however, on that point, have not been generally entertained; and, with the exception of Mr Hunt and Mr Saville Kent, nearly all other writers on the subject imply that the food is consumed by means of the solvent action of the saliva alone.

Feeling interested in this question, for two or three years past I have fed these flies under the microscope, and in the most favourable position for observation; and I was finally forced to the conclusion that the food was consumed by the joint action of the pseudo-tracheæ and teeth, the saliva merely acting as the vehicle which received the scraped-off particles. The food was thence sucked back into the mouth, before entering which it was probably subjected to the further action of the teeth. I regret that I am unable to-night to show you the living proboscis at work, as I am certain it would have interested you more than a mere description. The usual plan, however, has been to put the fly into the live-box along with a piece of sugar or meat, and to watch its movements under the microscope; but in this way, the back of the fly being towards the observer, very little information could be gained. Another plan was to put the fly in the live-box, with a spot of syrup on the cover; but in this way, again, the fly was compelled to suck, and the real function of the pseudo-tracheæ never came into play. The plan I adopted was to place a drop of rice-paste on the centre of a glass slip; then, taking the fly by the legs, its back was set on the drop, which extended to the margin of the wings and held it fast, when, after kicking for a few minutes, it became quiet, and reconciled to its temporary bondage. The fly was next put on the stage of the microscope, and with the aid of the bull's-eye condenser, a strong beam of light was thrown upon the head. The fly now being on its back, with the proboscis directly under the objective, the whole process of eating could be distinctly seen, and in this position the fly would continue to eat till one was tired of observing. Two motions could be noticed—a rasping or filing and what I would call a biting or snapping motion, just as if the fly was trying to obtain a firmer hold of the sugar; and some light is thrown on these movements by an examination of the slide I have prepared. In the first place, we find the lobes are channeled with numerous false tracheæ, usually twenty-nine or thirty on each lobe, although this number is not always constant. These tracheæ may be described as open tubes, like a piece of india-rubber tubing slit lengthwise, and kept open by semicircles or half-hoops, each semicircle terminating at one end in the form of a fork and at the other in a blunt point, so that throughout the greater length of the tube we have alternately a fork

and a blunt point, there being from 3000 to 4000 of these little forks on the lobes of the Blow-fly. The tracheæ spring from two curved chitinous plates, situated at the entrance to the mouth, and for some little distance from their attachment the rings are not bifurcated; and as the rings approach the extreme margin of the lobes, they become closed. Springing from the same chitinous plates are the teeth, variously estimated at from forty to sixty in number, bifurcated at their free ends. When the lobes are closed, the teeth rest between the false tracheæ; and when the lobes are quickly opened, the teeth spring forward, and in this way, in my opinion, act like so many little chisels. The opening of the lobes is effected by two powerful chitinous bands or muscles; and I would hint that a good rack-adjustment to the microscope is almost a necessity if one wishes to follow closely the nimble movements of the proboscis. I may mention that this object, as prepared by professional mounters, is only useful for showing the false tracheæ. As a rule, the teeth are too much flattened, and the chitinous plates that support the teeth and tracheæ are broken at the base, and turned over so that it is almost impossible to form anything like a correct idea of the relation of the different parts.

In the tongue of the Blow-fly, then, with its false tracheæ and teeth, we find an admirable arrangement for scraping and chiseling; and that it is used for this purpose I think I can almost prove, for under the microscope I have placed a piece of sugar, through which a hole was eaten by the fly, while lying on the stage of the microscope. The sugar was hard and crystallised, and too large to be covered by the open lobes, yet it was never allowed to fall; and as the work of scraping and chiseling went on, the proboscis gradually disappeared in the sugar, and finally emerged on the other side, leaving the sugar like a ring on the trunk of the fly; and there are, besides, certain minute points left by the action of the tracheæ which I think could hardly have remained had the saliva been the active solvent and sole agent in the consumption of the sugar. It is curious to note how observers differ. Mr Lowne says, "No solid food is taken by the fly;" while Mr Suffolk, an equally accurate observer, informs us, "I have frequently used raw meat as food for my flies, and have found it eaten freely." Now we all know how partial the Blow-fly seems to be to a tender roast or a leg of mutton; yet when placed on the stage of the microscope in the way described, neither coaxing nor starving would induce the fly to touch a piece of meat. This refusal is quite in keeping with what we know of the false tracheæ, whose sharp and pointed forks are totally unfitted to cope with a soft and yielding substance like flesh; and as the teeth cannot be made to oppose one another, they are alike useless for this purpose. The fly is content to sip the exuded juice, but cannot be said to eat meat

freely. It is in the larva stage, and not in the imago or perfect form, that the fly is carnivorous. The food of the Blow-fly consists largely of juices, and all forms of excreta and refuse which have become dry and encrusted, and it is on the latter that the tongue of the Blow-fly is most effective. I have said that the saliva acted as the vehicle which conveyed the food to the mouth and sucking-crop: it is also highly probable that it is used to cleanse the lobes from accidental impurities, or substances disliked by the fly; for if a brush is dipped in oil and drawn down the fissure formed by the closing of the lobes, the trunk will be extended, the lobes opened, and a copious flow of saliva poured out, which quickly covers the lobes. This continues for a few seconds, when the lobes are closed, and the trunk resumes its usual position. The same effects follow the application of vinegar, beer, &c.; while no such result follows when milk, tea, soup, or anything of that nature is given. Again, it has been thought that the false tracheæ, with their thousands of little forks, acted as a grating through which the food of the fly was sifted; but if the fly is put in the live-box with a drop of thin clear jelly containing a few air-bells, and if, when the fly is sucking, the course of these air-bells is watched, they will be found to move towards the centre of the lobes, and finally to disappear down what, for description's sake, may be called the throat of the fly. Had the tracheæ acted as a grating through which the food of the fly was sifted, these air-bells must have moved and disappeared in some other direction.

As I have found my own observations on these points so much at variance with what has been written on the Blow-fly, I have ventured to bring the subject under the notice of the Club, in the hope that if any of our members are interested in insect life, they may investigate this matter further, and probably throw some additional light on the subject of "the tongue of the Blow-fly in relation to its food."

At the fifth meeting (March 5, 1886), Mr W. E. Hoyle, M.A., M.R.C.S., F.R.S.E., gave a lecture "On the Structure of Small Parasites, as demonstrated by Ribbon Section-cutting, with practical Illustrations." The lecture was highly appreciated by the members, both on account of its interesting nature and of the clever manipulation by which it was illustrated. Two different forms of ribbon section-cutters were exhibited and described; and one of them was shown in operation, the organism being cut from end to end in continuous *attached* sections, so as to permit of an examination of the entire structure under the microscope.

