NAT. HIST. SOC.
OF
NORTHUMBERLAND
DURHAM
&
NEWCASTLE-ON-TYNE

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TRANSACTIONS

OF THE

NATURAL HISTORY SOCIETY

OF

NORTHUMBERLAND, DURHAM,

AND

NEWCASTLE-UPON-TYNE.

(New Series.)

VOL. VI.

NAT. HIST. SOC. OF NORTHUMBERLAND DURHAM & NEWCASTLE ON TYNE

LONDON:

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1923-1926.

1926-1926

1924-26
6
1924
Part 1

CONTENTS OF VOLUME VI.

(NEW SERIES).

PAGE

George Stewardson Brady, M.D., M.R.C.S., D.Sc., L.L.D., F.R.S. By Professor A. MEEK, D.Sc., F.Z.S. (with portrait and bibliography) 1

Reports on the Field Meetings of the Natural History Society :

For 1918. By W. E. BECK... 15

For 1919. By GEORGE SISSON 24

For 1920. By RANDLE B. COOKE. 34

Ryton Willows Pool. By B. MILLARD GRIFFITHS, D.Sc., F.L.S. and RANDLE B. COOKE 39

Bats. By GEORGE BOLAM 48

Experimental Legislation with reference to the Crab Fisheries of the East Coast of Britain. By ALEXANDER MEEK, D.Sc., F.Z.S. 63

Botanical Notes. By GEORGE BOLAM 80

The British Races of Aricia Medon (Esper) with Special Reference to the Areas in which they overlap. By J. W. HESLOP HARRISON, D.Sc.. F.R.S.E. and WILLIAM CARTER 89

Nicholas Temperley. By C. E. R. 108

Miscellanea (Part I) 110

Reports of the Natural History Society :

1919-1920 i

1920-1921 xx

1921-1922 xl

David Woolacott, D.Sc., F.G.S. By J. A. SMYTHE, D.Sc. (with portrait and bibliography) 115

Reports on the Field Meetings of the Natural History Society :

For 1921. By J.W. HESLOP HARRISON, D.Sc., F.R.S.E. 121

For 1922. By F. C. GARRETT, D.Sc. 128

For 1923. By J. R. JOHNSON 132

On the Crustacean Fauna of a salt water pond at Amble with some remarks on its bearing on the problem of the Inheritance of Acquired Characters. By ALEXANDER MEEK, D.Sc. 142

Some Crustacean Larvæ from the Northumberland Plankton. By OLGA M. JORGENSEN, M.Sc. 157

Fossil Flora of the Northumberland and Durham Coalfield. By EDITH BOLTON, M.Sc., F.L.S. 167

decapoda
Part 2
1926

PAGE

Fluctuations in Fisheries. By B. Storrow, M.Sc. 182
On Parthenogenesis, originating in Lepidopterous Crosses. By J. W. Heslop Harrison, D.Sc., F.R.S.E., and A. D. Peacock, M.Sc., F.R.S.E. 201
Variation and Hybridity in Willows. By J W. Heslop Harrison, D.Sc., F.R.S.E. 218
On two specimens of Giant Squid stranded on the Northumberland Coast. By Alexander Meek, D.Sc., and T. Russell Goddard, F.L.S. 229
Miscellanea (part II) 238
Reports of the Natural History Society :
1922-1923 ... ... i bis
1923-1924 ... ... xix bis
1924-1925 ... ... xxxviii bis

LIST OF PLATES AND OTHER ILLUSTRATIONS, Vol. VI. (New Series).

Portrait of the late Prof. George Steward-on Brady ... facing page 1
Vegetation Map of Ryton Willows Pool, 1918 38
Six pages of Graphs illustrating Prof. A. Meek's paper on Crab Fisheries .. .. 74 to 79
Plate illustrating Dr. J. W. Heslop Harrison and William Carter's paper on Aricia Medon (Esper) ... ... facing page 89
Map of the British Isles showing the distribution of Aricia Medon (Esper) 107
Portrait of the late Dr. David Woolacott ... ... facing page 115
Plates illustrating Miss Olga Jorgensen's paper on Crustacean Larvæ : ... ... facing page 166
Plate I. Diagram showing distribution of Ebalia larvæ during the years 1921-23
Plate II. Drawings of stages of Ebalia sp.
Plate III. Diagram showing distribution of Thysanoessa larvæ during the years 1921-23.
Plate IV. Drawings of Thysanoessa.
Four pages of Graphs illustrating Mr. B Storrow's paper on Fluctuations in Fisheries .. .. facing page 200
Plates illustrating Prof. A. Meek and T. Russell Goddard's paper on two specimens of Giant Squid :
Plate I. Photographs of two Giant Squids ...facing page 229
Plate II. Drawings of Foveolæ of Squids ... 237

NATURAL HISTORY SOCIETY
OF
NORTHUMBERLAND, DURHAM AND NEWCASTLE-UPON-TYNE.

REPORT OF THE COUNCIL
FOR 1919–1920.

The staff and students of Armstrong College returned to their own quarters last October, after which the reparations to the Hancock Museum engaged the attention of the Council. After an occupation of five years there was naturally a good deal of work necessary to restore the buildings to their pre-war conditions, and to carry this out the authorities of the College met the demands of the Natural History Society in a fair and generous spirit. Those portions of the Museum which had been allotted for their work, viz., the upper and lower west corridors, lower east corridor, front and rear work-rooms, have been whitewashed and distempered and the window and hot water pipes painted at their expense, under the supervision of their Clerk of Works, Mr. Rawling, to whom the thanks of the Council are due for his trouble and attention. The only expense which has fallen upon the Natural History Society was that incurred by the substitution of a washable instead of a flat distemper on the walls, an expense which it is anticipated will lead to ultimate economy of upkeep.

The heating apparatus, which has been a source of thought and anxiety to the Council for many years, has been thoroughly overhauled under the direction and supervision of Mr. Ernest Scott and Mr. Wilfred Hall, who have given their time ungrudgingly : an accelerator has been fitted, and so far as the tests have been carried out, there appears to be good

reason to anticipate not only that there will be greater economy in fuel but that the equable heating of all parts of the Museum will be regulated and maintained. This work was put in hand in October, but unfortunately owing to the moulders' strike the delivery of the accelerator was delayed and the work could only be completed after the winter season. It must be borne in mind, however, that the boilers are growing old and that provision will have to be made for their renewal in the not distant future.

Turning now to the attendance, the turnstile shews that during the year under review the number of visitors has been 36,144, which is satisfactory evidence of the interest of the public in the work of the Society. Of these, 1,425 were scholars from the Council and other schools who have attended somewhat irregularly under the guardianship of their teachers. It must be remembered that in making comparison with last year the figures were then considerably swollen by the admission of large numbers of soldiers and sailors, either resident in the local hospitals or stationed in the district, but who have now happily returned to their homes.

On the occasion of the march past on July 19th of the military troops and auxiliaries to the Peace celebrations, some 200 wounded soldiers—many of them wheeled hither by the Infirmary nurses—were given the opportunity of watching the procession from the safe standpoint of the Museum grounds, which was much enjoyed.

As regards membership, there has been a pleasing increase, the roll showing that there are 426 now on the books, of whom 397 are full members and 29 associates. There were four resignations during the year, against which there was an accession of 46 members and associates.

Unfortunately the Society is the poorer owing to the deaths of twelve valued members during the year: Lord Ravensworth, a Vice-President of the Society; the Rev. W. Johnson, a recognised authority on lichens; Mr. Sydney Pearson, a successful hunter of big game, and others.

It is a source of satisfaction that it was possible to restart the course of lectures which was a feature of work during the winters before the war, and thanks to willing co-operation a well balanced series was arranged, which, judging from the attendances, was appreciated by the public. The Curator also resumed his "talks" during the winter evenings. Details of these lectures and 'talks" are given at the end of the report, and to all the lecturers, who so willingly gave their help, the thanks of the Society are accorded.

The Round Table meetings held on Saturday afternoons were well supported when a special subject was presented; this, however, theatens to encroach on the province of the lectures, and should the open meetings not be better attended, it may be advisable to discontinue the experiment.

One hopeful evidence of serious work was the formation of an entomological section at the request of a band of enthusiastic workers, which promises to be successful not only in bringing those of kindred taste together but in the still more important result of co-ordinating the work of examining the records of the past and bringing them up to date, with indices and references, which should be of great assistance and value to all students.

The Wild Flower exhibit continues to be a source of attraction and help to those interested in botany, and to Mr. Randle B. Cooke thanks are specially due for specimens regularly supplied each week; others have kindly helped by bringing in flowers from time to time, and this assistance is appreciated.

Mr. Randle B. Cooke was also appointed Field President for the season, and under his able and enthusiastic leadership a programme of interesting meetings in the near locality is being carried out. In this the members of the newly-formed entomological section have found scope for good work.

There is at present great delay in getting work carried out in every direction, and owing to this cause Vol. V., part 2 of the Transactions is still in the hands of the printers.

The competition for the Hancock Prize was disappointing, only eight essays having been received and these not reaching the high standard of former years. The Council therefore exercised their right of withholding the prize on the recommendation of the judges, but awarded a smaller one to Miss Ida M. Dodds, a junior competitor, for her short meritorious paper. The Council are indebted to the Rev. J. E. Hull and Mr. George Bolam for their trouble in examining the essays.

The Endowment Fund has been augmented by a residuary legacy from the late Dr. Clement Stephenson of £952 5s. 6d., which together with a further instalment of £100 from Sir Geo. Noble, has been invested in War Loan and Great Eastern 3½ per Cent. Preference (Trustee) Stock.

In spite of the exercise of economy, the cost of upkeep, chiefly by way of salaries, wages and fuel has advanced in sympathy with the general increased cost all round; but there is reason for satisfaction with the balance sheet which the Hon. Treasurer is able to present.

The return of the Curator, Mr. E. Leonard Gill, has turned the course of work into normal channels, and to him, in conjunction with the other members of the staff, the Council readily express their thanks for the efficient and cheerful carrying on of the work of the Museum.

NEW MEMBERS ELECTED

FROM 1ST JULY, 1919, TO 30TH JUNE, 1920.

W. F. Askew, Bradleigh, Alverstone Avenue, Low Fell.
T. Beattie, M.D., F.R.C.P., 3, Ellison Place, Newcastle.
R. A. Bolam, M.D., M.R.C.P., 3, Queen's Square, Newcastle.
John Charlesworth, 44, Hotspur Street, Tynemouth.
J. B. Clark, Rosslyn, Beech Grove Road, Newcastle.
R. A. Dodds, Blagill House, Beech Grove Road, Newcastle.
Mrs. R. A. Dodds, ,, ,, ,, ,,
Hamilton Drummond, M.D., 4, Saville Place, Newcastle.
A. Duke, M.A., M.B., F.R.C.S.E., 72, Osborne Road, Newcastle.
Prof. G. Hickling, D.Sc., F.G.S., Armstrong College, Newcastle.

Alfred E. Hill, The Red House, Tynemouth.
James H. Horsley, Chirton, Clifton Road, Newcastle.
W. E. Hume, M.A., M.D., 4, Ellison Place, Newcastle.
Fred. Maling, Temperley Grange, Corbridge.
Fred. Milburn, 6, Fenham Terrace, Newcastle.
Sir Theodore Morison, K.C.I.E., M.A., Armstrong College, Newcastle.
W. Wilson Nimmo, Yarm House, Gosforth.
Sydney Pearson, Egglestone, Bellingham.
J. D. W. Penman, 132, Albert Road, Jarrow.
Lewis Priestman, Derwent Lodge, Shotley Bridge.
Lieut.-Col. Geo. Pollard, Seaton Delaval Hall, Seaton Delaval.
John Ridley Ritson, Sniperley Hall, Co. Durham.
Richard Robson, 122, St. George's Terrace, Newcastle.
Sir Herbert Rowell, K.B.E., The Manor House, Jesmond, Newcastle.
Thomas Smith, Hamsterley House, Low Westwood, Hamsterley Colliery, Co. Durham.
Herbert Taylor, 56, Manor House Road, Newcastle.
Miss M. Temperley, 4, Carlton Terrace, Low Fell.
George W. Temperley, 4, Carlton Terrace, Low Fell.
Septimus S. Ward, 44, Osborne Road, Newcastle.
J. D. Wardale, M.A., M.B., Carlton Villa West, Jesmond Rd., Newcastle.
Dr. Ethel Williams, 3, Osborne Terrace, Newcastle.

LIFE MEMBER

Master J. K. Bottomley, Kearsney, Westfield Drive, Gosforth.

ASSOCIATE MEMBERS

J. Baxter, 3, Orchard Street, Birtley.
Miss K. Blackburn, M.Sc., Armstrong College, Newcastle.
Miss Edith Bolton, Armstrong College, Newcastle.
P. Charlton, Whinney Leas Cottage, Chopwell.
Miss A. S. Dickinson, c/o Mrs. Manning, 437, Elswick Road, Newcastle.
J. R. Johnson, 3, Devon Gardens, Gateshead.
E. M. Harrison, The Avenue, Birtley.
Ronald N Oliver, 25, Lily Crescent, Newcastle.
H. Preston, Armstrong College, Newcastle.
Miss Richardson, The High School, Tankerville Terrace, Newcastle.
P. A. Sloan, Craiglea, Westfield Drive, Gosforth.
Miss Y. M. Herbert Smith, 1, Foley Avenue, Well Walk, Hampstead, N.W. 3.
M. Lawson Thompson, 40, Gosford Street, Middlesbrough.
Sydney Turnbull, The Avenue, Birtley.

CURATOR'S REPORT ON MUSEUM WORK

1919–1920.

Work of conservation has on the whole predominated over progressive work during the past year. In a museum which, like ours, has an enormous quantity of valuable store material and only a small staff, this must be the case pretty constantly. But there is a fair amount of progressive work to be reported too, as will appear from what is said under some of the following headings.

Conservation Work.—Much of Miss Scott's time and a good deal of Miss Hepburn's has been spent in working through the store collections. The Eltringham collection of exotic butterflies, the Raine collections of Continental butterflies and of British butterflies and moths, the Finlay collection of local lepidoptera and Col. Adamson's collection of Burmese butterflies; these and other store collections of insects have been dealt with by Miss Scott, the drawers re-lined where necessary, the insects cleaned and repaired, napthaline renewed and so on—altogether a large undertaking. Miss Scott has similarly overhauled the Alder collection of British shells and zoophytes and the Angas collection of foreign shells. The store collections overhauled by Miss Hepburn have included the Hancock collection of birds' skins, and the collections in tubes, bottles and jars of spirit, in particular Alder and Hancocks' tunicates and nudibranchs, and the Rev. J. E. Hull's spiders. The books in the library have been cleaned by Miss Scott, and an important piece of work has been done by Miss Hepburn in the complete arranging and listing of the foreign unbound periodical literature.

Labelling.—In work of a more progressive nature, the steadiest advance has been made in the matter of labelling. During the year we have bought a fair-sized fount of new type, selected with some care to combine the maximum of legibility with good wearing qualities and readiness in yielding clear impressions. In practice it has proved a great advance on any type we have tried before. The chief use to which

we have put it so far has been the printing of descriptive labels for the British birds. These labels, the provision of which we have had in view for some time, are designed to give the average visitor the sort of information he is most likely to want about any species of bird: though the amount that can be said is limited by the space available in the cases. With all the other things we have to attend to it will take us some time to label in this way the whole Hancock collection, but we have made a substantial beginning; labels for the birds of prey and the Picariae are finished, and those for the game birds and some others are well in hand. Labels for various other sorts of specimens have been printed too, among them a few general guide-labels such as one for the seals and sea-lions. The actual type-setting and printing is all being done by Miss Scott, and the results she is getting are excellent.

Geological Department.—In the Geology Room there is little progress actually to show. I have added one or two further cases to the introductory series, but the chief advance is one that does not yet appear, namely, the beginning of a series of large geological sections to run round the room on the frieze above the wall cases. Working sketches for three of these sections, all illustrating local geology, have been made by Dr. Woolacott, and I am just preparing to enlarge and paint them on the frieze itself. Important work on the contents of our Geology Room was done during the spring, when Mr. D. M. S. Watson paid us a two months' visit for the purpose of completing his researches on our Coal Measure amphibians. During his visit Mr. Watson did us various good services in addition to those incidental to his main work. For example, he named all our Old Red Sandstone fishes, and he sorted out and identified for us a large series of mammalian bones from the early Tertiaries (Phosphorites de Quercy) of the south of France. In connection with Mr. Watson's visit I have spent a good deal of time in mending some valuable fossil skulls, and I still have a number of casts to make for different purposes.

Ethnological Department.—During the war, when no work could be done in the Ethnology Gallery, many new specimens were acquired which now have to be incorporated in the collection. Miss Scott has done a good deal of work to this end: she has polished or otherwise cleaned a large number of objects and printed labels for them, and has made a beginning upon a much-needed overhaul of the wall cases in the gallery. For the time being, this work is suspended while the roof is repaired and the gallery re-decorated.

Odds and Ends—Among the many minor pieces of work are some connected with the restoration of parts of the building occupied during the war by the College. Thus the big-game heads have been cleaned and replaced on the wall of the lower west corridor. The counter in the entrance hall has again been used for a display of wild flowers which occupies a good deal of Miss Hepburn's time all through the summer. I have mounted a few birds for the collection and made skins of a few others.

"*Museum Talks.*"—I gave the usual series of six "museum talks" during the winter. Though the average attendance was only 39, they were in some respects not unsuccessful. An excellent informal lecture was given by Mr. D. M. S. Watson one Saturday afternoon, on the life represented in the local Coal Measures.

Help received.—The services rendered by Mr. Watson have already been referred to, as has also Dr. Woolacott's help with the large geological sections. Dr. Woolacott is helping us in another very practical way, by giving us selected specimens from borings, raised beaches, etc., to illustrate special features of local geology. The Rev. T. G. Hillard has supplied useful geographical data and corrections for the labelling of a number of the exotic shells in the show cases

E. Leonard Gill.

MUSEUM STAFF

Curator.....E. Leonard Gill, M.Sc.
Assistant Curator.....Miss Gladys Scott.
Lady Assistant .... Miss I. M. Hepburn.
Attendant..... .....A. E. Bennett.
Gardener .....H. Stones.

HONORARY CURATORS

Col. C. H. E. Adamson, C.I.E.
R. S. Bagnall, F.E.S., F.L.S.
H. Eltringham, M.A., D.Sc., F.Z.S.
Samuel Graham.
J. W. H. Harrison, D.Sc.
Prof. Alex. Meek, M.Sc., F.Z.S.
Prof. M. C. Potter, M.A., Sc.D.
Geo. B. Walsh, B.Sc.
D. Woolacott, D.Sc.

INFORMAL SATURDAY AFTERNOON MEETINGS

1919.
Oct. 25. "Sigillaria"—E. L. Gill.
Nov. 29. "Wild Roses"—J. W. H. Harrison, D.Sc.
1920.
Jan. 31. "Lake District Geology"—John Jeffrey, B Sc.
Apr. 24. "Life of the Low Main Seam at Newsham as represented in the Atthey Collection."—D. M. S. Watson.

CURATOR'S "MUSEUM TALKS."

Oct. 29. Skulls.
Nov. 26. Birds in Winter.
Dec. 17. Christmas Fare.
Jan. 28. Fossil Trees.
Feb. 25. Squids.
Mar. 31. Recent Acquisitions.

AFTERNOON LECTURES FOR YOUNG PEOPLE

1919.

Dec. 29. "Shore Life"—Geo. Hurrell, B.A.

1920.

Jan. 5. "The Atmosphere"—R. H. Bell.

EVENING MEETINGS

1919.

Oct. 8. "Huns of the Plant World"—S. Mangham, M.A.

Nov. 12. "Round with a Gamekeeper"—W. Percy Mail.

Dec. 10. "Coast Scenery"—T. Franklin Sibly, D.Sc., F.G S.

1920.

Jan. 14. "Some Entomological Problems of the War"—
A. D. Peacock, M Sc

Feb 11. "The Brain in Man and Animals"—J. A. Menzies, M.A., M.D.

