PROCEEDINGS AND TRANSACTIONS

OF THE

Dundee Naturalists' Society.

VOL. I. PART II.

1913-15.

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DUNDEE

PRINTED BY JOHN DURHAM & SON, 11 13 OVERGATE.

1916.

Alexander Hutcheson, F S A. Scot.,
President.

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Dundee Naturalists' Society.

SESSION 1914-15.

LIST OF OFFICE-BEARERS.

President.

ALEX. HUTCHESON, F.S.A. Scot.

Vice-Presidents.

ANGUS MACGILLIVRAY, C.M., M.D., D.Sc., F.R.S.E., F.S.A. Scot.

A. H. MILLAR, LL.D., F.S.A. Scot.

Hon. Treasurer.

WILLIAM KENNEDY.

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HENRY BOASE.
W. D. CARGILL, B.Sc.
JAMES B. CORR.
EVAN H. FRASER.
G. D. RATTRAY, F.S.A. Scot.
Prof. L. R. SUTHERLAND, M.B., C.M.
A. L. SWINTON.

Hon. Secretary.

ALEX. P. STEVENSON.

Assistant Secretary.

THOMAS NICOL.

Curator.

JAMES B. CORR.

SECTIONAL MEETINGS.

Ornithological Section.

Meetings held on the Tuesdays alternating with the Lectures.

Chairman and Convener—Prof. L. R. Sutherland, M.B., C.M.,

Hon. Secretary—Henry Boase.

Geological Section.

Meetings held on the second and fourth Fridays of the month

Chairman and Convener—James B. Corr

Hon. Secretary—Miss Bessie Martin

Archæological Section.

Meetings held on the First Friday of the month.

Chairman and Convener—Alex Hutcheson, F.S.A. Scot.

Hon. Secretary—Robert Donn, F.S.A. Scot.

COUNCIL'S REPORT, 1913-14.

In presenting their Report for the Session 1913-14—the third since the renascence of the Society—the Council are gratified in recording that the forward movement still continues Not only has the number of members been increased, but there were other indications of healthy life to be observed The numbers present at the fortnightly lectures have been very encouraging, and friends from a distance who have favoured us with communications have all expressed the pleasure they enjoyed from such interested and sympathetic audiences Ten meetings were held, and for these the Council were fortunate in securing lecturers who had something of value to tell the members, and the gift of telling that something in the clearest and happiest of ways Old friends were with us, like Professor McIntosh, who was reminiscent of the early days and members of the Society. Present members have also shown by their papers and demonstrations that the Society includes naturalists who observe and note for themselves in the wonderland of Nature, and can give such hints and helps that others may go and do likewise The subjects discussed have been varied. from the reproduction of well-known fishes to the odd habits and ways of the honey-bee and the economy of its hive. The story of the Atlantic Ocean was unfolded, its origin suggested, the life with which it teems described, and the ingenious appliances depicted by which recent explorers have sounded and measured its depths. Our minds were carried to early Christian times in Egypt as we heard the story of the ruined temples and monasteries in the sandy desert, while the life, human and otherwise, was detailed in lone St. Kilda, "placed far amid the melancholy main." The rich vegetation in and around our Scottish lochs was pictured and described by an enthusiastic botanist, while two lady ornithologists, equally enthusiastic and capable, interested us with a vivid account of the bird-life of the Isle of May Their wide knowledge and well-trained eyes enabled them to tell of the surprising number and variety of birds to be seen there, and helped to elucidate something of the mystery and meaning of bird migration The geological record of the course followed by the "silvery Tay" was related by one who has both knowledge of the ground through which it flows and the gift of putting scientific terms in a way to be apprehended by ordinary people Then the life-history of one of the greatest of modern scientific investigators and beneficial results of his labours were treated at length by one who

could well appreciate their importance in the divine art of healing—a striking example of the practical results to which "pure science" may lead In the lecturettes and demonstrations by members of the Society with which the lecture session closed illustrations were given of the ever present story which Nature has in store for those who have ears to hear and eyes to see.

The Council are specially grateful to all the lecturers for their services, and wish to record in black and white the Society's thanks to them—our hearty appreciation of the help given to further the aims of the Society.

The work done by the various Sections will be detailed by the Conveners, and it will be seen there is something to record of their work The generous cheque given by Mr R B. Sharp has induced the Council to take steps to have the ornithological specimens in the Society's collection properly arranged and made accessible In this they are specially indebted to the assistance of Professor L R Sutherland and the members of the Ornithological Section. While the Society may not hope to rival such a display of the bird life of the district as seen in the Perthshire Society's Museum, yet with the amount of material in possession of the Society, supplemented by gifts from Professor Sutherland, Mr Henry Boase, and others, no one need have any difficulty in identifying our local birds.

It is matter of great regret to the Council that they have lost by death one of the most active contributors of local birds to the Museum, Major John Nelson, V.D., who was ever mindful of the bird collection, and not very long before his last illness presented a black-backed gull to the Museum, showing the mature bird in winter plumage. Mr Hutcheson has prepared a short note on Major Nelson for insertion in the Minutes of Council, and this will be printed in the Transactions of the Society

The self-denying ordinance in No. IV. of the Society's Amended Rules came into force with the close ot Session 1913-14, and Dr. MacGillivray retired from the office of President While it is desirable that the honours ot the Society should be passed round, in this case there was a distinct feeling of loss to the Society from Dr. MacGillivray's retiral In making this acknowledgment the Council feel assured that they speak for the members of the Society in expressing this appreciation of the labour and interest in the Society's progress and welfare unremittingly shown by Dr. MacGillivray during his two years' term of office.

Major JOHN NELSON, V.D.,
Died August 5th, 1913, aged 73 years.

(Excerpt from Council Minutes.)

This meeting of the Council of the Dundee Naturalists' Society desires to record in its Minutes its deep sense of the loss the Society and the interests of scientific research generally have sustained by the death of Hon. Major John Nelson, V D , which took place on August 5th. Major Nelson was one of the early members of the Society, and was long a member of Council. As an ornithologist he devoted much of his time to a study of the birds of the Estuary of the Tay—a department of research in which, it may be said, he was thoroughly at home. In many ways he sought to advance the interests of the Society; and it was only recently he undertook to give a lecture on his favourite study, which no doubt would have proved deeply interesting and valuable as a contribution from his intimate knowledge and lengthened study of the wild birds of the Tay Unfortunately the lecture had to be abandoned on account of the advancing inroads of the illness to which he succumbed. This meeting regards this brief notice of his long connection with the Society as only a fitting tribute to his memory and an indication of the universal esteem in which Major Nelson was held by the members of the Dundee Naturalists' Society.

THE SOCIETY'S ORNITHOLOGICAL COLLECTIONS.

The following statement was made by the President as introductory to Professor D'Arcy Thompson's lecture, "Birds in the Ancient Classics" (October 20th, 1914), and is inserted here as indicating the richness of the Bird collections in the Society's Museum and the work done, or being done, in making them available to members, students, and the general public. Mr Hutcheson said:—

By way of preliminary to this evening's lecture, I may be allowed to refer briefly to its relationship to the department of Ornithology in the Society's work. All the members of the Society—at least, all the older members—will be aware that this

department has always engaged a large share of its attention, as the Society's cases of birds in the Museum will show. I propose, in a few sentences, to place before you the present attitude of the Society towards this interesting field of study.

First, I refer to the old collection of birds formed in the early days of the Society These are all stuffed and mounted in life-form This fine collection is mainly due to the late Major John Nelson, who himself contributed the greater number of the specimens as representative of the Water-birds of the Tay, his object being to obtain an example of every species, and at the time of his death, last year, the collection was, through his assiduity continued to the end of his life, left practically complete, there being very few blanks to fill

Since the resuscitation of the Society, three years ago, it has started the formation of a new collection of cabinet specimens These are arranged in trays contained in cabinets, and in this way are more compact and occupy less space than they would do if stuffed and mounted; while in this form they are every whit as available to students. It is intended to include an example of every species of local bird. Already several hundreds of skins have been got These have been tabulated, giving the species, the date when and the place where the specimen was got, its weight, sex, and all particulars carefully noted

This great labour has been undertaken and carried into successful execution by Professor Sutherland, the esteemed Professor of Pathology in University College, to whose self-denying services herein the Society holds itself very greatly indebted. He is also engaged in arranging and naming a large collection of birds' eggs, the nucleus of which was formed by the late Mr R N Kerr, and presented to the Society by Mr J. Harriot Bell of Belmont.

The large and expensive cabinets in which these collections of skins and eggs are contained were provided out of the funds of the Society

In his labours Professor Sutherland has been assisted by Mr Henry Boase, one of the members of the Council, whose enthusiasm in the study of Ornithology deserves special mention, as do also his valuable "Notes on Identification of certain Birds," in which he minutely describes over 160 Land and Water Birds. These Notes, published as an Appendix to Part I. of Vol. I. of the Transactions of the Society, evince close and painstaking inspection, and must prove in future an indispensable aid to students

ARCHÆOLOGICAL SECTION.

REPORT OF MEETINGS FOR SESSION 1913-14

The meetings of this Section were resumed in the Society's Room, Albert Institute, on Friday, 28th November, 1913, when a paper was contributed by Mr Alexander Hutcheson, President of the Section, on "The Culbin Sands, Morayshire."

Mr Hutcheson began by describing his explorations extending over two weeks, repeated during a like period in the following year, when he traversed the whole coast line from Nairn on the west to Burghead on the east, a distance of nearly 20 miles following the curves of the coast, and with the little fishing village of Findhorn as a centre to work from.

The Sands of Culbin lie wholly to the west of the river Findhorn, and were reached by coble from the village. The Sands were described as of dazzling whiteness in the sunlight, formed into dome-like mounds which have a long slope to the south-west and an almost sheer face to the north-east, in this offering a striking contrast to the craig-and-tail formation known to geologists in southern Scotland. There is, unless in the outskirts, no vegetation or life, and even the sea birds seem to avoid the place Numerous attempts, not always successful, have been made by Proprietors to stop the inroads of the sand on the cultivated lands by planting belts of trees. At one part Mr Hutcheson saw a plantation of trees, about 30 feet high, being engulfed by the sand, some of the trees only showing a foot or two above

The site of the Sands was once a most fertile tract with a large population, but about 1694 the great catastrophe happened, and people had to leave everything and fly before the sand, As the wind shifts about it is common for the old furrows to appear of what had been cultivated fields, along with the sites of houses and gardens. Relics of the Stone, Bronze, and Iron Ages are found, and between 1882-92 the Society of Antiquaries collected among the sandhills here over twenty thousand specimens; and here a fine Celtic Armlet was found in 1820

On Friday, 12th December, 1913, the subject for the evening was "Celtic Metalwork of the Christian Period, collateral to the Local Monuments," by Mr Robert Donn, F.S.A. Scot.

In opening, Mr Donn recalled the main features of the decoration of the Pagan Period in Scotland, and showed how these features were developed and adopted in the Early Christian Period The constant use of the open spiral and the return of the close spiral formed the chief features until the development of interlaced work That the Romans had little influence over the art was proved by the absence of classic details and by the similarity of the interlaced bands to those of Byzantium and Syria. Mr Donn showed how the growth and power of the art was centred in the church, and how new motives were brought through the missionary efforts of the Celtic Church. Natural forms are not used until the 8th Century, and even then are strongly influenced by Byzantium

The advent of the Vikings introduced serpent and dragon motives, and from this date the work becomes poorer, until the interlacing motives overcome the spiral

Many slides were exhibited illustrating the ornamentation as shown in Metalwork and Illumination.

On Friday, 16th January, 1914, Mr G Guthrie Roger, M.A., B Sc., lectured His subject was "Notes on the Midland Picts." Mr Roger traced the history of the Picts as found in various records and sought to deduce the character and strength of this people from their resistance to the Roman invasions. Beginning with Cæsar's records, the lecturer spoke of the origin of the branches of the Celtic people Later, he showed that the people were mainly pastoral, used chariots in war, painted their bodies, and fought almost naked

In describing the Battle of Mons Granpius, Mr Roger suggested that the native failure was owing to the Celtic lack of organised battle This must have been the first occasion in which they had united against a common foe. Although defeated, the natives must have been sufficiently strong to be formidable, for Agricola withdrew to winter quarters.

Mr Roger gave a list of tribes, and suggested their probable homes in Scotland. Touching again on the origin of the people, the lecturer pointed to certain facts which showed a connection with Central Europe. Native records showed that they were conscious of an Eastern connection, and believed that the Scots came via Spain and the Picts via the north (Owing to lack of time, the notes were not carried as far as the lecturer would have wished)

On 13th February, 1914—Lecture by Mr Charles Ower, C.E., F.S.A. Scot., on "Colour in Building Materials." The

lecturer explained that what he meant by "Materials" was any building material that could be cut with tools, and called attention to the differing effects that could be produced by different methods of dressing He then described and illustrated by specimens the various methods employed by the ancient Assyrians, Babylonians, and Egyptians Referring to the clay-bricks used by these nations, he pointed out how differences of colour could be produced by sun-dried and burnt bricks. Specimens of burnt Assyrian bricks were shown stamped with the characteristic cuneiform inscriptions The Egyptians largely employed bricks, strengthened with an admixture of straw, in the construction of their buildings The colours of the bricks varied from a pale buff to light brown. Their temples were built of limestone of a pale golden yellow colour. From a very early period the builders in the Nile Valley employed basalt, alabaster, and marble. The building materials used by the Greeks and Romans were then described The latter employed a rough wall of brick veneered with a thin coating of marble Cecilia Matella's tomb was built of grey travertine, with a base and frieze of white marble. In the Byzantine style of architecture, as illustrated by St. Sophia, Constantinople, brick was employed as the building material, and this was encrusted with marble and mosaic. In the ninth century was commenced the building of St Mark's, Venice, where we have this gorgeous display of colour carried to its utmost limits Italy was rich in coloured marbles, and reference was made to the use of red terra-cotta with shafts of white marble The lecturer advocated the employment of more colour in the exteriors of our buildings to counteract the effect of our cold, grey sandstone. A discussion followed on the adaptation of coloured building materials to our climate.

On 27th February, 1914, Mr Alexander Hutcheson, President of the Section, read a paper on "What is a Pict's House?" As this paper is printed in the Transactions under the title of "Early Underground Dwellings in Scotland," it is unnecessary to do more than mention it here.

The concluding meeting of the Section for this session was held in the Society's Rooms on 13th March, 1914, when a paper was read by Mr John Walker, F.S.A. Scot., on "Notes on the History of a Dundee Craft Guild—the Bonnetmakers' Incorporation."

Mr Walker began by tracing from documents belonging to the Bonnetmakers the history of the craft from 1496 downwards, giving many interesting particulars of their laws and procedure at their meetings in early times. He exhibited to the meeting

the oldest Minute-book, but mentioned that the volume known as the "Lockit Book"—a book with a lock attached—is never shown to anyone not a member of the Bonnetmaker Craft

Mr Walker related that the Bonnetmakers took a lease of a Waulk Mill at Dichty, now Panmure Bleachfield, for waulking cloth for bonnets, and the process then cost one penny Scots, or a twelfth part of a penny sterling, for each bonnet. Four classes of bonnets were made. They were very lasting, and the best cost several pounds Scots each (one pound Scots was equal to one shilling and eightpence sterling) A horse and cart went between the Waulk Mill and Dundee daily One thousand dozen of bonnets were "dichted" (finished) at the mill yearly. Many of the rules were very strict No master could fee an apprentice without getting the authority of the craft. Apprentices served five years No master was allowed to take an apprentice for any shorter time, nor more than one at a time St. Bride was Patron, and every master and every woman member had to pay —before the Reformation—one penny Scots weekly to the altar of St Bride in the Parish Church of Dundee The meetings of the craft were held in the Howff up to 1780, when the Trades Hall was built, which contained nine rooms—one for each craft or trade—up to 1838.

Many interesting old deeds and writings were, by the permission of the Deacons, exhibited at the meeting

GENERAL MEETINGS OF THE SOCIETY.

SESSION 1913-14.

14th October, 1913.

Dr Angus MacGillivray, President, in the chair.

The Session was opened with an address by Professor W C. McIntosh, M.D , LL D., F R.S., St Andrews University Professor McIntosh, after some very happy reminiscences of his early association with the Dundee Naturalists' Society and the dredging expeditions which then formed such a prominent feature in its excursions, proceeded to give a most interesting lecture on the "Reproduction of the Salmon and certain other Bony Fishes" The results were given of much original investigation, and the paper was largely illustrated by diagrams, drawings, and an extensive collection of museum preparations

4th November, 1913.

Dr. Angus MacGillivray, President, in the chair.

A lantern lecture was delivered by Mr George West, Botanical Department, University College, under the title of "Botanical Rambles round Scottish Lochs," Many pictures of lochs, some of them at an altitude of 2000 feet above sea level, were shown on the screen and their characteristic vegetation described On the Island of Lismore were three lochs, unique in being highly charged with lime. Here a peculiar growth flourished, and the stones at the sides of the lochs were covered with an encrustation of lime, making them appear like sponges. Stones in more peaty lochs were perfectly clean and devoid of this deposit of lime The large collection of slides, mostly photographed and prepared by Mr West, was specially attractive and interesting, supplemented as it was by the remarks which indicated the keen observation of the lecturer

25th November, 1913.