At the sixth and concluding meeting (April 2, 1886), Mr Alex. Frazer, M.A., optician, exhibited and described two pieces of

apparatus invented and constructed by himself—viz., a self-centering turntable and an improved form of centering nosepiece. The following are Mr Frazer's remarks on these:—

ON A SIMPLE FORM OF SELF-CENTERING TURNTABLE FOR RINGING MICROSCOPIC SPECIMENS.

The construction of a turntable is so well known, that it is only necessary to point out wherein this appliance differs from other machines of the same sort. It is made (1) much larger and heavier than usual, so that slides which have the specimen mounted *not* in the middle of the slide will not project beyond the edge of the disc when being ringed; (2) the springs are made with a special form of "washer," so that these (the springs) may be turned freely in any direction; (3) the turntable is provided with a simple arrangement, consisting of three screws, which are placed in such positions upon the table that slides either of one inch or one and a half inch, if placed against them, will be accurately centred; and the screws are also so arranged that when it is desired to use the turntable as a non-centering one, the screws may be depressed below the surface of the table.[1]

ON AN IMPROVED FORM OF CENTERING NOSEPIECE, FOR USE WITH BROOKE'S DOUBLE NOSEPIECE FOR MICROSCOPE.

The use of the double or triple nosepiece has become very general in microscopical investigation, and especially so in the departments of pathology and physiology; but the continued use of this appliance has shown that it labours under two defects. In the first place, when the nosepiece is moved in the usual way, and one objective put in place of another, it seldom happens that an object which was in the focus of one power is also in the focus of the other; and, as a consequence, the operation of refocusing must be performed. This defect may be remedied by making the sides of the nosepiece which hold the objectives of unequal lengths, or by putting an adapter in either side, and so correcting for the difference of adjustment for focus. When this correction has been made, the convenience of the nosepiece is much increased; but the error of want of concentricity may still remain—*i.e.*, a particular

[1] In the disc five holes are drilled: one of these is at a distance of 1½ in. from the centre; and of the others, two are placed in a line drawn parallel to a line which joins the first-mentioned screw and the centre, and at a distance of half an inch from it; and the other two are placed in a line which is three-quarters of an inch distant from the line of the first screw and the centre, and also parallel to it.

point in the middle part of the field of the lower power may not also be in the centre of the field of the higher. The appliance now described has been designed to remedy the defects both of want of centre and error of focus. It consists of an outer brass collar, which, in its upper part, is provided with a screw which fits one of the screwed ends of the nosepiece; and in its lower part consists of a brass collar which is provided with three mill-headed steel screws, placed at regular intervals in its circumference. These screws control an inner ring, into which the objective is screwed, and which may be moved laterally by means of the steel screws. This inner ring, and also the outer ring which supports it, may be made of any suitable length, and by this means the accurate adjustment for focus is effected; while the inner ring being, as already mentioned, capable of a lateral movement, the adjustment for "centre" may also be accurately made.

At the same meeting, Mr J. M. Turnbull exhibited an improved sliding nosepiece and adapter for the microscope. The following explanation of these was made by the inventor:—

ON AN IMPROVED SLIDING NOSEPIECE AND ADAPTER FOR THE MICROSCOPE.

In introducing this small piece of apparatus to your notice, it is not my intention to enter into any elaborate description of what has already been done in this direction. But you will perhaps allow me shortly to notice one or two of the contrivances that are used for this purpose—viz., changing the object-glasses of microscopes. The best known and most largely used of these are the ordinary double and triple nosepieces. These nosepieces are, no doubt, a most useful invention, but they are not without their defects. They are rather difficult and troublesome to make, and, unless the work of a really first-class optician, are usually worthless. Even in the best of them, the optical axis of the object-glass does not coincide with that of the eyepiece and instrument. This is an objection which is fatal to good work; and no matter how good the objective, if its axis is not in line with the eyepiece, it goes a great way to detract from its usefulness. There are also very few nosepieces which will stand the test of having an object on the stage of the microscope centred under a low power, and, having turned down the high power, to find the part wanted in the middle of the field. It is more than likely that it will be somewhere on its edge, or not in the field at all. Notwithstanding these defects, the nosepiece is without doubt the best appliance at present in use for the purpose—the other inventions, such

as Parkes's slipping-tube or the "turntable" adapter, being too clumsy, and hardly worth a passing consideraton.

Changing the power in the usual way, by unscrewing the objective and screwing in another, has always seemed to me both a tedious and needless way of working; and I have often revolved in my mind other means of arriving at the same result. The outcome of these cogitations is the small piece of apparatus now exhibited. It consists essentially of a small face-plate or "chuck," which screws into the ordinary "nose" of the microscope. On its face this has a slide which has fitted into it another sliding-piece, and into which the objective is screwed. As many of the other objectives as belong to the instrument are fitted with similar sliding-pieces, which also fit into the first. Once, therefore, an objective is fitted and centred with one of these sliding-pieces, having a sufficient length of tube to bring it very nearly into focus, it can be substituted in a moment for one of lower or higher power, as the case may be; and if an object has been previously centred on the stage with a low power, it will be found accurately centred in the field of that of the higher. I also wish to draw your attention to the fact that all the face parts of this appliance are finished on the lathe, which enables the optical axis of the eyepiece, instrument, and objective to be truly maintained, and does away with the failings of the ordinary double nosepiece in this respect. Another form of this adapter is to have two, three, or more objectives mounted together on one of the sliding-pieces, having on each objective a sufficient length of tube to bring it accurately into focus, and sliding one objective on another, as may be wished, central with the tube of the instrument—a small spring-point retaining it in that position. It is a matter of choice, however, as to which is the better form—whether it will be more convenient to have two or three objectives mounted together, or to have them separate.

Having thus described the appliance, I think I may fairly claim for it that it will change the objective of a microscope with great rapidity, with very accurate centering, and very close approximate focusing. Having made these claims for it, I commend the apparatus to the attention of all workers with the microscope, whose time is generally too valuable to waste on matters such as this.[1]

Throughout the session various meetings were held in the Club-room, No. 35, at 20 George Street, for practical work. One series embraced the study of the Optical Principles of the Microscope;

[1] [Since the above was exhibited to the Microscopic Section of the Field Club, the Royal Scottish Society of Arts has awarded a Silver Medal to Mr J. M. Turnbull for his invention.]

another, the study of Practical Biology; while a third, on Saturday evenings, was devoted to Cutting, Preparing, and Mounting Micro-objects. These meetings were sufficiently successful to induce the members attending them to endeavour to carry them on, on an improved basis, during another session.