Mar. 10. "Strangers Zoological"—
R. S. Bagnall, F.E.S., F.R.S.E., F.L.S.

PRIVATE EVENING MEETING OF THE SOCIETY

Mar. 26. Report on Field Meetings of 1919, by Geo. Sisson, Chairman of the Field Meetings Committee.

PATRON

The Right Hon. Lord Armstrong, M.A., D.C.L.

PRESIDENT

The Right Hon. Lord Joicey.

VICE-PRESIDENTS

The Duke of Northumberland.
Viscount Grey.
The Bishop of Newcastle.
Sir Hugh Bell, Bart.
Sir Arthur Middleton, Bart.
Sir Geo. J. W. Noble, Bart.
Sir Theodore Morison, K.C.I.E.
Prof. Sir Thos. Oliver, M.D.
The Lord Mayor of Newcastle.
Col. C. W. Napier-Clavering.
Lt.-Col. C. H. E. Adamson, C.I.E.
Col. W. M. Angus, C.B.
Prof. G. S. Brady, M.D., F.R.S.
Clive Cookson.
R. Coltman Clephan, F.S.A.
J. L Gracie
Samuel Graham.
Prof. A. Meek, M.Sc.
H. N. Middleton.
Prof. M. C. Potter, M.A., Sc.D.
J. D. Walker, J.P.

COUNCIL

Hugh P. Angus.
G. A. Atkinson.
R. S. Bagnall.
W. E. Beck
Edwin Burnup.
A. J. Haggie, J.P.
Wilfred Hall
Prof. J. A. Menzies, M.A , M.D.
A. M. Oliver, O.B E.
George Sisson.
Clarence D. Smith.
John Talbot.

HON. SECRETARIES

C. E. Robson. | J. Alaric Richardson.

HON. TREASURER

A. H. Dickinson.

HON. AUDITORS

Samuel Graham. | Frank Richardson.

TRUSTEES FOR THE SOCIETY

Elected at the Special General Meeting held on the 13th of December, 1905.

The Rt. Hon. Lord Armstrong.
The Rt. Hon. Lord Joicey.
Sir Hugh Bell, Bart.
Lt.-Col. C. H. E. Adamson, C.I.E.
Clive Cookson.
G. E. Henderson.
Edward Joicey.
J. H. B. Noble.

T. E. Hodgkin (elected Oct. 1st, 1917).

LIST OF DONATIONS

TO THE MUSEUM AND LIBRARY FOR THE YEAR ENDING JUNE 30TH, 1920.

J. H. ALLANSON.—Two "water-scorpions," *Nepa cinerea*.

HUGH P. ANGUS.—A living sea-slug, *Doris tubercula*, from Newbiggin.

GEO. A. ATKINSON.—Seven eggs of Japanese birds, collected by the donor (including 2 crow's, 3 bunting's). A set of ten six-inch ordnance maps of the lower Tyne valley.

R. S. BAGNALL, F.R.S.E.—Three examples of *Hypera fasciculata*, a rare weevil, from Warkworth.

W. E. BECK.—Fossiliferous rocks, containing corals, brachiopods, etc., from the neighbourhood of Church Stretton.

MRS. N. H. BEGBIE.—Case containing two jays and a whinchat, stuffed before 1840.

JAS. BLACKLOCK—A little auk found alive at Gosforth, Oct. 29th.

GEORGE BOLAM—Local mammals (in formalin), including 3 whiskered bats and a lesser shrew. A female oak egger, dark variety.

DR. G. S. BRADY, F.R.S.—Cabinet containing the donor's collection of ostracoda, including many type specimens from the *Challenger* expedition and other sources; also various slides of other entomostraca; a turntable, slide case, and a Cathcart freezing microtome.

BRITISH MUSEUM, TRUSTEES.—Various publications of the Natural History Museum, South Kensington, including the Economic Series booklets, Nos. 3–10; Map of Distribution of Anopheline Mosquitoes, by W. Dickson Lang; Guide to British Fresh-water Fishes.

ROSSE BUTTERFIELD—Batch of the curious pupæ of *Microdon*, a genus of Diptera.

RALPH CARR, L.D.S.—A fine male "bull trout," 32-inches long, caught by the donor in the Coquet at Warkworth.

J. D. CHALLONER—A human skull found in the sand at Sakhara, Egypt. An abnormal egg of the peewit.

P. CHARLTON.—Some hymenoptera (sawflies, ichneumons, etc.).

HENRY CLARKE.—A cabinet containing minerals, fossils, etc.

F. COLLEY.—A barn owl killed by boys close to Jesmond Dene.

HERBERT EGGLISHAW.—Male and female of *Xysticus pini*, a spider new to Co. Durham, taken by the donor at Houghton-le-Spring.

WM. ELTRINGHAM.—A nearly complete example of *Palæoxyris* (egg capsule of a fish) in a nodule from Crawcrook.

REV. MARK FLETCHER, M.A.—Quarterly Journal of the Geological Society, vol. 74, parts 2, 3, 4; vol. 75, part 1.

WM. P. GRACE.—Hornet clearwings from Whickham; larvæ, pupæ and moths, with poplar timber showing the damage done.

A. E. GRAVESON.—Fossil shell, *Cardium sp.*, from the Miocene of Malta.

C. I. GREENHOW.—Miscellaneous minerals, rocks and fossils, from the Yorkshire coast, Cornwall, and elsewhere.

MISS C. H. GREET.—An obsolete farm implement, a "barley humler," formerly used for taking the ears off barley; from the High Common, near Wooler.

DR. R. HARTMEYER.—Papers by the donor on British Tunicata:—"Die Ascidienfauna von Plymouth;" "Alder und Hancocks Britische Tunicaten" (the author's report on his examination of the collection in May, 1914).

J. D. HASTINGS.—Photographs taken on the Farne Islands; ten large prints showing breeding colonies, nests and eggs of the birds.

J. HORNSBY.—Collection of fossils, chiefly from Weardale limestones. Also some cones and other vegetable remains from Australia.

THOS. HUNTER.—Crossbill, male in red plumage, found exhausted in grounds of Seaton Delaval Hall, Oct. 30th.

MISS HUNTING.—Collection of mascots carried during the war by Senegalese and other African troops in France.

MRS. HUTCHINSON.—On loan: some cases of birds and some fine chalk fossils.

INDIA OFFICE (Secretary of State for India in Council).—Further volumes of "The Fauna of British India:" Coleoptera, Chrysomelidæ (Hispinæ and Cassidinæ), by S. Maulik; Diptera Brachycera, vol. 1., by E. Brunetti.

R. IRWIN.—Greater black-backed gull, female in adult winter plumage, shot on the Northumberland coast by the donor.

J. JEFFREY, B. Sc.—Some further graptolites and other fossils from the Skiddaw Slates; some exceptionally good examples of the trilobite *Phillipsia eichwaldi* from the Northumbrian Four-fathom Limestone; a collection of Lake District erratics from the Boulder Clay at Kenton, together with samples of the parent rocks.

F. R. MAIN.—Newly born young of the common lizard, alive.

DR. WM. MARTIN.—From the library of the late N. H. Martin: bound set of the Society's transactions, old series complete, new series vols. 1–3; and Field Club transactions, vols. 4 and 6.

A. H. MAY.—Examples of two rare British beetles to fill gaps in the reference collections: *Anthonomus varians* (3 specimens) and *Lesteva monticola* (2).

J. MCLAURIN.—A longicorn beetle (? *Palimna sp.*) from West Africa.

H. T. MENNELL, F.L.S.—Journal of the Linnean Society, Zoology, vol. 33, No. 224.

MRS W. C. MOUNTAIN.—A green-headed tanager, *Calliste tricolor*, from Brazil.

T. PERRY.—A young albino hedge sparrow from Blagdon.

MRS. PLUMMER.—Samples of nitrate of soda from Chile.

W. MARK PYBUS.—"The Scottish Naturalist," July, 1914 (completing a series presented previously).

FREDC. RAINE (the late).—By bequest: the testator's herbarium of plants of the south of France, together with a number of papers bearing on it.

MRS. F. RAINE.—Some books from the library of the late Fredc. Raine: including Stuart Thompson's "Flowering Plants of the Riviera" and E. Jahandiez's "Les Isles d' Hyères."

MR REDFORD (per Jos. Wright).—Lantern slide showing a thrush's "anvil stone," surrounded by broken snail shells, in the sandhills of the Northumberland coast.

GEORGE REID.—Stand-case containing four ptarmigan.

HUGH RICHARDSON, M.A.—A fine dodecahedral crystal of iron pyrites (diameter 60 mm) from Elba.

ERNEST SCOTT.—Live sticklebacks; fine examples of the spider *Epeira quadrata*; two fungi (boletus and puff-ball).

A. SCOTT (South Shields).—Crayfishes of various sizes from the river Blyth.

MISS SCOTT (Ryton).—A bird's nest encrusted with lime in the dripping-well at Knaresborough.

GEORGE SISSON.—Some books, including the collected scientific papers of W. A. Forbes.

P. SLOAN.—Large butterfly, *Caligo sp.*, and large moth, *Thysania sp.*, from Brazil. A humming-bird's nest from Santos, Brazil.

DR. H. F. STANDING.—Skulls from Madagascar; four lemurs' skulls and semi-fossilized skulls of hippopotamus and pig; also a human skull and a monkey's.

J. TREWICK.—Two large living slow-worms, one of them 18 inches long.

H. S. WALLACE.—A living slow-worm. Male stag-beetle from Reading, alive.

AMOS WELFORD.—"Elementary Text-book of Entomology," by W. F. Kirby; 'The Butterflies of Great Britain and their Transformations," by J. O. Westwood.

W. J. WILSON.—Collection of small prepared samples of timbers used in joinery in England and Japan.

DR. D. WOOLACOTT.—Specimens illustrating special features of local geology; samples of shells, bored rocks, etc., from the "raised beach" deposits on the Durham coast; sample cores from recent borings in Co. Durham.

JOS. WRIGHT.—A hand microtome of the "candle" pattern.

REV. R. STEWART WRIGHT.—Further ethnological specimens from East and Central Africa; a Masai shield, a pig of copper made by natives at Katanga, and a Hottentot digging-stone for weighting the digging-stick.

The publications received by exchange with British and foreign scientific institutions are acknowledged in a separate list which is published later (in the Transactions) as an appendix to the report.

DONATIONS TO THE ENDOWMENT FUND

FROM JULY 1ST, 1919, TO JUNE 30TH, 1920.

	£	s.	d.
Dr. Clement Stephenson (bequest) ...	952	5	6
Sir George Noble ...	100	0	0
Sir Hugh Bell	50	0	0
Anonymous	5	0	0
	£1,107	5	6

THE HONORARY TREASURER IN ACCOUNT WITH THE NATURAL HISTORY SOCIETY

CURRENT ACCOUNT FROM JULY 1ST, 1919, TO JUNE 30TH, 1920.

RECEIPTS	£	s.	d.	PAYMENTS	£	s.	d.
Members' Subscriptions	351	17	0	Balance due Treasurer July 1st, 1919	4	16	11
Museum Admission Fees	351	0	11	Salaries	900	4	0
Education Committee's Grant	10	0	0	Advertising	12	19	8
	361	0	11	Fuel, Lighting, and Water	104	12	6
Sale of Guide Books, etc	21	3	5	Insurance	72	18	0
Interest on Investments	460	2	11	Materials and Fittings	37	3	6
Sundries	21	6	4	Postage and Carriage	14	17	3
Transferred from Publication Account	3	6	5	Printing	45	2	6
Balance due to Treasurer	129	6	11	Property Tax	50	16	10
				Building Repair Fund	40	0	0
				Stationery	5	7	0
				Subscriptions: Museums Association 1 1 0			
				Ray Society 1 1 0			
				Sundries 57 3 9			
					59	5	9
	£1,348	3	11		£1,348	3	11

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

BUILDING REPAIR FUND

	£	s.	d.		£	s.	d.
Balance, 1st July, 1919	152	8	1	Sundry repairs	18	8	9
Transferred from General Account	40	0	0	J. Rowell & Sons, Heating Apparatus 149 14 10			
Transferred from Deposit Account	221	9	4	Adam Robertson, Decorating Museum 139 4 6			
				288 19 4			
				Less—			
				Allowance from Armstrong College for Reparation 67 10 0			
					221	9	4
				Balance, 30th June, 1920	173	19	4
	£413	17	5		£413	17	5

PUBLICATION ACCOUNT

	£	s.	d.		£	s.	d.
Sale of Transactions	3	6	5	Balance 30th June, transferred to General Account	3	6	5
	£3	6	5		£3	6	5

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

DEPOSIT ACCOUNT

	£ s. d.		£ s. d.
Balance, July 1st 1919—		On deposit with Crown Building Society (Crawhall Bequest)	300 0 0
In Bank 124 14 11		,, Crown Permanent Building Society ... (Crawhall Bequest)	300 0 0
In Building Societies 600 0 0		,, ,, Stephenson Bequest	500 0 0
	724 14 11	A. E. Mathews, Multiplex Hammond Typewriter...	20 0 0
Interest on Investments	32 6 6	T. & W. G. Maddison, transport and legacy duties re Raine Collection	29 0 0
Income Tax repaid to April, 1919.....	150 14 10	Miller & Richard, Type	8 7 7
Stephenson Bequest.....	500 0 0	Purchase of Specimen	3 0 0
Grant from Armstrong College	50 0 0	Transferred to Building Repair Fund	221 9 4
A. Woodcock, donation for specimens	3 0 0	Balance, June 30th, 1920	84 18 2
Bank Interest on Account	5 18 10		
	£1,466 15 1		£1,466 15 1

ENDOWMENT ACCOUNT

	£ s. d.		£ s. d.
Balance, July 1st, 1919.....	83 14 9	£400 Great Eastern Railway 3½% Preference Stock	214 7 3
Donations and Subscriptions	623 0 6	£500 5% War Stock, 1929–1947	433 19 2
Bank Interest	2 19 5	Balance, June 30th, 1920	61 8 3
	£709 14 8		£709 14 8

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

INVESTMENTS

The following is a list of the Investments held by the Society, June 30th, 1920 :—

		Taken at cost.
		£ s. d.
Coppin Bequest—		
£2,000 0 0	Newcastle Corporation 3½ per cent. Irredeemable Stock	2,000 0 0
500 0 0	River Wear Commission 4½ per cent. Funded Debt	500 0 0
Crawhall Bequest—		
2,946 18 1	Midland Railway Company's Consolidated 2½ per cent. Preference Stock	6,000 0 0
1,900 0 0	North-Eastern Railway Company's 4½ per cent. Preference Stock	
1,400 0 0	Newcastle and Gateshead Water Company's Consolidated 5 per cent. Preference Stock	
400 0 0	Armstrong, Whitworth & Co., Ld., 4 per cent. Debenture Stock	2,000 0 0
485 0 0	Newcastle and Gateshead Water Company's Ordinary Stock	
80 0 0	Weardale and Consett Water Company's 10 per cent. Maximum Ordinary Stock	
350 0 0	,, ,, 7 ,, ,, ,, ...	
Stephenson Bequest—		
1,050 0 0	5% War Loan, 1929–1947	1,423 13 8
500 0 0	5% War Loan, 1929–1947	
Endowment Fund—		
1,800 0 0	Canadian 4 per cent. Registered Stock	3,884 14 0
421 0 0	Newcastle and Gateshead Water Co.'s 5 per cent. Preference Stock	
500 0 0	,, ,, 5 per cent. Consolidated Preference Stock	
789 9 5	5 per cent. War Loan, 1929—1947...	
400 0 0	Great Eastern Railway Co.'s 3½% Preference Shares	
		£15,808 7 8

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A H. DICKINSON, Hon. Treasurer.

NATURAL HISTORY SOCIETY

OF

NORTHUMBERLAND, DURHAM AND NEWCASTLE-UPON-TYNE.

REPORT OF THE COUNCIL

FOR 1920–1921.

In reviewing the work of the Natural History Society during the past year there is no feature of outstanding importance to remark upon. The Curator and his capable assistants have resolutely set themselves to take up the threads which were dropped of necessity during the period of the Great War, and the result of this is seen in the good work which has been accomplished in the Museum; that it is apparent and recognised is shewn by the growing interest of the public, who come from time to time and repeat their visits.

The number of visitors who have registered through the turnstile is 46,749, which is more than during the record year of 1919 when so many soldiers and sailors (admitted free) were stationed in the neighbourhood. This is evidence of the growth of interest in natural history and an encouraging feature to the Council in their effort to popularise the Museum.

Children from the Council Schools numbered 984 and it is regrettable that this scheme, which is of important educational value, is only so fitfully carried out. From the Royal Grammar School there were 15 visits, which brought some 218 boys to the Museum during the year.

Death has lost to the Society eight valued members, including two of the oldest, Mr. J. H. Richardson who joined in 1881, and Mr. James Sutherland in 1884. Eleven

members have resigned. Against this loss 18 new members and 16 associates have been elected, bringing the roll up to 438.

The heating apparatus has not been tested so severely as might have been the case owing to the winter having been exceptionally mild, but it has been demonstrated that the Museum can be heated more quickly and more equably than heretofore. Owing to the high cost of fuel it cannot yet be claimed that any economy has been effected. On two separate occasions there has been damage done to the ceiling and wall of the East Corridor by leakage from the roof; as the result of inspection Messrs. W. E. Beck and J. J. Hill reported that this was due to faulty construction, particularly of a gutter too narrow and too shallow to meet and carry off the rush of water after severe rain storms or melting of snow. Under their supervision this has been remedied by the substitution of an asphalt gutter giving greater accommodation and outflow. The lightning conductors have been overhauled and put in order under the direction of Major H. E. Burton, R.E., whose experience of such apparatus has been of great assistance. The interior telephone has also been put into working order and new wiring installed by Mr. C. V. Swan. To these gentlemen the Council are indebted for their valuable help. Other repairs, excepting such as were absolutely necessary, have been postponed.

A well-balanced syllabus of excellent lectures was arranged for the winter season, which included one on "Big Game of East Africa," kindly given by Mr. A. Blayney Percival, Government Ranger, at home on leave, which attracted an audience of 308. Two lectures were specially set aside for children, and at one of these no less than 494 were present, which creates a record. The Council feel that some apology should be offered to the public for the crowding at these meetings owing to limited accommodation, and would only too gladly welcome the possibility of having an adequate hall built for the purpose. It is evident that such a feature of

work as these lectures is desired by the public. The Curator, with his accustomed clearness and ability, also gave a series of attractive Museum Talks.

To the lecturers who so willingly gave their help gratuitously in planning, preparing and delivering these lectures, work entailing time and thought, the Council give their cordial thanks.

The Entomological Section, which was started in January, 1920, has already justified its formation ; steady progress has been made, and it has drawn to the Museum a body of serious students. Under the chairmanship of Dr. F. C. Garrett, ably supported by Dr. J. W. Heslop Harrison and Mr. A. D. Peacock, M.Sc., special exhibits of insects, practical demonstrations of work and short lectures followed by live discussions have been held in the library during the winter evenings, taking the place of the Saturday afternoon "Round Table" talks ; while a few outdoor meetings have also been held.

The exhibit of wild flowers in the entrance hall has been continued ; Mr. Randle B. Cooke has regularly brought in freshly gathered specimens, without which it would be impossible to continue the display ; to him thanks are specially due, as well as to other occasional contributors.

Railway restrictions, both as regards fares and accommodation, are conditions which govern the Field Meetings, but a somewhat more extended programme was arranged for the current season, and in Dr. J. W. Heslop Harrison the Society has a Field President of wide knowledge, whose personality is a strong factor in the success of outdoor work.

Vol. V., part 2, of the Society's Transactions is at last ready for distribution.

For some unknown cause the Hancock Prize Competition has languished, not a single essay having been received last season. Possibly the number of new competitors capable of doing advanced work is exhausted ; possibly juniors of

tender age feel the futility of attempting to compete with their elders. The matter has been under consideration, and in order to stimulate interest, it has been decided to allow former winners of the prize to compete this year.