Dr Angus MacGillivray, President, in the chair

The Rev. Robert Scott, B D , late of Cairo, gave a lecture on "Early Christian Remains in the Egyptian Desert." Lantern slides were shown, illustrating what remained of Early Christian Churches, and much valuable information was given concerning the people and the country Mr Scott also alluded to the signs

which indicated the faiths of the older inhabitants of the desert Referring to the soil, he said it had at one time been very fertile, but now it was so covered with sand that cultivation was exceedingly difficult.

2nd December, 1913.

Dr Angus MacGillivray, President, in the chair

Miss Leonora Jeffrey Rintoul and Miss Evelyn V Baxter, Honorary Members of the British Ornithologists' Union, gave a graphic account of "Bird Life on the Isle of May." Frequent and lengthy stays on the May Island gave them special opportunities of investigating the bird population By permission of the Commissioners of the Northern Lights they had the privilege of using rooms in the large new lighthouse, the only one electrically lighted in Scotland. Much valuable data had been obtained from their observations, and many interesting discoveries made. The lecturers noted 170 species of birds, some very uncommon, several new to Scotland, and one new to the British Isles There is very little cover on the island for birds to hide in, and the small area made it possible to examine the ground several times a day. Thus the regular passage in spring and autumn was proved of birds formerly considered casual visitors An important link was added to the chain of evidence of the existence, under certain weather conditions, of a great system of east and west migration, and this probably occurred all over the East Coast of Britain The lantern slides exhibited were excellent in quality and profuse in number, one showing the latest discovery by the lecturers—the Eastern pied chat.

16th December, 1913.

Dr. Angus McGillivray President, in the chair.

Mr Thomas Nicol, the lecturer for this evening, contributed an interesting paper on "St. Kilda . its People and its Birds." From his personal knowledge and experience Mr Nicol gave a most attractive description of the island and its people The habits and customs of the inhabitants, the quaint character of their dwellings, the various points of interest in the lonely island, and the rugged grandeur of its rocks and shore, all found vivid presentment in word and picture, while the lantern slides also showed many of the various birds noted by Mr Nicol

20th January, 1914.

Dr. Angus MacGillivray, President, in the chair.

A lecture on "The Geological Record, and How to Read It," was delivered by Mr James B. Corr Taking as his text the

Geology of the Tay from its source to the sea, the lecturer pointed out the story revealed by a study of the rock formations through which the river took its course. Away in the north-west of Sutherland, Mr Corr said, they had a fragment of the oldest landscape in Europe, which had been preserved by its being submerged and covered with sandstone The second land surface of the British Isles was to be found alongside that old landscape, and was a red sandstone That formed the surface of practically the whole of the northern part of Scotland, and when one came to the centre of the country evidence was found of compression to the north-west, great areas of rock being removed for a distance of ten miles in that direction The source of the Tay was in Silurian rock, and from there to Loch Dochart it passed through a comparatively uniform strata, which must have been exposed since the Silurian period The windings of the river were difficult to follow The natural course would be in a straight line to the sea, but the irregularities of surface or variations in the hardness of the rock determined the course of the stream Loch Tay was 350 feet above the level of the sea, but as they had part of it 500 feet deep, that area was 150 feet below the sea-level, which made the drainage of the loch impossible The present course of the river must have been followed since the Old Red Sandstone period, but a whole series of geological epochs were passed over, which indicated that during all these periods the country over which the river flowed had not been under water There was distinct evidence of the Ice Age in the valley of the Tay When Nansen crossed Greenland he found, on putting his ear to the ice, that thousands of feet below the surface water was rushing towards the sea, and that was the condition of Scotland during the Ice period After that time the whole valley of the Tay between the Sidlaws and the Ochils had been submerged, leaving a deposit of clay. By this time the climate had so much improved that dense forests filled the valley, and from remains found in the Carse of Gowrie it was evident that huge animals lived in these forests, having found their way from the Continent during the time when the German Ocean was dry land. This forest period was followed by another submergence, and further deposits of alluvium had been laid down Examination of the rock enabled the geologist to read the story of all these changes. The lecture was fully illustrated by maps and diagrams.

3rd February, 1914.

A. H. Millar, LL.D., Vice-President, in the chair.

Dr. F. M. Milne, M.A., B Sc, M.B., in his lecture on "Pasteur and his Work," in clear and admirable style, gave a most interesting sketch of the man and his life's work Dr. Milne traced the life and career of the great Frenchman, touching on

his early discoveries in medical research, before speaking of the great work he accomplished in the interests of mankind. On the problem of spontaneous generation—the battle ground of scientists and philosophers for many centuries, Pasteur was led into discoveries which culminated in what was now known as modern surgical technique and medical treatment by vaccination Another accomplishment of world-wide significance by Pasteur in the sixties of last century, was his valuable work by which he was able to overcome the mysterious disease which threatened to ruin the silk-worm industry of France In 1877 he turned to new and laborious work by which he was able to combat successfully the ravages of the anthrax bacillus in cattle Still further in his wonderful activities, was his valuable research regarding hydrophobia, and Dr Milne spoke fully as to the foundation of the Pasteur Institute and its beneficent work.

17th February, 1914.

Dr Angus MacGillivray, President, in the chair.

The Rev. G. A Frank Knight, M.A, Perth, lectured on "The North Atlantic Ocean" The lecture was largely illustrated by lantern slides, many of which had been prepared in connection with the work of the "Challenger" expedition.

Mr Knight gave a description of the various instruments used in sounding the depths of the sea, and securing species, &c, and paid a high tribute to the work done by the late Lord Kelvin, whose fertile genius was so evident in their invention The Atlantic Ocean had always been the Atlantic Ocean, and never dry land This ocean had gradually contracted and forced up mountains on either side, the Hebrides having been thus formed, and the mountains here were probably the oldest ranges on the face of the globe Mr Knight sketched in interesting fashion the floor of the Atlantic, dealing with the conglomeration of life abounding there. He said there was always abundance of life in the ocean, and many a tragedy could have been averted if only the shipwrecked sailor, cast away in an open boat, had known that by dragging a cloth of any kind through the water, he could have obtained sufficient food on which to live, provided he had a supply of fresh water All sorts of weird and uncanny-like animals and fish were thrown upon the screen, some of which had most up to-date capabilities in the way of catching their food by electric light, while some which lived in the deepest depths were liable, if they got beyond a certain pressure of water, to tumble upwards until, on reaching the surface, they burst! In spite of the tremendous depths at which many of these fish lived, a great amount of their food was obtained from the surface, seaweed, dead fish, &c, sinking down in enormous quantities.

3rd March, 1914.

Dr Angus MacGillivray, President, in the chair.

Mr Robert Murray delivered a lecture on "Bees—some odd points about them" The lecture was quite evidently a talk upon the "beasties" by one who knew and loved them, and had become thoroughly acquainted with the insects and their ways Mr Murray traced the development of the insects from the comb to the hive, and by means of an actual hive showed the habits of the bees. Dealing with the remarkable homing instincts of bees, he said that he once shifted a hive four feet away from its usual position, and laid down his hat on the former site Some time afterwards, when he looked inside the hat, he found that a number of bees had mistaken it for the hive. The difficulty of finding the queen bee on different occasions was humorously referred to by Mr Murray.

17th March, 1914.

W. H. Cargill, B.Sc , in the chair.

The concluding meeting of the Session 1913-1914 was devoted to lectures and demonstrations. Mr A. L. Swinton dealt with "The Botany of the Seaside," explaining how the influence of the sea results in producing a flora quite distinct from anything met inland. Taking the Braes of St. Cyrus, he dealt with each zone from the great plateau above the cliffs, across links, sea marsh, and sand dunes, to the strand emergent zone and the submerged one, where the plants are always covered by water. Describing how the plants had adapted themselves to their habitat, he noted the cushion habit of the sea-side plants, the prostrate stems and the thick, fleshy leaves. Mr Edwin D. Sturrock discussed "The Seashore after a Storm," with special reference to the great storm which took place on 20th January, 1912, when the seashore of St. Andrews' Bay was a mass of living organisms. Mr James B Corr lectured on "The Inmates of a Rock Pool" To see these inmates in all their beauty, Mr Corr said they must be examined in their natural habitat. but by descriptions and lantern slides was able to give some idea of their interest and grace The lecturer told a most wonderful story of the life-history of some interesting zoophytes.

FINANCIAL STATEMENT.

1st April, 1913, to 31st March, 1914.

To Balance at 1st April, 1913, ..	£146	15	3		
,, Donation from R B Sharp, Esq., A/c Ornithological Section,	50	0	0		
				£196	15 3
ORDINARY INCOME, 1913-14					
To 359 Members' Subscriptions at 2/6 each, .	£44	17	6		
,, 2 Associates' do at 5/- each,	0	10	0		
,, Interest from Dundee Harbour Trustees on Bond for £50, ..	1	13	0		
,, Interest from Banks, .	3	5	4		
				50	5 10
				£247	1 1
ORDINARY EXPENDITURE, 1913-1914					
By Printing, Stationery, and Postages,	£3	0	2		
,, Advertising Lectures and other Meetings,	7	0	0		
,, Fire Insurance on Policy for £800,	1	9	4		
,, Lantern and Operator at Lectures, .	4	4	0		
,, Lecturers' Expenses,	2	1	0		
,, Stuffing Birds &c., for Society's Collection,	2	6	9		
,, Expenses on Excursion to Crail (Deficit),	5	1	9		
,, Gratuities to Attendants for Services at Lectures, &c.,	1	7	6		
,, President's, Hon Secretaries', and Treasurer's Expenses, .	1	13	10		
,, Working Expenses of Archæological Section,	0	9	0		
,, Do Botanical Section,	0	12	6		
,, Do Geological Section,	0	9	3		
,, Do Ornithological Section,	0	14	3½		
,, Sundries, ..	0	8	1		
				£30	17 8½
EXTRAORDINARY EXPENSES, 1913 1914					
By Birds purchased for Society's Collection,	17	9	6		
,, Case for Society's Specimens (to A/c of Estimate),	20	7	6		
				37	17 0
				£68	14 8½
By Balance, . ..				178	6 4½
				£247	1 1

STATEMENT OF FUNDS AS AT 31st MARCH, 1914

Dundee Harbour Trust Bond for £50 lodged in Royal Bank of Scotland,	£50	0	0
Dundee Savings Bank on Deposit Account,	127	15	7
Cash in Treasurer's hands, .. .	0	10	9½
	£178	6	4½

E and O. E., Dundee, 28th March, 1914.

WILLIAM KENNEDY, *Hon. Treasurer.*

Dundee, 31st March, 1914.—Examined, compared with vouchers, and found correct.

C. YOUNG,
D. F. CHALMERS, } *Auditors.*

COUNCIL'S REPORT, 1914-15

When the Council met to reconsider the arrangements which they had made early in the Session 1914-15 for carrying out their projected programme, they did so under changed circumstances. These were the outbreak of war, the almost feverish interest every one seemed to take in its progress, and, further, that some of the lecturers arranged with had intimated their inability through military duties to undertake the papers the Council were counting upon. It therefore became necessary to readjust the programme, and ultimately it was decided to reduce the meetings to one a month, instead of once a fortnight as in previous Sessions. But the Session had just started when the Police Regulations as to the lighting of public buildings made it necessary for the Free Library Board to intimate their inability to allow the Society to hold its public meetings in the Albert Institute. This was a matter of regret, for the privilege granted to us by the Free Library Board was very convenient both for lecturers and audiences. We were fortunate, however, in being able to secure the Oak Room in Lamb's Hotel, and there, with the single exception of Professor D'Arcy Thompson's opening lecture, all the meetings have been held.

In addition to the perhaps sentimental satisfaction in renewing the Society's relationship with Lamb's, the meeting-place was very convenient and comfortable, the attendances very gratifying, and in a sense social and homely. The papers, if less numerous than in former Sessions, were interesting, varied, and helpful. Professor D'Arcy Thompson dealing with "Birds in the Ancient Classics," brought to bear on the subject his biological knowledge and his equally great classical scholarship, and mingled both in a very human treatment of his old-world natural history discussion. Mr J. B. Cott, with a most elaborate gathering of shells, explained the different forms these organisms assumed and the relation the form bore to life and habit. Mr Robert Donn gave a most exhaustive story as to the extent and development of Celtic Ornament on Stone and Parchment, and brought to notice the richness of our own country-side in specimens of the Sculptured Stones. Dr A. H. Millar, out of the treasures of his knowledge sketched "The Natural History of Shakespeare's Time," and indicated by passages from the great dramatist's plays, set against extracts from the Natural History books of the period, that Shakespeare must have been familiar with the books referred to and the current views on Natural History held by the common people among whom he was brought up. Dr. Doris L. Mackinnon, in her usual lucid and charming style, made the matter of "Animal Geography" as interesting as

a fairy tale, while Mr Henry Boase, in his discourse on "Bird Migration in our own Neighbourhood," gave the Society the benefit of his close and careful observations on the subject His carefully-prepared tables showing the times of arrival and departure of migrating birds indicated his keen investigations, and showed that to him who has eyes to see and knowledge to note our own Bay of Invergowrie, or almost any other place, may be a veritable Selborne to him who cares to observe it.

The lectures were well illustrated by specimens and lantern slides, and the Council are glad to record their warmest thanks to the various friends who gave their services. It is a matter of congratulation that all the lecturers were connected with the Society. At these meetings we were fortunate in having our President in the chair, and the Council have been specially pleased at his remarks as Chairman, his wide knowledge of field Natural History and his ready recital of facts observed by himself were much appreciated, and indicated how much pleasure might be obtained by any one who cares to walk afield with open and inquiring eyes.

Under the circumstances it has not been possible to have numerous sectional meetings this Session, but those held will be referred to in the reports of their recorders. Mr Corr will have something to say as to the progress of the Museum The books in the Library, while not so much utilised as they might be, have still been consulted by members. The more valuable books are placed in the Society's Room A considerable collection of the Royal Microscopical Society's Journal and other books have been presented to the Society's library by the Trustees of the late John Hood, F R.M S By the death of Mr Hood and Mr Alex. Hutton we have lost two old and highly valued members of the Society who from its inception took much interest in it and did their full share in its work.

The Publications Committee have in view another issue of the Society's Proceedings, in which it is hoped to include some special papers written by members

The Council have to thank the members for the confidence placed in them during the past Session The times were certainly abnormal, but they did their best, and leave it to the members to say whether under the circumstances during the Session and after it might not be the wisest and safest thing to re-elect them *en bloc* (a suggestion which was carried out by a slight re-arrangement of the office-bearers.)

ORNITHOLOGICAL SECTION.

I have pleasure in reporting at the Annual General Meeting of the Dundee Naturalists' Society that the Ornithological Section has been able to carry out a limited programme during the 1914-15 Session. Five meetings were held, at which there was an average attendance of fourteen.

The following papers were read at Section meetings .—

"Local Nesting Birds,"	E H Fraser	14th Nov , 1914
"In Wild Lochaber,"	Thomas Nicol	12th Jan , 1915
"Songs and Calls,"	Henry Boase	26th Jan., 1915
"Feeding Habits,"	J W. Kippen	23rd Feb., 1915

During the early Summer of 1914 two excursions were carried out successfully—one to Redmyre Loch on 30th May, and the other to Auchmithie on 13th June. No excursions of the Section will be held this Summer.

A Report on the Migrations noted in the district during 1914 was sent as usual to Miss Baxter, of Largo, for the Scottish Migration Report.

(Signed) HENRY BOASE,
Hon Secy of the Section

ARCHÆOLOGICAL SECTION.

REPORT OF MEETINGS FOR SESSION 1914-15.

The Archæologioal Section has been carried on as usual during the winter, although, as in the case ot the Society's Lecture Course, it was found necessary for the like reasons to abridge somewhat the number of its meetings and papers.

The meetings were held in the Society's Room in the Albert Institute.

The opening meeting was held on 4th December, 1914, when a paper was read by the President, who is also Convener of this Section, on "The Tongue as a Magical Symbol." In the course of the paper Mr Hutcheson dealt very fully with the symbol of the protruded or lolling tongue in Early Art, and from the wide-spread use of the symbol concluded that it is of great significance,

although so far no writer has been found to deal with it as a cult He divided his subject under four heads, illustrating each by pictures and drawings, as follows —

1 Ancient Symbolism as represented by sculptures of the Gorgon's head, asses with lolling tongues at Mycenæ, examples in Early Roman, Egyptian, and Celtic sculpture, and references drawn from old masters

2 Heraldry, Ancient and Modern, as a sign of contempt, threatened attack, and power

3 Modern survivals amongst the Maoris of New Zealand in their war dance, or "Haka," and in the club, or "Meri," and spear of the chief, and in Thibet

4 Local every-day usage as when the small boy by this symbol shows defiance

At the meeting on 5th February, 1915, it was intimated that Mr Robert Donn, F S A Scot, who had hitherto officiated as Secretary to the Section, had joined H M Forces

A paper was read at this meeting by Mr G Guthrie Roger, M A, B Sc, on "The Scottish Token Coinage, with particular reference to Dundee and District"

Mr Roger commenced by pointing out that the development of the minor coinage was modern, and that Government long shirked its responsibilities in this matter With the development of trade in Elizabethan and Stuart times the necessity for a coinage of small values became clamant, and gave rise to the issue of the seventeenth century trade tokens, mainly in the reign of Charles II Scotland had no share in this issue Hence the one specimen known was of late date, and probably issued by an Englishman It was not till 1780 that the first of the Angus farthings appeared in Glasgow These were speedily followed by others, the bulk of which appeared after the great impulse given by the issue of the "Anglesea Mines" tokens of 1787 and succeeding years A special note was made by the work of James Wright, Jr, of Dundee, whose intentions were less to produce a medium of exchange than to form an architectural and historical record—his contributions to the Dundee, Edinburgh, Perth and Forfar tokens all showing public buildings

A considerable number of tokens were exhibited, as well from Mr Roger's own collection as from that in the Museum, kindly lent by Dr Millar Mr Roger pointed out from the specimens before him many features of interest in the designs, and dwelt for a short time on those peculiarities of defect or otherwise which give to some specimens a special interest in the eyes of collectors

The concluding meeting of the Section was held on 5th March, 1915, when a paper was read by the President on "The Cult of the Undressed Stone—a Study in Nature Worship"

In the elucidation of the problem presented by the superstitious feelings with which the undressed stone has been regarded by early races, some of the forms of Nature worship were reviewed and descanted on, with literary references, ancient and modern. Analogy was traced between Jacob's Bethel-stone and the Baitylos, undressed stones worshipped by the Greeks.