The Annual Conversazione took place on 20th April, in the Masonic Hall, and was highly successful. As on former occasions, it partook largely of the nature of a microscopic exhibition, and the many and varied exhibits were inspected by members and their friends with keen interest. The pleasure of those present was much enhanced by the performances, throughout the evening, of a vocal party under the direction of Mr Wm. Murray, and of the Albany Orchestral Society, who kindly gave their services on the occasion. About 400 were present.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Club was held on the evening of October 22, 1886, in the Hall, 20 George Street,—Mr Symington Grieve, President, in the Chair. The Secretary reported that during the past Session there had been held in all 30 meetings, 13 of these being indoor meetings, and 17 field meetings. The following list gives the dates and localities of these meetings, viz.:—

Indoor Meetings: (1) *Ordinary Evening Meetings*, 1885—Oct. 23, Nov. 20, Dec. 18; 1886—Jan. 22, Feb. 19, March 19. (2) *Microscopic Meetings*, 1885—Nov. 6, Dec. 4; 1886—Jan. 8, Feb. 5, March 5, April 2. (3) *Annual Conversazione*—April 20, 1886.

Field Meetings, 1886: May 1, Sea-shore, Kirkcaldy to Kinghorn; May 8, Gilmerton and Burdiehouse; May 15, Roslin; May 22, Auchendinny and Firth Woods; May 29, Aberdour; June 2, Banks of Canal to Slateford; June 5, Ormiston Hall and Pencaitland; June 12, Balerno to Glencorse; June 16, Sea-shore at Caroline Park; June 19, West Linton; June 26, Blair Woods, Wemyss; June 30, Joppa; July 3, Philpstoun Loch; July 10, Balerno to Glencorse; July 14, Corstorphine Hill; July 17, Auchencorth Moss; Sept. 18, Colinton and the Pentlands to Currie.

The Financial Statement showed that, including a balance from last account, the income had been £85, 11s. 5½d., and the expenditure £62, 15s. 1½d., thus leaving a balance in favour of the Club of £22, 16s. 4d.

The election of Office-bearers for Session 1886-87 was next proceeded with, when, after the vacancies were filled up, the complete list stood as under:—

President.—Symington Grieve.

Vice-Presidents.

J. M. Macfarlane, D.Sc. | Alex. Frazer, M.A. | John Rattray, M.A., B.Sc.

Council.

F. G. Pearcey.	William Forgan.	John Allan.
Arch. Craig, Jun.	William Bonnar.	J. D. Murray.
W. I. MacAdam, F.C.S., F.I.C.	John Henderson.	John Lindsay.
A. D. Richardson.	A. B. Steele.	Wm. Penman.

Honorary Secretary and Treasurer.—Andrew Moffat.

Auditors.—Hugh H. Pillans; Robert Stewart, S.S.C.

During the past Session 36 names have been withdrawn from the roll, and 43 new names have been added, making a net increase of 7, which gives a total roll of ordinary members at the close of Session 1885-86 of 221.

The following alterations of the Laws were also agreed to, viz.:—

"That those members of the Club who desire to take part in the practical work of the Microscopic Section shall enrol themselves, and contribute the additional sum of 2s. 6d. yearly to a separate fund to be at the disposal of the Section for the purchase of materials, microscopical journals, or such other purpose as the members of the Section shall resolve upon. That this Section shall have the power of appointing its own Secretary, who shall, in addition to discharging the usual functions so far as regards the Section only, have the charge of the Cabinet and the micro-material in the Club-room.

That Rule I. be deleted, and that the following Rule be put in its place: 'That this Society, instituted for the Practical Study of Natural History in all its branches, be called The Edinburgh Field Naturalists' and Microscopical Society.'"

INDEX.

OFFICE-BEARERS, 1881-82.

President.—John Walcot.

Vice-President.—P. B. Gibb.

Council.

Symington Grieve.
B. H. Hossack.
J. A. Brodie.
Wm. C. S. Hunter.
Arch. Craig.
James Simpson.
John Lindsay.
Hugh H. Pillans.
T. B. Sprague.
John Heggie.
Chas. F. Robertson.
W. Tait Kinnear.

Auditors.—Alexander Matheson, Robert Thomson.

Honorary Secretary and Treasurer.—Andrew Moffat.

LIST OF MEMBERS, 1881-82.

Original Members marked thus.*

Honorary Members.

Brown, Robert, Ph.D., F.L.S., London.
Clark, Alex., Old Aberdeen.
Edward, Thomas, Banff.
Grieve, David, F.R.S.E., Hobart House, Dalkeith.
Peach, Chas. W., A.L.S., 30 Haddington Place.

Ordinary Members.

Aitken, William, 13 Henderson Row.
Allardice, C. B., 3 Polwarth Cres.
Anderson, Miss A. J. R., 3 Howard Place.
Anderson, Miss S. A., 3 Howard Pl.
Annandale, David, 5 George Square.
Bird, George, 15 Thirlstane Road, West.
Bogie, James, 1 Victoria Street.
Bonnar, Wm., 14 South Castle St.
Brodie, J. A., Tweed Villa, Bonnington.
Brown, George L., Millburn House, Morningside.
Brown, Miss L. G., Bellsmill House.
Brown, Miss J. M., Bellsmill House.
Bryden, Mrs, 72 Great King Street.
Bryden, Miss, 72 Great King Street.
*Colvin, Rev. R. F., 7 Church Hill.
Cotton, Miss Maria, 26 Mayfield Terrace.
Cowan, Charles Wm., Valleyfield, Penicuik.
Craig, Archibald, jun., 16 Blacket Place.
Craigie, Miss, 13 Polwarth Terrace.
Cunningham, Miss, 2 Haddington Place.
Cunningham, Wm., 2 Haddington Place.
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Edmunds, Edmund, 9 Fettes Row.
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Forbes, Miss, Langside, Glasgow.
*Fraser, P. Neill, Rockville, Murrayfield.
Fraser, Alex., M.A., 7 Lothian St.
Galloway, James, St Fillans, Trinity.
Gibb, Philip B., M.A., 14 Picardy Place.
Gloag, David, 1 Royston Terrace.
Gouthwaite, Miss, 28 Dublin Street.
Gray, Arch., 13 Inverleith Row.
Gray, Joseph T., M.A., 21 Tantallon Place.
Grieve, Symington, Salisbury View, Dalkeith Road.
Grieve, Miss Amelia, Salisbury View, Dalkeith Road.
Groom, Miss, Downie Terrace, Corstorphine.
Groves, Charles H., M.D., Forthland House, Trinity.
Harrow, John, jun., Bonnington Grove.
Hay, Alex., Restalrig Road.
Heggie, John, 149 Warrender Park Road.
Henderson, Miss, 6 Carlton Terrace.
Herbert, A. B., 19 Strathearn Road.
Hogg, Andrew, 33 George Street.
Hossack, B. H., Orkney.
Hunter, Wm. C. S., M.A., Dundee.
Hutchison, Robert, F.R.S.E., 29 Chester Street.
Hutchison, Mrs, 34 Manor Place.
Innes, Miss Agnes H., 4 Cobden Rd.
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Kinnear, W. Tait, 5 Crichton St.
Laughton, William, Currie.
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Lindsay, John, 20 Balmoral Place.
Livingstone, Matthew, 108 Gilmore Place.
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M'Intosh, Mrs James, 42 Queen St.
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Melvin, Alex., 24 Castle Street.
Miller, Peter, 8 Bellevue Terrace.
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Milne, John K., Kevock Tower, Lasswade.