It will interest those members who had the advantage of enjoying the friendship of Mr. John Hancock, to know that his collection of eggs has been carefully catalogued by Mr. Hugh Blair.

Large mammals are ever an attractive feature of museums, and a greater variety of them would be a welcome addition to the collections. In this direction a magnificent black-maned lion, presented by Mr. Bostock, has been added, and several smaller mammals have been acquired during the year. Many fine heads of the larger East African game have been loaned to the Museum by Mr. A. Blayney Percival, and are exhibited in the corridors.

There is practically no addition to the Endowment Fund to report, but the Hon. Treasurer would remind members that it is still open, and in face of the increasingly heavy expenses of upkeep any contributions would not only be thankfully received but would materially relieve his responsibility. No appeal has been made for monetary help during the War, nor has the subscription been raised, as in the case of so many other institutions, and some credit may be claimed for carrying on the work with efficiency under the circumstances. Additional membership to meet the increase in expenses is necessary, and all who have the interest of the Hancock Museum at heart can help to secure this object.

As the ordinary income of the Society is quite inadequate to meet any special expenditure, it has been necessary during the year to spend part of the Stephenson Bequest on repairs which could no longer be postponed.

In conclusion, it is impossible to speak too highly of the excellent and conscientious work of the Curator and his willing colleagues on the staff, each one of whom has the interest of the Museum at heart.

NEW MEMBERS ELECTED

FROM 1ST JULY, 1920, TO 30TH JUNE, 1921.

James M. Anderson, 63, Hunter's Road, Newcastle.
Charles Atkinson, West House, Wylam.
Miss Norah Balls, Deneside, Tynemouth.
Hugh M. S. Blair, Thorney House, Laygate, South Shields.
Mrs. G. Burns, 1, Kelvin Grove, Newcastle.
Peter Charlton, Whinney Leas Cottage, Chopwell.
Fred W. Flattely, Armstrong College, Newcastle.
Leonard S. Houseman, Alnmouth.
Alfred B. Oliver, 25, Lily Crescent, Newcastle.
W. A. Ridley, Hawthorn House, Hooper Gate, Rowslands Gill.
Robert R. Rowell, 2, Station Road, Forest Hall.
T. W. Rowe, J.P., 82, Fern Avenue, Newcastle.
E. P. Reynolds, c/o Messrs. Cookson, Milburn House, Newcastle.
A. Munro Sutherland, Thurso House, Fernwood Road, Newcastle.
M. Lawson Thompson, F.E.S., 40, Gosford Street, Middlesbrough.
G. W. Todd, Clifton House, Chopwell.
W. A. White, Adderstone, Jesmond, Newcastle.
St. Mary's Training College, Fenham.

ASSOCIATE MEMBERS

A. W. Bartlett, M.A., B Sc., Armstrong College, Newcastle.
B. S. Buck, Furzefield, Gosforth.
Wm. Robert Dodd, 24, Havelock Terrace, Gateshead.
Alexander Elder, 5, Springfield Avenue, Eighton Banks.
Mrs. Garrett, West Croft, Elvaston Road, Hexham.
B. Millard Griffiths, M.Sc., Armstrong College, Newcastle.
Harold Hall, 41, Greenfield Place, Ryton.
David Kyle, 16, Eldon Square, Newcastle.
Miss W. Lomas, B.Sc., Armstrong College, Newcastle.
Miss E G. Pearson, 2, Winchester Terrace, Newcastle.
Charles Simpson, R.I., Conrad House, Bentinck Terrace, Newcastle.
Eric Smith, 14, Ravensworth Road, Heaton.
John Stewart, 30, Kent Street, Newcastle.
James Stewart, ,, ,,
Miss S. Thomas, 206, Ladykirk Road, Newcastle.
Miss A. Thomas, ,, ,,

CURATOR'S REPORT ON MUSEUM WORK

1920–1921.

Of our average working day at the Museum a considerable part is taken up by incidental matters, and especially in seeing visitors. A report such as this does not, therefore, aim at rendering account of the working hours of the staff; its object is only to record the more noteworthy features in the year's history of the Museum.

Mammals.—Some valuable acquisitions have been made in this section. Mr. A. Blayney Percival, Government Game Ranger of British East Africa, was in England during part of the year and spent some time at the Museum. He deposited with us, on loan, his big game heads, horns and skins, and we have incorporated most of them in the collection of African heads occupying the wall of the lower east corridor. This collection, which already comprised a number of heads lent by Mr. Harold Cookson and the Hon. Jasper Ridley, is now, with the addition of Mr. Percival's trophies, a most interesting and attractive exhibit, providing some good illustrations of geographical variation. It may be mentioned here that we have been compelled, through lack of the necessary wall space and with the utmost regret, to decline the magnificent collection of big game trophies made by the late Mr. Sydney Pearson of Bellingham, and offered to us by Mrs. Pearson. Five small mammals, all good additions to our rather inadequate general series, have been acquired by purchase, and one very imposing further addition is the lion presented three years ago by Councillor E. H. Bostock, which has now been received from the taxidermist, Mr. Chas. Kirk of Glasgow. It is a splendid animal and has been very finely mounted.

Birds.—I have set up a few birds during the year, the most interesting of them being a blackcap which tried to winter in Northumberland. But the chief thing to be recorded for the Bird Room is a fair amount of progress with the descriptive

labels that we began upon last year, the object of which is to give in brief such information about each species as an ordinary visitor is likely to want.

Insects.—In this department the outstanding event has been the arrival of the late Mr. John Gardner's collection of British lepidoptera. Mr. Gardner had left the collection to us in his will, but finding himself unable to look after it properly owing failing health he decided to hand it over to the Museum during his life. As it actually happened, we only received it a very short time before his death. Thanks to the great care with which Mr. Alexander Rosie prepared the collection for transport and supervised its removal, it reached us without sustaining the slightest damage. As for the collection itself, for purposes of reference it will altogether supersede anything that we had before. In the small forms (the Micro-lepidoptera) particularly it will probably be the best collection in any provincial museum. A good deal of entomological work has been going on apart from the Gardner collection. Many insects have been set, and for the use of the Entomological Section some cases representing the orders of insects were put together by Miss Scott. Several of these will form the basis of permanent exhibition cases.

Fossils.—Though there is little change to record in the exhibited collection, some amount of work has been done among the amphibian and fish remains from the local Coal Measures, chiefly in connexion with Prof. D. M. S. Watson's investigations. I have also spent a little time upon the remarkable series of fossils collected by Mr. Wm. Eltringham from the clay-ironstone nodules at Crawcrook.

Ethnography.—Such of Miss Scott's time as has not been taken up in printing or in work on the insects has been mainly devoted to the ethnographical collections. She has completely overhauled the cases representing China and Japan, Africa, and Egypt; much cleaning and repairing of objects was necessary, new specimens were worked in and many new labels printed. The collection of Chinese coins presented

by Mr. J. G. Watson had also to be installed. The necessary data for each coin were printed on the card on which it was mounted; and the whole series, with dynasty headings and general descriptive labels, forms an attractive addition to the gallery.

Miscellanea.—Among these may be mentioned batches of lantern slides which I made for some of our lecturers, and some useful sets of glass-topped boxes put together by A. E. Bennett and Miss Hepburn. My "museum talks," judged by the attendances, were unusually successful last winter; in spite of one or two small audiences the average attendance was 98.

Special Help.—We have been indebted during the year to several members and others for special services of various kinds. Mr. A. Blayney Percival not only helped with the arrangement of the big game heads but gave us (in place of one of my "museum talks") a most interesting lecture illustrated by his unique photographs of East African game animals. Mr. Alex. Rosie, who superintended the transport of Mr. Gardner's lepidoptera, has further undertaken the large amount of work which the collection needs, including setting out the 'micros' with better spacing in an additional cabinet given us for the purpose by Mr. Gardner. Another most useful piece of work has been done by Mr. Hugh. M. S. Blair in the preparation of a full catalogue of the Hancock Collection of British birds' eggs. Of another kind was the practical help given us by Mr. C. V. Swan, who with his own hands and at his own expense rewired our internal telephone system and put it into working order, at the same time adding extensions for signalling during lantern lectures.

Donations.—Mr. Gardner's great collection of lepidoptera tends rather to overshadow the other acquisitions of the year, but besides that and the lion from Councillor Bostock there are many donations of great interest, as the list given separately will show. The vendace from Lochmaben presented by Mr. J. Henry Holmes, the East African insects sent

by Dr. R. R. Scott and the skulls given by Mr. Philip Spence and Mr. Wm. Yellowly are especially valuable additions to the zoological collection; while among noteworthy accessions to the ethnographical gallery are the suit of Japanese armour from Mr. Jno. S. Robson, the collection of Chinese coins made up for us by Mr. Jno. G. Watson, and the English "by-gones" from Mrs. Sydney Pearson. The samples of Lake District and Solway rocks found in the boulder clay at Kenton quarry and presented by Mr. John Jeffrey are a very interesting addition to our illustrations of local geology.

E. Leonard Gill.

MUSEUM STAFF

Curator.....E. Leonard Gill, M.Sc.
Assistant Curator.....Miss Gladys Scott.
Clerical Assistant .....Miss I. M. Hepburn.
Attendant.....A. E. Bennett.
Gardener .....H. Stones.

HONORARY CURATORS

Col. C. H. E. Adamson, C.I.E.
R. S. Bagnall, F.E.S., F.L.S.
H. Eltringham, M.A., D.Sc., F.Z.S.
Samuel Graham.
J. W. H. Harrison, D.Sc.
Prof. Alex. Meek, D.Sc., F.Z.S.
Prof. M. C. Potter, M.A., Sc.D.
Geo. B. Walsh, B.Sc.
D. Woolacott, D.Sc., F.G.S.

CURATOR'S "MUSEUM TALKS."

Oct. 27. Birds in Autumn.
Nov. 24. Mimicry.
Jan. 26. Birds in the Garden and on the Farm.
Feb. 23. Teeth.
Mar. 23. South America.

AFTERNOON LECTURES FOR YOUNG PEOPLE

1920.
Dec. 28. Prof. A. Meek, M.Sc., F.Z.S.,: "Water Babies."
1921.
Jan. 4. Mr. Geo. Bolam: "Beasts of Northumberland."

EVENING MEETINGS

1920.
Oct. 13. Rev. Arthur Watts, F.G.S.: "The Earth in relation to Man"; chair taken by Mr. Geo. Sisson.
Nov. 10 Mr. N. Temperley, J.P.: "Pollination, B.C. 900"; chair taken by Dr. W. Martin.
Dec. 8. Rev. J. E. Hull, M.A.: "The Cheese-mite and its kindred"; chair taken by Mr. Ernest Scott.
Dec. 21. Mr. A. Blayney Percival, F.Z S.: "The Big Game of East Africa"; chair taken by Mr. J. Alaric Richardson.
1921.
Jan. 12. Prof. G. Hickling, D.Sc.: "Coal Forests"; chair taken by Mr. N. Temperley, J.P.
Feb. 8 Mr. Edward Davidson: "Afforestation"; chair taken by Mr. W. H. Young, F.L.S., F.Z.S.
Mar. 9. Mr. J. G. Black, B.A.: "Birdnesting"; chair taken by Mr. Jos. G. Angus, J.P.

PRIVATE EVENING MEETING OF THE SOCIETY

1921.
Mar. 18 Chair taken by Mr. J. D. Walker, J.P. Report on the Field Meetings of 1920, by Mr. Randle B. Cooke, Chairman of the Field Meetings Committee. Report on the work of the Entomological Section by Dr. F. C. Garrett (Chairman) and Dr. J. W. H. Harrison (Joint Hon. Secretary).

PATRON

The Right Hon. Lord Armstrong, M.A., D.C.L.

PRESIDENT

The Right Hon. Lord Joicey.

VICE-PRESIDENTS

The Duke of Northumberland.
Viscount Grey.
The Bishop of Newcastle.
Sir Hugh Bell, Bart.
Sir Arthur Middleton, Bart.
Sir Geo. J. W. Noble, Bart.
Sir Theodore Morison, K.C.I.E.
Prof. Sir Thos. Oliver, M.D.
The Lord Mayor of Newcastle.
Col. C. W. Napier-Clavering.
Lt.-Col. C. H. E. Adamson, C.I.E.
Col. W. M. Angus, C.B.
Prof. G. S. Brady, M.D., F.R.S.
Clive Cookson.
R. Coltman Clephan, F.S.A.
J. L Gracie
Samuel Graham.
Prof. A. Meek, D.Sc.
H. N. Middleton
Prof. M. C. Potter, M.A., Sc.D.
Ernest Scott.
J. D. Walker, J.P.

COUNCIL

Hugh P. Angus.
G. A. Atkinson.
R. S. Bagnall, F.R.S.E.
H. I. Brackenbury.
Edwin Burnup.
A. J. Haggie, J.P.
Prof. H. J. Hutchens, M.A.
A. M. Oliver, O.B.E.
T. W. Sharp.
Clarence D. Smith.
C. V. Swan.
John Talbot, M.A.

HON. SECRETARIES

C. E. Robson. | J. Alaric Richardson.

HON. TREASURER

A. H. Dickinson.

HON. AUDITORS

Samuel Graham. | Frank Richardson.

TRUSTEES FOR THE SOCIETY

Elected at the Special General Meeting held on the 13th of December, 1905.

The Rt. Hon. Lord Armstrong.
The Rt. Hon. Lord Joicey.
Sir Hugh Bell, Bart.
Lt.-Col. C. H. E. Adamson, C.I.E.
Clive Cookson.
G. E. Henderson.
Edward Joicey.
J. H. B. Noble.

T. E. Hodgkin (elected Oct. 1st, 1917).

LIST OF DONATIONS

TO THE MUSEUM AND LIBRARY FOR THE YEAR ENDING JUNE 30TH, 1921.

J. H. ALLANSON.—Fossils from Mainforth Colliery, Ferryhill, including a nearly complete right ramus of the lower jaw of *Megalichthys*. Fasciated stem and flower-head of a daisy.

HUGH P. ANGUS.—Samples of a fungus (dry rot?) found growing on whitewash. A piece of elm showing a small branch which has formed a natural graft into a fork above it. Three fresh specimens of the bee *Andræna fulva* (April 11).

RIGHT HON. LORD ARMSTRONG.—A mole, pale sandy grey variety, one of several similar moles caught at Cragside, winter 1920-21.

S. ASH.—Part of a red deer's antler found at Stocksfield; believed to be out of a landslide.

RICHARD S. BAGNALL.—Small glass-topped case of striking (chiefly exotic) beetles.

PALLISTER BARKAS.—Cast in Coal Measure shale of a Bothrodendron scar. A number of early microphotographs of diatoms, etc.

DRAYCOTT BIRKETT.—Specimens from New Zealand: beautifully finished small stone adze and another stone implement from Paraparaumu Beach, North Island; "dreikanter" stone cut by driven sand, from Miramar, Wellington; gold quartz from Moonlight Creek, South Island.

BRITISH MUSEUM (Natural History).—Catalogue of Lepidoptera Phalænæ, Supplement, vol. 2, text and plates. Economic Series, No I. A, The House Fly, its life history, etc.; No. II., Furniture Beetles.

EDWIN BURNUP.—Copy of Wallis Budge's Catalogue of the Roman Antiquities in the Museum at the Chesters. Back numbers of the Society's Transactions.

ADMIRAL SEVERIANO DE CASTILLIO (Rio de Janeiro) —Piece of stem of a liana from Brazilian forests, showing in section a perfect white cross formed by the arrangement of the different tissues.

ISAAC CLARK.—Two (out of four) large concretions from a horse's stomach; one whole, the other broken open to show concentric layers and nucleus of hair.

STANLEY COCHRANE.—Large case on oak table containing a pair of great bustards (believed to be British) and a male little bustard in breeding plumage.

CLIVE COOKSON.—A variety of the meadow pipit, pale buff with nearly white inner secondary quills, shot by the donor on the Allendale moors, Sept. 11th, 1920.

C. E. CRAWHALL.—Teal drake in full plumage, from near Haydon Bridge.

MRS. V. C. DARLING (per H. G. Carr-Ellison).—On loan: four Canadian birds in cases, viz., snow bunting, waxwing, hairy woodpecker and prairie chicken.

D. MAINLAND DODD.—Greenstone skinning-knife of the extinct Chippeway tribe of North American Indians.

REV. P. C. FIELDING.—A cock bullfinch, an old cage bird, which had turned black at its last moult.

REV. MARK FLETCHER.—The Quarterly Journal of the Geological Society, parts 298-300, vol. 75; parts 301-303 vol 76.

MORLEY FORSTER.—A dragonfly, *Libellula quadrimaculata*, male, from Keswick.

JOHN GARDNER (the late) —The donor's celebrated collection of British Lepidoptera, including his remarkably fine series of the 'micros'; together with the cabinets in which the collection is contained

SAMUEL GRAHAM.—A number of very good box bodies for making up as glass-topped boxes and some cardboard trays. An unbound series of the Society's Transactions.

J. DREWRY HASTINGS.—A series of 52 photographic lantern slides of animals in the London Zoological Gardens.

J. HENDERSON (Falloden).—A double hen's egg laid by a white Wyandotte—two large shell-less eggs joined by a narrow peduncle.

ELLWOOD HOLMES.—A box of minerals and fossils, the latter chiefly from the Carboniferous Limestone and Lias.

JNO. HY. HOLMES.—Two well-preserved vendace (*Coregonus vandesius*) from Lochmaben, Dumfriesshire, caught some time prior to 1912. Also a finely-grown colony of madrepore coral.

EDWARD HUNTER.—A large spider (*Mygale sp.*) from Jamaica.

W. D. HUNTER.—A stuffed bittern, cased.

INDIA OFFICE (Secretary of State for India in Council).—A further volume of "The Fauna of British India": Mollusca, III.; vol 3, Land Operculates, by G. K. Gude.

MRS. IVISON (Blaydon).—Two females of the common lizard (*Lacerta vivipara*) from near Blaydon, one with a re-grown tail. A living larva of the water beetle *Dytiscus*.

JOHN JEFFREY, B.Sc.—Further examples of Lake District and Solway erratics from the boulder clay at Kenton.

ALEX. KELLY (Aberdeen).—A series (12) of shells of *Terebratula cranium* from the Shetland-Faroe Channel.

MISS IDA M. LIVENS.—Two Chinese 'door gods'; coloured symbolic figures on paper.

DAN MADDOCK.—Two spiders imported with bananas, one from Canary and the other from Jamaica.

MRS. MALING (Twizell House, near Belford, per Dr. Hamilton Drummond).—A male blackcap (*Sylvia atricapilla*) which survived the late autumn and winter about the grounds of Twizell House until Jan. 9th, when it was found dead.

ROBERT W. MARSHALL.—A horse's hoof, shod, from a Flanders battlefield.

HENRY T. MENNELL.—A number of shells of the rare British species of *Fusus*, collected from the Tyne fishing vessels many years ago by the donor. Also six bound volumes of scientific papers collected from various sources; and a copy of Wm. Wallace's "Alston Moor."

"NATURE" (Proprietors of).—*Nature* weekly for the year.

MRS. SYDNEY PEARSON.—A number of objects interesting as "bygones," *e.g.*, tinder-lighter in the form of a flintlock pistol; an early pattern of revolver, with six muzzle-loading barrels; lead tobacco jar. Also six deckles of different sizes for making hand-made paper; a skull found on the Athi Plains, British East Africa; pottery, nails, etc., collected by the donor from the Roman station at Bainbridge, Yorkshire.

A. BLAYNEY PERCIVAL.—Three East African birds' skins, viz., two male golden cuckoos (*Chrysococcyx cupreus*) and an example of a large newly-described species of plantain-eater, *Corythæola yalaensis*. An enormous pair of horns of a bull Ankoli, a breed of domestic cattle from Uganda. Also, on loan, a collection of East African big game trophies, including about 45 mounted heads, 35 skulls or pairs of horns, and a number of fine skins.