Reference was made to Scottish examples, chief among which is the Scottish Coronation Stone, which was described and its reputed history briefly noted, by which it has come to be regarded as absolutely indispensable to the inauguration and coronation of a British Sovereign.

Among local undressed stones accorded a reverential treatment were mentioned the stone from which the County of Clackmannan takes its name, the "blue stones," so called, of St Andrews and Crail, the "Dundee Stone" compared with "London Stone," from which measurements were computed, at which meetings were held and edicts served, the Hare-stane at Strathmartin, the Paddock-stane at Invergowrie, &c.

In reviewing the evidences, Mr Hutcheson concluded that the reverential feeling with which early man came first to regard the undressed stone was probably because in his observation of the scheme of Nature, where everything seemed subject to constant and more or less rapid change, the boulder-stone would seem to his uninstructed eye to possess an element of endurance and unchangeableness which linked it with Divine power.

GEOLOGICAL SECTION.

EXCURSIONS, 1914

April 3rd—**Excursion to Law Hill.** 13 members present. The first part of the evening was occupied by Mr Roger, who spoke of the Law Hill from the Archæological point of view. He stated the hill was the site of a vitrified fort used by the Picts. He drew attention to the double mound running round the summit and stated that no hill naturally would have that particular formation.

Several stones forming part of the rampart were examined, and found to consist of *Gneiss*, *Mica Schist*, *Andesite*, and *Sandstone*. On the north-east side attention was drawn to the rusty brown soil, the result of the disintegration of the Basaltic rock composing the hill. On the south-west slope an exposed surface of the rock was discovered to be smooth and polished with striations, apparently due to glacial action

April 17th.—**Excursion to Stannergate.** 11 members present. At this excursion the nature of the rocks was examined in the railway cutting extending from the bridge at the Orphan Institution to West Ferry, and also the exposures on the beach. *Purple Andesite* similar to that of Balgay Hill was found, as well as masses of *Volcanic Breccia* and *Amygdaloidal rock*. Much of the latter was green coloured, due probably to Chlorite. Two beds of *agglomerate* (one reported by Mr Murray at the railway cutting and one on the beach) were also found. Mr Murray also reported finding indications of an old beach and also a bed of *Volcanic Tuff*.

April 24th—**Excursion to Reres Hill.** 10 members present. The work really began on the summit of the hill. Here Mr Corr stated that from the sea up to the base of Reres Hill and surrounding it was a bed of loose sea sand, in some places over 15 feet in depth Some of the specimens of rock here examined were distinctly *porphyritic*, the crystals being sharply defined, though farther east on the slope *amygdaloidal rock* was again obtained, but not quite so discoloured as that found on the beach. *Andesite rock* was found in the blown sand On the beach similar rocks are exposed

May 1st.—**Excursion from Wormit to Peashill Point.** 11 members present. Rocks were examined at several points from the west end of the Esplanade to Peashill

The rock here is a mass of *Andesitic Lava*, probably a continuation of the lava flow which overlies the Fife hills. Specimens of *Rock Crystals* and *Calcite* were obtained, as well as pieces of rock showing the incipient formation of agates.

The quarry being reached, an examination was made of part of the fresh rock underlying the accumulation of boulder clay. This rock was sedimentary in character, made up of grains of greyish igneous rock, probably formed from the waste of dacite lava. The specimens showed distinct layers, differing in colour and quality of grain.

On the east side of the quarry was a fragment of the old 50-feet beach, digging operations yielding water-worn pebbles. Specimens of "dog tooth" spar were found. Overlying the

Sandstone was a bed of igneous rock, the specimens showing a green colour

Farther west on the beach the dip of the rock was distinctly seen In the foreground was yellowish sandstone, and behind it a deposit of shale This latter was searched in the hope of obtaining fossils, as this bed has yielded *Parka decipiens* and fossil fishes.

Tracks were made to the Point, where the salmon coloured dacite lava already examined on the opposite side of the river reappears on the south side

Between the sandstone on the East, and the dacite lava on the West, *a bed of agglomerate* was noted, and specimens showing a mixture of grey and pink rock were secured The question was raised whether this may not have been a volcanic vent

May 8th—**Excursion to Newport** to examine rocks was postponed owing to inclement weather

May 15th—**Excursion to Causewayhead Quarry.** 11 members present The rocks here consist of huge masses of dark coloured rock, commonly known as whinstone, but microscopic examination shows it to be an *Enstatite Andesite* Much of the rock was very much weathered, giving rise to *Steatite* or *Soapstone.* The Andesite contained quantities of red particles, known as *Bronzite.*

Leaving the quarry and returning to the main road, we noted the fine illustration of mountain and valley formation, the valley being probably formed by denudation To the left were seen numerous projecting lava escarpments

May 22nd—**Excursion to Newton Hill.** 11 members present. The cutting on the face of the hill was visited and examined, and found to be a distinctly *acid Andesite.* After the boulder clay had been removed from the surface of the overhanging top, distinct scratches were seen, these being probably due to glacial striation

May 29th—**Excursion to Kames at Wormit.** 11 members present This excursion was led by Mr Peebles, who has a special theory regarding the formation of these deposits. Much discussion took place at various vantage points, but it was considered advisable to have a night during the winter session specially devoted to the subject

June 5th.—**Excursion from Tayport to Newport by Beach.** 8 members present. Examination was first made of the cutting through which the railway runs West of Tayport. Specimens of

Calcite were numerous, and it was specially noted that the Andesite here found contained *Bronzites*, thus the rock being apparently similar to that found at Causewayhead Quarry

Arriving at the beach attention was directed to the dip of the rocks to the south-east, and to the rock itself which was Andesite, containing conspicuous irregular veins of sandstone, termed by the leader, Mr Murray, "*lick-ups*"

Between the second and third lighthouses part of a raised beach (probably 25 feet) was noticed, and travelling west towards Newport the beach was again plainly evident

Here also were seen veins of Old Red Sandstone and beds of what was apparently conglomerate, but was, on examination, considered *agglomerate*

West of the third lighthouse a bed of pure agglomerate, similar to that found on the opposite side of the river was noted, the constituents containing no water worn but sharp cornered material, which was probably the lining of a volcanic vent

June 12th—**Excursion to Ninewells West.** 8 members present This excursion was arranged for the purpose of completing the work carried out in the previous session

There have been no winter meetings of this session

BESSIE MARTIN, *Hon Secretary.*

CURATOR'S REPORT

During the past two years the chief additions to the Collections of the Dundee Naturalists' Society have been made to the Ornithological Department. A large cabinet has been constructed by the Society for the reception of the collections of Birds' Eggs and Birds' Skins which are in course of arrangement by Professor Sutherland. In addition to a cabinet of about 80 drawers, show cases are provided for a display of a type series illustrating variations in the size, colour, markings, &c., of eggs, and the exhibition of a complete suite of specimens to elucidate the osteology of the bird. These osteological specimens have been carefully prepared by Professor Sutherland, and will form a very valuable acquisition to the Ornithological Department.

The collection of birds' skins, as far as catalogued, consists of 211 specimens of British birds, all authenticated as regards locality, date, sex, plumage, &c., and representing 108 species.

The most recent addition to the Society's collection of Birds consists of 5 fine specimens of Northern and Arctic birds, viz. —

Snowy Owl
King Duck (male), from Davis Straits
Great Northern Diver
Red Throated Diver, in summer plumage
Black Throated Diver

These birds have been beautifully set up in characteristic attitudes by Charles Kirk, of Glasgow, and are exhibited at present amongst our local birds.

JAMES B. CORR, *Curator.*

ADDITIONS TO THE LIBRARY.

From the Trustess of the late Mr John Hood, F.R.M.S.—

Journal of the Royal Microscopical Society, 20 vols., 1881-1895, 1909-1913

Life of a Scotch Naturalist, Thomas Edward, by Samuel Smiles, 1876

Hooker's Student's Flora of the British Islands, 1878

GENERAL MEETINGS OF THE SOCIETY.

SESSION 1914-15.

30th October, 1914.

Mr Alexander Hutcheson, President, in the chair

The opening lecture was delivered by Professor D'Arcy W Thompson, C.B., M.A —the subject being "Birds in the Ancient Classics" In the course of his paper, which was illustrated by a collection of beautiful lantern slides, in which many of the birds in the old classics were identified with present-day species, Professor Thompson dealt with the references to birds which appear in the works of the ancient classic authors Of all the poets of antiquity, Virgil it was who spoke oftenest and most truthfully of the ways of beast and bird and all the sweet life of the countryside The Professor quoted the references to the stock-dove, the rock-dove, the swallow, and the nightingale. From Aristophanes, the comedy of "The Birds" supplied many references to a great number and variety of birds and details of their range and habits.

The following Lectures were given in Lamb's Rooms :—

17th November, 1914,

Mr Alexander Hutcheson, President, in the chair.

A lecture on "Shell Architecture" was delivered by Mr James B Corr Every plant and every animal, the lecturer said, was constructed on some definite plan, having reference to the functions of the organism and the nature of its environment It was this architectural and engineering part of the business which was to occupy their attention—the wonderful unity of plan in the thousands and thousands of shells that were found within the range of Neptune's kingdom Reference was made to our imperfect knowledge of the Mollusca, notwithstanding the extensive literature on the subject. This was largely accounted for by the fact that for a long period only the shells were collected and classified, no attention being given to the architect, the late occupant of the now tenantless tenement. The shells found on a rocky coast were compared with those which found a congenial home on a sandy beach Some mollusca, *e.g.* fresh-water snails, were extremely sensitive to changes in the nature of their surroundings, and, in response to these changes,

varieties are frequently produced As many as 155 varieties of *Limnæa peregra* have been recorded The various spiral constructions so common amongst the univalves were described and illustrated These were shown to coincide with what is termed the "logarithmic spiral," but it was pointed out that this mathematical accuracy of construction was simply the result of the great law of symmetry in Nature Various groups of shells, such as the Strombs, Cowries, Cones, &c , were described, and the changes which occur in the forms of their shells during growth illustrated by numerous specimens. A large collection of over a thousand shells from Mr Corr's own cabinet was on exhibition, and explained by him at the close of the lecture

15th December, 1914.

Mr Alexander Hutcheson, President, in the chair.

Mr Robert Donn, F.S.A. Scot., delivered a lecture on "Stone and Parchment: Studies in a local Art." An enthusiastic but discriminating student of Celtic Art, Mr Donn dealt in the main with stones erected in the earlier ages in the neighbourhood of Dundee Many of these specimens, the lecturer stated, were particularly fine In the City Museum casts of the finest were to be seen The actual purpose of the stones was somewhat doubtful. Perhaps some had served as monuments to the dead—memorials of great men—or merely as boundary stones The ornamentation of the stones, especially in its interlaced work, was shown to exist also on parchment in ancient Irish manuscripts of the Gospels, such as the Book of Kells and the Book of Durrow, which were described Much of the beauty in Celtic Art, Mr Donn maintained, was due to the spread of Christianity at that time, although, as he showed by comparisons, the influence of Egyptian, Byzantine, and Scandinavian Art was also to be traced The lantern slides with which the lecture was illustrated were specially helpful, and suggestive of the lecturer's contention.

19th January, 1915.

Mr Alexander Hutcheson, President, in the chair.

A lecture on "Natural History in Shakespeare's Time" was delivered by Mr A H Millar, LL.D., F.S.A. Scot.

Dr. Millar opened his lecture with a brief reference to the Shakespeare controversy He pointed out that the knowledge displayed by the immortal dramatist of different sciences and trades was extraordinary and intimate, as almost to justify the contention that the plays were written not by one man, but by a syndicate. Ample evidence was present in Shakespeare's work

that he had read all the books on natural history then available, including that by Bartholomæus—the standard treatise of the times. Dr Millar gave most interesting parallel quotations from Shakespeare and the current natural history books, showing that, in some cases, the dramatist had almost paraphrased descriptions given of animals and plants, including, among others, the popularly accepted legends of the toad which "weareth a jewel in her head" and the mandragora shrieking "like mandrake torn out o' the earth."

16th February, 1915

Mr Alexander Hutcheson, President, in the chair.

Miss Doris L. Mackinnon, D.Sc., lectured on "Animal Geography." Describing the multiplication of animals, and the corresponding necessity of finding larger areas in which they might exist, Dr Mackinnon proceeded to show the influence upon them of the different barriers—such as seas, mountains, and deserts—which they met with in the course of their migration from one tract of land to another. She also discussed the geological changes which the Earth had undergone, dealing particularly with the Glacial Epoch and the changes in the distribution of fauna which had resulted therefrom. The lecture was admirably illustrated by limelight views.

16th March, 1915

Mr Alexander Hutcheson, President, in the chair.

Mr Henry Boase gave the results of his keen observation of bird life in our immediate surroundings in the course of a lecture on "Bird Migration in our Neighbourhood." Of 152 different species which Mr Boase had observed over the past few years, some 130 showed strongly marked migrations. By means of a large number of carefully prepared diagrams, thrown upon the screen, Mr Boase indicated the routes of the Spring and Autumn migrations in the Estuary of the Tay. Alluding to the disturbing effects which the present war might have upon the migratory habits of birds, it was possible that the Tay district would benefit by the visits of new species.

FINANCIAL STATEMENT.

1st April, 1914, to 31st March, 1915.

To Balance at 1st April, 1914, ...				£178	6 4½
ORDINARY INCOME, 1914-1915					
To 1913 1914 Subscriptions paid in 1914 15, ..	£0	5	0		
,, 302 Members' Subscriptions for 1914-1915 Session at 2/6 each,	37	15	0		
,, 2 Associates' do do at 5/- each,	0	10	0		
,, One Copy of Society's Proceedings for 1912-13 sold,	0	2	6		
,, Interest from Dundee Harbour Trustees on Bond for £50, ..	1	15	3		
,, Interest from Dundee Savings Bank, ..	2	6	9		
				42	14 6
				£221	0 10½
ORDINARY EXPENDITURE, 1914-1915					
By Printing, Stationery, and Postages,	£4	12	6		
,, Advertising Lectures, &c., ..	4	10	8		
,, Fire Insurance Premium, .. .	1	14	6		
,, Lantern and Operator at Lectures,	2	9	1		
,, Ornithological Section—Working Expenses for the Session,	0	9	2		
,, President's, Secretaries', and Treasurer's Expenses,	1	10	9		
,, Sundries, . .	1	18	6		
				£17	5 2
EXTRAORDINARY EXPENSES, 1914 1915.					
By Birds, &c., purchased for Society's Collection in Museum, ...	£11	19	1		
,, Balance of Contract of Case for Society's Specimens in Museum, ..	18	11	4		
,, Drawers for Cases for do do	8	13	0		
,, Covers for Drawers for do do	3	13	4½		
,, Trays for do do	2	11	0		
,, Microscope for Society,	9	0	0		
,, Cost of Printing Proceedings of Society, 1912-13,	29	8	6		
,, Cost of Oak Room, Lamb's Hotel, for Lectures, 1914 15, ..	2	15	0		
				86	11 3½
				£103	16 5½
By Balance, ...				117	4 5
				£221	0 10½

STATEMENT OF FUNDS AS AT 31ST MARCH, 1915

Dundee Harbour Trust Bond for £50 lodged in Royal Bank of Scotland, ...	£50	0	0
Dundee Savings Bank Deposit Account, ...	63	10	8
Cash in Treasurer's hands, ...	3	13	9
	£117	4	5

E. and O. E., Dundee, 30th March, 1915

WILLIAM KENNEDY, *Hon Treasurer.*

Dundee, 30th March, 1915.—Examined, compared with vouchers, and found correct

D. F. CHALMERS,
JOHN M. INCHES, } *Auditors.*

EARLY UNDERGROUND DWELLINGS IN SCOTLAND.

By Alexander Hutcheson, F.S.A. Scot., Broughty Ferry,
President of the Dundee Naturalists' Society.