Milne, Mrs, Kevock Tower, Lasswade.
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Oliver, John S., 12 Greenhill Park.
Philip, James, 5 Argyle Place.
Pillans, Hugh H., 12 Dryden Place.
Pillans, Miss, 12 Dryden Place.
Pottage, John C., 117 Princes St.
Potts, George H., Fettes Mount, Lasswade.
Purves, A. P., W.S., 102 George St.
Robertson, Charles F., 54 Blacket Place.
Robertson, Rev. J. M., 60 Blacket Place.
*Sadler, John, Royal Botanic Garden.
Shaw, John O., Beauly, Victoria Park, Trinity.
Simpson, Jas., Anatomical Museum, Park Place.
*Skirving, R. Scott, 29 Drummond Place.
Sprague, T. B., 29 Buckingham Ter.
Steele, Miss, 16 Upper Gray Street.
Stewart, Robert, 8 Atholl Place.
Stewart, James R., 10 Salisbury Rd.
Stewart, Mrs James R., 10 Salisbury Road.
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Taylor, William, M.D., 67 York Pl.
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Thomson, Robert, LL.B., 6 Shandwick Place.
Usher, Andrew, Blackford House.
Walcot, John, 50 Northumberland Street.
Walcot, Miss, 50 Northumberland Street.
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Wilson, Miss Katie, 2 Archibald Pl.
Wilson, Thomas, S.S.C., 4 Maitland Street.
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Original Members marked thus.*

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Anderson, Miss S. A., 3 Howard Place.
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Bryden, Miss, 72 Great King Street.
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Hutchison, Robert, F.R.S.E., 29 Chester Street.
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Leishman, Miss, Schoolhouse, Currie.
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M'Intosh, Mrs James, 42 Queen St.
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Miller, R. K., 4 Bonnington Ter.
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Milne, John K., Kevock Tower, Lasswade.
Milne, Mrs, Kevock Tower, Lasswade.
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Pillans, Hugh H., 12 Dryden Place.
Pillans, Miss, 12 Dryden Place.
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Potts, George H., Fettes Mount, Lasswade.
Purves, A. P., W.S., 102 George St.
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Robertson, C. F., 54 Blacket Place.
Robertson, Peter, 5 Teviot Place.
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Shaw, John O., Beauly, Victoria Park, Trinity.
Simpson, Jas., Anatomical Museum, Park Place.
*Skirving, R. Scott, 29 Drummond Place.
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Smith, Miss B. H., 11 Pilrig Street.
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Walcot, Miss, 50 Northumberland Street.
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Walker, Wm. F., 5 Restalrig Ter.
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Wilson, Miss Helen, 7 Coates Place.
Wilson, James T., Restalrig House.
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Vice-President.—P. B. Gibb, M.A.

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Symington Grieve.
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Auditors.—Alexander Matheson, M.A., W.S.; J. A. Brodie.

LIST OF MEMBERS. 1883-84.

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Alexander, Robert, 4 Abbey Street.
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Allardice, C. B., 5 Polwarth Cres.
Amoore, J. S., 7 Abercromby Place.
Anderson, Miss A. J. R., 3 Howard Place.
Anderson, Miss S. A., 3 Howard Place.
Annandale, David, 5 George Square.
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Bashford, W. T., Argyle House, Portobello.
Beale, Geo., Dean Public School.
Bird, George, 63 Haymarket Terrace.
Bogie, James, 5 Marchhall Crescent.
Bonnar, Wm., 54 Castle Street.
Brodie, J. A., Tweed Villa, Bonnington.
Brotherston, G. M., 18 St John Street.
Brown, George L., Millburn House, Morningside.
Brown, Miss L. G., Bellsmill House.
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Bryden, Miss, 72 Great King Street.
Carr, T. F. Robertson, Berwick-on-Tweed.
*Colvin, Rev. R. F., Teviothead, Jedburgh.
Cotton, Miss Maria, 26 Mayfield Terrace.
Cowan, Charles Wm., Valleyfield, Penicuik.
Coyne, R. A. F. A., 21 Archibald Pl.
Craig, Archibald, jun., 16 Blacket Place.
Craig, Mrs J. B., 18 Queen's Cres.
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Cunningham, Miss, 2 Haddington Place.
Cunningham, William, 6 Inverleith Gardens.
Cunningham, Mrs Wm., 6 Inverleith Gardens.
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Drummond, A. P., M.B., C.M., 30 Broughton Place.
Duncan, Esdaile, Dean Public School.
Eddington, Alexander, 9 Montrose Terrace.
Edmunds, Arthur, 9 Fettes Row.
Edmunds, Edmund, 9 Fettes Row.
Eld, Thos. W., 2 Ramsay Gardens.
Ewart, James, 1 Dundas Street.
Farquharson, Thos. Ker, Roseville, St Catherine's Place, Grange.
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Forbes, Miss, Langside, Glasgow.
Forgan, William, 3 Warriston Cres.
Foulis, James, M.D., 34 Heriot Row.
Fraser, Charles, 13 Greenhill Place.
Fraser, Mrs, 13 Greenhill Place.
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*Fraser, P. Neill, Rockville, Murrayfield.
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Galloway, James, St Fillans, Trinity.
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Gibb, Philip B., M.A., 14 Picardy Place.
Gloag, David, 1 Royston Terrace.
Gouthwaite, Miss, 13 Woodburn Terrace.
Gray, Arch., Bank Street.
Gray, Jos. T., M.A., 21 Tantallon Pl.
Grieve, Miss Amelia, Salisbury View, Dalkeith Road.
Grieve, Somerville, Salisbury View, Dalkeith Road.
Grieve, Symington, 7 Queensberry Terrace.
Grinsell, Miss, 13 Royal Crescent.
Groom, Miss, Downie Terrace, Corstorphine.