WM. PHILIPSON.—An album of Australian ferns, lycopods, mosses, etc.

R. M. POWELL.—Geological specimens from Cleveland, including a large *Pecten equivalvis* and a block of ironstone containing fossilized wood.

J. PROUDLOCK.—A tree sparrow, female, from Seaton Delaval.

LAWRENCE RICHARDSON.—A tawny owl picked up under telegraph wires near Coxwold, Yorkshire.

JOHN S. ROBSON.—A fine suit of Japanese armour, with sword. Two West Australian boomerangs and two red-wood parrying shields.

ALFRED J. ROLLIN.—A branch of Scotch fir with a remarkable clustered gall, from Haydon Bridge.

AUSTIN SCOTT.—Young crayfishes from a tributary of the Blyth; one just hatched, the other about a quarter grown.

ERNEST SCOTT.—A small piece of Maori fishing net made of 'flax,' brought by the donor from Lake Tarawera in 1875. A whip made by the donor from the same 'flax.'

DR. RALPH R. SCOTT.—A large number of insects from the neighbourhood of Dar-es-Salaam, East Africa; Anopheles, Culex, Stegomyia and other biting flies; ticks; beetles, hemiptera, neuroptera, etc.; larvæ and pupæ of some of the mosquitoes. Also samples of bandages made from native bark-cloth and used by the German army in East Africa.

R. R. SHARP.—Specimens from the Congo for mounting: head of situtunga antelope, and skin and skull of "antbear" (aardvark, *Orycteropus æthiopicus*).

GEORGE SISSON.—A cricket from a boiler-house at Blaydon.

G. SOUTHERN.—Fossils from the Barton Clay (Upper Eocene) collected at Barton, Hants., by the donor; including about 60 named species of shells.

PHILIP SPENCE.—Skulls of lion, baboon and very young monkey, all showing transition from milk to permanent dentition; and adult skulls of macaque, polecat, seal, wallaby and macaw; skull of young alligator.

W. STAVELY.—A living kestrel (still living at the Museum).

JOHN STERLING.—A large caterpillar of the goat moth, *Cossus ligniperda*, from Grassmere, alive.

E. H. STEVENS.—Fruiting specimens of the moss *Dicranella squarrosa*, from near Rothbury.

C. V. SWAN.—Two small showcases in ebonized mahogany.

A. W. THOMPSON.—Silver coins of Charles II. (1683) and George III. (1818).

J. W. THOMPSON.—Large concretionary cone, six inches deep, from the Beaumont Seam; column of stalagmite from old workings in the High Main (disused for 40 years); samples of "mussel-band" full of Anthracosia. All from East Holywell Colliery.

JOS. WALKER (Gateshead).—Collection of minerals and fossils (Carboniferous, Cretaceous, etc.) made by the donor's father.

H. S. WALLACE.—Collection of insects in spirit from a single locality in Rhodesia: beetles, diptera, hemiptera, large hymenoptera, etc. Large longicorn beetle (Cerambycidæ) from Philadelphia. A blackbird's nest with four abnormal eggs and with the hen bird dead on the nest in the natural brooding attitude.

E. ARNOLD WALLIS.—A lizard, *Lacerta vivipara*, male, alive, caught by the donor on Ross Links. Young skylark, nearly full-fledged, found dead at same time (June 4, 1921) and place.

P. WALTHER.—A large batch of cocoons of saturnid moths collected by the donor in New Jersey, U.S.A.

JNO. G. WATSON.—A collection of 170 Chinese coins, selected and fully labelled, covering the whole history of coinage in China; including two 'knife coins' and two 'cloth coins.' Also 10 Japanese and 7 Corean coins.

GEO. WILKINSON.—Waterworn flint pebble from Marsden containing a curious segmented fossil (? cephalopod shell).

DR. D. WOOLACOTT.—Further specimens illustrating special features of local geology: shells from the 'raised beach' at Easington, and limestone bored by Saxicava also from the 'raised beach.'

WM. YELLOWLY.—Five skulls: Rhesus monkey (2), crab-eating monkey palm civet, and racoon.

DONATIONS TO THE ENDOWMENT FUND

FROM JULY 1ST, 1920, TO JUNE 30TH, 1921.

	£	s.	d.
Anonymous	2	18	0

THE HONORARY TREASURER IN ACCOUNT WITH THE NATURAL HISTORY SOCIETY

CURRENT ACCOUNT FROM JULY 1ST, 1920, TO JUNE 30TH, 1921.

RECEIPTS	£	s.	d.
Members' Subscriptions	382	14	0
Museum Admission Fees 395 4 4			
Education Committee's Grant 10 0 0			
St. Mary's Training College..... 2 2 0			
	407	6	4
Sale of Guide Books, etc	21	13	7
Interest on Investments 507 16 4			
Income Tax repaid to April, 1920 ..... 157 15 11			
" " " 1921 ..... 163 1 10			
	828	14	1
Sundries	0	12	8
Balance due Treasurer	96	18	0
	£1,737	18	8

PAYMENTS	£	s.	d.
Balance due Treasurer July 1st, 1920	129	6	11
Salaries	982	6	8
Advertising	16	19	10
Fuel, Lighting, and Water	134	13	1
Insurance	79	1	6
Materials and Fittings	16	2	4
Postage and Carriage	27	8	5
Printing	45	12	0
Property Tax	50	16	10
Building Repair Fund	40	0	0
Stationery	9	4	9
Publication Account	153	2	8
Subscriptions: Museums Association ... 2 2 0			
Ray Society 1 1 0			
Sundries 50 0 8			
	53	3	8
	£1,737	18	8

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

BUILDING REPAIR FUND

	£	s.	d.
Balance, 1st July, 1920	173	19	4
Transferred from General Account	40	0	0
Transferred from Deposit Account	446	3	3
	£660	2	7

	£	s.	d.
Sundry repairs	10	2	10
J. Rowell & Sons, Heating Apparatus	162	0	11
Robson & Coleman " "	31	16	6
James Lunn, Repairs to Roof	160	0	0
Wm T. Wallace " "	62	7	1
R. Watson " "	29	18	9
Balance, 30th June, 1921	203	16	6
	£660	2	7

PUBLICATION ACCOUNT

	£	s.	d.
Sale of Transactions	6	10	10
Transferred from General Account	153	2	8
	£159	13	6

	£	s.	d.
Line Blocks	10	15	0
Transactions, Vol. V., part 2	148	18	6
	£159	13	6

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

DEPOSIT ACCOUNT

	£	s.	d.
Balance, July 1st 1920—			
In Bank	84	18	2
In Building Societies	1100	0	0
	1184	18	2
Interest on Investments	50	7	9
Income Tax repaid to April, 1920.....	159	5	3
Drawn from Building Society (Stephenson Bequest).....	500	0	0
Bank Interest on Account	5	18	0
	£1,900	9	2

		£	s.	d.
On deposit with Crown Building Society	Crawhall Bequest	300	0	0
,, Crown Permanent Building Society ...	Crawhall Bequest	300	0	0
,, ,, Stephenson Bequest		500	0	0
Rowland Ward, Specimens.....		25	0	0
Income Tax Rebate transferred to General Account		159	5	3
Transferred to Building Repair Fund		446	3	3
Balance, June 30th, 1921		170	0	8
		£1,900	9	2

ENDOWMENT ACCOUNT

	£	s.	d.
Balance, July 1st, 1920.....	61	8	3
Donation	2	18	0
Bank Interest	2	16	0
	£67	2	3

	£	s.	d.
Balance, June 30th, 1921	67	2	3
	£67	2	3

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

INVESTMENTS

The following is a list of the Investments held by the Society, June 30th, 1921 :—

		Taken at cost. £	s.	d.
Coppin Bequest—				
£2,000 0 0	Newcastle Corporation 3½ per cent. Irredeemable Stock	2,000	0	0
500 0 0	River Wear Commission 4½ per cent. Funded Debt	500	0	0
Crawhall Bequest—				
2,946 18 1	Midland Railway Company's Consolidated 2½ per cent. Preference Stock	6,000	0	0
1,900 0 0	North-Eastern Railway Company's 4 per cent. Preference Stock			
1,400 0 0	Newcastle and Gateshead Water Company's Consolidated 5 per cent. Preference Stock			
400 0 0	Armstrong, Whitworth & Co., Ld., 4 per cent. Debenture Stock	2,000	0	0
485 0 0	Newcastle and Gateshead Water Company's Ordinary Stock			
491 0 0	Durham County Water Board 6 per cent. Redeemable Stock			
Stephenson Bequest—				
1,050 0 0	5% War Loan, 1929-1947	1,423	13	8
500 0 0	5% War Loan, 1929-1947			
Endowment Fund—				
1,800 0 0	Canadian 4 per cent. Registered Stock	3,884	14	0
421 0 0	Newcastle and Gateshead Water Co.'s 5 per cent. Preference Stock			
500 0 0	,, ,, 5 per cent. Consolidated Preference Stock			
789 9 5	5 per cent. War Loan, 1929—1947.....			
400 0 0	Great Eastern Railway Co.'s 3½% Preference Shares			
		£15,808	7	8

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A H. DICKINSON, Hon. Treasurer.

NATURAL HISTORY SOCIETY
OF
NORTHUMBERLAND, DURHAM AND NEWCASTLE-UPON-TYNE.

REPORT OF THE COUNCIL
FOR 1921–1922.

THE loss sustained by the death of so many who have been closely associated with the Natural History Society is of more than local significance, for amongst these are numbered Dr. J. G. Baker, F.L.S., F.R.S., joint author of the Flora of Northumberland and Durham, who later filled the important position of Curator at Kew Gardens; Dr. G. S. Brady, LL.D., F.R.S., the last of the distinguished group who brought fame to the Society in the middle period of last century, an indefatigable naturalist widely known for his numerous works on British and foreign Crustacea, including those collected by the "Challenger" expedition; Mr. John Gardner, F.E.S., a recognised authority on British Lepidoptera; the Right Hon. Thos. Burt, C.B., M.P., pioneer of trades unionism, whose wide experience in labour matters will be sorely missed; all of whom leave the world poorer by their passing away.

The Society has also lost valued colleagues in Mr. R. Coltman Clephan, F.S.A., a Vice-President, whose knowledge of ethnology was helpful; Mr. T. E. Hodgkin, M.A., a Trustee and active member of Council, whose financial advice was highly useful; Dr. J. A. Menzies, M.A., Professor of Physiology, who gave his services both on the Council and on the lecture platform; and Mr. W. J. Bellerby, a keen botanist, who served for some years as joint hon. auditor to the Society. The loss of these and all other esteemed members is deplored.

The attendance of visitors for last year (which included soldiers and sailors admitted free) was in the nature of a record; with the slump in trade and consequent spread of unemployment, it was to be expected that there would be a falling off in numbers this year. Such has been the experience not only of kindred institutions, but also of places of amusement, and it is therefore a matter of congratulation that the turnstile registered a total of 31,788.

Fortunately there has been a gratifying increase in the number of new subscribers who have joined the Society. Partly owing to the Botanical, Entomological and Ornithological Sections recently formed for special study of these branches, and partly due to individual efforts of the Council, 24 members and 28 associates have been enrolled, and allowing for 16 lost by death and 22 by resignation, the membership now stands at 476.

While the increased cost of upkeep of the Museum and its activities has been maintained, the lessened number of visitors has seriously affected the revenue; and after considerable deliberation and hesitation, the Council came to the conclusion that the charges for admission should be raised to sixpence for adults and twopence for children. Other institutions have been obliged to increase their subscriptions as well as admission charges in order to meet expenses, but by strict economy and watchfulness, this Society has hitherto been able to continue its useful work without making a demand either upon the members or upon the public.

The lectures delivered during the winter months have reached a high standard of excellence, which has appealed to large audiences, and the Society is indebted to the generous and voluntary help of those who have, at considerable trouble, prepared and delivered these lectures. The Curator has again delighted his listeners with a series of "Museum Talks" on specimens illustrating various branches of natural history, while the new Sections previously referred to have by their Committees arranged and carried out a programme of

exhibits, discussions and specialised lectures, not only for beginners but for all interested in these subjects, which have been followed with keen interest and enthusiasm. Details of these activities are enumerated at the end of the Report.

The exhibit of wild flowers is ever an attraction to visitors to the Museum, and thanks to Mr. Randle B. Cooke, a fresh supply has been received regularly, which with other occasional contributors has enabled the display to be continued.

With more favourable travelling facilities, it has been possible to extend the area of the Field Meetings, with the result that much useful work is being done under the able and enthusiastic leadership of Dr. F. C. Garrett, Field President.

With a view to stimulating the Hancock Prize Competition, the Council decided to widen its scope by removing the restrictions which confined the subject matter to an account of a single day's ramble and by making former winners again eligible for the prize. This has brought forth an increase in the number of essays submitted to 24; of these 14 were seniors and 10 juniors, Mr. George A. Atkinson generously providing a special prize for the latter.

To examine and adjudicate upon such a varied collection of essays is no light or easy task, and to the Rev. J. E. Hull and Mr. George Bolam the thanks of the Council are accorded.

Amongst the additions to the collections must be mentioned the gift, shortly before his death, of his splendid collection of British Lepidoptera by the late Mr. J. Gardner of Hart, which should prove of great value to all students and lovers of entomology; that of a rarely seen mammal, an Aardvark, from Central Africa, by Mr. R. R. Sharp; a golden eagle, the gift of Mr. Philip Noble, which has been placed in the aviary and proved to be a great attraction to visitors; and many other donations, which are referred to by the Curator in his Report.

In past years when repairs were being carried out, the absence of complete detailed plans of the various floors, heating apparatus of the buildings, etc., has caused some

difficulty; such plans have now been carefully drawn and have already proved their usefulness.

After an absence of twenty-eight years the British Medical Association held their Annual Meeting in Newcastle, and during their visit last summer it was the pleasure of the Council to accord the freedom of the Hancock Museum to the members. On the evening of Wednesday, July 20th, a brilliant reception was given by the local branch of the Association within the Museum, which was largely attended.

The Council makes a strong appeal to all members to help by interesting friends in the Hancock Museum and the Society's activities and by introducing new subscribers, which would not only relieve the Hon. Treasurer of much responsibility and anxiety but would also enable the extension of useful educational work.

Finally the Council once again place on record their appreciation and thanks to the Curator, Mr. Gill, and his able assistants for so willingly and conscientiously fulfilling their varied duties.

Since this report was written Mr. Gill has been appointed to an important post at the Royal Scottish Museum, Edinburgh, and carries the good wishes of the Natural History Society with him.

NEW MEMBERS ELECTED

FROM 1ST JULY, 1921, TO 30TH JUNE, 1922.

C. F. Allsop, 42, Moorside, Fenham.
Sidney Ash, 22, Ellison Place.
D. Balfour, Ravensbourne, Gosforth.
A. W. Bartlett, M.A., B.Sc., Armstrong College.
J. Beaumont, Greyscliffe, North Avenue, Gosforth.
J. D. Billany, 5, Dene Crescent, Walker.
Dr. John Boleyn, 6, Selborne Avenue, Low Fell.
Miss Evelyn Browne, Westacres, Benwell.
Norman A. Collard, 3, Portland Terrace.
Mrs. A. McF. Cooke, Kilbryde, Corbridge.
Thos. Dixon, Riding Mill.
Jos. Fenwick, Bracken Dene, Belle Vue Bank, Low Fell.
Charles M. Forster, 4, Osborne Villas.
Wm. J. Fordham, M.R.C.S., L.R.C.P., D.P.H., F.E.S., 7, Rosslyn Avenue, Low Fell.
John A. Frew, Underfell, Belle Vue Bank, Low Fell.
E. Coleridge Gair, Lime Croft, Grainger Park Road.
Mrs. J. Gardner, Laurel Lodge, Hart, West Hartlepool.
J. Sydney Giles, Fowler Street, South Shields.
Dr. J. W. H. Harrison, The Bungalow, Elizabethville, Birtley.
W. J. Harrison, 20, Jesmond Road.
C. O. Holmes, 33, Otterburn Avenue, Gosforth.
Alfred Jameson, Granville, Rectory Drive, Gosforth.
Mrs. M. G. Knyvett, The Vicarage, Benwell.
Jos. S. Lock, 4, Appletree Gardens, Walkerville.
Charles Martin, 24, Bewick Road, Gateshead.
C. W. Mayhew, 66, Lovaine Place.
Mrs. John Moffat, 125, Osborne Road.
Ed. Stoddard Pattison, 11, Sydenham Terrace, Whitley Bay.
J. W. Philipson, Fellside House, Stocksfield.
Wm. Raw, M.B.O.U., 170, New Bridge Street.
Miss S. Rintoul, 6, Frognal Gardens, Hampstead, London, N.W.3.
J. L. Robinson, 6, Lambton Road.
Frank S. Steenberg, The Quarry, Stocksfield.
John F. Stewart, 2, Archbold Terrace.
George H. Storey, 3, Regent Villas, Salters Road, Gosforth.
E. R. Thomas, M.A., M.Sc., Royal Grammar School.
Norman D. Walker, Sorbie, Elmfield Road, Gosforth.
Robert Winter, 89, Lodore Road, High West Jesmond.
Arthur H. Wilson, 2, Claremont Place, Gateshead.

ASSOCIATE MEMBERS.

H. W. Bailey, Woodside, Grange Road, Fenham.
Joseph Bishop, 1, Dobing Street, Stockton-on-Tees.
P. W. Campbell, 14, Nelson Street.
William Carr, B.Sc., Brantwood, Whickham.
Guest L. Close, 12, Station Avenue North, Fencehouses.
Miss E. F. Conway, 28, Beechgrove Road.
N. R. Cole, 589, Welbeck Road, Walker.
E. G. Cooke, 67, Shortridge Terrace.
Miss Violet Dixon, 66, Hartington Terrace, South Shields.
Miss A. Donald, 98, Fairholm Road, Benwell Grove.
Miss Evelyn Dransfield, 21, Queen's Road.
Chas. Holloway, 148, Wharton Street, South Shields.
Carlyle Hunter, 17, Eldon Place.
Miss L. A. Hutchinson, 62, Towneley Street, West Stanley.
Harry Ingram, 38, Brandling Place South.
J. K. McDougle, Ingram House, Bamburgh.
G. W. Macpartling, 47, Tosson Terrace, Heaton.
Miss G. V. Morpeth, 114, Wingrove Road
W. H. Nunn, 19, Eslington Terrace.
Miss N. Nicholson, 7, Liberty Terrace, Tantobie, S.O.
Miss Enid Ormston, 8, Collingwood Terrace.
Miss E. Parnaby, 176, Windsor Avenue, Gateshead.
Donald Palmer, 39, Osborne Road.
R. W. Pyle, 8, Norham Road, Whitley Bay.
Miss Audrey Raimes, 21, Albury Road, Jesmond.
W. S. Richardson, 35 Newlands Road, High West Jesmond.
Miss M. I. Ritson, 34, Holly Avenue.
A. J. Scholfield, B.A., Secondary School, Washington.
John Smailes, Kibblesworth, Gateshead.
Mrs. E. Wardley Smith, 10, Wellesley Terrace.
Matthew Thompson, 10, Nixon Street.
P. Wardle, 168, Trewhitt Road, Heaton.
Miss E. Williamson, 3, Cliftonville, South Gosforth.

CURATOR'S REPORT ON MUSEUM WORK

1921–1922.

Work has been in progress in the Museum on a number of different lines during the year, but perhaps the leading activity of all has been the drafting and printing of labels. Miss Scott is getting excellent work out of our press and different founts of type, in the printing both of ordinary small labels and of the larger descriptive labels. Further descriptive labels for the birds have been drawn up and printed, as well as for some of the orders of insects and certain other groups of objects; and the labels printed for individual specimens have included large batches for the ethnographical section, for the fossil fishes, amphibia and plants, and for skulls and spirit specimens.