In reviewing the early evidences of man in Scotland, not the least interesting are those relating to the provisions he has made for a dwelling-place

To us the subject is doubly interesting, because from the dawn of history down to late mediæval times Scotland has possessed an architecture stamped with an individuality in native art. The Brochs—the earliest of the castellated structures of Scotland—are wholly native in design and construction. They are unknown out of Scotland. It is practically the same in regard to the Castles that come after, known as the Scottish Baronial There is not known to be in Scotland any example of Domestic Architecture of the Norman period, yet in all those showing Norman and later English, followed by Rennaissance influences, they exhibit, especially when examined in detail, an individuality which may be called National, which differentiates their style from every other

It is the same in reference to the class of underground dwellings which forms the subject of this paper. These also, as I hope to shew, may be claimed as national and peculiar to Scotland

Nothing is more difficult in Archæological research than to determine periods of time. Sequence of events may sometimes be obtained, but a chronology is in many cases impossible, especially when history, as here, is silent on the subject. No ancient writer is known to cast a light on the period when artificial subterranean structures were first constructed.

Among modern works on Scottish Architecture, with the exception of Billings' monumental work on the *Baronial and Ecclesiastical Antiquities of Scotland*, nothing worthy of the special subject of Domestic Architecture had appeared until twenty-five years ago, when Messrs MacGibbon and Ross published their great work, *The Castellated and Domestic Architecture of Scotland from the 12th to the 18th Century*. The title is comprehensive enough to have covered a larger field, but it cannot be

alleged that the authors have scrimped the information presented to their readers. Billings' volumes, with a solitary exception, furnished no plans. This desideratum is supplied in ample measure by Messrs MacGibbon and Ross. Alike in the wide range of buildings dealt with, as in the wealth of historic notes and illustrations contained in the five large volumes of which the work consists, subsequently followed by other three volumes dealing with ecclesiastical buildings, the able authors have placed all students of Scottish Architecture under a debt of the deepest gratitude The field covered by those writers is so vast that it was doubtless felt necessary to restrict it alike in respect of period and subject. It is, however, matter for regret that they have left out of the scheme of their work any review of the houses of the common people, in which their critical ability as architects could not but have proved of great value to succeeding students

In directing attention, therefore, to an early underground class of dwellings in Scotland, the only sources of information available are such scanty references to reported discoveries as may be derived from magazines, more fully from the *Proceedings* of the Society of Antiquaries, and mainly from what has been set forth by Dr. Joseph Anderson in his book, *Scotland in Pagan Times—The Iron Age,* where he summarises the evidences, and ascribes to those structures a suppositionary period.

In modern days the Police, armed with the Public Health Acts, insist that an underground apartment shall no longer be regarded as a dwelling-house, but in early times the human race was cradled underground. The security from enemies and shelter from the elements offered by the humble cavern early commended it as a suitable habitation for man Many ancient examples have been identified from an examination of their floors shewing the relics of man's presence mingled with the bones of extinct mammalia.

In Scotland, as elsewhere, man's earliest shelter from the elements would be the natural cave. He might, as a protection from wild beasts, roll a stone to block up the entrance, but of structure there would be none Of the natural caves in Scotland which may have sheltered man none show artificial shaping, although some few are not destitute of surface decoration of late origin, as in the Fife Coast Caves.

It is different in many foreign countries, where a wealth of artificially-cut caverns and galleries, divided into compartments with connecting staircases and passages, exist in precipitous rock-faces, used first as human habitations, and latterly—many of them in modern times—as robbers' dens.

England could show several examples of the latter even in the last century

In the rock-cut temples of Luxor in Egypt, and of Elephanta in India, cave-sculpture attains its highest level

To deal at length with any of these forms of occupation would be foreign to the objects of this paper, but a short digression may be pardonable to direct attention to Scottish examples of the use of the natural or mountain cavern as a dwelling-place Here man found ready-made a secure retreat from savage beast or human foe, from tempests' blast and bitter cold, and he has never forgotten it! In the Middle Ages caves were also the ready resort of bands of robbers and broken men of every description who lived by rapine or plunder. Those who have read Crockett's story, *The Grey Man*, will remember the terrible picture he portrays of the cave of Sawny Bean, the traditional head of a family of cannibals, the scene of whose depredations placed him in Galloway, but which a local tradition ascribes indifferently to the Glack of Newtyle and to Denfind, near Monikie, as described by Hollinshead and Pitscottie The entrances to such caves were often cunningly contrived to avoid observation. In the Highlands of Scotland there were many such, and there are no more stirring pages in literature than those which deal with well authenticated cases of men flying from pursuit finding shelter and safety for many days, or even months, in such concealment as a cave would afford The flight of Prince Charles after Culloden was marked by his finding shelter in such places, which are yet existent in the wild and secluded valleys of the Highlands, known, it may be, now only to the few older inhabitants The late Rev John McLean, minister of Grandtully, whose family could trace their residence in that district for many generations, took me to see a cavern in Strathbraan which sheltered for many months one of the refugees from Culloden.

The cave had two openings, so that its occupant, should one of the openings be discovered, either by his being seen to enter or otherwise, could make his escape by the other One of the entrances opened from a depression behind a rocky knoll near the top of a hill, while the other was much lower down and concealed from observation in a rock-face among fallen boulders This lower opening afforded a view up and down the strath, the public road being visible for several miles in both directions, so that when strangers appeared he could, himself unseen, observe all their movements In this way he saw on several occasions bands of English soldiers pass his hiding-place He was careful never to leave the cave but under cloud of night, and to preserve secrecy he never asked food from any people in the strath, but was in the habit of crossing the hills to Strath Tummel, where he was known, and ultimately, when the search slackened, he rejoined

his family, and ever afterward was known as "John of the Cave," which in modern Scots would take the form of "John Wemyss" —a surname of ancient repute in Scotland, believed to be territorial in its origin, although the popular cognomen of the Culloden refugee shows how, in another way, the surname of Wemyss may have had its rise.

The underground retreat had its counterpart in most—perhaps in all—of the ancient castles in Britain and on the Continent, in their secret rooms and passages. To tell of those in Scottish castles alone would fill a volume Those secret resorts were indispensable to the safety of the inmates, and especially the secret outlets, which usually issued in some dense undergrowth or rocky defile

The artificial subterranean dwellings in Scotland are indifferently referred to as "Picts' houses," "Weems" (from the Gaelic "Uamh"—a cavern), and "Eird-houses" (from "Yird"—the common old Scottish term for "earth"), the two latter designations being literally descriptive. I propose in what follows to use the term Earth-house as being least liable to misconception.

The circumstances which led to the discovery of an Earth-house near Perth, in which I was privileged to bear a part, may be here cited as an introduction Early in 1904 the formation of a new roadway on the north side of the River Tay, close to the public road to Dundee, led to the discovery of certain remains of rude stone buildings, considered to be of ancient origin, and I was asked on behalf of the Council of the Society of Antiquaries, who had been notified, to inspect the remains. I lost no time in doing so, and was gratified to find, in place of the foundations of cottages, as previous experiences had led me to anticipate, the remains of one of those underground structures to which I have referred, several of which I had visited, and with the general aspects of which I was well acquainted. Certain peculiarities differentiating this example from others served to emphasize the importance of investigating closely all discoveries, however unpromising, but before describing these it will be proper to deal with the general features of the Earth-houses.

They mostly all conform to one type—that of being wholly underground, almost invariably in the form of a long narrow curving gallery, having a very narrow and low-sloping entrance passage facing towards the east or south-east From the inner end of this passage the gallery forming the Earth-house gradually increases in height and width, curving usually to the left, and terminating at the inner extremity in a slightly enlarged chamber having a closed and rounded end. The walls are usually erected in the lower part of boulders or large stones set on edge, and on

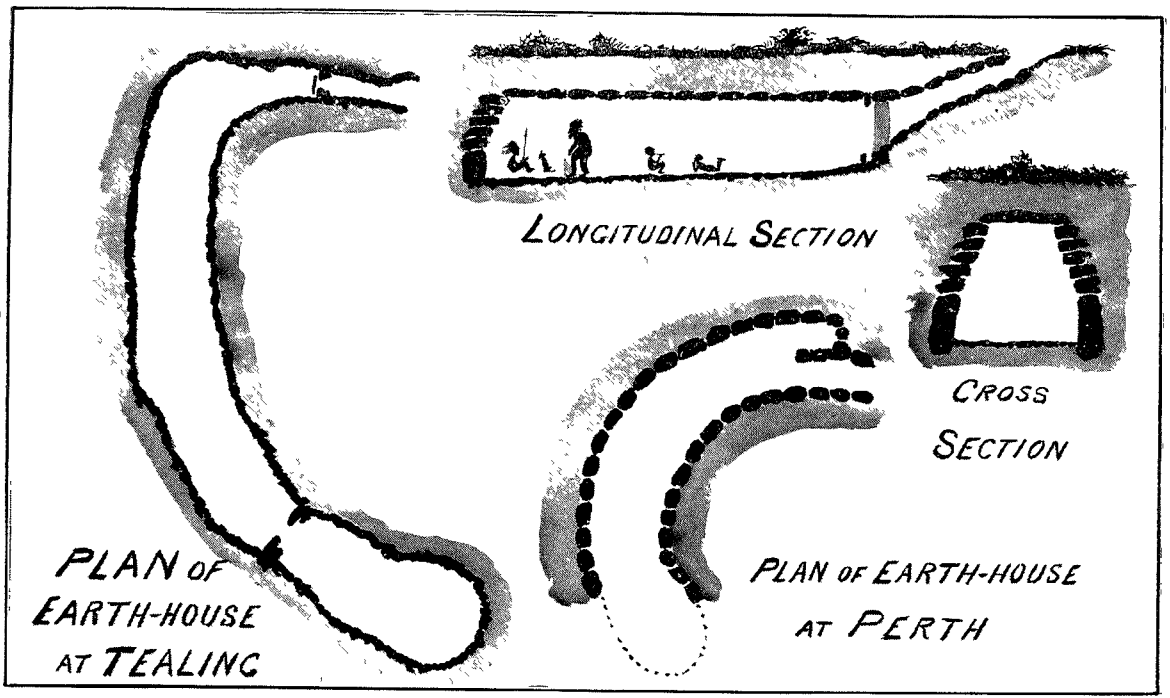
the top of these, smaller stones are built up to form a wall of very rude description, wholly formed of unhewn stones laid flat and built dry without mortar or lime, and without any of the characteristic "bond" of modern masonry, and carried up to a total height of from five to seven feet above the floor. The builders were evidently wholly unacquainted with the principle of the arch in Architecture, whereby stones are cut and fitted to the curve and radii of a circle to span an opening too wide for being lintelled across; and so to get over this difficulty of roofing, and yet to give as much floor space as possible, the side walls were erected, not perpendicular, but with a convergence inwards so as to reduce the span for the roof, which consisted of slabs of stone of great size and weight, some of them as much as eight feet long and over a ton in weight, which rested flat on the tops of the two converging side walls of the Earth-house.

This mode of construction has, by some writers, been called the cyclopean arch, and this unadvised use of the term has led to much confusion Strictly speaking, it is no arch at all, but produced by making each of the upper courses of the wall project a little beyond that below in a sort of rude corbelling until the desired height is reached, when the roof is completed by spanning the intervening space with stone slabs long enough to rest upon and consolidate the otherwise leaning forward and unstable walls, and strong enough to resist fracture and uphold the superincumbent soil above them. In an Earth-house at Buchaam, Strathdon, the width of the chamber at the floor was 9 feet 3 inches, contracted to 7 feet 9 inches at 4 feet from the floor, and at the roof to 5 feet in width, the total height being from 6 to 7 feet The whole structure of the Earth-house is hidden beneath the surface, sometimes having as much as five feet of soil on the top.

The labour involved in the construction of such structures, extending as they sometimes do to 80 feet in length and more, and to form a trench inclusive of provision for the side walls and roof and covering soil of on an average about 12 feet in width and depth, must have been very great Consider also the collection, carriage, and handling of the stones for the walls. As for the huge roofing slabs, the delicate work of placing such weighty stones in position at the top of loosely-built walls, where no mortar has been used to preserve the stones in juxtaposition, seems a task utterly beyond human accomplishment at a time when there existed no pulleys, chains, or other lifting appliances such as the mason of to-day finds absolutely necessary for lifting and placing in position such weighty stones as here described.

To furnish a better idea of the form of these curious structures than can be given by mere description I have prepared a diagram

exhibiting an ideal section, and plans of the Earth-house at Perth and of another at Tealing, near Dundee, the latter of which may be taken as a typical example, and may be visited by those whose curiosity has been stimulated to make an examination of an actual specimen. It is situated in a park immediately to the north-west of Tealing House, and at a distance of about $4\frac{1}{2}$ miles northward from the Maryfield Car Terminus. It was accidentally come upon during agricultural operations in the summer of 1871, but appeared to have been discovered and partly explored before, although no account has been traced of any earlier exploration. At present no part of the roof remains. It has its entrance from the eastward, and curves, as most of the examples do, to the left It measures about 80 feet in length, and at the floor level is about 7 feet in width. It has been divided into three parts The entrance passage, 3 feet wide and 10 feet long, slopes rapidly downwards, and at the inner end of this passage an ingenious doorway has been introduced—two side slabs have been firmly fixed in the ground and steadied sideways by the outside edges of these slabs being inserted into the side walls of the passage so that there is left an opening a little over 1 foot in width between them, barely sufficient to allow a stout person to pass through; then at a distance of about 4 inches from the slabs of the doorway, and on the inner side, a slab has been sunk edgewise in the floor, and, standing about 3 inches high, forms a groove in which another stone slab to serve as a door could be placed and drawn backward and forward to open or close the narrow opening mentioned. Doubtless there had been a similar groove or channel in the roof to keep the sliding slab from falling inwards When once this sliding slab was placed in position to close the doorway, and a piece of wood or another smaller piece of stone jammed in at each side, the interior would be most effectually closed against all intruders. At about 26 feet from the inner end another cross division and doorway had been formed, although it is not now apparent how the aperture was closed, doubtless it would be in some similarly effective manner as at the outer entrance above described When this Earth-house was cleared out horses' teeth and other bits of bones and quantities of charcoal were found, also many interesting relics of occupation, amongst which were pieces of the lustrous red glazed pottery formerly called Samian Ware, now known as Terra Sigillata (sealed clay), a name devised to describe a species of dish-ware of fine bright-red clay, beautifully glazed, and having usually a raised decoration upon it It is not known to have been manufactured in Britain, but is usually found in Roman sites here and on the Continent. The pieces found at Tealing point to Roman times. There were also here found a bracelet, bronze rings, bits of cinerary urns, and no fewer than ten querns, or grindstones, for grinding corn, partly whole and partly broken; also remains of stone cups or lamps, and a number of spinning


LONGITUDINAL SECTION
CROSS SECTION
PLAN OF EARTH-HOUSE AT TEALING
PLAN OF EARTH-HOUSE AT PERTH

whorls. Unfortunately these interesting relics are not now known to be in existence. No other such collection has been recorded as recovered from an Earth-house.

Another local, much larger, and more elaborate example of an Earth-house was discovered about 1860 at Pitcur, near Coupar Angus. I visited it shortly after its discovery. It was the first one I had seen. It measured in all about 230 feet in length, but doubled on itself, and contained several chambers and exits, as well as apparently two fireplaces, although this may be considered a debateable point If secrecy was desired—and it would seem that such structures were designed for concealment—the presence of a fire which would cause smoke would only serve to betray the hiding-place to an enemy. Heat was scarcely necessary, the atmosphere in such confined quarters would be close enough at times. If a fire was necessary for cooking purposes, no fireplace was needed; the fire would be kindled on the floor, as in all the primitive Highland cottages, and the smoke would escape by the entrance-way, to which the upward sloping floor and exit passages would contribute, and there would almost certainly be other means of ventilation, but nothing of the nature of a chimney has been detected. The recesses at Pitcur supposed to be fireplaces may have been places for food or other valuables. Moreover, however it may have been in the case of the earliest examples of the Earth-house, there are reasons for believing that in later times they were associated with an over-ground dwelling-house, from the interior of which—mayhap in some secluded recess or corner—access could readily and without observation be got to the underground retreat, and once inside and the place secured as above described, its occupants would be practically unassailable. The only access was a low, narrow passage, in some cases not more than 18 inches wide by 2 feet in height, sloping steeply downwards for 10 or more feet The attitude which such a confined entrance made necessary to an attacking foe reduced him to two alternatives—either he had to slide downwards feet foremost or crawl in on hands and knees head foremost, with more than a suspicion that a well-armed opponent was watching his descent in the darkness below, and, besides, there was the sliding stone door to be disposed of before entrance could be effected. It seems certain that in most cases the knowledge of these conditions would effectually prevent any attempt at attack.

I shall now endeavour to show in what respect the Perth Earth-house differed from the usual type The long, low, narrow entrance-passage and curving gallery chambers, widening and increasing in height inward, showed that the Perth example conformed to the established type; but while all other examples hitherto disclosed are wholly subterranean, the surrounding conditions at Perth showed that this example must have risen

considerably above the original surface, even when allowance is made for possible surface denudation on the somewhat steeply-sloping river bank. Presumably it would be covered by earth being heaped above it to such a depth as would afford at once protection and that concealment which seems to have formed an essential element in their construction

It is not improbable that other examples of mound-covered Earth-houses have existed and been removed in the progress of agriculture without any record remaining The fact that the Earth-house is confined to practically level country now arable would account for the removal of the mound-form, or at least of so much of the structure as projected above and impeded cultivation, and this doubtless was the early fate of this Perth example Similar remains may lie unsuspected in other places never to be disclosed until some such digging operations going deeper than the reach of the plough, as happened here, shall bring them to the light

Further, a critical examination of the side walls at Perth raised a doubt as to whether the usual covering of stone slabs had been used for the roof. At the time of my visit little was left of the walls but the lower tier of large stones, with here and there some portions of a second tier, and I learned from the workmen that before the artificial character of the remains was recognised two upper tiers or courses of stone had been removed, which would show that the walls were at least five feet in height The removal of these upper courses prevented the possibility of determining whether the walls in their full height converged inwards, as in other examples. Consideration of the available evidence does not support such assumption. Such a wall as this, only some 18 inches thick at bottom, would, if erected to the usual height of 6 or 7 feet, be a very weak wall if built with a hang towards the interior, and more especially so if required to support a roof with superincumbent earth-covering I therefore conclude that these walls must have been erected practically upright. In an Earth-house at Murroes, in Forfarshire, and another at Kinord, Aberdeenshire, the side walls were formed of single slabs set on end and upright. The width of the Perth Earth-house averaged 7 feet. It seems scarcely possible that, if this width was maintained upwards, stone slabs would be used, which must have been of great weight, to rest upon such very insufficient walls. If then, as it would seem, the roof was of timber, another feature of difference would be indicated.