Groves, Charles H., M.D., Forthland House, Trinity.
Hall, George, 4 Marchhall Road.
Hall, Miss, 4 Portgower Place.
Hardie, William, Belleville, Dalkeith Road.
Hately, W., 12 Bruntsfield Place.
Heggie, John, 2 Watt Terrace.
Henderson, John, Phrenological Museum, Chambers Street.
Henderson, Miss, 6 Carlton Terrace.
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Honeyman, Robert, 94 West Bow.
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Hume, William, 1 Lothian Street.
Hunter, James, Minto House.
Hutchison, Mrs, 22 Manor Place.
Hutchison, Robert, F.R.S.E., 29 Chester Street.
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Jenner, Charles, F.R.S.E., Easter Duddingston Lodge.
King, Mark, 120 Pitt Street, Leith.
Kinnear, W. Tait, 5 Crichton Street.
Knight, Donald, Museum of Science and Art.
Kynoch, Miss, 2 Darnaway Street.
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M'Intosh, James, 42 Queen Street.
M'Intosh, Mrs James, 42 Queen St.
Mackay, Miss, 69 Northumberland Street.
M'Kean, James, 11 Sylvan Place.
Marshall, John Arch., 41 Minto St.
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Miller, Peter, 8 Bellevue Terrace.
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Milne, Mrs, Kevock Tower, Lasswade.
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Murray, J. D., 68 Haymarket Ter.
Nesbit, John, 162 High Street, Portobello.
Nisbet, Miss, 21 York Place.
Ogilvie, Miss, 18 Buckingham Ter.
Oliver, Geo. W., Royal Botanic Garden.
Oliver, John S., 12 Greenhill Park.
Peacock, Thomas R., Abbotsford Cottage, 5 Dalkeith Street, Joppa.
Philip, James, 5 Argyle Place.
Pillans, Hugh H., 12 Dryden Place.
Pillans, Miss, 12 Dryden Place.
Pottage, John C., 117 Princes St.
Potts, George H., Fettes Mount, Lasswade.
Purves, A. P., W.S., 102 George St.
Purves, Samuel, 70 Haymarket Ter.
Ranken, William, 11 Spence Street.
Rattray, John, M.A., B.Sc., Marine Station, Granton.
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Robertson, C. F., 54 Blacket Place.
Robertson, George, Lothian Road Public School.
Robertson, Rev. J. M., 60 Blacket Place.
Russell, John, 6 Thirlstane Rd., East.
Scott, Miss, 50 Lauder Road.

Shaw, John O., Beauly, Victoria Park, Trinity.
Simpson, Jas., Anatomical Museum, Park Place.
*Skirving, R. Scot, 29 Drummond Place.
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Smith, Miss B. H., 11 Pilrig Street.
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Stewart, Mrs James R., 10 Salisbury Road.
Stewart, Miss, 53 Lothian Street.
Stewart, Robert, S.S.C., 8 Atholl Place.
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Thomson, Miss H. B., 98 Lauriston Place.
Thomson, Robert, LL.B., 6 Shandwick Place.
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Turner, Daniel, 24 George Street.
Usher, Andrew, Blackford House.
Walcot, John, 50 Northumberland Street.
Walcot, Miss, 50 Northumberland Street.
Walker, David, 2 Bellevue Terrace.
Walker, Wm. F., 5 Restalrig Ter.
Wardlaw, Geo., 14 St John's Hill.
Watt, Adam, 13 St John Street.
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Wilson, Miss Katie, 2 Archibald Pl.
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Wood, T. A. D., Viewforth, Brunstane Road, Joppa.
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Cunningham, William, 6 Inverleith Gardens.
40 Cunningham, Mrs Wm., 6 Inverleith Gardens.
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Dowell, Miss, 13 Palmerston Place.
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50 Edmunds, Edmund, 9 Fettes Row.
Eld, Thos. W., 2 Ramsay Gardens.
Ewart, James, 1 Dundas Street.
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Farquharson, Thos. Ker, Roseville, St Catherine's Place, Grange.
Ferguson, John, 15 Brighton Place, Portobello.
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60 Fraser, Hugh, Leith Walk Nurseries.
Fraser, Mrs, 13 Greenhill Place.
Fraser, Miss Minnie, 1 Marchmont Road.
*Fraser, P. Neill, Rockville, Murrayfield.
Frazer, Alex., M.A., 7 Lothian St.
Galloway, James, St Fillans, Trinity.
Gay, David, 2 Windsor Street.
Gibb, Philip B., M.A., 14 Picardy Place.
Gilchrist, James, 17 Manor Place.
Gloag, David, 1 Royston Terrace.
70 Gouthwaite, Miss, 13 Woodburn Terrace.
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Gray, Jos. T., M.A., Parkside.