Apart from the printing, Miss Scott has done a large amount of work in the two departments under her special charge, those of ethnography and insects. In the ethnographical gallery she has overhauled and refitted several of the cases, including those representing New Zealand and the South Seas, and has incorporated many fresh specimens in these and other parts of the gallery. Among the insects, she has installed in the show-cases a good set of British dragonflies, with introductory and other labels; worked through the exhibited series of insects and the reference portion of the Eltringham collection of exotic butterflies, doing whatever was necessary to put them into good order; incorporated in the reference collection of beetles a batch of about 500 specimens which Mr. G. B. Walsh has had in hand for critical examination; and set a number of fresh insects in various groups.

A special feature of this year's work in the Museum has been the presence on the staff of a voluntary pupil assistant. Since the middle of November Mr. Christopher D. Bennett, of Stocksfield, has been with us in that capacity, and has done some most useful pieces of work. He has cleaned up and mounted a number of mammalian skulls, worked through

large quantities of shells to select those useful for the exhibited series, put up many specimens for exhibition in jars of spirit or formalin, and carried out or shared in various other smaller jobs. Latterly his chief occupation has been with the collection of minerals. For five years this fine collection had remained just as it was left by Mr. P. Walther after his prolonged and very valuable labours upon it; it was practically ready throughout for final finishing and labelling, and it is a pleasure to have this work in hand at last. Mr. Bennett is making out the text of the labels from the catalogue left by Mr. Walther; the Rev. Mark Fletcher is checking the text in preparation for the printing by Miss Scott; and with sloping false-bottoms which we are fitting into the cases, together with neat and uniform labels and some improvements in the specimen trays, the whole collection will gain an appearance of finish which so far it has always lacked.

During part of the year a great deal of my own time was taken up in making lantern slides to illustrate various lectures given at the Museum in the winter session. In the geological department I have re-arranged the specimens of Coal Measure and Permian fishes on which I have myself done special work and have labelled them so as to make them as intelligible as possible. A minor but quite satisfactory job in which we all had a hand was the fitting up, as a special exhibit, of a set of bones and horns from the bed of the Tyne. In the intervals of her routine work Miss Hepburn has done some useful work for the Museum; it has included making up glass-topped boxes, setting out a collection of early mammalian remains from the phosphate deposits of Quercy (identified for us recently by Prof. D. M. S. Watson), overhauling some of the store collections of insects, and preparing some of the fittings for the work on the minerals.

My "Museum Talks" last winter brought larger audiences than ever before. The highest figure was 230, the lowest 58, and the average 115. In addition to these public fixtures I have given talks to various school and club parties visiting

the Museum and have conducted others round in a more general way.

We have to acknowledge important help in Museum work given us from outside. Mr. Alexander Rosie has put very many hours of patient and beautifully finished work into the installation of the late Mr. Gardner's micro-lepidoptera in their new cabinet. The identification of the beetles sent back by Mr. Walsh also represents an immense amount of critical microscopic work on his part. The Rev. Mark Fletcher's valuable help with the mineral labels has been spoken of already. Another member of the Armstrong College staff, Mr. A. W. Bartlett, is doing a most useful piece of work in identifying and labelling a large number of botanical specimens, chiefly tropical and of economic interest. Finally, mention must be made of Mr. Randle B. Cooke's great services in supplying the very popular wild flower counter and in maintaining on it all through the winter a remarkably comprehensive exhibition of twigs of trees and bushes in bud and in early flower.

Of the year's accessions to the Museum several are particularly noteworthy. The bones and horns from the Tyne were discovered in the course of work on the foundations of the High Level Bridge and were given to us by the Chief Engineer to the North Eastern Railway, Mr. C. F. Bengough. The minerals presented by Mr. J. Jeffrey include a number of rarities and some specially good specimens. Among the ethnographical objects presented by Mr. Brodrick Dale and Mr. George E. Spencer were many that formed good additions to the series in our cases. Several welcome acquisitions have been made in the way of mammals. Through Mr. George Bolam's kindness we are gradually getting together a presentable series of British bats preserved in fluid; and other good new specimens are the American squirrel from Mr. J. Challoner, the marmoset from Mr. H. Bradbury, and the aardvark presented last year as a skin by Mr. R. R. Sharp, now in its place as a fine example of the work of Messrs.

Rowland Ward. Some interesting live birds have come in during the year, one of them, a golden eagle from Inverness-shire presented by Mr. Philip Noble, forming a magnificent new tenant for the condor's old cage.

This is the last report that I shall be called upon to present as Curator of the Hancock Museum. When I was appointed to the position twenty-one years ago I hardly thought that so much of my working life would be passed here. Looking round the Museum I can see that much has been changed. But many more changes are long overdue, and there is less to show for my long term of office than I like to think of. Those who are closely associated with the Museum will know that my own failings are not alone to blame; the Society's resources are by no means adequate to the work which it undertakes. The record would have been still poorer if I had not been so fortunate in the other members of our small staff who have worked with me. As it is, there is much that I can look back upon with very great pleasure and satisfaction; I leave the Hancock Museum with many regrets, and with most grateful memories of the constant kindness I have met with both from the officers of the Society and from the many friends I have made among the members.

E. Leonard Gill.

MUSEUM STAFF

CURATOR..... E. LEONARD GILL, M Sc.
ASSISTANT CURATOR ..... MISS GLADYS SCOTT.
CLERICAL ASSISTANT ..... MISS I. M. HEPBURN.
ATTENDANT..... ..... A. E. BENNETT.
GARDENER ..... H. STONES.

HONORARY CURATORS

Col. C. H. E. Adamson, C.I.E.
R. S. Bagnall, F.E.S., F.L.S., F.R.S.E.
H. Eltringham, M.A., D.Sc., F.Z.S.
Samuel Graham.
J. W. H. Harrison, D.Sc.
Prof. Alex. Meek, D.Sc., F.Z.S.
Prof. M. C. Potter, M.A., Sc.D.
Alexander Rosie.
Geo. B. Walsh, B.Sc.
D. Woolacott, D.Sc., F.G.S.

CURATOR'S "MUSEUM TALKS."

Oct. 29. Elephants.
Nov. 30. Farne Island Birds.
Dec. 21. Archaic Animals.
Jan. 25. History in Rocks.
Feb. 22. Some of our Scarcer Birds.
Mar. 29. Our Native Song Birds.

AFTERNOON LECTURES FOR YOUNG PEOPLE

1921.

Dec. 27. Dr. F. C. Garrett: "Butterfly Wanderers."

1922.

Jan. 3. Mr. H. S. Wallace, F.E.S.: "Monkey to Man."

PRIVATE EVENING MEETING OF THE SOCIETY

1922.

April 10. Chair taken by Mr. Richard Adamson, F.R.H.S. Report on the Field Meetings of 1921, by Dr. J. W. H. Harrison, Chairman of the Field Meetings Committee. The Hancock Prize Essay for 1921, by Mr. Wm. Eltringham, of Ryton, was read; also the Essay for the Special Junior Prize, won by Master John Willis, of the Duke's School, Alnwick.

EVENING MEETINGS

1921.

Oct. 12. Mr. A. W. Bartlett, M.A., B.Sc.: "A Tropical Forest."
Nov. 9. Mr. R. A. Harper Gray, M.A., M.Sc.: "Harmful and useful Insects."
Dec. 14. Mr. Geo. Bolam: "Birds."

1922.

Jan. 18. Mr. H. Preston, B.Sc: "Hawks of the Insect World."
Feb. 8. Dr. J. W. H. Harrison: "Plant Galls."
Mar. 8. Mr. Ellis W. Heaton, B.Sc.: "Volcanic Rocks."

ENTOMOLOGICAL SECTION

1921.

Oct. 13. Various Members: "Collecting Experiences"
Nov. 10. Mr. A. D. Peacock, M.Sc.: "Sawflies."
Dec. 8. Miss H. H. Harrison: "Stick Insects."
Mr. Wm. Carter: "The Castle Eden Argus."

1922.

Jan. 12. Dr. J. W. H. Harrison: "Melanism."
Mar. 9. Mr. H. S. Wallace: "Entomology of a Journalist."
Apr. 6. General Meeting.

ORNITHOLOGICAL SECTION

1922.

Feb. 3. Discussion on "Changes in Local Bird Life during the last fifty years," introduced by Mr. Geo. Bolam.
Mar. 3. Mr. W. Raw, M.B.O U.: "British Birds of Prey."
Mar. 31. Mr. Isaac Clark: "Birds' Eggs."

BOTANICAL SECTION

1922.

Jan. 22. Exhibition of Botanical Specimens.
Feb. 8. Dr. J. W. H. Harrison: "Plant Galls" (Joint Meeting with other members.)
Mar. 17. Miss M. A. Temperley: "Flowers of Early Spring."

PATRON

The Right Hon. Lord Armstrong, M.A., D.C.L.

PRESIDENT

The Right Hon. Lord Joicey.

VICE-PRESIDENTS

The Duke of Northumberland.
Viscount Grey.
The Bishop of Newcastle.
Sir Hugh Bell, Bart.
Sir Geo. J. W. Noble, Bart.
Sir Theodore Morison, K.C.I.E.
Prof. Sir Thos. Oliver, M.D.
The Lord Mayor of Newcastle.
Col. C. W. Napier-Clavering.
Lt.-Col. C. H. E. Adamson, C.I.E.
Col. W. M. Angus, C B.
Prof. G. S. Brady, M.D., F.R.S.
Clive Cookson.
R. Coltman Clephan, F.S.A.
J. L Gracie
Samuel Graham.
Wilfred Hall.
Prof. A. Meek, D.Sc.
Prof. M. C. Potter, M.A., Sc.D.
Ernest Scott.
J. D. Walker, J.P.

COUNCIL

Hugh P. Angus.
R. S Bagnall, F.R.S.E.
W. E. Beck.
H. I. Brackenbury.
Edwin Burnup
Randle B. Cooke.
J. W. H. Harrison, D.Sc.
Thomas Reed, C.A.
T. W. Sharp.
George Sisson.
Capt. C. V. Swan, M.C.
Geo. H. Waddilove, J.P.

HON. SECRETARIES

C. E. Robson. | J. Alaric Richardson.

HON. TREASURER

A. H. Dickinson.

HON. AUDITORS

Samuel Graham. | Frank Richardson.

TRUSTEES FOR THE SOCIETY

Elected at the Special General Meeting held on the 13th of December, 1905.

The Rt. Hon. Lord Armstrong.
The Rt. Hon. Lord Joicey.
Sir Hugh Bell, Bart.
Lt.-Col. C. H. E. Adamson, C.I.E.
Clive Cookson.
G. E. Henderson.
Edward Joicey.
J. H. B. Noble.

T. E. Hodgkin (elected Oct. 1st, 1917).

LIST OF DONATIONS

TO THE MUSEUM AND LIBRARY FOR THE YEAR ENDING JUNE 30TH, 1922.

HUGH P. ANGUS.—An example of the topknot, *Zeugopterus punctatus*, a rare flatfish, found alive at Newbiggin, Sept. 3rd. A dove for the aviary.

J. H. ARMSTRONG.—The hand of a mummy from the Tombs of the Kings, Luxor (1890). An emu's egg.

C. F. BENGOUGH (Chief Engineer, North Eastern Railway), per J. Taylor Thompson, Resident Engineer, Newcastle.—Bones and horns from the bed of the Tyne in the foundations of the High Level Bridge; chiefly those of red deer, but also of aurochs (*Bos primigenius*) and horse, and possibly of roe deer.

J. D. BILLANY.—Two young jays, alive, from Essex.

GEO. BOLAM.—A male whiskered bat from Alston, October. Male pipistrelle from North Tyne, June; and a newly born young of the pipistrelle, born in captivity, June.

H. BRADBURY.—A marmoset, *Hapale jacchus* which had been kept as a pet.

MAJOR A. S. BREWIS.—The egg of a kiwi, brought by the donor from New Zealand.

BRITISH MUSEUM (NATURAL HISTORY), the Trustees.—Copies of the following publications: Handbook of British Lichens; Catalogue of Cretaceous Bryozoa, vol 3; Economic Series, No. 12, The Cockroach.

K. W. CAMPBELL.—Two dragonflies from Oxfordshire: *Libellula depressa*, male, and *Anax imperator*, female.

W. CARTER.—Samples of "peacock coal" from Sutty Row Colliery, near Wark, North Tyne. Photograph of the donor's series of varieties of the brown argus butterfly, including the "Durham argus" and the unique variety lately taken by him.

JOHN CHALLONER, Junr.—An American grey squirrel in good winter coat, shot near Masham, Yorks.

THOS. CHARLTON.—"Curios," chiefly connected with the war.

ISAAC CLARK.—A cock linnet, cage bird, which had turned very largely white in its last moult. A number of mounted and cased birds from the donor's collection.

REV. CANON CRAWHALL.—A hen pheasant which had partially assumed the cock's plumage; shot in December near Haydon Bridge.

BRODRICK DALE.—Ethnographical objects from Africa, North America, South Sea Islands, Australia.

GEO. A. EMERY.—Two weasels from Dumfriesshire, one of them regarded as representing a distinct form locally known as the "grass weasel."

DR. J. GARSON.—A small scorpion, *Buthus occitanus*, found alive in a miner's house at Emondsley, Co. Durham, September; doubtless introduced with foreign fruit.

SAMUEL GRAHAM.—A green cockroach, *Panchlora sp.*, imported with bananas. A number of "freak" birds' eggs (guillemot, red grouse, rock ptarmigan); eggs of black-throated diver, shoveler and golden pheasant formerly in John Hancock's collection.

DR. J. W. HESLOP HARRISON.—A batch of young European stick insects, *Bacillus rossii*.

MRS. HENDRY.—A Roman tear bottle dug up near Naples.

J. G. HENRY.—A two-horned seed from China.

PETER HETHERINGTON.—"Silver dregs"—thin iridescent metallic sheets left in pans after silver is run off—from old lead mines in Allendale.

REV. J. M. HICK.—An albino mole from Hampshire.

F. IVES.—A large African centipede.

JOHN JEFFREY, B.Sc.—Further examples of graptolites from the Skiddaw Slates. Piece of a Dalbeattie granite boulder from the boulder clay at Kenton. Examples of the following minerals: Greenockite, crystals; scheelite, crystals and massive; zoisite, crystals; staurolite and cyanite, crystals; apophyllite, crystals; pyrolusite, dendritic; tetradymite, pectolite, wolframite, serpentine, strontiocalcite, celestine, scorodite.

J. J. JOICEY.—Copy of the Bulletin of the Hill Museum, a Magazine of Lepidopterology, vol. 1, no. 1.

PROF. ALEX. MEEK, D.Sc.—Salmon and sea trout smolts from the Tyne. Copy of the Report of the Dove Marine Laboratory, Cullercoats, June, 1921.

Mr. MOFFATT (Leazes Park).—An Egyptian goose which had lived for a number of years in the Leazes Park.

PHILIP E. NOBLE.—A living golden eagle, taken from the nest in Inverness-shire in 1921.

COL. G. POLLARD.—A living example of the nematode worm Gordius, from water.

MR. POTTS (Whickham).—Another Gordius, from soil.

PROF. E. B. POULTON, F.R.S.—By exchange: examples of several large stick and leaf insects.

H. PRESTON, B.Sc.—A small flint scraper from the Yorkshire Wolds.

H. PRESTON (Marley Hill).—A male "timberman" beetle, *Astynomus ædilis*.

WM. RAW.—Two specimens of the Australian moloch lizard, *Moloch horridus*.

MISS ROBERTS.—An African native "guitar" with seven strings.

C. E. ROBSON.—Curlew's wing feather showing extreme abrasion before the moult, picked up at Holy Island in June.

ERNEST SCOTT.—A number of living glow-worms, *Lampyris noctiluca*, male and female. A female of the sawfly *Sirex noctilio*.

DR. RALPH R. SCOTT.—A collection of the more striking beetles (about 65 specimens) from the neighbourhood of Dar-es-Salaam.

MR. SCOTT (Gosforth).—Very large "freak" egg of a white Leghorn hen.

R. R. SHARP.—On loan: fine mounted head of a bull African buffalo, shot by the lender.

MRS. H. A. SISSON.—A large collection of shells, British and foreign; many of the British specimens labelled by Albany Hancock.

GEORGE SISSON.—A living cricket from a boiler house at Blaydon.

COL. G. R. B. SPAIN.—Cast of a gastropod shell, *Euomphalus sp.*, in a red Carboniferous limestone.

GEORGE E. SPENCER.—A large number of ethnographical objects collected about 1880 by the late Mr. Harry Hodgson; chiefly West African, and including leather work, copies of the Koran, weapons, musical instruments, and various utensils.

W. THOMPSON.—A young heron, alive, picked up exhausted in the Town Moor Recreation Ground after living for ten days about the Newcastle parks. (Kept for some weeks in the aviary).

H. S. WALLACE.—Some interesting fossils (coral, leaves of deciduous trees) and other geological specimens from Spitsbergen. A number of ammonites from Whitby. "Freak" eggs of blackbird and pigeon.

MISS LETITIA WALLACE, the late.—By bequest, an ornamental group of pieces of coralloidal aragonite (flos-ferri) and stalactitic calcite.

WM. YELLOWLY.—A New Zealand lizard.

LOUIS ZOLLNER.—An unusually large male great northern diver, shot by the donor off the coast of Iceland, June, 1909.

THE HONORARY TREASURER IN ACCOUNT WITH THE NATURAL HISTORY SOCIETY

CURRENT ACCOUNT FROM JULY 1ST, 1921, TO JUNE 30TH, 1922.

RECEIPTS	£	s.	d.
Members' Subscriptions	413	11	0
Museum Admission Fees 282 16 10			
Education Committee's Grant 10 0 0			
Royal Grammar School (3 years) 6 6 0			
St. Mary's Training College... ..... 2 2 0			
	301	4	10
Sale of Guide Books, etc	15	3	1
Interest on Investments	496	4	6
Income Tax repaid to April, 1922	163	11	8
British Medical Association, donation	10	10	0
Sundries	0	9	9
Balance due to Treasurer	209	5	7
	£1,609	19	9

PAYMENTS	£	s.	d.
Balance due Treasurer July 1st, 1921	96	18	0
Salaries	1004	7	9
Advertising	14	7	10
Fuel, Lighting, and Water	131	0	8
Insurance	82	4	11
Materials and Fittings	50	5	0
Postage and Carriage	39	13	7
Printing	30	3	5
Property Tax	59	16	10
Building Repair Fund	40	0	0
Stationery	6	3	9
Publication Account	17	0	7
Subscriptions: Museums Association ... 2 2 0			
Ray Society 1 1 0			
Sundries 43 14 7			
	46	17	7
	£1,609	19	9

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

BUILDING REPAIR FUND

	£	s.	d.
Balance, 1st July, 1921	203	16	6
Transferred from General Account	40	0	0
Transferred from Deposit Account	45	6	1
	£289	2	7

	£	s.	d.
Sundry repairs	9	17	2
G. G Laidler, Painting Window Sills	12	0	0
R. Watson, New Gutters (Caretaker's house)	33	6	1
Balance, 30th June, 1922	233	19	4
	£289	2	7

PUBLICATION ACCOUNT

	£	s.	d.
Sale of Transactions	3	4	11
Transferred from General Account	17	0	7
	£20	5	6

	£	s.	d.
Loan of Blocks	0	16	0
Transactions, Vol. V., part 2 (balance)	19	9	6
	£20	5	6

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

DEPOSIT ACCOUNT

	£	s.	d.		£	s.	d.
Balance, July 1st, 1921—				On deposit with Crown Building Society (Crawhall Bequest)	300	0	0
In Bank	170	0	8	,, Crown Permanent Building Society (Crawhall Bequest)	300	0	0
In Building Societies	600	0	0	Charles Kirk, Mounting Lion	36	5	0
	770	0	8	Rowland Ward, Mounting Specimens	18	19	3
Interest on Investments	27	0	0	J. J. Hill, Plans of Museum	44	4	1
Bank Interest on Account	1	18	3	Currie & Co., Carriage of Mr. Gardner's Cabinet	10	10	0
				Transferred to Building Repair Fund	45	6	1
				Balance, June 30th, 1922	43	14	6
	£798	18	11		£798	18	11

ENDOWMENT ACCOUNT

	£	s.	d.		£	s.	d.
Balance, July 1st, 1921	67	2	3	Balance, June 30th, 1922	69	0	5
Bank Interest	1	18	2				
	£69	0	5		£69	0	5

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A. H. DICKINSON, Hon. Treasurer.