It seems clear, therefore, that the Perth structure, while conforming in plan to the essential features, yet differed from the type in being only partially excavated and partly above ground, roofed presumably with timber and covered with soil, and so conformed to the cairn or mound, to be afterwards

referred to The Perth Earth-house measured 45 feet in length, including the entrance passage, but as the side walls terminated abruptly at the inner end it is to be presumed a portion had been cut off when the public road between Dundee and Perth, upon which it impinged, was diverted early in last century

Many other examples of the Earth-house have been discovered in the shires of Perth and Forfar, and elsewhere in Scotland At Airlie, in Forfarshire, there was a group of five, suggesting still more undiscovered A considerable group was discovered about a hundred years ago on a muir at Kildrummy, in Aberdeenshire. They amounted to between forty and fifty No article of furniture, it is stated, was found in any one of them, nor any utensil or instrument, either of stone or metal, but only quantities of wood ashes and charcoal, so it is said, but reliance cannot be placed on records of search made so long ago. That this large group was connected with an overground village seems highly probable Mr David Macritchie, F.S.A. Scot., who has written much about the Pitcur Earth-house, mentions the existence of a local tradition there that on or near this site stood a "tounie," inhabited by a community of clever little people.

The present inheritors of the tradition, he says, assume that the little people lived above ground, and do not connect them at all with the Earth-house, the existence of which was unknown until a comparatively recent date But, in view of a mass of folk-lore ascribing to such little people an underground life, the presumption may well be that the "tounie" of modern Pitcur tradition, referred to an overhead village, the inhabitants of which used the Earth-house as a place of retreat, some recollection or knowledge of which may have lingered on in the earlier days in the district.

The term "Pict's house," already pointed out as one of the names by which these underground structures are known in Scotland, is in agreement with the inherited belief, so widespread in Scotland, that the Picts, or "Pechs"—if this meant the same race—were a people of diminutive stature, but possessed of immense bodily strength. Sir Walter Scott's character, the Black Dwarf, will readily be remembered, so notable for his popularly accredited achievements in moving immense blocks of stone Mr Macritchie, applying these traditions to the Pitcur Earth-house, puts forth three solutions of the problems presented by the manipulation of the huge roofing flags:—First, that they were placed in position by the aid of machinery, second, that otherwise they infer a great number of workers and the expenditure of much time; or, third, that the builders possessed an almost brutal strength of body; and concludes—"The absolute rudeness of the structure renders the first supposition untenable, while either or both of the others seem worthy of acceptance."

It is remarkable how widely spread is the tradition in Scotland that the Picts, or Pechs, as they are popularly named, were a diminutive race possessed of great bodily strength and of great ability as builders, although their habitations, strangely enough, were always said to be in green mounds or hillocks

There is scarcely a valley in the Highlands of Scotland where a "Shian" (pronounced Sheean—a fairy hillock) may not be pointed out to the visitor The Pechs were also known as Fairies or Men of Peace Lochs and hills are named after them, and every glen has its tradition of their doings The Old Steeple, Dundee, by a local tradition, is said to have been erected by the Pechs, and the tale is told that in crossing the Tay to Fife in their coracles of ox-hide after the completion of their gigantic task, when they looked back and contemplated the magnitude of the Tower as it loomed in majesty above the lowly dwellings of the old town around its base, exclaimed among themselves it was "worth another groat." Unfortunately tradition is silent as to how many groats they got for their labour, nor does it tell why they went to Fife Possibly it was because the "Kingdom" then formed a not unimportant part of Southern Pictavia, and included the Pictish capital, Abernethy, where the celebrated Round Tower is also attributed to the same skilful builders.

Tradition says the "Pechs" were at one time very numerous in Scotland, but gradually got fewer in number, and as they decreased got more and more shy and out of touch with the dominant race of the Scots, who monopolised the country, and in their decline took to performing the rites and ceremonies of their religion in the twilight and in moonlight, and this gave rise to a superstition that they only appeared then, and since they, as a part of their religious ceremonies, were in the habit of circling several times in succession round the old worship stones, spectators at a distance counted the same persons again and again, so that the total, increased by miscalculation, became a great number, while in the distance, in the gloaming or in moonlight, they appeared of diminutive size If you question a Highlander he will reply, "I have never seen a fairy myself," but will be sure to add, "there were plenty of people in the country in my grandfather's time who had seen them."

It has been suggested that, whether the Earth-houses were originally erected by a diminutive race who once lived in Scotland, they may have been occupied in secrecy by survivors of an alien race who, by only going out in the night time in search of food, gave rise to the above-mentioned tradition.

To return to the subject of the Earth-houses, they are commonly discovered in arable land by the plough coming in contact with the stones of the roof. Their range includes the

whole eastern area of Scotland from Berwickshire in the south to the Shetland Isles Dr Joseph Anderson, in one of his volumes on Scotland in Pagan times, has fully discussed the subject He points out that there is a Cornish group and an Irish group; that, while the Cornish group comes nearer to the special features of the Scottish examples, neither Cornish nor Irish can be said to be identical with the Scottish group, which are so peculiar that they must be held to constitute a distinction sufficiently charcteristic to separate them from all other varieties of underground structures. Taken altogether, however, no other underground structures are known in any other part of the world. Those excavated chambers possessing the characteristics which have been described are peculiar to the Celtic area, and the specially typical form with the strongly marked curvature is found only in Scotland. Dr. Anderson traces them down to the period terminating the Roman occupation from stones bearing Roman workmanship having in several of the Earth-houses been found utilised as ordinary building-stones in the walls, and concludes that the structures themselves are not Roman in any sense, but in all their distinctive features Celtic, and Celtic exclusively He ascribes them to Scotland's Iron Age—the Pagan period of her Celtic people In thus expressing his opinion of the period of the Earth-house he may be regarded as practically excluding the idea that they can in any way be ascribed to a period so remote as the Neolithic Age; nay, he will not even contemplate assigning them to the Bronze Age, apparently for the reason—and that reason alone—that the relics found in the Earth-houses point to the Iron Age only.

In considering this point it is necessary to remember, in reference to the age of the relics discovered, that in the course of time these underground retreats would be utilised by successive generations of men down to quite recent times, when tinkers and other nomadic wanderers would take up abode in them, and that each succeeding year a company of occupants, on taking up abode, would thoroughly ransack the "ben-most bore" and innermost crevice of their dwelling, so that it would be next to impossible for any relic to evade discovery. All the more thorough would such a search prove, since it would be well known to the searchers that any relics which might be left by preceding occupants would have practically a like value to their successors

Let us suppose, for the sake of argument, that a family of the late Neolithic Age were to vacate their lodging—granting they had such a lodging as the Earth-house—leaving behind them, as we may be sure, nothing valuable, but only some broken or rudely fashioned stone vessel or implement, and to be succeeded by a family of the Early Bronze Age. The newcomers

would have a look round, pick up and utilise the few relics that might be left These relics would not be new to them, they would know their purpose and use them as their forerunners had done By and bye, as the years and ages rolled on, each succeeding series of occupants would act in like fashion towards relics left by their predecessors, and one can easily realise how, in such rude conditions, where a scrap of flint was an ever-ready weapon and a pot-sherd was a drinking cup, little would remain to evince the succession of races who had sought and found shelter in such miserable abodes. But it seems proper to enquire. Were the relics found in these structures so very meagre and restricted in their range as Dr. Anderson's arguments and conclusions would indicate? I have shown how few relics were likely to survive The rarity of recorded instances may have been due to want of observation on the part of the explorers. Such discoveries are usually made by unskilled workmen I do not think I overstate the situation when I suggest that in most cases the whole idea of the explorers is the discovery of treasure in the shape of hidden money! Stone implements, bits of metal or pottery would not appeal to them and would be passed over unnoticed and unrecognised as being anything uncommon I once exhibited to an intelligent workman a flint arrow-head, at the same time asking him if he knew what it was or had ever seen one before. "Oh yes," he replied, "I have seen them often" "Where have you seen them?" I asked "Along the beach," was the reply. He once lived by the seashore. I was startled Could it be possible, I mused, that this man had come on an unsuspected "flint factory of old times?" The pleasurable anticipation of an interesting discovery was, however, largely discounted when, on drawing his attention to the delicately formed point and fine workmanship of the shaft and barbs, he declared his belief that these features were entirely the work of Nature, and that they grew in that form as the shells grew, among which he had often seen the arrow-heads. He promised to bring me some arrow-heads when next he visited the place where he had seen them. It is scarcely necessary to report that he has never redeemed his promise.

I could relate many instances of careless and irresponsive handling of ancient relics in the hands of workmen, and even, sad to say, by those from whom better treatment might have been expected. This aspect of mingled ignorance and carelessness is responsible for the paucity of relics reported from many an ancient site.

To return to Dr. Anderson's argument for the period of the Earth-houses, based as it is on what he considers the restricted range of the relics discovered in them, it is cognate to this line of argument (although I shall hope to show there are other lines

which may be followed up in claiming for these structures a greatly more extended range) to cite the wide variety of relics yielded by the Tealing Earth-house These were pieces of cinerary urns, unglazed pottery, fire-glazed pottery, beads, brass and bronze rings and pins, stone cups or lamps, spinning whorls and grindstones If one example furnished such a variety, what might not many other examples have yielded to careful search? The contents of the Perth Earth-house had before my visit been all shovelled out and buried in the formation of the new road I spent an hour or two in a search which in such conditions was hopeless from the first. A single flake of black flint, a flint nodule, with some animal bones too much broken and decayed for identification, made up all the relics that could be found in what had escaped the shovel after the interior and the bulk of the floor had been dug out.

In claiming a greater age for the Earth-houses than that conceded by Dr. Anderson, it will be instructive to consider the basis of his conclusions, and I cannot do this more effectively than by quoting what he says in summing up his review of the description of an Earth-house at Cairn Conan, near Arbroath, which, he says, is an example of those "which by their association or contents disclose indications of the period of their type" He mentions the discovery in the Earth-house of fragments of coarse wheel-made pottery, closely resembling some varieties found in the vicinity of Roman stations in Scotland, a bronze needle, and a portion of a quern But on the surface above was a circular space 20 feet in diameter, rudely laid with undressed stone flags, amongst which were found a part of a bronze ring about 3 inches diameter, the upper stone of a quern or hand-millstone, two lead whorls, a number of rudely hollowed stone vessels of various sizes, and fragments of iron greatly corroded, but recognisable as having been cutting implements On the strength of these discoveries he says, "We have distinct evidence of an underground chamber associated with an overground habitation of less permanent structure, of which time and cultivation had removed all traces except the circular paved floor and its casual relics," and concludes, "There can be no doubt that the people who occupied this overground habitation also possessed the underground structure, and used it for purposes connected with their daily life,"

"There is little now left," he continues, "to disclose what the manner of that life was, but that little is highly significant It discloses that they were a people cultivating grain and rearing cattle and sheep They had utensils of stone, it is true, and these of the very rudest form and fabrication, but they also possessed wheel-made pottery and weapons or implements of bronze, iron, and lead." Now, the careful reader cannot fail to

observe that, while Dr Anderson ultimately sums up his disquisition on the period of the Earth-houses by limiting them to the Iron Age of the Pagan period, he in the passages quoted fails to give any weight to the existence here, as well as at Tealing, of the articles of stone and bronze We are tempted to ask why, on the ground of association alone, should the "rudely hollowed stone vessels," the flints, the bronze rings and pins—all of which suggest an earlier civilization—be assigned to the later Iron Age? It lends cogency to this inquiry that so little is recorded as to the characteristics of these relics The stone and bronze relics of Tealing have not been described and are not known to exist It is the same with all the other like relics found elsewhere in these structures, referred to only as bronze rings and pins, beads of streaked glass, &c., otherwise undescribed Is it not more reasonable to consider that some at least of these differing relics of earlier types represent successive races rather than that they are all attributable to the latest occupants?

Other, and perhaps stronger, arguments can be adduced to claim for the Earth-house a greater age than hitherto assigned To mention two: There is, first, the strong family likeness bètween these structures and the chambered tombs of the Stone Age, and here again Dr. Anderson must be quoted. At page 305 of his work on the Stone Age he lays down the dictum that, alike in relation to the Bronze and Stone Ages, "there is no vestige of a dwelling or a defensive construction known in Scotland which can be proved by evidence to have been the work of the men of either of those Ages." The "evidence," as we have seen, upon which Dr Anderson assigns the Earth-houses to the Iron Age is based on the relics of occupation found in them, and I have shown how unreliable the argument may be when we consider the results of successive occupation of the same structure by different races. The like evidence has doubtless actuated in his conclusion that no vestige of a dwelling-house of the Bronze or Stone Ages exists in Scotland, but he thereby ignores a source of evidence of great weight—namely, that among all early races the tomb and the dwelling-house were each the counterpart of the other. Professor Nilsson, the celebrated Swedish antiquary, in his learned work on the Stone Age in Scandinavia, emphasises the identity of the design for the gallery-chambers for the dead with the dwelling-houses for the living amongst all the ancient peoples in the North of Europe, and considers it to have been universal and having its origin in the cave-dwellings, which were also used by the cave-dwellers as burial-places He says, "If we compare dwelling-houses more closely with sepulchres, we shall find that they resemble each other amongst all rude nations; and if we enquire into the cause of this curious ethnological fact, we shall feel convinced that it must be so and cannot be otherwise

The rude child of Nature has a presentiment, although dim and confused, of a continuation of life after death But, unable to soar to a purer and nobler conception thereof, he believes that the departed are destined to continue after death the same activity which marked their life in this world. Therefore he builds the same kind of dwellings for the dead as for the living, therefore he places them in the grave in the same position which they were wont to take while alive in their hut, and therefore he hangs upon them or places beside them their implements of daily use." Further, he goes on, "What I have now adduced may be enough to prove that, if any ruins of dwelling-houses from the period now in question and the people belonging to it are found amongst us, they must be, in respect to form and construction, exactly like the sepulchres of that period and of that rude tribe" (p. 142).

Professor Nilsson further shows how the gallery chamber had its beginning, and traces thus its transition from the natural or mountain cave—"The savage could find such dwellings only where there were mountains with caves If he wandered out of such a district into the plains, and wanted to fix his habitation there, he was compelled to collect blocks of stone, and to form with them caves resembling as much as possible the mountain caves. In this manner the gallery houses arose, where the long, narrow gallery corresponds with the narrow entrance to the mountain cave, and the chamber with the cave itself This may, therefore, vary in shape, but the gallery is never wanting" He describes these "galleries" as the invariable accompaniment of all the Scandinavian tombs of the Stone Age—long, narrow, and low, sometimes curved, so that passage through them could only be accomplished by crawling on hands and knees. In this construction they conform to the entrance passage in Scottish Burial-chambers and Earth-houses, another point of resemblance being that the entrance always faces to the south-east, towards sunrise for warmth, which in the case of the Burial-chamber is a striking proof that it is based on the plan of the dwelling-house

The application of these arguments to the identity of construction of the Scottish Earth-houses and the Burial-chambers in the Cairns of the Stone Age will be obvious from what follows.

One of the most remarkable of these Cairns is that at Yarhouse, in Caithness. It was examined by Dr Anderson in 1865-6, and is described in his book, *Scotland in Pagan Times The Bronze and Stone Ages.* The Cairn is of huge dimensions and of remarkable form, having horns projecting out buttress-fashion at four points, but it is with the contained Burial-chambers we are chiefly concerned He describes them as having an entrance passage 40 feet long, about 2 feet wide, height not

mentioned, but two door-jambs are stated to be "about 2½ feet high" At the inner end of the passage are two upright slabs projecting from the side walls and leaving "a doorway 18 inches wide." (Compare this with the entrance passage and similar doorway in the Earth-house at Tealing) The chamber is short, but is separated into three compartments, the respective divisions being formed of flags sunk on end into the floor and let into the wall on either side, leaving an opening of about 2 feet wide for entrance to the next compartment After describing the details of formation of the chamber, the lintelled passage, the unsquared and undressed stones, the overlapping courses of the side walls, the flat roof slabs, and absence of any kind of mortar and cement, Dr. Anderson concludes thus.—"In all these respects its constructional features are not different from those of the dry-built structures of the early Christian period, or of the Iron Age of the Pagan time" He is here, evidently, referring to the Earth-houses Notwithstanding, however, these points of similarity, surely worthy of more consideration, he dismisses them summarily, alleging that "its singularity of form and the absolute individuality of its architectural conception preclude the possibility of assigning to it any relationship with them"

With all deference to so great an authority, I submit that in place of, as here, citing his own conclusions and private investigations on a subject so technical, Dr Anderson would have been wisely advised to seek guidance, painfully awanting in the numerous drawings submitted to his readers, as well as in the want of technical knowledge apparent in the letterpress—for instance, when the terms "arch," "arched," "spring of arch," "vaulted," and "vaulting" have been used to describe a form of construction which ought not to have been so described. The use of such terms is, in the circumstances, thoroughly misleading and unwarranted Had these Cairns exhibited anything which could be properly described as an arch or vault, it would have followed that they cannot be assigned to the Stone Age

That there is a close relationship between the chambers in the Cairns of the Stone Age and the Earth-houses is established by the following considerations. Both exhibit the same principles of construction The large blocks at the base of the walls, and smaller stones higher up, the convergence of the side walls so as to reduce the span of roof to a manageable width, the roofs formed of massive slabs stretching flat across from side wall to side wall; the low and narrow passage, averaging at the entrance about 2 feet wide and 2 feet high, the division of the chamber into separate compartments by upright stone slabs set on end and projecting from the side walls; the masonry of untooled stones, built dry without any kind of mortar or cement; the entrance always facing towards the south-east.