Gray, Mrs Robert, Bank of Scotland House, Bank Street.
Grieve, Miss Amelia, Salisbury View, Dalkeith Road.
Grieve, Somerville, Salisbury View, Dalkeith Road.
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Hay, Miss Maggie, 1 Ardmillan Terrace.
Heggie, John, 2 Watt Terrace.
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Henderson, John R., M.B., C.M., Scottish Marine Station, Granton.
Henderson, Miss, 6 Carlton Terrace.
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Hogg, Andrew, 94 George Street.
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Hume, William, 1 Lothian Street.
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Hurry, R., 56 India Street.
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Hutchison, Robert, F.R.S.E., 29 Chester Street.
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King, Mark, 120 Pitt Street, Leith.
Knight, Donald, Museum of Science and Art.
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Ligertwood, George C., M.A., 9 Spottiswoode Street.
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Lindsay, Thomas, 5 East Hermitage Place, Leith.
Livingstone, Matthew, 108 Gilmore Place.
Lorimer, Miss, 16 Mayfield Terrace.
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MacAlpine, Mrs A. N., 10 Spring Gardens.
Macfarlane, J. M., D.Sc., 3 Bellevue Terrace.
120 M'Glashen, Robert L., 1 Brandon St.
M'Gregor, Miss, 4 Marmion Terrace.
M'Gregor, Miss Maggie, 4 Marmion Terrace.
M'Intosh, James, 42 Queen Street.
M'Intosh, Mrs James, 42 Queen St.
Mackay, Miss, 69 Northumberland Street.
M'Kean, James, 3 Warrender Park Terrace.
M'Kean, Miss Minnie, 2 Inverleith Terrace.
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Marshall, Ralph, 1 Lorne Terrace.
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Miller, R. K., 13 Lennox Street.
Miller, Peter, 8 Bellevue Terrace.
Milne, John K., Kevock Tower, Lasswade.
Milne, Mrs, Kevock Tower, Lasswade.
Mitchell, John L., 106 Princes Street.
Moffat, Andrew, 28 Lutton Place.
Monteith, James, 20 Cumberland Street.
140 Morham, Robert, 2 Bright Crescent.
Murray, Chas. G., 68 Haymarket Terrace.
Murray, J. D., 68 Haymarket Ter.
Murray, Wm., 8 Clifton Terrace.
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Nisbet, Miss, 21 York Place.
Ogilvie, Miss, 18 Buckingham Ter.
Oliver, John S., 12 Greenhill Park.
Peacock, Alex., 9 M'Laren Road.
Peacock, Miss, 9 M'Laren Road.

150 Peacock, Thomas R., 9 M'Laren Rd.
Philip, James, 5 Argyle Place.
Pillans, Hugh H., 12 Dryden Place.
Pillans, Miss, 12 Dryden Place.
Potts, George H., Fettes Mount, Lasswade.
Purves, Samuel, 70 Haymarket Ter.
Ranken, William, 11 Spence Street.
Rattray, John, M.A., B.Sc., Marine Station, Granton.
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Richardson, A. D., Royal Botanic Garden.
160 Robertson, C. F., 54 Blacket Place.
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Robertson, Rev. J. M., Stirling.
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Simpson, Jas., Anatomical Museum, Park Place.
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*Skirving, R. Scot, 29 Drummond Place.
Smith, Alexander W., 4 West Castle Road.
170 Smith, Miss, 34 Dublin Street.
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180 Stewart, James R., 10 Salisbury Rd.
Stewart, Miss, 53 Lothian Street.
Stewart, Robert, S.S.C., 21 Warriston Crescent.
Stewart, Mrs Robert, 21 Warriston Crescent.
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Suttar, John, Dispensary, Royal Infirmary.
Taylor, Charles, Pinkhill Nurseries.
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Terras, James, 34 Findhorn Place.
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Turnbull, J. M., 6 Rose Street.
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Walker, David, 2 Bellevue Terrace.
200 Walker, Wm. F., 5 Restalrig Ter.
Wardlaw, Geo., 14 St John's Hill.
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White, Miss, 1 Cumin Place.
White, P. J., 25 Castle Terrace.
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210 Wright, J. C., 20 Royal Crescent.
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Yule, Robert, 6 Mansfield Place.
214 Ziegler, John, Sunnyside, Corstorphine.

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		Mr Symington Grieve,	1885.

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Anderson, G. R., 33 Howard Place.
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Bird, George, 63 Haymarket Terrace.
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Dowell, Miss, 13 Palmerston Place.
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Ewart, James, 1 Dundas Street.
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Farquharson, Thos. Ker, Roseville, St Catherine's Place, Grange.
Ferguson, John, 15 Brighton Place, Portobello.
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Forgan, William, 3 Warriston Cres.
Foulis, James, M.D., 34 Heriot Row.
Fraser, Charles, 13 Greenhill Place.
Fraser, Mrs, 13 Greenhill Place.
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Grieve, Somerville, Salisbury View, Dalkeith Road.
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Hay, Miss Maggie, 1 Ardmillan Ter.
Heggie, John, 3 Dalkeith St., Joppa.
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Henderson, Miss, 6 Carlton Terrace.
Henderson, Mrs, 6 Carlton Terrace.
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Hume, William, 1 Lothian Street.
90 Hunter, James, 7 Melgund Terrace.
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Hurry, R., 56 India Street.
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Hutchison, Robert, F.R.S.E., 29 Chester Street.
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Macfarlane, J. M., D.Sc., F.R.S.E., 15 Scotland Street.
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120 M'Glashen, Robert L., 1 Brandon St.
M'Intosh, James, 42 Queen Street.
Mackay, Miss, 69 Northumberland Street.
M'Kean, James, 3 Warrender Park Terrace.
M'Kean, Miss J., 1 Inverleith Ter.
M'Kean, Miss Minnie, 1 Inverleith Terrace.
M'Kechnie, Chas., 60 Northumberland Street.
Marshall, Hugh, B.Sc., 1 Lorne Ter.
Marshall, John Arch., 41 Minto St.
Marshall, Ralph, 1 Lorne Terrace.
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Morham, Robert, 2 Bright Crescent.
140 Muir, John, 115 Warrender Park Road.
Murray, Chas. G., 68 Haymarket Ter.
Murray, J. D., 68 Haymarket Ter.
Murray, Wm., 8 Clifton Terrace.
Neill, John, 8 Wemyss Place.
Nesbit, John, 162 High Street, Portobello.
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Ogilvie, Miss, 18 Buckingham Ter.
Oliver, John S., 12 Greenhill Park.
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150 Patterson, J. C., 6 Mentone Terrace.
Peacock, Alex., 9 M'Laren Road.
Peacock, Miss, 9 M'Laren Road.
Peacock, Thomas R., 9 M'Laren Rd.