INVESTMENTS

The following is a list of the Investments held by the Society, June 30th, 1922 :—

	£	s.	d.
Coppin Bequest—			
Newcastle Corporation 3½ per cent. Irredeemable Stock	2,000	0	0
River Wear Commission 4½ per cent. Funded Debt	500	0	0
Crawhall Bequest—			
Midland Railway Company's Consolidated 2½ per cent. Preference Stock	2,946	18	1
North-Eastern Railway Company's 4 per cent. Preference Stock	1,900	0	0
Newcastle and Gateshead Water Company's Consolidated 5 per cent. Preference Stock	1,400	0	0
Armstrong, Whitworth & Co., Ltd., 4 per cent. Debenture Stock	400	0	0
Newcastle and Gateshead Water Company's Ordinary Stock	485	0	0
Durham County Water Board 6 per cent. Redeemable Stock	491	0	0
Stephenson Bequest—			
5% War Loan, 1929–1947	1,050	0	0
5% War Loan, 1929–1947	500	0	0
Endowment Fund—			
Canadian 4 per cent. Registered Stock	1,800	0	0
Newcastle and Gateshead Water Co 's 5 per cent. Preference Stock	421	0	0
,, ,, ,, 5 per cent. Consolidated Preference Stock	500	0	0
5 per cent. War Loan, 1929—1947	789	9	5
Great Eastern Railway Co.'s 3½ per cent. Preference Shares	400	0	0
	£15,583	7	6

FRANK RICHARDSON, Hon. Auditor.
C. E. ROBSON, Joint Hon. Secretary.

A H. DICKINSON, Hon. Treasurer.

LIST OF MEMBERS

OF THE

NATURAL HISTORY SOCIETY

OF

NORTHUMBERLAND, DURHAM, AND NEWCASTLE-ON-TYNE

REVISED TO JUNE 30TH, 1922.

*** Except where otherwise stated, the addresses given are in Newcastle-upon-Tyne.

*** The letters F.C. in place of the date of election indicate that the member joined the Society in 1903 under Rule 3 as a former member of the Tyneside Naturalists' Field Club.

	Elected.
Adamson, Lt.-Col. C. H. E., J.P., C.I.E. *(V.-P.)*, Crag Hall, North Jesmond	1896
Adamson, Miss C. T., Crag Hall, North Jesmond	1903
Adamson, Richard, F.R.H.S., Winlaton, Blaydon-on-Tyne	F.C.
Addison, J. G., The Grange, East Boldon, S.O.	F.C.
Allan, Edward, Osborne Villas	1903
Allden, W. F., Elmfield Road, Gosforth	1906
Allendale, Right Hon. Viscount, Bywell Hall, Stocksfield	1911
Allsopp, C. F., 42, Moorside, Fenham	1922
Anderson, Jas. M., 63, Hunter's Road	1920
Anderson, Dr. Robt., 4 Gladstone Terrace, Gateshead	1910
Angus, Col. W. M., J.P. C.B. *(V.-P.)*, Benwell Cottage	1884
Angus, Jos. G., Westover, Low Fell	1902
Angus, Hugh P., Eslington Villa, Low Fell	1902
Angus, Geo., 37, Percy Park, Tynemouth	1917
Appleby, Alfred, Stotes Hall, Jesmond	1918
Armstrong, J. H., 5, Windsor Terrace	1890
Armstrong, The Right Hon. Lord, J.P., M.A., D.C.L. *(Patron)*, Bamburgh Castle, Northumberland	1889
Ash, Sidney, 22, Ellison Place	1922

	Elected.
Askew, W. F., Long Acre, Stocksfield	1920
Atkinson, Chas., West House, Wylam	1921
Atkinson, Geo. A., Williton, Riding Mill-on-Tyne	1899
Bagnall, Richard S., F.E.S., F.L.S., F.R.S.E., 15, Grey Street	1905
Bainbridge, Geo. B., Espley Hall, Morpeth	1912
Balfour, D., Ravensbourne, Gosforth	1922
Balls, Miss Norah, Deneside, Tynemouth	1920
Bartlett, A. W., M.A., B.Sc., Armstrong College	1922
Baumgartner, Mrs. J. R., Rothay Holme, Ambleside	1911
Beattie, T., M.D., F.R.C.P., 3, Windsor Terrace	1920
Beaumont, J., Greyscliffe, N. Avenue, Gosforth	1922
Beavan, Frederick, Dene Brow, Jesmond Park West	1912
Beck, W. E., 30, St. Mary's Place	1889
Bell, G. F., 55, Highbury	1913
Bell, Sir Hugh, Bart. *(V.-P.)*, Rounton Grange, Northallerton	1905
Bell, John G., 49, Osborne Road	1899
Belt, Thomas, Bigg Market	1907
Benson, Harry, Denehurst, Jesmond Park East	1896
Billany, J. D., 5, Dene Crescent, Walker	1922
Blair, Hugh M. S., Thorney House, Laygate, South Shields	1921
Blair, Robert, F.S.A., Harton Lodge, South Shields	F.C.
Blayney, Mrs. B. W., Allonby House, Dene Drive, Rowlands Gill	1918
Bolam, R. A , M.D., M.R.C.P., 3, Queen's Square	1920
Boleyn, Dr. John, 6, Selbourne Avenue, Low Fell	1922
Boocock, J. T., 80, Falmouth Road, Heaton	1913
Bottomley, J. K., Kearsney, Westfield Drive, Gosforth	1920
Bowes-Lyon, Hon. Francis, Ridley Hall, Haydon Bridge	1905
Brackenbury, Hereward I., Seaton Burn House, Dudley, S.O.	1905
Browne, Lady, Westacres, Benwell	1918
Browne, B. C., Fawdon House	1911
Browne, Miss Evelyn, Westacres, Benwell	1922
Bullerwell, R. G. A., M.Sc., 2, Millbank Crescent, Bedlington	1910
Bulman, H. F., Morwick Hall, Warkworth	1905
Burdon, Col. Rowland, J.P., Castle Eden, Co. Durham	1903
Burn, J. H., Dipton House, Riding Mill	1916
Burns, Mrs. G., 1, Kelvin Grove	1920
Burnup, John, Brantwood, Gosforth	1884
Burnup, Edwin, Ravensworth, Windermere	1904
Burnup, Miss Winnifred E., Ravensworth, Windermere	1910
Burton, W. S., 2, Elmfield Villas, Gosforth	1911

	Elected.
Cackett, Jas. T., 113, Osborne Road	1901
Cadman, Chris. C., North of England Fish Hatchery, Barrasford, Northumberland	1906
Carrick, F., The Elms, Elmfield Road, Gosforth	1916
Carr, Wm. Cochran, Lower Condercum, Benwell	1904
Carter, William, 145, Pilgrim Street	1919
Challoner, John D., 15, Framlington Place	1898
Chapman, Abel, Houxty, Wark-on-Tyne	1908
Chapman, Francis, Lynton, Graham Park Road, Gosforth	1916
Charlesworth, John, 44, Hotspur Street, Tynemouth	1920
Charlton, Chas. F., 21, Claremont Place	1912
Charlton, P., Whinney Leas Cottage, Chopwell	1920
Chaston, Ed. C., 36, St. George's Terrace	1913
Clark, Isaac, 12, Clayton Road	F.C.
Clark, J. B , Rosslyn, Beech Grove Road	1920
Clayton, Major Ed., Walwick Hall, Humshaugh	1907
Cochrane, A. H. J., Jesmond Dene House	1911
Cochrane, Mrs. Alfred, Jesmond Dene House	1911
Cochrane, Cecil A., Oakfield House, Gosforth	1903
Cochrane, Henry H., Eshwood Hall, near Durham	1915
Cohen, Charles, 32, Osborne Road	1908
Collard, Norman A., 3, Portland Terrace	1922
Cooke, Randle B., Kilbryde, Corbridge	1905
Cooke, Mrs. A. McF., ,, ,,	1921
Cookson, Clive *(V.-P.)*, Nether Warden, Hexham	1903
Cookson, Kenneth ,, ,,	1904
Cookson, Harold, Shapley, Winchfield, Hants	1906
Cooper, R. W., 2, Sydenham Terrace	1911
Corder, Percy, Eastfield, Jesmond Park East	1911
Corder, Walter S., J.P., Rosella Place, North Shields	1911
Cowen, Joseph, Stella Hall, Blaydon-on-Tyne	F.C.
Cowper, J., 7, Framlington Place	1914
Coxon, Herbert, Loansdean, Morpeth	1917
Cruddas, Miss Dora, Haughton Castle, Humshaugh	1904
Cruddas, Miss Eleanor ,, ,,	1904
Cutter, C. F., Fountain Cottage, Low Fell	1916
Dalgleish, R. S., South End, Fernwood Road	1916
Dendy, F. W., D.C.L., Eldon House, Osborne Road	1905
Devey, Dr. Thos. V., 88, Westgate Road	F.C.
Dickinson, A. H., 52, Dean Street *(Hon. Treasurer)*	1884
Dixon, Thos., Riding Mill	1922
Dodd, D. Mainland, 3, Fenham Terrace	1902

	Elected.
Dodds, R. A., Blagill House, Beech Grove Road	1920
Dodds, Mrs. R. A., ,, ,,	1920
Dove, Ed. J., J.P., Oaklands, Riding Mill	1912
Drummond, D., M.D., Saville Place	1902
Drummond, Hamilton, M.D., 4, Saville Place	1920
Duke, A , M.A., M.B., F.R.C.S.E., 72, Osborne Road	1920
Dunn, N., Sunnybrae, Alnmouth	1902
Durham, The Right Hon., The Earl of, Lambton Castle, Fence Houses, Co. Durham	1903
Eeles, Robt., Greencroft Park, Lanchester	1914
Eltringham, H., M.A., D.Sc., F.Z.S., 8, Museum Road, Oxford	1902
Fenwick, Jos., Bracken Dene, Belle Vue Bank, Low Fell	1922
Ferguson, John, South View, Hexham	1885
Ferguson, William, 2, St. Thomas' Place	1905
Finlay, Rev. W., Seaton Burn	F.C.
Flattely, Fred. W., Armstrong College	1921
Fletcher, Rev. Mark, M.A., F.G.S., The Vicarage, Benton	1918
Fordham, Wm. J., M.R.C.S., L.R.C.P., D.P.H., F.E.S., 7, Rosslyn Avenue, Low Fell	1921
Forster, Chas. M., 4, Osborne Villas	1922
Forster, John J., J.P., Woodslea, Clayton Road.	1884
Forster, Fred. E., 32, Grainger Street	1901
Forster, C. D., Burradon, Rothbury	1906
Forster, J. H. B., Whitworth House, Spennymoor	1917
Forster, W. Deans, The Cottage, Dalton	1918
Fowkes, W. H., 32, Marine Avenue, Whitley Bay	F.C.
Frazer, T. Burdon, Woodside, Lindisfarne Road	1911
Frew, John A., Underfell, Belle Vue Bank, Low Fell	1922
Gair, E. Coleridge, Lime Croft, Grainger Park Road	1922
Gardner, Major F. W., B.A., 15, Lesbury Road, Heaton	1919
Gardner, Mrs. J., Laurel Lodge, Hart, West Hartlepool	1921
Garrett, F.C., D.Sc., F.C.S., West Croft, Elvaston Road, Hexham	1918
Gibson, Wm. W., 7, Grey Street	1909
Giles, J. Sydney, Fowler Street, South Shields	1922
Glendenning, G. H., Warkworth House, Warkworth	1913
Gracie, John L. *(V.-P.)*, 11, Sydenham Terrace	1896
Graham, Samuel *(V.-P.)*, 107, High Park Road	1885
Green, Newbey S., 29, Brandling Park	1907
Greenwell, Winship, Bothal, Morpeth	F.C.

	Elected.
Grey, Right Hon. Viscount *(V.-P.)*, Falloden, Northumberland	1905
Gurney, Miss H. M., M.D., The White House, Grainger Park Road	1912
Hadcock, Major Sir A. C., Harden, Longbenton	1901
Haggie. A. J , J.P., The Manor House, Long Benton	1914
Haggie, Stanley S., West Jesmond Villa, Osborne Avenue	1919
Hale, R. E , Howick Grange, Lesbury	1916
Hall, Wilfred *(V.-P.)*, Prior's Terrace, Tynemouth	1903
Hand, T. W., Public Library, Leeds	F.C.
Hardie, W. J , Stalheim, Graham Park Road, Gosforth	1912
Harle, W. A., 8, Osborne Avenue	1904
Harrison, J. W. H., D.Sc., The Bungalow, Elizabethville, Birtley	1921
Harrison, The Misses (in Memoriam A. P. H.), 2, Napier Mansions, Mount Ephraim Road, Tunbridge Wells	1906
Harrison, Thomas, Eastburn, Hexham	1905
Harrison, W. J., 20, Jesmond Road	1922
Havelock, John, Eastwood, Jesmond Park East	1907
Henderson, G. E., Framlington Place	1886
Henderson, W. F., Moorfield, Claremont	1884
Henderson, J. C., 22, Percy Gardens, Tynemouth	1917
Henderson, Mrs. J. C., ,, ,,	1917
Heron, J. P. Maxwell, 65, Eldon Street	1912
Heslop, Jas., South Close, Riding Mill	1914
Hick, Rev. J. M., M.A., Springfield, Elphinstone Road, Southsea	F.C.
Hickling, Prof. G., D.Sc., F.G.S., Armstrong College	1920
Higginbottom, A. H., Peel Buildings, Peel Street	1914
Hill, Alfred E., The Red House, Tynemouth	1920
Hill, B. P., B.Sc., 37, Holly Avenue	1919
Hill, J. J., M.S.A., Runnymede, Ponteland	1909
Hobbs, A. Holmested, M.D., 24, Ellison Place	1903
Hodgkin, Mrs. T. E., Old Ridley, Stocksfield	1905
Holmes, C. O., 33, Otterburn Avenue, Gosforth	1922
Holmes, Stephen, 10, Osborne Villas	1903
Holmes, J. H., Wellburn, Jesmond Dene Road	1911
Holmes, Miss, ,, ,, ,,	1911
Holmes, William, Woodhurst, Moor Road, Gosforth	1914
Holzapfel, Max, Kenton Lodge, Gosforth	1905
Houseman, Leonard S., Alnmouth	1920
Howden, Prof. R., M.A., F.R.S.E., 14, Burdon Terrace	1903
Hull, Rev. J. E., M.A., Belford Vicarage, Northumberland	F.C.
Hume, W. E., M.A., M.D., 4, Ellison Place	1920

	Elected.
Hunter, Edward, Wentworth, Gosforth	1902
Hunter, Sir G. B., D.Sc., J.P., The Willows, Clayton Road	1902
Irving, J. A., West Fell, Corbridge-on-Tyne	1906
Jackson, Joseph, 41, Leazes Terrace	1888
Jameson, Alfred, Granville, Rectory Drive, Gosforth	1922
Jeffreys, Harold, B.A., M.Sc., St. John's College, Cambridge	1917
Joicey, The Right Hon. Lord *(President)*, Ford Castle, Ford, Northumberland	1888
Joicey, Hon. Hugh Edward, Ford Castle, Ford, Northumberland	1910
Joicey, Hon. Jas. Arthur, Longhirst, Morpeth	1906
Kirk, William, J.P., Norton Hall, Stockton	1903
Kirkup, Fred O., The Manor House, Medomsley	1918
Kirkup, Austin, Manor House, Penshaw, Fencehouses	1916
Knothe, Rudolph, 3, Haldane Terrace	1884
Knott, Sir James, Bart., Close House, Wylam	1907
Knowles W. H., F.S.A., 25, Collingwood Street	1893
Knyvett, Mrs. M. G., The Vicarage, Benwell	1922
Laidlaw, P. O., Stonecroft, Fourstones, R.S.O.	1892
Lamb, Edmund G., M.A., Borden Wood, Liphook, Hants	1891
Lawson, Wilfrid H., Lindisfarne, Ryton	F.C.
Leach, C. C., Seghill Hall, Northumberland	1903
Leathart, T. H., Low Angerton, Hartburn, Morpeth	1904
Livens, W. M., Ellison Place	1918
Lindsey, Mrs. L., Sandysike, near Brampton	1911
Lisle, George, Bentham Buildings, Side	1906
Literary and Philosophical Society, Westgate Road	1916
Lock, Jos. S , 4, Appletree Gardens, Walkerville	1922
Lockhart, H. B., Arcot Hall, Dudley	1918
Logan, Jas., 10, Eskdale Terrace	1912
Louis, Prof. Henry, M.A., D.Sc , A.R.S.M., 4, Osborne Terrace	1902
Macarthy, Leonard, Benwell Park	1918
Maling, Fred., Temperley Grange, Corbridge	1920
Maling, John Ford, 25, Eslington Terrace	1903
Manson, Jas. McD., Hillcroft North, Low Fell	1910
Martin, Chas., 24, Bewick Road, Gateshead	1922
Martin, Dr. W., West Villa, Akenside Terrace	1914
Mayhew, C. W., 66, Lovaine Place	1922
McLean, John S , 3, Lindisfarne Road	1917

	Elected.
Meek, Prof. Alex., D.Sc., F.Z.S., F.L.S., Armstrong College *(V.-P.)*	1895
Meikle, Jas. E., Beauclere, Riding Mill-on-Tyne	1907
Mein, M. M., Beechwood, Graham Park Road, Gosforth	1902
Mein, N., Beechwood, Clayton Road	1917
Merz, Chas. H., The Ems, Gosforth	1910
Middleton, H. N., J.P. *(V.-P.)*, Lowood, Melrose (N.B.)	1884
Milburn, Fred., 6, Fenham Terrace	1920
Milburn, Sir Leonard, Bart., Guyzance, Acklington	1918
Mitcalfe, J. Stanley, 60, Percy Park, Tynemouth	F.C.
Mitchell Mrs. E. H., Jesmond Towers	1904
Moffatt, Mrs. John, 125, Osborne Road	1922
Mountain, W. C., 8, Sydenham Terrace	1918
Morris, F. W., Wantage, Beltingham, Bardon Mill-on-Tyne	1915
Morison, Sir Theodore, K.C.I.E., M.A. *(V.-P.)* Armstrong College	1920
Napier-Clavering, Col. C. W., *(V.-P.)*, Axwell Park	1908
Newall, F. S., J.P., Castle Hill, Wylam-on-Tyne	1896
Newcastle, Lord Bishop of *(V.-P.)*, Benwell Tower	1908
Newbigin, E. R., 4, Tankerville Terrace	1916
Newton, Edward, Thirston House, Felton	1889
Nicholson, Geo., 26, Lancaster Street	1917
Nimmo, W. Wilson, Yarm House, Gosforth	1920
Nisbet, E. T., Birnie Knowes, Cullercoats	1918
Noble, Lady, Jesmond Dene House	1911
Noble, Miss, Jesmond Dene House	1887
Noble, Major Sir Geo. J. W. *(V.-P.)*, Hornton Lodge, Camden Hill, London, W. 8.	1877
Noble, S. W. A., Kent House, Knightsbridge, London, W.	1887
Noble, J. H. B., Ardkinglas, Inverary	1904
Noble, Philip E., Jesmond Dene House	1903
Northbourne, The Right Hon. Lord, Betteshanger, Dover	
Northumberland, His Grace the Duke of, *(V.-P.)*, Alnwick Castle	
Oliver, Alfred B., 24, Eldon Place	1920
Oliver, Arthur Moule, West House, Cleadon	1910
Oliver, Prof. Sir Thos., M.D., F.R.C.P. *(V.-P.)*, Ellison Place	1889
Ormond, John G., Bywell, Stocksfield	1909
Park, A. B., Holly Lodge, Gosforth	F.C.
Parmeter, Percy, The Union Club	1919
Parrington, M. W., Hill House, Monkwearmouth	1915