These are remarkable similarities, too remarkable for coincidence, as we are expected to believe.

There are two outstanding features of difference. One is that the Cairned Burial-chamber is wholly above ground and covered over with a cairn of stones, whereas the Earth-house is, as a rule, wholly underground, although in the Perth example the evidences point to its being only partly excavated and partly covered by a mound of earth or cairn of stones; and I have shown how it might be the adventitious survivor of a type, which may have had many examples

The other point of difference is that the Earth-houses usually exhibit the feature of curvature, and in this are in contrast with the Cairn Burial-chamber, which, along with the approaching passage, is, judged by the plans, usually without or with little curvature; but in both cases there are exceptions to what would otherwise appear to be the rule

It is a recognised fact in the social ethics of pre-historic races that the Burial-chamber corresponded in design with the dwelling-house, but the need for defence for the latter would be more clamant than for the former, and this, following the inevitable if slow course of development and transition towards the low cairn and the underlying cist, would result, in the case of the dwelling-house, in the device of the curved gallery, hence probably also the sunken dwelling in preference to the cairn chamber, especially in plains and flat country, where stones for cairn construction might be hard to procure In this way, it seems reasonable to conclude, the curvature of the underground dwelling had its origin in the effectiveness of a curve as a means of repelling attack

On a review of the evidences as to the age of the Earth-houses, I contend that, either in themselves or in their type, they form the earliest example of a Scottish stone-built dwelling, and this mainly because of their rude strength and simplicity of construction But I do not rely on this feature alone There is another characteristic which points to great antiquity, in that, while they provide for the safety of their human occupants, they afford no protection whatever for cattle or sheep, which, if then domesticated, would be left at the mercy of the invaders. This cannot but be one essential element in the inquiry as to the origin of the Earth-house. So far as known to me, no writer has previously raised this point Giving this due weight and consideration, it seems to place the origin of these structures very far back—either before there were any domesticated herds of animals or to the very early days of cattle-owning communities, when as yet no method had been devised for protecting the flocks and herds from marauders. In all other Scottish defensive

works—the brochs and hill forts, as also in their successors, the earliest of the motes—protection was provided for the flocks of the owners. In this defect of provision the Earth-house fell short of its promise, and later the protecting fold with the overground dwelling would be added, but the underground stronghold of his fathers would still appeal to the husbandman as an absolutely necessary refuge, and so it would come to pass that many an ages-old Earth-house would afford shelter and protection against stress and danger at a time not so very far removed from our own, when the country was still overrun by wandering predatory bands, who under the darkness and cover of night, actuated by ravage, revenge, or plunder, attacked with murderous purpose the household.

It is proper to remark that, although the Scottish Earth-house stands alone in its special features, its type is common to other countries The Bible records (Isa iv 5-6) in connection with the dwellings on Mount Zion—"There shall be a tabernacle for a shadow in the daytime from the heat, and for a place of refuge and for a covert from storm and rain." The Scottish Earth-house, when it became an adjunct to an overground dwelling-house, could not be more fittingly described.

Virgil pictures the life lived in such resorts "Caves," he calls them, but adds, "delved deep under the earth," showing he refers not to a natural cave, but to an artificial formation, and he goes on, "with store of timber laid up for firewood, when they lengthen out the night with games."

Tacitus, in discussing the manners and customs of certain Continental races, says, "They dig subterranean caves which they use as winter retreats and granaries, and upon an invasion, when the open country is plundered, those retreats remain unviolated, either because the enemy is ignorant of them, or because he will not trouble with the search."

If these Continental recesses were constructed with defensive works like that at Tealing, one could readily understand why they remained inviolate.

In like manner Grammere says, "The Norwegian farmer had a subterranean room near by his house, or even under it, with a secret passage leading afield, which served as an escape from the attack of a foe, or from a sudden outbreak of fire."

Nilsson, describing a part of Asia Minor, which has by many been regarded as the cradle of the human race, says, "There man dwelt in mountain-caverns, and thence the nations were disseminated over far distant lands, carrying with them their earliest memories, their native customs and manners. But a great many remained behind, and their numbers increased

more and more · so much so that the caverns formed by nature could not shelter them all any longer ; they then dug out caves for themselves in the softer rocks ; the number of these increased, and thus by degrees whole villages or towns of caves sprang into existence." (*Ibid*, p. 153.)

To conclude, I venture to propose the following postulates :—

1. Man's earliest dwelling and shelter from adverse weather conditions in temperate countries was the natural or mountain cave

2. His first attempt at a natural dwelling was an imitation cave. The Earth-house, in structure, is based on the natural or mountain cave, specialised by conditions existing in plain and flat country where natural caves did not exist, or, if existent, were not in sufficient numbers to accommodate expansion of population

3. Early man's dwelling-place was the exact counterpart of the burial-place of his dead ; hence cave-burial synchronised with cave-dwellings.

4. This identity of the dwellings of the living with the chambers for the dead prevailed among all early races.

5. The Scottish Cairned Burial-Chamber of the Stone Age must therefore in its characteristics be regarded as identical with the Living-chambers of the same Age.

6 The Earth-houses of Scotland and the Cairned Burial-chambers of the Stone Age are structurally identical, differing only in the former being usually curved in plan and wholly or partly sunk below the surface and wholly or partly covered with a mound or covering of earth, while the latter are only occasionally and slightly curved and wholly above ground and covered by a cairn of stones.

7. The likeness between the Earth-house and the Cairned Burial-chamber warrants a close relationship, and justifies the claim here made for a reconsideration of the argument which assigns the Earth-houses of Scotland to the Iron Age.

Note.—It may be here remarked that the "Dug-out" as a means of defence on scientific principles has attained extraordinary prominence in the present war, and may be said to have revolutionised the whole art of war.

NOTES ON THE NESTING SEASON ON TENTSMUIR, 1912.

By JOHN W. KIPPEN, Tayport.

Tentsmuir is a veritable paradise to the bird lover during the nesting season. From the beginning of May till the end of July there is always something of interest going on, so that one can wander for hours over the moor without feeling fatigue. The strong exhilarating air from the open sea, the endless stretches of purple heather (bell, heath, and ling), the ceaseless cries of the birds—noisy and irritating from the gulls and terns, melancholy from the golden plover and whaups, and rather annoying from the red-shanks—together with the feeling of loneliness and freedom, form a combination which makes a visit to the moor truly delightful.

Roughly Tentsmuir may be divided into three parts:—Scotscraig Moor, nearest Tayport and lying next the estuary of the Tay; Earlshall Moor, nearest Leuchars, and Kinshaldy, between these. Scotscraig Moor is by far the richest in bird life. It is now strictly preserved as a breeding ground for grouse, and one cannot wander over it without being challenged by a keeper, but the fringe of it nearest the open sea, from one hundred to two hundred yards wide, consisting of two rows of sand dunes with a damp valley between them, can be traversed freely. Kinshaldy and Earlshall Moors are not so closely watched, and I have wandered all over them without being spoken to.

To spend a whole day on Tentsmuir, I should recommend you to take the train to Leuchars Junction, walk a mile and a half when you reach the moor, and keep round the sea side of it, never venturing further inland than about a quarter of a mile. By the time you reach Tayport you will have covered over a dozen miles, not counting your peregrinations backwards and forwards on that quarter of a mile belt. In that walk, with the exception of woodcock, you have a chance of seeing all the birds which use the moor as a nesting place. Some of the nests require careful looking for; others you cannot help seeing, the trouble being to avoid treading on them. There are three draw-wells on the way, and as there is abundance of drift wood on the shore, two very important factors for pic-nicking are thus provided.

The three Terns or Sea-swallows (so called from the forked tail) which nest on the moor are the Common, the Lesser, and the

Sandwich, probably also the Arctic Tern, but I am not sure. They are at their best in the first and second week of June. A year ago I walked round the edge of the moor from Leuchars to Tayport. The nests began as soon as we got on to the moor, and continued right round to the point at the mouth of the Tay. Sometimes they were isolated, and sometimes in colonies, but there they were all the way. The nest is always on dry ground, amongst short heather, in the sand, or in the short scanty grass clothing the sand dunes. As a rule, it is a depression in the ground, more or less lined (usually less) with short grasses. The eggs are three in number, and the colour varies very much, even in the same nest. The ground colour may be brown, green, or stone colour, and there are many dark blotches. The birds are exceedingly noisy, and easily betray the presence of their nests. They are given to swooping at the intruder, especially if the young are hatched out. At this time it is most interesting to take up a position between the colony and the sea, and watch the endless procession of parent birds coming in from the sea, each with a little fish glittering in its bill. The young terns, after they are able to run about, look absurdly fat and large, and soon learn to cower down amongst the grass and heather when any person approaches. The Lesser Tern is a much smaller bird with the usual Tern characteristics, but having a white patch on its forehead. There are not many of them, but I know of one colony which has nested for years at the foot of a ridge of drifting sand on the east side of the large amphitheatre.

The greatest number of nests in one season has been nine. The nest is hardly worthy of the name. It is the merest depression in the loose sand, with no lining whatsoever. In it three eggs are laid, and their protective colouring is very marked—the ground colour of pale stone with a few dark spots and blotches, making them difficult to see. The drifting sand often covers up the eggs until only the ends are visible; this must keep the eggs warm and help in the process of incubation. The birds will leave their eggs for a long time, as they do not care to visit them if observed. I have watched them carefully from a distance and have never yet seen any bird near its nest.

These Lesser Terns are the last to nest, and the eggs are to be seen at the end of June.

The Sandwich Tern is becoming a rare nesting bird on Tentsmuir. It is slightly larger than the Common Tern, and has a black bill and black legs, while the Common Tern has reddish orange bill and legs, the bill having a black tip. About seven or eight years ago there was a colony of about 130 nests on the Scotscraig Moor. The place selected was a bare bit of sandy ground in the middle of the moor, about twenty feet square, and

in that limited space about 130 nests were placed So close together were they, that it was almost impossible to walk without treading on some of the nests The nests differ little from those of the Common Tern, but the clutch seems to be usually two eggs, which differ very much from the Common Tern's They are much larger, and so like the colour of dry sand, that were it not for the number of nests so close together and the screaming of the birds overhead, it would be extremely difficult to detect them Two summers ago there were only six nests, and last season only one nest was found, though three pairs of the birds were to be seen flying about.

The only gull which nests on the moor is the Black-headed Gull, and there are several large colonies which change their habitat every year As a rule, they seem to choose flat, boggy ground, but last year I found about forty nests on the tops of the sandhills beside the boggy ground. The largest colony of them which I have seen was on the Kinshaldy Moor, four years ago (1908). Beyond the ice-house, and inland from it, there is a long stretch of damp ground, very flat, about a mile and a half long, and about a quarter of a mile wide. Here the nests were in hundreds; at almost every step we found one, and the din overhead was deafening, while every now and then an angry gull would swoop down at us, almost touching our heads. Last year at this place there were probably not more than fifty nests The Gull's nest is a distinct advance on the Tern's in regard to structure. It is always slightly raised above the ground, and a good amount of material is used in its construction, chiefly rushes and dried grasses. The eggs are three in number, and though they vary a good deal in colour, even in the same nest, the prevailing ground colour is olive green or brown, with dark brown and black blotches or spots The eggs are in all stages of development. Some are freshly laid, others deep set; in some you will see a small hole, with the beak of the young bird just protruding, and you can notice the hard covering at the point of the bill which enables the chick to break through the shell, in others one egg may be in the nest and two young fluffy objects lying on the grass beside it—their first attempt to explore the world at large. Here and there a bigger ball of down with a bill and two legs walks away from you, with no sign of hurry, but gawky, and yet dignified, just keeps beyond your reach, and makes little attempt at concealment. The eggs are taken in great numbers by the folk of Tayport, who consider them very good eating.

The other birds which nest on the moor are not to be found in such numbers as the gulls and terns. There are three plovers —the Lapwing or Green Plover, the Golden Plover, and the Ringed Plover.

The Lapwing is to be found all over the moor, and is fairly plentiful. The nest with its four eggs is so well known, that I shall only remark on the shape of the eggs, which are pear shaped, the narrow end being very much pointed The four eggs are always arranged in the nest with the narrow ends pointing to the centre, and this economises space

The Golden Plover is fairly abundant, although not nearly so numerous as the Lapwings They are rather shy birds and keep well out of reach. Their melancholy cry of "Weep-weep" can be heard for a considerable distance, and the bird can usually be seen standing on some slight eminence a good way off They are very handsome birds, and the colour harmonizes beautifully with the heather stems, making a sitting bird almost invisible With them there is more construction of the nest than with the Lapwing, and the eggs are larger and more beautiful, with dark markings on a brown ground.

The Ringed Plovers get their name from the white ring on the neck, and are very plentiful all over the moor, especially on the sandy parts They are very difficult of approach, rising from the nest long before you get near, and running about uttering cries all the time. Their nests are very interesting, they are always placed in sand or small gravel, and consist of a distinct hollow lined with broken pieces of shells or white stones As a rule, not an atom of grass or bent is used, except in cases where the nest has been placed in the shelter of a grassy tuft, when occasionally a few stray bits of grass may be seen. Whether the bird places them there, or whether they have fallen there, is a matter of conjecture. The eggs, four in number, of the usual pear shape, are about the size of a blackbird's, stone colour with little dark spots, and so much do they resemble their surroundings, that a person could easily be standing a yard from the nest and not notice it. There is a shelly ridge in the amphitheatre, which always contains a number of their nests, and also a stretch of sand near the ice-house, but I have also seen their nests in the middle of the moor where the turf was broken, and a small patch of sand about a foot square was visible.

A very noisy bird is the Redshank. Fortunately you usually encounter only one pair at a time, and as they circle round and round you, they utter their continual, irritating cries, while their red legs are clearly visible against their white under parts. This performance they keep up until you are well away from their nest, when you are handed over to the next pair, which treat you to the same display.

The nest with four eggs is very well hidden in the heather or among the stems of the sand-sedge, and is very difficult to find,

Those I have found were come upon accidentally, the bird just rising as I was about to step on the nest In this case off it flew without uttering a sound. The eggs are very beautiful, and again the protective colouring is remarkable. Were these eggs laid on the sand, they would easily be seen, but amongst heather they are almost invisible.

A more uncommon bird is the little Dunlin You see the birds fairly often, but it is a matter of great difficulty to find a nest, so well is it hidden The bird is seen in flocks round the shore in the winter time, but only a few remain to nest.

The next of the waders I shall notice is the Common Snipe. There are a good few pairs breeding on the moor, but, like the Redshank and Dunlin, their nests are very difficult to find They are very well hidden amongst the heather and the stems of the sand-sedge, and as the colour of the eggs matches the colour of the lining of the nest, they are doubly protected. The bird is a very close sitter, and trusts to sitting quiet to escape notice. When flushed, it flies off very rapidly with a markedly zig-zag motion. The "drumming" or "bleating" is another of the peculiarities of the snipe. Two seasons ago I watched for over half an hour the action of the bird in the air. It would rise to a considerable height, and then suddenly drop towards the earth, emitting as it descended a long-drawn, tremulous musical note. It then mounted upwards again, no sound being audible, but as soon as it began to drop, the note was repeated. This performance went on continually, and I imagined it was for the benefit of its mate sitting on a nest in a patch of sedgy ground underneath the performer. The note is produced by the rapid passage of the air during the descent, causing the two outer feathers of the spread tail to vibrate I can remember long ago one of our boyish amusements was to stick two stiff feathers in one end of a cork, and, having fastened a piece of string to the other end, to whirl it rapidly round our heads, thus producing a humming or singing sort of note. We did not then know that the snipe had perfected a musical instrument of the same type.

What I might term the sentinel of the moor during the nesting season is the Whaup or Curlew. As soon as your head appears over a sand-hill, up he gets, and commonly his lady with him, may be a quarter of a mile away, their wild alarm cries telling the whole neighbourhood that danger is approaching. Round and round in wide circles they fly, their wings flapping rapidly, their long, curved bills clearly seen against the sky, their long legs trailing behind, and the alarm cries continually sounding This cry is very different from the bubbling notes to which it gives utterance while feeding on the mud flats, and which, in the stillness of the evening, can be heard more than a

mile away The nest is not difficult to see if you come anywhere near it It is fairly large, and consists mostly of withered grasses, sedges, and rushes The four large eggs are rather noticeable—large for the size of the bird—and are usually olive green, with brown spots. The nests which I have seen were anything but well hidden, but that may have been the reason I found them.