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Penman, Wm., 8 Lauriston Park.
Philip, James, 5 Argyle Place.
Pillans, Hugh H., 12 Dryden Place.
Pillans, Miss, 12 Dryden Place.
Potts, George H., Fettes Mount, Lasswade.
160 Purves, Samuel, 70 Haymarket Ter.
Ranken, William, 11 Spence Street.
Rattray, John, M.A., B.Sc., F.R.S.E., 15 Scotland Street.
Reid, Andrew, 2 Lixmount Terrace, Trinity.
Richardson, A. D., Royal Botanic Garden.
Robertson, C. F., 54 Blacket Place.
Robertson, George, Lothian Road Public School.
Sanderson, Dr Alfred, St Martin's Lodge, Wardie Crescent.
Shaw, John O., Beauly, Victoria Park, Trinity.
Skinner, Jas., 21 West Maitland St.
170*Skirving, R. Scot, 29 Drummond Place.
Smith, Alexander W., 4 West Castle Road.
Smith, Miss, 34 Dublin Street.
Smith, Mrs Geo., 25 East Claremont Street.
Smith, R. C., 205 Morningside Road.
Somerville, Alex., B.Sc., F.L.S., 34 Granby Ter., Hillhead, Glasgow.
Sprague, T. B., M.A., F.R.S.E., 29 Buckingham Terrace.
Sprague, Mrs T. B., 29 Buckingham Terrace.
Stalkartt, Mrs, 14 Melville Terrace.
Steele, Adam B., 10 Comely Bank.
180 Steele, Miss, 16 Upper Gray Street.
Stevenson, William C., Leadervale, Trinity Road.
Stewart, James, 8 Morningside Ter.
Stewart, James R., 10 Salisbury Rd.
Stewart, Miss, 53 Lothian Street.
Stewart, Robert, S.S.C., 21 Warriston Crescent.
Storrie, James, 5 Bowhill Terrace.
Sutherland, John, 4 Caledonian Rd.
Suttar, John, Dispensary, Royal Infirmary.
Taylor, William, M.D., 12 Melville Street.
190 Terras, James, 34 Findhorn Place.
Thomson, Miss H. B., 98 Lauriston Place.
Thomson, Mrs, 6A Bruntsfield Place.
Thomson, Robert, LL.B., 6 Shandwick Place.
Todd, Miss M. G., Bruntsfield Lodge.
Torrie, Robert, 198 Bonnington Road, Leith.
Turnbull, George, 16 Thistle Street.
Turnbull, J. M., 6 Rose Street.
Turner, Daniel, S.L., 24 George St.
Usher, Andrew, Blackford House.
200 Walcot, John, 50 Northumberland Street.
Walker, David, 2 Bellevue Terrace.
Walker, John B., 22 London Street.
Walker, Wm. F., 5 Restalrig Ter.
Wallace, William, 147 Constitution Street, Leith.
Wardlaw, Geo., 14 St John's Hill.
Watson, Dr Wm., 49 Grange Road.
Watson, Mrs, 49 Grange Road.
White, Miss, 6 Roslin Terrace, Joppa.
Wilson, George A., 46 Queensferry Street.
210 Wilson, James T., Restalrig House
Wilson, Miss Helen, 1 Lennox St.
Wilson, Miss Katie, 2 Archibald Pl.
Wood, Alex., 4 Avondale Place.
Wood, T. A. D., Viewforth, Brunstane Road, Joppa.
Wright, Hilda, Ravenswood, Craiglockhart.
Wright, J. C., 7 Cluny Avenue.
Wright, Thomas, 16 Broughton St.
Young, David E., 22 Rosehall Ter.
Young, Mrs D. E., 22 Rosehall Ter.
Yule, Robert, 6 Mansfield Place.
221 Ziegler, John, Sunnyside, Corstorphine.

Programme and Plan of Arrangements

FOR THE

CONVERSAZIONE

AND

MICROSCOPIC SOIREE

OF THE

Edinburgh Naturalists' Field Club.

FREEMASONS' HALL, GEORGE STREET,

FRIDAY, 17th APRIL 1885.

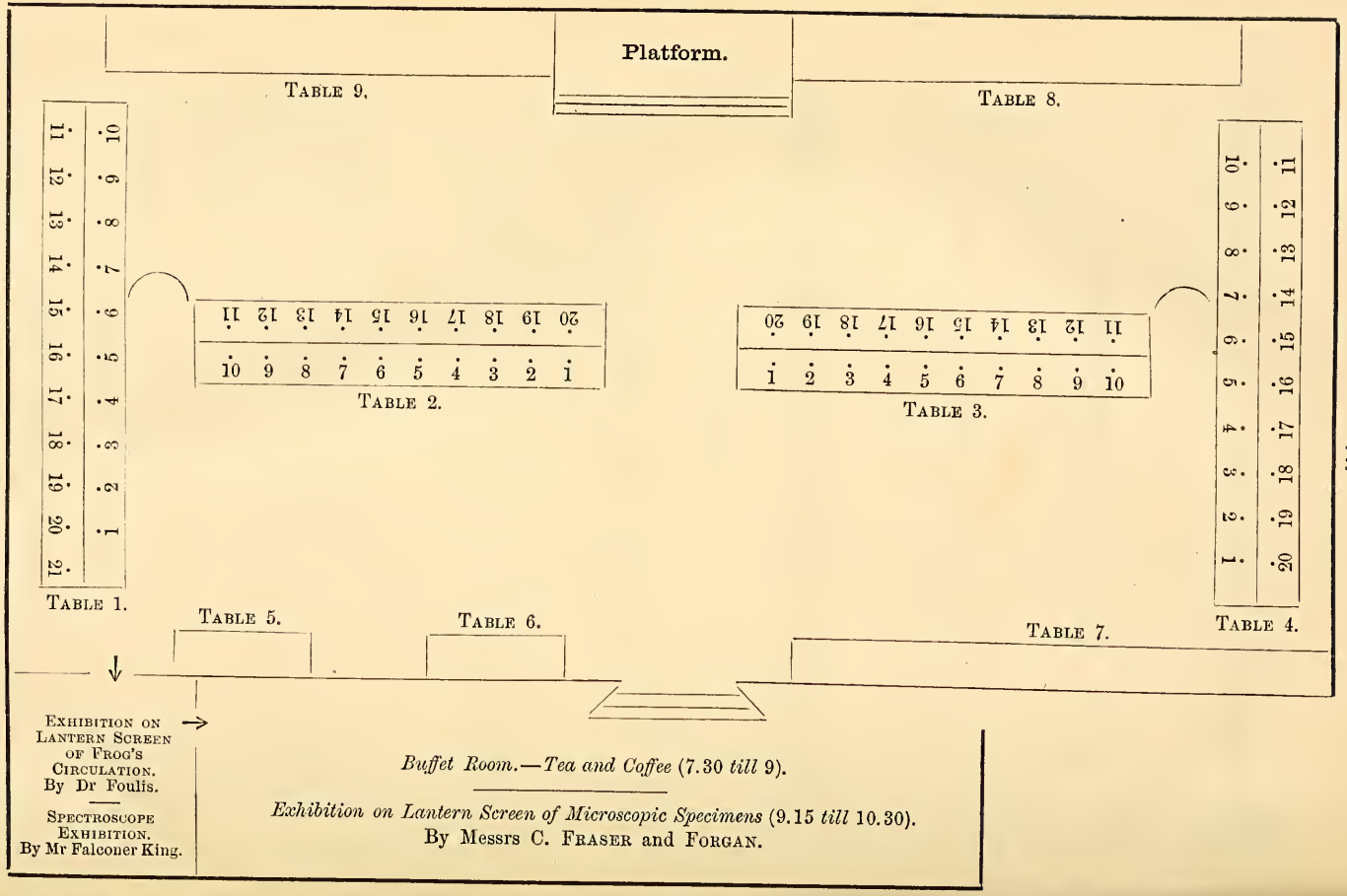
Programme of Band Music.