	Elected.
Parsons, Hon. C. A., J.P., F.R.S., M. Inst. C.E., Holeyn Hall, Wylam-on-Tyne (and 6, Windsor Terrace)	1903
Pattison, Ed. Stoddard, 11, Sydenham Terrace, Whitley Bay	1921
Pattinson, Hugh Lee, 13, Mosley Street	1892
Pease, Howard, J.P., Otterburn Tower, Northumberland	1905
Pease, J. Beaumont, J.P., 13, Stratton Street, London, W. 1	1903
Pease, Mrs., Alnmouth	1905
Peile, Henry, Duke's House, Hexham	1910
Penman, J. D. W., 132, Albert Road, Jarrow	1920
Philipps, Mrs. Bertram, Dinton House, Dinton, Salisbury	1904
Philipson, J. W., Fellside House, Stocksfield	1922
Pickering, H., 13, South Parade, Whitley Bay	1919
Pollard, Lieut-Col. George, Seaton Delaval Hall, Seaton Delaval	1920
Potter, The Rev. Prof. M. C., M.A., Sc.D. *(V.-P.)*, Armstrong College	1889
Potts, Edward, Whitburn Road, Cleadon, Sunderland	F.C.
Priestman, Francis, Shotley Park, Shotley Bridge	1910
Priestman, Lewis, Derwent Lodge, Shotley Bridge	1920
Proctor, J. H., Ravenswood, Westgate Road	1910
Pumphrey, Bernard, 115, Osborne Road	1902
Punshon, Mrs., Ingleby House, Northallerton	1906
Pybus, Major F. C., F.R.C.S., Windsor House, Jesmond Road	1913
Pybus, W. Mark, Milburn House, Dean Street	1884
Ramsay, N. F., Alnmouth	1912
Raw, Wm., 12, "Side"	1921
Reed, Col. Sir Joseph, Horton Grange, Dudley	1916
Reed, Thomas, C.A., 1, High West Street, Gateshead	1917
Reid, Sidney, 26, Claremont Place	1911
Renwick, Sir George, Bart., J.P., Springhill, Morpeth	1902
Reynolds, E. P., c/o Messrs. Cookson, Milburn House	1921
Rich, F. W., 6, Jesmond Gardens	1886
Richardson, Edmund R., 2, Tankerville Terrace	1911
Richardson, Frank, Clifton Cottage, Clifton Road	1911
Richardson, George B., M.A., Lindum, Jesmond Park	1903
Richardson, J. Alaric *(Hon. Secretary)*, Anster, Grainger Park Road	1897
Richardson, Lawrence, Stoneham, Beechgrove Road	1903
Richardson, R. Morris, The Union Club	1918
Richardson, Miss S. A., Ashfield House, Elswick Road	1881
Ridley, C. A., Melrose Cottage, Alnmouth	1915
Ridley, Viscountess, Blagdon, Cramlington, Northumberland	1917

	Elected.
Ridley, W. A., Hawthorn House, Hooper Gate, Rowlands Gill	1920
Rintoul, Miss S., 6, Frognall Gardens, Hampstead, N.W. 3	1922
Ritson, John Ridley, Sniperley Hall, Co. Durham	1920
Ritson, U. A., J.P., Jesmond Gardens	1887
Ritson, W. H., J.P., Springwell Hall, Durham	1902
Robinson, J. L., 6, Lambton Road	1922
Robson, C. E. *(Hon. Secretary)*, Priorsdale, Clayton Road	1903
Robson, John S., Boscombe, Bournemouth	1887
Robson, Jos. T., Beetholme, Osborne Gardens, Monkseaton	1917
Robson, Mrs. M. A., 6, Collingwood Terrace	1905
Robson, Richard, Eslington Court	1920
Robson, Robt., 13, Framlington Place	1884
Rodgers, Major R. M., 21, Oaklands, Gosforth	1908
Rogerson, John E., J.P., Mount Oswald, Durham	1880
Rollin, Charles, Keys House, 212, Gilesgate, Durham	1917
Ross, Charles, Fairfield, Westoe, South Shields	1915
Rowell, Robert R , 2, Station Road, Forest Hall	1920
Rowe, T. W., J.P., Rock Villa, Gowan Terrace	1920
Runciman, Rt. Hon. Walter, M.P., Doxford Hall, Chathill	1912
Ryott, W. H., 2, Sydenham Terrace	1884
Sanderson, Thos., 2, Devonshire Terrace	1913
Sanderson, W. J., J.P., Eastfield, Warkworth	1889
Scott, Ernest *(V.-P.)*, 5, Colbeck Terrace, Tynemouth	1901
Sharp-Naters, John G., Stelling Hall, Stocksfield-on-Tyne	1883
Sharp, Wm., Blythswood South, Osborne Road	1883
Simpson, J. B., J.P., Bradley Hall, Wylam-on-Tyne	1903
Simpson, Thos., The Crofts, Hepscott, Morpeth	1888
Simpson, Benjamin F., The Cottage, Bucklebury, Berkshire	1919
Sisson, George, West Oakwood, Westgate Road,	1899
Sisson, J. Arnott, 4, Fenham Terrace	1902
Smart, G. S., Corchester, Corbridge-on-Tyne	1902
Smith, Clarence D., Lough Brow, Hexham	1909
Smith, E. W. F. Fraser, 1, Collingwood Terrace	1918
Smith, John, 128, Rye Hill	1908
Smith, Lancelot, Piper Close, Corbridge-on-Tyne	1909
Smith, Mrs., Hencotes House, Hexham	1907
Smith, Thomas, Hamsterley House, Low Westwood, Hamsterley Colliery, Co Durham	1920
Smythe, Dr. J. A , 10, Queen's Gardens, Benton	1913
Spain, Col. Geo. R. B., C.M.G., 7, Tankerville Place	1907
Spence, R. F., Backworth Lodge, Backworth	F.C.
Spence, Philip, Mellbreak, Elmfield Park, Gosforth	1912

	Elected.
Spencer, Ralph, Netherwitton Hall, Morpeth	1911
Squance, H. S , South Hill The Cedars, Sunderland	1917
Steenberg, Frank S., The Quarry, Stocksfield	1921
Stephens, Rev. T., Horsley Vicarage, Otterburn	F.C.
Stephenson, W. E., Throckley House, Newburn	1918
Stewart, John F., 2, Archbold Terrace	1922
Storey, George H., 3, Regent Villas, Salters Road, Gosforth	1922
Storey, Samuel, J.P., Southill	F.C.
Straker, F., J.P., Angerton Hall, Morpeth	1888
Straker, John C., J.P., The Leazes, Hexham	1903
Straker, Chas. E., High Warden, Hexham	1912
St. Mary's Training College, Fenham	1921
Sutherland, Sir A. Munro, Bart., Thurso House, Fernwood Road	1904
Sutherland, A Munro, Thurso House, Fernwood Road	1920
Swan, Capt. C. V., M.C., 5, Osborne Villas, Jesmond	1909
Swan, E. W., Allerwash, Fourstones	1912
Swan, Mrs. A. S., Daneswood, North Avenue, Gosforth	1913
Swanston, William, 7, Sydenham Terrace	1902
Taylor, Herbert, 56, Manor House Road	1920
Taylor, Thomas, J.P., Chipchase Castle, Wark-on-Tyne	1903
Temperley, George W , 4, Selborne Avenue, Low Fell	1919
Temperley, Henry, 1, Fenham Terrace	1909
Temperley, Miss M., 4, Carlton Terrace, Low Fell	1920
Temperley, W. A., 1, Osborne Avenue	1904
Temperley, Nicholas, J.P., 4, Carlton Terrace, Low Fell	1914
Thomas, E.R., M.A., M.Sc., Royal Grammar School	1922
Thompson, Miss Jessica, The Cottage, Whickham	1889
Thompson, J. W., Holywell Grange, Shiremoor	1917
Thompson, M. Lawson, F E.S., 40, Gosford St., Middlesbrough	1921
Thompson, R. J., 38, Eldon Street	1913
Thomson, Miss M. H., 22, Wentworth Place	1906
Thomson, James, M.A., 22, Wentworth Place	1911
Todd, G. W., Clifton House, Chopwell	1920
Turner, G. Grey, M.B., M.S., F.R.C.S., The Hawthorns, Osborne Road	1919
Turner, W. Leonard, Heatherlea, Stocksfield	1914
Vaughan, W. S., The Poplars, Gosforth	1918
Waddilove, Geo. H., J.P , Brunton, Hexham	1904
Waggot, Jas. B., 19, Percy Park Road, Tynemouth	1911
Wallace, H. S., F.E.S., 9, Sydney Grove	1913

	Elected.
Walker, John D., J.P. *(V.-P.)*, 3, Ellison Place	1888
Walker, Norman D., Sorbie, Elmfield Road, Gosforth	1922
Walther, P., 508, Muriel Parkway, Elizabeth, New Jersey, U.S.A.	1906
Walther, W., Eastfield House, 15, Granville Road	1912
Ward, Percy F., 27, Mosley Street	1907
Ward, Septimus S., 44, Osborne Road	1920
Wardale, J. D., M.A , M.B., Carlton Villa West, Jesmond Road, Newcastle	1920
Watson-Armstrong, Hon. W., c/o Post Office, Irvines Landing Rander Harbor, via Vancouver, B.C., Canada	1912
Watts, Rev. Arthur, F.G.S., Yewtree Villa, Tuffley, Gloucester	1903
Watts, John, Blythswood North, Osborne Road	1917
Watts, Frank R., Gorton Villa, Salcombe, South Devon	1918
White, W. A , Adderstone, Jesmond	1921
White, Mrs. W. H., Knaresdale, Slaggyford	F.C.
Williams, Dr Ethel, 3, Osborne Terrace	1920
Wilson, Arthur H , 2, Claremont Place, Gateshead	1922
Wilson, Henry B., 11, Osborne Avenue	1907
Wilson, W. N. C., National Provincial and Union Bank of England, Ltd.	1918
Wilson, J. R. R., M. Inst. C.E., F.G.S., 4, Park Terrace	1918
Wilson, Cuthbert B., 49, Grey Street	1908
Winstanley, R. H., 18, Oaklands, Gosforth	1917
Winter, Robert, 89, Lodore Road, High West Jesmond	1922
Wood, J., J.P., Coxhoe Hall, Coxhoe, Durham	1903
Wood, James Scott, 90, Falmouth Road, Heaton	F.C.
Woodcock, Alfred, M.Sc., 23, Lesbury Road, Heaton	1907
Woods, Sir Jas. E., J.P., London	1896
Woolacott, D., D.Sc., 8, The Oaks West, Sunderland	F.C.
Wright, Jos., 7, St. Mary's Place	1911
Young, W. H., F.Z.S., F.L.S., 10, Marden Road, Whitley Bay	1901
Zöllner, Louis, 6, Osborne Terrace	1904

HONORARY MEMBERS.

Bidwell, Edward, M.B.O.U.	1, Trigg Lane, London.
Garwood, Prof. E. J., M.A., F.G.S....	University College, London.
Jackson, A. Randell, M.D., D.Sc. ...	67, Hoole Road, Chester.
Mennell, Henry T., F.L.S.	Park Hill Rise, Croydon.
Perkins, V. R.	Wottoon-under-Edge, Gloucester.
Wright, Rev. R. Stewart, F.R.G.S , F.R.S.G.S.	South Africa.

LIFE MEMBER.

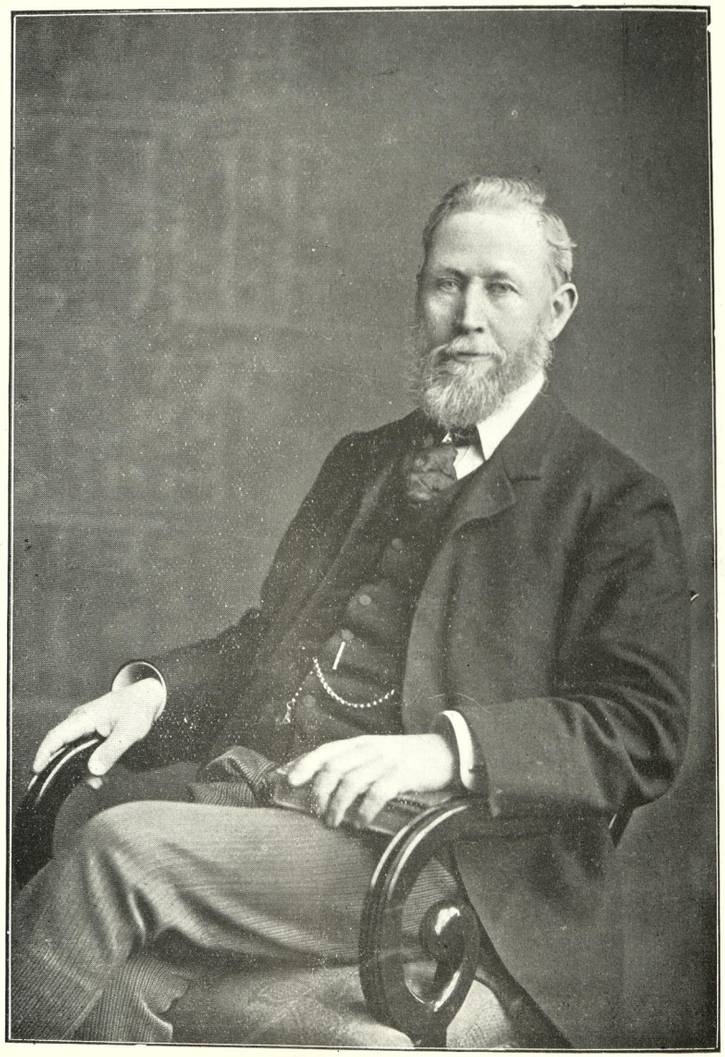
	Elected.
Bottomley, Master J. K., Kearsney, Westward Drive, Gosforth	1920

ASSOCIATES.

Bailey, H. W., Woodside, Grange Road, Fenham	1921
Baxter, J., 37, Lancaster Terrace, Chester-le-Street	1920
Bishop, Joseph, 1, Dobing Street, Stockton-on-Tees	1922
Blackburn, Miss K., M.Sc., Armstrong College, Newcastle	1920
Buck, B. S., Furzefield, Gosforth	1920
Campbell, P.W., 14, Nelson Street	1921
Carr, William, Brantwood, Whickham	1921
Clague, Wm. Douglas, White House, High Heworth, Felling	1909
Close, Guest L , 12, Station Avenue North, Fencehouses	1921
Cole, N. R., 589, Welbeck Road, Walker	1922
Cooke, E. G., 67, Shortridge Terrace	1921
Dickinson, Miss A. S., c/o Miss Henderson, 24, Granville Street, Gateshead	1920
Dixon, Miss Violet, 66, Hartington Terrace, South Shields	1921
Dodd, Wm Robert, 24, Havelock Terrace, Gateshead	1921
Donald, Miss E., 3, Cliftonville, South Gosforth	1921
Dransfield, Miss Evelyn, 21, Queen's Road	1921
Edmunds, Miss Annie, Providence Cottage, Bridport, Dorset	1909
Elder, Alexander, 5, Springfield Avenue, Eighton Banks	1920
Garrett, Mrs , West Croft, Elvaston Road, Hexham	1920
Griffiths, B. Millard, M.Sc., Armstrong College	1921
Hall, Harold, 41, Greenfield Place, Ryton	1920
Harrison, E. M., The Avenue, Birtley	1920
Heslop, Miss Mary K., M.Sc., 20, Framlington Place	1907
Holloway, Chas , 148, Wharton Street, South Shields	1922
Hunter, Carlyle, 17, Eldon Place	1922
Hutchinson, Miss L. A., 62, Towneley Street, West Stanley	1921
Ingram, Harry, 38, Brandling Place S.	1922
Jeffrey, John, B.Sc., 59, Grove Street	1912
Johnson, J. R., 3, Devon Gardens, Gateshead	1920
Kyle, David, 16, Eldon Square	1920
Lomas, Miss W., B.Sc., Neville's Cross Training College, Durham	1921
Macpartling, G. W., 47, Tossen Terrace, Heaton	1922
Main, Francis R., 25, Highbury	1919
McDougle, J. K., Ingram House, Bamburgh	1922

	Elected.
Morpeth, Miss G. V., 114, Wingrove Road	1921
Nicholson, Miss Nancy, 7, Liberty Terrace, Tantobie, S.O.	1922
Nunn, W. H., 19, Eslington Terrace	1921
Oliver, Ronald N., 24, Eldon Place, Newcastle	1920
Ormston, Miss Enid, 8, Collingwood Terrace	1922
Palmer, Donald, 39, Osborne Road	1922
Patterson, J. E., 2, East Avenue, Benton	1906
Peacock, A. D., M Sc., F.E.S., Armstrong College	1911
Pearson, Miss E G. 2, Winchester Terrace	1921
Preston, H., 26, Glen Terrace, Washington Station, Co. Durham	1920
Pyle, R. W., 2, Norham Road, Whitley Bay	1921
Raimes, Miss Audrey, 21, Albury Road, Jesmond	1921
Richardson, Miss, The High School, Tankerville Ter., Newcastle	1920
Richardson, W. S., 35, Newlands Road, High West Jesmond	1922
Ritson, Miss M. I., 34, Holly Avenue	1921
Rosie, David, 224, Ellesmere Road	1898
Schofield, A. J., B.A., Secondary School, Washington	1921
Simpson, Chas., R I., Conrad House, Bentinck Terrace	1921
Sloan, P. A., Craiglea, Westfield Drive, Gosforth	1920
Smailes, John, Kibblesworth, near Gateshead	1921
Smith, Eric, 14, Ravensworth Road, Heaton	1920
Smith, Miss Y. M. Herbert, 1, Foley Avenue, Well Walk, Hamstead, N W. 3.	1920
Smith, Mrs. E. Wardley, 10, Wellesley Terrace	1921
Stewart, John, 28, Bridge Street, Gateshead	1920
Stewart, James, 30, Kent Street	1920
Thomas, Miss S., 206, Ladykirk Road	1920
Thomas, Miss A., ,,	1921
Thompson, Matthew, 10, Nixon Street	1922
Turnbull, Sydney, The Avenue, Birtley	1920
Wardle, R., 168, Threwhitt Road, Heaton	1921
Watson, Alastair S., 31, Osborne Road	1919

The Honorary Secretaries will be obliged for notification of change of address.



THE LATE PROFESSOR GEORGE STEWARDSON BRADY.
(From a block kindly lent by A. J. A. Woodcock, M.Sc.)

George Stewardson Brady.

By Professor A. Meek, D.Sc., F.Z.S.

Professor G. S. Brady, M.D., M.R.C.S., D.Sc., LL.D., F.R.S., C.M.Z.S., was born in Gateshead on April 13th, 1832, and died in Sheffield on December 25th, 1921. He was in practice as a doctor in Sunderland for nearly 50 years and was a consulting physician of the Sunderland Infirmary. He was Professor of Natural History in what is now Armstrong College of the University of Durham for over thirty years. His association with the Newcastle Natural History Society and the Tyneside Field Club was a longstanding one. It dates from 1849, and he was indeed the last link we had with the distinguished naturalists of the middle of last century; the naturalists whose work made the "Transactions" of their day so interesting and important and which with the noble building which houses their collections may be regarded as a testimony to their memory.

His father, Henry Brady, was a surgeon in Gateshead, and he was a prominent member of the Newcastle Society of Friends. At that period Gateshead had not grown to the extent we know it to-day, and G. S. Brady delighted to recall the pleasure a little dene close to the town gave him when he was a child. It was "studded with hyacinth and blue speedwell, and fruitful with unnumbered blackberries." As a boy he was taken to visit the upland regions of Derbyshire, where his mother's people were tenant farmers. There he was the companion of a cousin a few years older, and introduced to methods of catching fish and game. He used to remark with a twinkle in his eye, that the method was not always that recognised as legal. From these and other memories of his childhood and boyhood which he liked to recall, it is evident that he had early opportunities for appreciating the beauties which nature spreads so liberally, and for learning at first-hand the elements of natural history in relation to such a background.