Of the ducks nesting on the moor, the largest is the Eider Duck or Dunter, as it is locally termed. There is a striking difference in plumage between the male and the female. I never saw any of the males near a nest, and it is perhaps just as well that they do not visit their domiciles too often, for the conspicuous plumage, which can be easily seen a quarter of a mile away, would not be conducive to the safety of the nest. During a walk over the moor at the breeding season you can often see as many as a dozen of the males in company, and they allow you to approach fairly near before they take to their heavy flight The nest is a large structure, beautifully and plentifully lined with down from the breast of the female. It is roomy, holding five large eggs, almost completely covered with the down, and, being placed deep amongst the heather, grasses, or sedges, is not nearly so conspicuous as its size would lead one to think It is even less easily seen when the bird is sitting on it, for her brown-grey colour matches her surroundings perfectly Let me give an instance of this Last summer two of us went for one of our rambles on the moor We were walking over a stretch of short heather at a place where I had got an Eider Duck's nest the previous season, and we were looking to see if the bird was nesting in the same spot again · but no trace of a nest could we see. We were walking about ten yards apart, when my companion, who was a little behind, called my attention to a flower. I stopped and turned round to see what he had picked up, and then noticed one yard behind me an Eider Duck sitting on its nest I had actually walked close past it! We both stood looking down on the bird I wanted to see if she would let me touch her without leaving her nest, and for this purpose knelt down on the ground beside her, and she did not stir until my hand was just touching her back, when she waddled off and took to flight. The nest contained five large bluey-green eggs

I have often wondered how the young ducks got to the sea. The nests are often more than a mile from the water, and webbed feet are not at all adapted for walking amongst heather stems. A Tayport doctor assured me that one day he actually saw the parent bird making its way to the sea, waddling through the grass and sand, with its young on its back.

The most handsome duck on the moor is the Sheld-duck. Both the male and female have the same bright plumage, and one

would be apt to think that this would be a considerable drawback as regards concealment during the nesting time The bird, however, has solved the problem for herself, and there is no nest on the moor which is safer; though you may see her approaching or leaving it, that does not imply that you will see the nest. It is usually placed well down a rabbit burrow, far beyond your reach, and there, in the darkness, the nest is built, the eggs laid, and the brood hatched. How the young get to the water is another story The nests are sometimes more than a mile from the water, and as the clutch may number over a dozen eggs, I cannot see how the method adopted by the Eider Duck already quoted (whose clutch is usually five) can be used by the Sheld-duck; yet, get to the water they must. Last summer I saw a proud mother Sheld-duck with twelve young ones swimming about in the Morton Loch. There are usually very evident signs at the outside of the rabbit burrow that a Sheld-duck is nesting within, the marks of the duck's feet may be seen in the loose sand, and also a good few bits of white down lying about the entrance Last summer I saw the nest for the first time. The keeper saw a duck enter a rabbit hole at the foot of a little mound, and out of idle curiosity he proceeded to investigate matters. Probing the hole with his stick, he found that the tunnel lay parallel to the slope of the mound. He took his pocket knife and began opening up the hole at the side of the mound, and found that the passage did not lie deeper than six inches under the surface After continuing for about seven feet the top of the mound was reached, and it was then found that the tunnel went deeper into the earth. No further digging was necessary, for now the light of day could penetrate; the nest was almost visible, and the large white eggs could be seen. I was taken to see the excavation the following evening, and when I put my arm down the tunnel I touched the duck, which just slipped off the nest and went further into the bowels of the earth. There were thirteen eggs in the nest.

The Common Wild Duck, Mallard or Mire Duck is also to be found occasionally. There is one spot where there is always a nest, namely, in the herbage round a small pond beside the ice-house.

During incubation the Drake, in his conspicuous plumage, appears to go away into retirement, and leaves his more sober hued wife to attend to the nest She is a pretty close sitter, and as the nest is placed in a hollow, among the long grass or rushes, it easily escapes notice It is beautifully lined with the bird's down, and may contain as many as fourteen eggs, usually pale blue or pale cream. On one occasion I almost put my foot on the duck, and, as she rose, she squirted over the eggs a vile smelling greenish liquid, evidently designed to prevent interference with them. The Eider Duck has a similar habit.

The other birds which nest in rabbit burrows are the Stockdove and the Wheatear. There are a number of Stockdoves and Wheatears about, but, although I have found their broken egg-shells, I have not yet been able to locate their nests.

Meadow Pipits are abundant, and so are the Skylarks, though I should say there are far more of the latter on the Tayport Golf Course than on the whole of Tentsmuir.

The Woodcock still nests among the sand-sedge at the foot of some old fir trees at the Fetters, and grouse and partridges are fairly plentiful.

Along the burns and ditches that intersect the moor are to be found plenty of water hens, and a few coots are now nesting beside the Morton Loch.

This then is a faint description of what may be seen on a walk over Tentsmuir, but no words of mine can describe, what I might term, the atmosphere of the place. The solitude of the place gives no feeling of loneliness; there is too much life all around for that. As you leave the moor and take to the firm sand about two miles out from Tayport, and the clamour of the terns is gradually diminishing, as they settle down on their nests again, there is a strange quiet over all The sand-hills hide the moor and its life from your sight, and now you begin to feel tired and think longingly of the tea-table at home But it is a healthy tire, and the ozone you have been inhaling for hours will do you a world of good, and I feel pretty sure that you will be making a private resolution, before the season is done, to have another day on Tentsmuir.

TENTSMUIR DURING 1914

This was most certainly a Tern's season. I never saw such numbers of terns previously. Their nests were overflowing off the moor on to the sands, and many of them were well under high-water mark I usually reckon the first week of June to be the time for the first clutch to be laid, but this year it was a fortnight earlier. Beginning about two miles along the edge of the moor from Tayport you came upon the first of the nests, and right round the edge of the moor, in the short grass and on the sand, the nests continued in abundance till about a mile beyond Kinshaldy fishing station, when they abruptly stopped, and not a nest was to be seen on the remaining miles to Leuchars Roughly, I should say there were about six miles of nests. By the first week of July most of the eggs were hatched, and so the nesting season, which began a fortnight earlier than usual, finished a fortnight earlier. It is one of the interesting sights at this season to sit on the edge of the moor beside the open sea, and

watch the procession of birds passing out and in, those passing inland having invariably a little fish in their mouths, which can easily be seen by the glitter it makes in the sunlight. I used to think the fish were meant for the feeding of the young birds, and so, no doubt, they are when the young are there; but this year I noticed the fish-carrying going on before any eggs were hatched, and I was forced to the conclusion, that the fish supply was meant for the sitting birds They go far afield in the hunt for food, even well up the river, crossing over Scotscraig policies en route. The keeper of Scotscraig remarked this year, that he had never before seen such numbers passing and repassing over the woods, those going moor-wards all carrying fish

From the moment of hatching the young, terns bear one distinguishing mark, namely, the dark tip of the bill The bills lack the orange colouring of the mature birds, but still the dark tip is there, which forms one, and perhaps the best, distinguishing mark between the Common Terns and the Arctic Terns.

A colony of these Arctic Terns took up their quarters on the open sand clear off the moor There were perhaps about fifty nests, each with a clutch of two eggs laid in a depression of the sand The locality was so far round the shore, about eight miles from Tayport, that surely they were safe from disturbance. One Saturday I found the nests; the next Saturday they were all gone The spring tide during the week had made a clean sweep of the whole colony. Some laid a second clutch closer inshore, beyond the reach of the waves, and, I hope, managed to rear their families in safety.

Mingled with the Arctic Terns' nests was a considerable number of the nests of the Little Tern, and they shared the same fate at the deluge, and one or two made other nests nearer the moor.

A favourite resort of the Little Tern is the sandy amphitheatre nearer Tayport One Saturday morning I got fourteen nests with eggs at this spot, but they never were hatched out A strong wind sent some of the eggs rolling about, while the drifting sand covered up others, and no trace of these fourteen nests could I find three days later. Truly these Little Terns have arrayed against them in their domestic arrangements many forces of nature, and yet, when they do get a chance, the hot sand hastens on the work of incubation.

A noticeable thing this season was the great mortality amongst the young terns. At one spot in particular, sea-ward from the ice-house, where there were scores of nests, dead chicks were lying all about—but not in the nests. The season was a very dry one, and the sand was easily blown about by the wind,

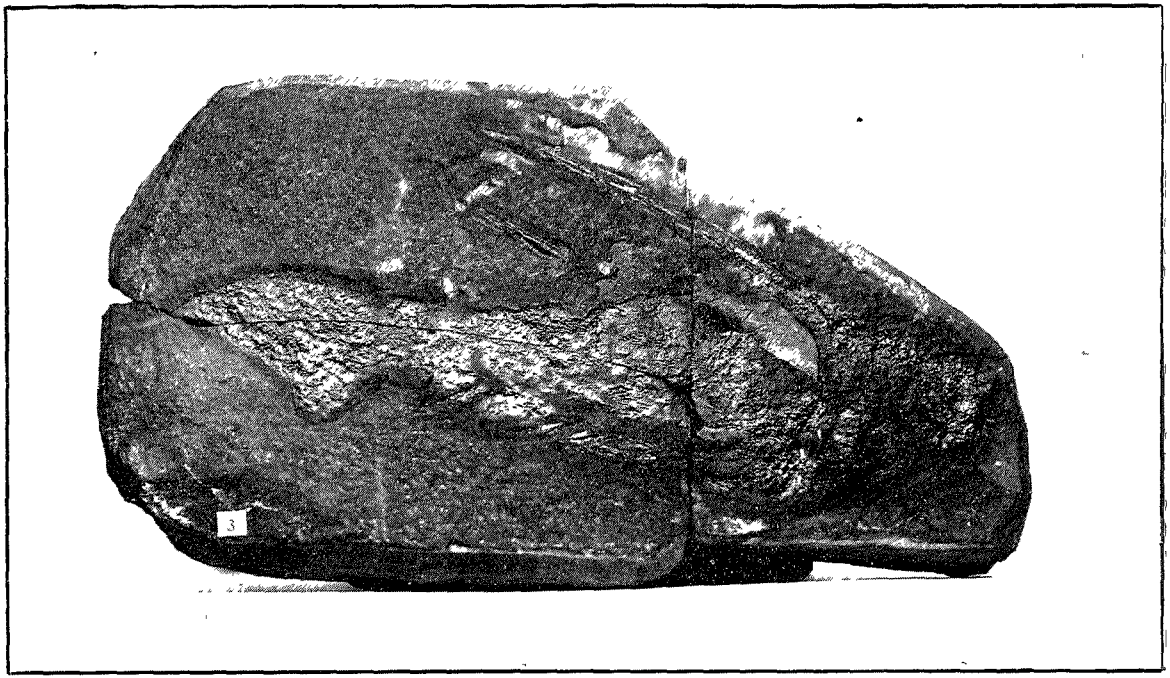
and it was quite a common occurrence to find the little birds cowering for shelter beside the stems of the sea-marram with a thick covering of sand over their down. I picked up a good number in this condition, and, though they were alive, they were not lively

To find out what birds nested on Lucky Scaup, I made a careful search of the island one forenoon during the nesting season. Not a gull's or a tern's nest was to be found. A skylark's nest was amongst the grass, and four ringed-plovers' on the shingle, and that was all I went over every bit of the ground above high-water mark, and felt quite certain I had found every nest then on the island

As already mentioned, the season 1914 was very dry, and in consequence there were no marshy parts on the moor, and the long valley between the sand dunes parallel to the sea and stretching from the first salmon-fishing to Kinshaldy—a distance of over three miles—which, in 1913, was almost one continuous lake, dotted with numerous islands, was absolutely dry. This valley is one of the favourite nesting places of the black-headed gulls, and their nests are almost continuous from one end to the other, in addition to other colonies on the seaward side, on the little sandy hillocks; and also on the moor side of the valley, amongst the heather and rushes There are hardly any gulls' nests on the Leuchars side of Kinshaldy fishing station The first clutch was laid this year by the 20th May, and the eggs were mostly all taken, for a certain section of Tayport folk have a strong liking for gulls' eggs The second and third clutches were nearly all left to hatch out, and even on the 10th of July there were eggs in some of the nests.

It is a remarkable thing that the Leuchars end of the moor is avoided by the gulls and terns, I have walked often from Leuchars round to Tayport, and have found that it is not till the neighbourhood of Kinshaldy fishing station is reached that the birds become abundant, and Scotscraig end is by far the best It is true, that from the moment you step on to the moor at the Leuchars end, you may come upon the nest of a curlew, a ringed plover, a golden plover, a lapwing, a skylark, a meadow pipit, a partridge, a redshank, an eider duck, a dunlin, or a grouse, but you have a walk of six good miles from Leuchars Junction before you get into the thick of things, but from that point onwards to the Tay side you are surfeited with abundance, and the continual screaming of the birds is apt to get on your nerves.

The moor presents one aspect of bird life, the mud flats at Tayport present another; and we are fortunate in having, at our very door, so remarkable a combination.



PAREXUS INCURVUS (Ag.).

Photo by J B CORR

THE FOSSILS OF FORFARSHIRE.

By James B. Corr, Dundee Museum.

INTRODUCTION.

The primeval fauna of the Old Red Sandstone deposits of Forfarshire carries us back to a very remote period in the life history of the earth Towards the close of the Silurian epoch considerable geographical changes were in progress in the north-west corner of Europe An extensive area, including the whole of Scotland, was elevated above the sea level, and probably a long interval intervened between this elevation, which terminated the Silurian period, and the deposition of the lower beds of the Old Red Sandstone This new land surface, after being subjected for ages to the natural wear and tear of disintegrating forces, slowly subsided until the low lying tracts in the north and in the centre of Scotland became completely submerged. In these submerged areas what are now termed the Old Red Sandstone formations were deposited.

The largest of these areas of submergence lies in the north Stretching from the base of the Grampians across the Moray Firth, it includes the whole of Caithness and the Orkney Islands, its northern margin reaching the Shetland Islands. How far this great sea extended eastwards we cannot tell. In Scandinavia the same class of rocks occur which formed the land surface of Scotland during the deposition of the Old Red Sandstone, so that the eastern boundary is probably concealed by the German Ocean.

The Forfarshire rocks are representative of the deposits occupying the central valley of Scotland At the time of their deposition this area is believed to have been a great inland lake or sea with a continental drainage This central area of deposition, which includes all the fossiliferous deposits of Forfarshire, Professor Geikie has designated Lake Caledonia. We can easily picture to ourselves the peacefulness and tranquility of this great inland sea, its water glistening in the bright sunshine which no human eye had yet witnessed. Not a sound disturbs the marvellous silence, save the breaking of the waves into a thousand ripples on the peebly beach. Not even the scream of a sea-fowl can be heard on the shores of this great sea, for we are still a long way from the evolution of bird life But although there were long periods of quiescence, we have ample evidence to convince us that Lake Caledonia was frequently subjected to scenes of intense volcanic activity.

Let us imagine ourselves stationed on one of the yet unnamed peaks of the eastern range of the Grampians, and endeavour to grasp the general aspects presented by the eastern portion of the central valley of Scotland during the Old Red Sandstone period Here, surrounded by the wildest and most rugged mountain scenery in Scotland, we might witness. not only the birth of Forfarshire, but some of the grandest events recorded in the past history of our planet. Let us attempt to reproduce the scene Stretching from the base of the Grampians across what is now Forfarshire and the lower basin of the Tay, would be observed a vast expanse of water extending as far as the eye could reach towards the east, and bounded on the north by a range of hills whose serrated summits could just be discerned in hazy outline projected on the distant horizon While gazing across this great lake towards these distant hills, the water would suddenly and quite unexpectedly give evidence by their commotion of the near approach of some great sub-aqueous disturbance Huge waves roll towards the base of the mountains, breaking with a tremendous and deafening noise on the beach, or dashing with irresistible fury against the rock-bound coast. At intervals low rumbling sounds would be heard, at which the very mountains would tremble. Immediately the sky is darkened by vast clouds of vapour, mingled with volcanic ash and debris, projected high into the atmosphere by volcanic action, and descending in dense dark showers into the bed of the lake. Rocks are torn from the earth's foundations and discharged into the atmosphere with terrific force Terrible scenes of destruction and desolation follow, unparalleled in the annals of modern volcanic eruptions Along the southern shores of the Firth of Tay to-day we have the records of these events, many of them unfortunately of a very fragmentary nature, and hard to decipher, since the original impressions are almost obliterated by the lapse of untold ages To add to the difficulty of interpretation other characters, the result of chemical disintegration and recrystallization, have been superimposed at subsequent periods, so that these records commemorating, not the history of a nation, but the evolution of a universe, partake of the nature of a palimpsest Notwithstanding, however, the obscurity of these primeval monuments, and the difficulty we experience in deciphering and translating their singular and occasionally ambiguous characters, we may hope in the near future

"To read what is still unread
In the manuscripts of God."