Overture,	"The Wild Huntsman,"	*Rudolf Mersy.*
Selection,	"Robert Bruce,"	*Bonnisseau.*
Waltz,	"Marien,"	*Gung'l.*
Selection,	"Falka,"	*Chassaigne.*
Waltz,	"Estudiantina,"	*Waldteufel.*
Selection,	"William Tell,"	*Rossini.*
Waltz,	"Hypatia,"	*M. Osterlere.*

"GOD SAVE THE QUEEN."

RUDOLF MERSY, Leader.

PLAN OF EXHIBITION-HALL.



LIST OF EXHIBITS

AND THEIR ARRANGEMENT.

(The Microscopic preparations on Tables I.-IV. are lighted by electric lamps provided by Mr J. Mitchell.)

TABLE I.—Preparations 1-10 illustrate Root-structure, and Protoplasmic Movements in Root Hairs, exhibited by Mr A. D. Richardson.

Preparations 11-21 illustrate the Gland-structure of Nepenthes and Cephalotus—plants suited for catching and digesting flies—exhibited by Dr J. M. Macfarlane.

TABLE II.—Preparations 1-5 show various organs of the Spider, exhibited by Messrs J. L. Murray and Purves.

Alongside preparation 1 are—Water-Spiders from Luffness Links, exhibited by Mr Archibald Gray; Spiders' Nests, exhibited by Mrs Clapperton and Mr Purves.

Preparations 6, 7 show grouped Diatoms and arranged slide of Butterfly Scales, exhibited by Mr Turnbull.

Preparations 8-10 illustrate Mouth-Organs of Insects, exhibited by Mr J. Lindsay.

Preparations 11-20 form a series of Human Parasites, exhibited by Mr Alex. Frazer, M.A.

TABLE III.—Preparations 1-5 are Marine Diatoms and other Algæ, exhibited by Mr J. Rattray, M.A., B.Sc.

Preparations 6-9 are the Teeth (Odontophore) of rare British Molluscs, exhibited by Miss M. M'Kean.

Preparation 10 shows the appearance of a Coal-Miner's Lung who has been affected with Anthracosis, exhibited by Mr Philip J. White.

Preparation 11, shown by Zeiss microscope, Mr J. Donaldson.

Preparation 12 is a section of Doleritic Rock, shown by polarised light, exhibited by Mrs Clapperton.

Preparation 13 shows Circulation of the Protoplasm and green Chlorophyll Granules in Cells of the Leaf of Anacharis, exhibited by Mrs Dowell.

Preparations 14-16 are objects seen under polarised light, exhibited by Messrs Forgan, C. Fraser, and Hume.

Preparations 17, 18 are Zoophytes preserved in the expanded state, exhibited by Dr Henderson.

Preparation 19 shows Moving-spores of a Water-weed (Pleurococcus), exhibited by Councillor Walcot.

Preparation 20 is a section of Black-Pepper Stem, exhibited by Miss Cadell.

TABLE IV.—Preparation 1 is a Double-stained section of Stem, exhibited by Mr J. Henderson.

Preparations 2 and 3 are Crystals viewed by polarised light, exhibited by Messrs Wardlaw and John G. Patterson.

Preparation 4 shows Head-parts of the "Water-boatman" insect (Notonecta), exhibited by Mrs Bryden.

Preparations 5 and 6 illustrate the Structure of the Fore and Hind Leg of the Water-Beetle (Dyticus), exhibited by Messrs Bird and Symington Grieve.

Preparations 7 and 8 are Barbadoes Polycistinæ and Moth Scales, shown by dark-ground illumination, exhibited by Mr Heggie.

Preparations 9-12 show Traube's Cells, and forms of Vegetable-cell growth, exhibited by Mr A. N. M'Alpine, B.Sc.

Preparations 13 and 14 are injected Animal Tissues, exhibited by Mr Hume.

Microscope 15 shows electrical decomposition of Water into its constituent elements, exhibited by Mr Mitchell.

Preparation 16 is a Foraminiferous Gathering, exhibited by Mr J. Allan.

TABLE V.—Exhibition of British Lepidoptera, by Mr H. G. Aldis; and of East Indian Lepidoptera, by Mr G. M. Brotherston.

TABLE VI.—Collection of Fossils from the Edinburgh Rocks, exhibited by Mr John Henderson.

Fossils, exhibited by Mrs Clapperton.

Coloured Plates of two Great Auk Eggs, and Litho. Plate of Bones found in a Shell-Mound at Oronsay, exhibited by Mr Symington Grieve.

TABLE VII.—Specimens illustrative of Scottish Ornithology, exhibited by Mr Bird.

Sterna of Birds and Ear-bones of Mammals, exhibited by Messrs D. Knight and P. J. White.

West Indian Birds, exhibited by Mr J. H. Eld.

New Zealand Apteryx, exhibited by Mr J. Ferguson.

Australian Birds, and Blind Fish from Kentucky Caves, exhibited by Mr P. J. White.

General Bird Collection, exhibited by Messrs Aitken and Fraser, and Mrs Clapperton.

TABLE VIII.—Challenger Expedition Specimens, and Living Animals from the Scottish Marine Station, exhibited by Dr John Murray.

Demonstration on Photo-Micrography, by Mr Forgan.

Exhibition of Electrical Apparatus, by Mr Mitchell.

TABLE IX.—Exhibition of Scientific Instruments and Microscopic Appliances, by Messrs Alex. Frazer and Hume.

There will be exhibits of Rare Plants from the Edinburgh neighbourhood by Mr Archibald Gray and others.

In the Small Side-Hall Dr Foulis will exhibit on a screen the Circulation of Blood in a Frog; and Mr Falconer King will give a demonstration on Spectrum Analysis.

At 9.15 Messrs C. Fraser and Forgan will give a Lantern Demonstration of Microscopic Specimens in the Large Side-Hall.

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