At present we are concerned with the palæontological rather than the geological aspects of this lake. If we compare the organic remains of Lake Caledonia with those of the Old Red Sandstone lake in the north of Scotland, we find that during this epoch the northern waters possessed a richer and more varied

fauna, and moreover, were comparatively free from those more or less violent volcanic outbursts which at frequent intervals disturbed the quiescence of the central area. In Forfarshire fossil organic remains are by no means abundant. The Sandstones of the Moray Firth, on the other hand, are particularly rich in fossils; while the Orkney quarries, according to Hugh Miller, could "supply all the museums in Europe with fossil fishes by the ship load." But though somewhat meagre in the number of species, and though specimens are frequently in a very imperfect and fragmentary condition, our Forfarshire fossil fishes are extremely interesting to the student of palæontology, since they illustrate some of the earlier phases in the evolution of a long series of organisms stretching from the dawn of vertebrate life on our planet up to the present day.

The existence of the remains of vertebrate animals in strata older than the carboniferous was first demonstrated in 1827. In that year Dr Fleming of Flisk obtained from the yellow sandstones of Drumdryan quarry near Cupar "certain organisms" which he believed to be "scales of vertebrate animals, probably those of a fish." In the same year Professor Sedgwick and Sir Roderick I. Murchison discovered fish remains in the Lower Red Sandstone of Caithness. It was also in 1827 that Mr John Martin discovered the fossiliferous nature of the coarse conglomerate at Scat Craig, near Elgin, which has since yielded scales, cranial bones, teeth, and dorsal spines in abundance. About the same time Hugh Miller was devoting his spare moments to the investigation of the Old Red Sandstone formations of Cromarty. It was in 1831 that he first exposed, "with a single stroke of the hammer," one of the most remarkable and anomalous fossils of this remarkable age. This was the Pterichthys or "winged fish of Cromarty." Hugh Miller was in no hurry to make known his discovery, as seven years elapsed before he introduced this extraordinary organism to the acquaintance of geologists. It was not until 1841 that he published the results of his labours in a most interesting little volume, forming one of our most cherished classics in geological literature.

While our geologists at home were making these contributions to our knowledge of the fossiliferous formations of Scotland, a young student on the quiet shores of Lake Neuchâtel in Switzerland was absorbed in the study of the structure and organisation of fossil fishes. Meditating on these strange organisms during his solitary walks by the lake, and working at his self-imposed task far into the night, Louis Agassiz, while still a young man, laid the foundation of the science of Palæozoic Ichthyology. His "Recherches sur les Poissons Fossiles" is a remarkable book, which occupied the greater part of his time for the space of ten years. This was immediately followed by his beautiful

monograph on the "Fossil Fishes of the Old Red Sandstone" These finely illustrated volumes remain a permanent monument to the brilliant genius and indefatigable industry of this illustrious savant.

On plate I of the second volume of his "Poissons Fossiles," published in 1835, Agassiz figures the first fossil fish discovered in Forfarshire. It was found in a quarry near Glamis by a workman, who at once handed it over to Sir Charles Lyell of Kinnordy Sir Charles sent the specimen to Agassiz for identification, who named it *Cephalaspis lyelli* This specimen is now in the British Museum So strange were some of these Old Red Sandstone fishes, separated by untold ages from those that haunt our lakes and seas to-day, that at first they suggested to Agassiz a connecting link between fishes and crustaceans Such abnormal types of vertebrate life as Pterichthys and Cephalaspis, though classed by Agassiz and subsequent authorities amongst the Fishes, are now separated from the true Fishes, and assigned a position lower in the scale of organisation.

With the exception of a few spines, the first true fishes from the Old Red Sandstone of Forfarshire were obtained at Farnell near Montrose in July 1857 by the Rev. Hugh Mitchell of Craig, and were exhibited to the Geological section of the British Association at the meeting held at Aberdeen in 1859. They were submitted to Sir Philip Egerton for examination He found two distinct species represented, one of which was named *Acanthodes mitchelli*, and the other *Climatius scutiger* These beds soon yielded a rich harvest, including a beautiful specimen of *Ischnacanthus gracilis*, discovered by the Rev. Henry Brewster of Farnell. Subsequently numerous specimens of fossil fishes and other organisms were found in various quarries throughout the country. Tealing yielded a number of interesting specimens to the researches of Mr Walter McNicol and Mr Allan Mathewson. The most successful collector, however, of Forfarshire fossils was undoubtedly the late Mr James Powrie of Reswallie, whose extensive collection of local fossils, unrivalled for the beauty and rarity of the specimens, is now permanently located in our National Museum at Edinburgh. Mr Powrie was early in the field, and collected in all parts of the country, but his collection is particularly rich in specimens from Turin Hill near Forfar.

We hope in a series of articles on the "Fossils of Forfarshire" to introduce our readers to the more important organic remains found in our own district, calling attention more particularly to the specimens of these organisms in the Society's Collection.

FOSSIL FISHES.

I.—Acanthodian Fishes.

The fossil fishes included in this order form a small but interesting series of Elasmobranchs related to our existing sharks These primitive palæozoic sharks are usually only a few inches in length, with a cartilaginous skeleton, the surface of which is usually calcified but does not exhibit the character of true bone The so-called bones of the cranium, the jaws, and the pectoral girdle present the appearance of bone, though bone cells are wanting. Embedded in the skin are hard enamelled placoid scales, which in these early sharks are flattened and closely fitted together. Each of the fins are provided with an anterior spine. There are no gill covers, and the five gill-slits open on each side of the body as in our modern sharks The vertebral column is continued into the upper part of the caudal fin, thus giving rise to a heterocercal tail The Acanthodian fishes are divided into three Families, viz. :—

I. Diplacanthidæ.
II. Ischnacanthidæ.
III. Acanthodidæ.

Family Diplacanthidæ.

The earlier forms of Ancathodian fishes are included in the family Diplacanthidæ. They have two dorsal fins, usually represented in fossil specimens by two strong spines In well preserved specimens a series of paired ventral spines may be observed between the pectoral and pelvic fins. These curious intermediate ventral spines are characteristic of all the Diplacanthoid fishes. Eight species of this family occur in the Lower Old Red Sandstones of Forfarshire, nearly all of which are represented by specimens in the Society's Collection

Parexus incurvus (Agassiz).
„ falcatus (Powrie).
Climatius reticulatus (Agassiz).
„ scutiger (Egerton).
„ uncinatus (Powrie).
„ macnicoli „
„ grandis „
„ gracilis „
„ elegans „

Parexus (Agassiz, 1845).

The following is Mr Powrie's definition of the genus:— "Body short, deep, tapering posteriorly, compressed laterally; head medium size, somewhat ovate, compressed, branchial

arches small, exposed; tail large, heterocercal; fins membranous, preceded by stout conical spines, striated longitudinally, ridges crenate or smooth; two dorsals, two pectorals, two ventrals, one anal, anterior dorsal stout, very large-toothed anteriorly, situated immediately behind the supra-occipital process; several pairs of intermediate dermal spines between the pectorals and ventrals" This genus is represented by two species, both of which are from the Lower Old Red Sandstone of Forfarshire.

Parexus incurvus (Agassiz)

In Agassiz's Monograph of the Fossil Fishes of the Old Red Sandstone, published in 1845, two spines from the Balruddery collection are described and figured (Plate xxxiii). These two spines I saw many years ago in the collection at Rossie Priory, but I have reason to believe they are now in Edinburgh. One of the spines was over two inches in length and perfectly straight, while the other was somewhat shorter and considerably bent. Though obviously the dorsal spines of fishes, they were quite new to Agassiz, who established the genus *Parexus* for their reception, including both under the same specific name *incurvus* These two spines were afterwards shown to be anterior dorsal spines, and must therefore be specifically distinct. Mr Powrie retained Agassiz's specific name for the fish having the straight spine.

This single spine was all that Agassiz ever saw of this singular and rare fish, and the genus remained undefined till 1864, when Mr James Powrie of Reswallie was fortunate in securing a beautiful and complete example of this species at Turin Hill. This specimen Mr Powrie described and figured in the Quart. Jour. Geol. Soc., vol. xx, where for the first time the genus is defined, together with a detailed description of the species. This fine and unique specimen is now in the collection of the Dundee Naturalists' Society. We shall here quote from the article above referred to—Mr Powrie's detailed account of this species, compiled from a comparison of all available specimens

"In this specimen the head is medium-sized and compressed laterally. The eye-orbits occupy a nearly central position on each side, and are large. The mouth is indistinct, but seems to have been small, opening rather below, The teeth I have never seen The bronchial arches are exposed, small, and placed immediately behind and rather below the eye-orbits; in a specimen where they are well preserved they seem to be eight in number. The body is laterally compressed, stout, short, and deepest immediately under the anterior dorsal, the depth being about one-fourth of the entire length of the fish; thence it rapidly tapers to the tail, which is heterocercal, large, and very broad,

the outline both above and below curved outwardly; its length is not much less than one-fourth of that of the entire fish. The spines consist of two dorsals, two pectorals, two ventrals, and one anal Four pairs of dermal spines are situated between the pectorals and ventrals The spines are all striated longitudinally, and have crenate ridges. The anterior dorsal is very long and stout, its length being nearly one-half of that of the entire fish; it is toothed posteriorly, and, as described by Agassiz, the teeth are rather distant, short, stout, sharp, and point upwards, 'arqées en haut.' It is situated immediately behind the head and opposite to the pectorals, and is perfectly straight. The posterior dorsal is situated about half-way between the anterior dorsal and the commencement of the caudal fin, and is quite straight, stout, and about two-fifths of the length of the anterior. The pectorals are attached to the coracoids or pectoral bones; they are large and much bent, resembling in form those of *Climatius reticulatus*. The ventrals of medium size, stout and curved backwards, are placed not much, if at all, in advance of the posterior dorsal The anal is comparatively small, somewhat curved, and not much behind the ventrals. In none of my specimens are the intermediate spines well preserved; they seem to have been short, stout, and rather curved. The scales are rather large, and, unlike those of the other genera, are arranged in irregular, wavy lines both on the body and fins; their outer surface is not preserved in any of my fishes, but a specimen belonging to Mr Mitchell clearly shows that the surface, like that of all the other genera, is smooth and slightly raised in the centre; the inner surface is undoubtedly sculptured, but too indistinctly to admit of correct description."

Parexus incurvus has been recorded from the following localities: Balruddery, Farnell, Canterland Den, and Turin Hill.

Parexus falcatus (Powrie)

At a meeting of the Edinburgh Geological Society held on 1st April, 1869, Mr James Powrie, Vice-President, read a communication, "On the Earliest Known Vestiges of Vertebrate Life." In this "paper" Mr Powrie described a new species of the genus *Parexus*, two specimens of which he had found in the Turin Hill Quarry. To this species Mr Powrie applied the specific term *falcatus* on account of its seythe-shaped anterior dorsal spine. It is easily distinguished from *P. incurvus* by its comparatively larger head and smaller body The anterior dorsal spine, though very large and broad at the base, differs considerably from that of the preceding species It is shorter, much curved, with a few widely spaced posterior denticles, and is situated immediately above the pectoral arch The second dorsal spine is about half as long as the first, and placed

immediately in advance of the anal, which it somewhat exceeds in size.

Specimens of *Parexus falcatus* are rare, and have only been recorded from Turin Hill. This species is represented in the Society's collection by an imperfect anterior dorsal spine, presented to the Society by Mr James Powrie, Reswallie.

(*To be continued.*)

CATALOGUE OF FOSSIL FISHES

From the Lower Old Red Sandstone of Forfarshire

In the Collection of the Dundee Naturalists' Society.

By James B. Corr, Dundee Museum.

I.—OSTROCODERMI.

Family—**Pteraspidæ.**

Pteraspis mitchelli (Powrie)

(Geologist, vol. vii., 1864).

(1)

Ventral Plate showing the concave surface. These remains were formerly thought to represent the dorsal shield of an organism allied to Pteraspis, and were described by Professor Ray Lancaster, in his monograph, under the term Scaphaspis They are now regarded by our best authority—the late Professor Traquair—as the ventral plates of Pteraspis.

(2)

A fine specimen of the convex surface of the anterior half of the dorsal shield ; Newtyle.

Presented by James Powrie, Esq.

(3)

Two Ventral Plates showing the convex surface with the counterpart of one of them ; Newtyle.

Presented by Alex. Hutcheson, Esq.

Family—**Cephalaspidæ.**

Cephalaspis lyelli (Agassiz).

(Poiss. Foss., vol. ii., 1835).

(4)

A nearly complete specimen, though considerably crushed and flattened. The dorsal surface is exposed, showing the general outline, but the details are not well preserved ; Turin Hill.

Presented by James Powrie, Esq.

(5)

Shield almost complete, orbits not preserved, the natural outline and elevation of the shield is well shown; Leysmill. The only specimen recorded from this locality.

Presented by Allan Mathewson, Esq., 1873.

II.—ELASMOBRANCHII

Family—**Acanthodidæ.**

ACANTHODES MITCHELLI (Egerton).

(Rep. Brit. Assoc., 1860..

(6)

Complete fish, lateral aspect, showing the dorsal, pectoral, ventral and anal spines in their natural position. The branchial slits and the scales are well preserved; Duntrune Quarry

Presented by Walter McNicol, Esq

(7)

Nearly complete but somewhat crushed specimen Head well preserved, displaying the character of the cranial bones; Duntrune Quarry.

Presented by Walter McNicol, Esq.

(8)

A rather crushed specimen, but exhibiting some interesting details; Duntrune Quarry.

Presented by Allan Mathewson, Esq.

(9)

Specimen exhibiting the ventral aspect, with the details of the head well displayed; Tealing.

Presented by James B. Corr.

(10)

Incomplete specimen, wants the posterior part of the body as far as the dorsal spine; Duntrune Quarry.

Presented by Walter McNicol, Esq.

Family—**Ischnacanthidæ.**

DIPLICANTHUS GRACILIS (Egerton).

(Figs. and Descrips. Brit. Org. Remains, dec. x)

ISCHNACANTHUS GRACILIS (Powrie).

(Trans. Edin. Geol. Soc., vol. i.)

(11)

Complete specimen, showing dentition and numerous details of structure; Tealing.

Presented by Allan Mathewson, Esq.

(12)

Large specimen, slightly damaged about the head, probably exceeding $6\frac{3}{4}$ inches in length; Tealing.

Presented by James B. Corr.

(13)

Two small specimens, almost complete, from Turin Hill.

Presented by James Powrie, Esq.

(14)

Fragment with the teeth in the upper and lower jaws well displayed; Turin Hill Quarry.

Presented by James Powrie, Esq.

(15)

Crushed specimen, but some of the details well preserved; Turin Hill Quarry.

Presented by James Powrie, Esq.

(16)

Complete specimen in a curved position; also a well preserved head.

Presented by James B. Corr.

(17)

Complete specimen, showing all the spines, from the blue shale of Forfarshire.

Presented by Walter McNicol, Esq

Family—**Diplacanthidæ.**

CLIMATIUS RETICULATUS (Agassiz).

(Poiss. Foss. V.G.R., p. 120, pl. xxxiii)

(18)

This fine specimen is almost complete, wanting only a small portion of the tail. It must have been over eight inches in length. The branchial arches on both sides are very pronounced. The two dorsal and the anal spines are shown in position Both the ventral spines are displayed in situ, but the pectorals are displaced and are shown lying on the surface; Turin Hill.

Presented by James Powrie, Esq.

CLIMATIUS SCUTIGER (Egerton).

(Figs. and Descrips. Brit. Org. Remains, dec. x.)

(19)

Small complete specimen from Duntrune. This is a very small species, not exceeding $2\frac{1}{2}$ inches in length, the head and branchial apparatus occupying one-fifth of the total length.

Presented by Walter McNicol, Esq.

(20)

Incomplete specimen; wants the caudal region; Duntrune.

Presented by Walter McNicol, Esq.

CLIMATIUS MACNICOLI (Powrie).

(Quart. Jour. Geol. Soc., vol. xx.)

(21)

A very small but almost complete specimen, slightly damaged at both ends.

Presented by James B. Corr.

(22)

Fragment of a large specimen, wanting the head and most of the tail. The extremely minute scales are very well preserved, and many of the intermediate ventral spines are shown, Turin Hill.

Presented by James Powrie, Esq.

CLIMATIUS GRANDIS (Powrie).

(Trans. Edin. Geol. Soc., vol. i.).

(23)

A complete specimen, with the exception of the caudal region, a few of the spines seem to be amissing. This specimen is considerably crushed, but when complete must have measured at least 18 inches in length; Turin Hill.

Presented by James Powrie, Esq.

PAREXUS INCURVUS (Agassiz).

(Poiss. Foss. V.G.R., p. 120, pl. xxxiii.).

(24)

The type specimen discovered at Turin Hill by Mr James Powrie, figured and described in the Quart. Jour. Geol. Soc., vol. xx. The original type is an imperfect anterior dorsal spine described by Agassiz in 1845. Nothing further was known of the fish till 1864, when the discovery of this complete specimen by Mr Powrie enabled him to give an accurate definition of the genus and a detailed description of the species.

From Mr Powrie's Collection.

(25)

In this specimen, which is almost complete, the anterior dorsal spine and the petoral spines are shown in situ A few details of the head can be detected which are not preserved in the type specimen. The outline of the body and the arrangement of the extremely minute scales are displayed as far as the caudal region; Turin Hill.

Presented by James Powrie, Esq.

PAREXUS FALCATUS (Powrie).

(Trans. Edin. Geol. Soc., vol. i.).

(26)

Imperfect anterior dorsal spine from Turin Hill, showing the characteristic longitudinal striations and the minute ornamentation.

Presented by James Powrie, Esq.