One of his earliest friends was Daniel Oliver, the botanist. Later they became companions in botanical excursions and Brady always consulted Oliver when in botanical difficulties. The tutor of his early years was John Storey who was a keen botanist and encouraged collecting, taking his class to the Ouseburn and Pandon Dene. But perhaps Tuffen West had a greater influence than any of those he was likely to meet as a boy. Zoologists are familiar with the name of Tuffen West and the part he played in drawing the plates of zoological monographs published in the latter half of the last century; but not many will know that West was a pupil of Brady's father about the year 1840, was an inmate of the Brady household for several years, and was originally destined to be a doctor. He attended the lectures at the Newcastle School of Medicine and with the older Brady pursued his studies as a medical student. West's spare time was spent in dissecting and articulating skeletons of the smaller animals, ransacking the countryside for specimens, and Brady said he was more adept at this work than anyone he met afterwards. West was a botanist also and at this period he taught himself to draw the specimens he collected with fidelity and accuracy. This was the beginning of his art career and examples of his work done at the period adorn the walls of the room occupied by the Professor of Zoology at Armstrong College.

It is evident therefore that even before going to school Brady had already come into close contact with natural history and had come under the influence of men who either were, or were destined to be, well-known naturalists. At eleven he went to the Friends' School at Ackworth and afterwards to Tulkett Hall, Preston. He carried with him a bent for natural history and he remarked that it met with such encouragement as in these days was practicable.

On his return to Gateshead he was entered as a student of the College of Medicine in Newcastle. In 1857 he began practising as a doctor in Sunderland and later as has been stated was a consulting physician of the Infirmary.

With his brothers, Henry and Tom, he was a pioneer in photography at this early period when the indulgence of such a hobby meant carrying a heavy equipment into the field, and the use of paper negatives made transparent by impregnating them with wax. Mr. Walter Corder informs me that amongst those "calotype" negatives, as they were called were many taken in the fifties of North-country subjects, which unfortunately were lost. Brady was also as his papers show a good draughtsman, and his sketches from Nature indicated true artistic feeling and abilities of a high order.

He joined the Tyneside Field Club in 1849, and his student days were thus not confined to the work of the profession he had taken up, but marked the beginnings of his brilliant career as a naturalist. At this early period of his life he had already in fact found that natural history was to be his hobby, and it is interesting to reflect that many medical men have similarly been led to adopt natural history as a recreation, and like Brady have become distinguished naturalists. He came into intimate association with the naturalists of the district, who had already acquired a wide fame, and he recorded with gratitude the value of meeting them and the friendships he made with many of them. He had a great admiration for both the Hancocks, so dissimilar in nature, but both commanding respect and a high place in the annals of Newcastle Natural History. Amongst his friends of the period he mentioned Alder, St. John, W. B. Scott, Oliver, Abbs, Embleton, Atthey, and in later years, Howse, Norman and Hodge. These names are well-known to all of us, and Brady used to tell of the meetings they had in Newcastle and of the Field Days, and gave us several pawky character sketches of those who took part.

Brady's first contribution to scientific literature was in 1860 when he published in the Transactions a "Catalogue of the Marine Algae of Northumberland and Durham." It was an excellent performance and must have cost him much time and labour. The list is still an authoritative guide, and is used

by all students of the subject. This was succeeded by other papers on Algae and one on Echinodermata. In 1862 he gave evidence of a predilection for microscopic work and of the choice he was making of his life-work by writing his first paper on Entomostraca.

We have thus in the sixties to picture Brady occupied as a physician and seeking recreation by visits to the shore and to local ponds for material, and devoting his holidays in large measure to extending his collections. He became an adept at plankton gathering, and was if not the first, one of the first, to adopt a net made of silk. He employed also a small silk net for concentrating his catches for preservation. The activities of the Natural History Society in the early sixties in carrying out dredging trips off the coasts of Northumberland and Durham enabled him to obtain specimens from deep water. His spare time in the winter was given to an examination of the material and confining himself more and more to the study of microscopic Crustacea he speedily advanced into a position of authority.

Like his brother, H. B. Brady, he was a keen microscopist, and like him also, he attained wide reputation. The work of the one on Foraminifera and of the other on Entomostraca brought them into prominence and gained for them the friendship of others employed in the same fields elsewhere at home and abroad.

The seventies constituted an important epoch in G. S. Brady's life. He was employed in preparing the monograph on the free and semi-parasitic Copepoda of Britain, which was published by the Ray Society in 1879. He was called upon to undertake the examination of the Ostracoda and the Copepoda collected during the expedition of the "Challenger." The report on the Ostracoda appeared in 1880 (vol. 1) and that on the Copepoda in 1884 (vol. 8). These were monumental tasks which he carried out with characteristic care and thoroughness.

In 1875 he succeeded Professor H. Alleyne Nicholson as Professor of Natural History at what was called the College of Physical Science, now Armstrong College, Newcastle, and he held the Chair until 1906 when he resigned and went to live in Sheffield. The duties of the Chair involved only the giving of lectures and he was thus left with plenty of time to carry on his work of investigation. The work tended to increase, for it became the habit of collectors at home and abroad to send their Entomostraca to Brady for description.

In recognition of his work, the local Field Club elected him their President in 1875, 1892, 1893 and 1906, and his addresses on these occasions are still well worth reading for they indicate a broad-minded outlook and a fund of common-sense. Honours were conferred upon him at home and abroad. He was elected a Fellow of the Royal Society, a Corresponding Member of the Zoological Society and of foreign societies. Other workers in Carcinology testified to his eminence by using his name for their new genera and species. He was brought into friendly correspondence with such workers all over the world. But, above all, he valued the more intimate friendship he had with naturalists at home, as Canon Norman, David Robertson (the Naturalist of Cumbrae) and Dr. Thomas Scott. With Robertson he had many holiday excursions to the Scilly Islands, the Norfolk Broads, the West of Ireland and the West of Scotland. Brady found him "the most even-tempered and genial of companions—come fair, come foul. He was never disheartened; and how great a gift a comrade of that kind is none but those who have experienced the reverse can ever fully know."

His friendship with Canon Norman was productive of two monographs of great importance. The one was the account of the Marine and Fresh Water Ostracoda of the North Atlantic, and North Western Europe, the two parts of which were published in 1889 and 1895 in the Transactions of the Royal Dublin Society. The authors found by experiment that they could adequately restore specimens which had been

preserved in a dried state, sometimes for many years, and were thus able to utilise valuable material which otherwise would have been wasted. The other paper was a catalogue of the Crustacea of Northumberland and Durham, which after many delays was duly accomplished and published in the Transactions of the Natural History Society in 1909.

His work also extended into the realms of Palæontology. His papers on British Entomostraca from Post-Tertiary formations in collaboration with H. W. Crosskey and D. Robertson, and that on the Entomostraca of the Tertiary formation of Antwerp are of great value.

He retired as has been said from the Chair at Armstrong College, and from his work at Sunderland in 1906, and went to live in Sheffield. Even after his retirement at the age of 74 he continued his work. He found the Sheffield area disappointing, but was employed in describing collections from several expeditions. The last paper he published in the Transactions of the Natural History Society was an 'Amended description of *Diaptomus sancti patricii*' in 1912. During this period he described collections made in South Africa, the Entomostraca collected at the German South Polar Expedition, and we find that a paper on the pelagic Entomostraca of Durban Bay, and his description of the Ostracoda and Copepoda collected by the Australian Antarctic Expedition, bear the date 1915; and he was then 83.

It was with great reluctance that he undertook the last-mentioned work, for as he expressed it, he was losing grip of the developments of the subject, and felt that he must leave the field for his successors. Nor was he able to work as he was accustomed to do. His wife died not long after they had retired to Sheffield. His only son died early in 1921. All his old friends, he used to say, had gone. He had that feeling of loneliness which such events of a long life inevitably bring. Towards the end he lived almost altogether in the memory of his earlier years and the doings of the present day had very

little interest for him. After a long, happy life, he began to fail early in 1921, and passed away quietly on the evening of Christmas Day that year.

After his wife's death his daughter Emily became his constant companion and help. He is survived by Miss Brady and her two sisters, one the wife of Dr. Charles Atkin, Sheffield, and the other the wife of Dr. Hubbersty, Sunderland.

G. S. Brady will ever be remembered as a pioneer in a path of natural history not used by many investigators. His monographs and papers bear testimony to the arduous work he performed, and they will be consulted for guidance by all those who seek to traverse the same road. They amount together to a very complete account of fresh water and marine Entomostraca from many different parts of the globe. Brady used to remark on the relative sameness of the plankton, freshwater and marine, from widely remote regions. His work paved the way, with that of G. O. Sars and others for a better understanding of the wide distribution of species and of the factors which promote it.

As a Society, then, we regard him as not merely a link with the brilliant members of the last century, but as one of them. Some of us who came intimately into association with him learned to appreciate him as a friend endowed with a most kindly nature. He was an excellent colleague and the best of companions during an excursion at sea or on land. He had an intense love of nature and of poetry and he was deeply religious. He had a keen sense of humour and delighted in recounting amusing incidents and stories. Until his later years he was deeply interested in all matters social and political, and it may be added from the experience of his mother's relations as farmers in Derbyshire, a severe critic of our land laws.

LIST OF PUBLISHED PAPERS

Trans. Tyneside Naturalists' Field Club.

Vol.	IV.	1860	Catalogue of Marine Algæ of Northumberland and Durham.
,,	V.	1861	Algological Notes.
,,	,,	1862	do.
,,	,,	1863	Report on Echinodermata—dredging expedition.
,,	VI.	1863	On Algæ in Winch's Herbarium.
,,	,,	1863	On the Zoology of Hylton Dene
,,	,,	1863	On the Pelagic Entomostraca–dredging expedition.
,,	,,	1863	On the Algæ do. do.
,,	,,	1863	Introductory do. do.
,,	,,	1863	On Ostracoda new to Britain.

Intellectual Observer.

Vol.	I.	1862	On Entomostraca
,,	II.	1863	Photographic delineation of microscopic objects
,,	III.	1863	On Stalk-eyed Crustacea.
,,	IV.	1864	British Star Fishes.
,,	V.	1864	Salt Marshes and their Inhabitants.
,,	VII.	1865	British Oceanic Entomostraca.
,,	,,	1865	Microscopic Crystals.
,,	,,	1865	Naturalists' Field Clubs.
,,	IX.	1866	Connemara.
,,	X.	1867	Variations of Crustacea in relation to Darwin's Theory.
,,	XII.	1867	Synopsis of British Ostracoda.
,,	,,	1868	Crustacean Fauna of English Lakes.

Popular Science Review.

Review of Ansted's "Channel Islands"

Trans. Natural History Society of Northumberland and Durham.

Vol.	I.	1865	Dredging Report.
,,	,,	1865	On Pelagic Entomostraca (dredging report).
,,	,,	1866	On Naturalists' Field Clubs.
,,	,,	1867	Monograph of British Bosminidæ, &c. (with Rev. A. M. Norman).

Vol.	III.	1869	On the Crustacean Fauna of Salt Marshes of Northumberland and Durham.
,,	,,	1869	On an Entomostracan inhabiting a Coal Mine.
,,	,,	1870	A list of fresh water Algæ collected in Northumberland and Durham.
,,	,,	1870	On Entomostraca collected in the Northumberland and Durham District (1869).
,,	IV.	1871	Presidential Address to Tyneside Field Club.
,,	,,	1872	A List of the non-parasitic marine Copepoda of the North-east Coast of England.
		1891	A Revision of the British fresh water Cyclopidæ and Calanidæ.
		1892	Presidential Address—Tyneside Field Club.
		1893	Presidential Address—Tyneside Field Club.
		1895	On Entomostraca collected in the Solway District and at Seaton Sluice in 1894.
		1898	On the British Species of Daphnia and some allied genera.
		1900	On *Ilyopsyllus coriaceus* and other crustacea collected at Alnmouth in 1899.
			An afternoon dredging off Cullercoats.
		1901	On Copepoda and other Crustacea taken in Ireland and on the North East Coast of England.
		1903	On Entomostraca found at the roots of *Laminaria*.
		1905	On Copepoda and other Crustacea taken off Northumberland and Durham in July 1904.
		1906	On the Crustacean Fauna of a salt water pond at Amble
		1909	Crustacea of Northumberland and Durham (with Rev. A. M. Norman).
		1912	An amended description of *Diaptomus Sancti Patricii*.

Reports of the Challenger Expedition.

1880	On the Ostracoda.
1884	On the Copepoda.

Transactions of the Royal Society of Edinburgh.

1890	On Ostracoda collected in the South Sea Islands by H. B. Brady, LL.D, F.R.S.

Transactions of the Royal Dublin Society.

1889 Vol. IV. Series II. A Monograph of the marine and freshwater Ostracoda of the North Atlantic and of North Western Europe Section I. Podocopa (with Rev. Dr. Norman).

1895 Part II. of the same.

Philosophical Transactions of the Royal Society of London.

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Palæontographical Society.

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Ray Society.

1877-80 A Monograph of the free and semi-parasitic Copepoda of the British Islands. 3 vols.

Transactions of the Zoological Society.

Vol. V. 1865 On new or imperfectly known species of Marine Ostracoda.

1875 A Monograph of the fossil Ostracoda of the Antwerp Crag.

XIV. 1897 A Supplementary Report on the Myodocopa of the Challenger Expedition.

,, 1898 On new or imperfectly known Ostracoda chiefly from New Zealand.

XV. 1899 On the Copepoda of New Zealand.

1901 On new or imperfectly known species of Ostracoda chiefly from the Zoological Museum of Copenhagen.

Proceedings of the Zoological Society.

1871 A Review of the European Cypridinidae.

1872 On two new species of British Holothuroidea (with D. Robertson).

1875 A Review of the British Marine Mites.

1877 On fresh water Mites taken in Great Britain and Ireland.

1886 On fresh water Entomostraca from South Australia.

1904 On Entomostraca collected in Natal by J. Gibson Esq.

1906 On the Entomostracan Fauna of the New Zealand Lakes.

1910 A Revision of the species of British Ostracoda belonging to the sub-families Candoninae and Herpetocypridinae.

1911 Notes on Marine Ostracoda from Madeira

Friends' Examiner.

Review of "The Bird."

January, 1868 The modern spirit in the Study of Nature.

Manchester Friend.

1872 Review of the Duke of Somerset on Christian Theology.

1872 Thoughts on Darwinism.

1873 On the state of the Society.

1885 Lumen siccum: an essay on the exercise of the intellect in matters of religious belief.

Annals of Tropical Medicine and Parasitology.

1907 Notes on Dr. Graham's collection of Cyclopidae from the African Gold Coast.

1910 On some species of Cyclops and other Entomostraca collected by Dr. J. N Dalziel in Northern Nigeria.

Deutsche Sud-Polar Expedition, 1902-1903.

1910 Ueber die Copepoden der Staemme Harpacticoida, Cyclopoida, Notodelphyoida und Caligoida.

Annals of the Durban Museum.

Vol. I. Part 1. 1914 On some pelagic Entomostraca collected by Mr. J. G. Gibson in Durban Bay.

Further pelagic Entomostraca.

do. do.

Vol. I. Part 2. 1915 Notes on pelagic Entromostraca of Durban Bay.

Australian Antarctic Expedition.

Vol V. Sec. C 1915 Copepoda, Cladocera, Halocypridae.

Transactions of the Linnean Society.

Vol. XXVI. 1868 A Monograph of the recent British Ostracoda.

Journal of the Linnean Society.

1886 Notes on Entomostraca collected by A. Haly in Ceylon.

British Association Reports.

1865 On Dredging on the coasts of Northumberland and Durham.

1866 On Ostracoda dredged amongst the Hebrides.

1875 On Dredging on the coasts of Durham and North Yorkshire (with D. Robertson).

Reports of Fishery Board for Scotland.

1887 Notes on Entomostraca.

1888 Description of a new species of *Cyclops*.

Geological Magazine.

Feb. 1871 On Fossil (post tertiary) Ostracoda from Canada and the U.S. (with Rev. H. W. Crosskey).

Annals and Magazine of Natural History.

1865 On Ostracoda new to Britain.

1865 On fossil Entomostraca from the Brick-Earth of the Nar

1868 Contributions to the study of Entomostraca, No. 1.

1868 do do. No. 2.

1868 do. do. No. 3.

1869 do. do. No. 4.

1869 Notes of week's dredging in the West of Ireland (with D Robertson).

1870 On the Ostracoda and Foraminifers of Tidal Rivers (with D. Robertson)

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1872 do do No. 6 *

1873 do do. No. 8.*

1874 do. do. No. 9.*

* with D. Robertson.

1875 Notes on Entomostraca from Kerguelen Island.

1903 List of Ostracoda collected by Geo. Murray, F.R.S., during the cruise of the "Oceana" in 1898.

Journal of Royal Microscopical Society.

1869 On an Entomostracan inhabiting a Coal Mine.

1894 On Fucitrogus rhodymeniæ, a gall-producing Copepod.

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Passim Descriptions of various marine Ostracoda.

Nature.

1870 March 3rd. Review of G. O. Sars Crustaces d'eau douce de Norvege. Part 1. Malacostraca.

1870 March 10th. The Microscopic Fauna of the English Fen District.

1870 September 8th Notes on Protective Adaptation in Marine Animals.

1873 May 22nd. On the Method of collecting and preserving Entomostraca and other Microzoa.

1895 Jan 31st. On the Natural History of the Solway.

Proceedings of the University of Durham Philosophical Society.

1898 Nov. 3rd. On the nature and origin of fresh water faunas.

British Museum Publications.

1907 Ostracoda of the National Antarctic Expedition.

British Medical Journal.

1870 April 2nd. Notes on the use of Hydrate of Chloral.

Medical Times and Gazette.

1859 March 12th. On the Medicinal Action of Glonoin.

1867 April 13th. A case of sublingual tumour partially removed by operation.

Address to Sunderland Medico-Chirurgical Society.

1872 On Zymotic Diseases.

Annals of the Natal Government Museum.

Vol. I. Part 2. 1907 March. On Entomostraca collected in Natal by Mr. James Gibson. (Part 2).

Vol. II. Part 4 1913 On fresh water Entomostraca from various parts of South Africa.

Report to the Northumberland Sea Fisheries Committee.

1900 On the Marine microfauna as a source of food supply.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1918.

READ MARCH 19TH, 1919, BY W. E. BECK, ESQ., CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1918.

It is my duty to-night to give an account of the open air work during the past Season, and in concluding my task as Field President, to which position you kindly elected me, I feel I cannot allow this occasion to pass without expressing a deep feeling of gratitude at the welcome change which has taken place in the fortunes of our Country. The clouds of War which have been hanging over us so long with their attendant scenes of misery and sorrow, are now passing away to be followed, I sincerely hope, by bright and happy times.

The First Field Meeting was held on May 15th on the lower reaches of the River Wansbeck in beautiful weather. Leaving the train at North Seaton Station, the members proceeded to the river banks passing *en route* a pond covered by the bloom of the Water Crowfoot. By the river in a small runner, the larvæ of the Caddis Fly were seen ensconced in their cases. Passing Sheepwash, rich in all its spring foliage, the Oak being conspicuously in front of the Ash, the route lay across pleasant meadows to Bothal.

After lunch the party proceeded by the riverside towards Morpeth, admiring by the way masses of blue Hyacinth intermingled with the white of the wild Garlic, whilst groups of the Water Avens, Wood Geranium and Campion, gave tone and colour to the scenery. Considering the fairly dense population, quite a number of birds both migratory and resident were seen or heard : the most interesting being the Dipper, Cuckoo, Swift, Willow Warbler, Spotted Flycatcher, Tree Pipit, Green Finch, Chaffinch, Yellow Hammer, Sky-lark, Kestrel and Wild Duck. Only two butterflies, the Large White and Small Tortoise-shell were noted. About fifty-five plants and trees were observed in bloom.

The Second Field Meeting was held on June 1st in Hollinside and Gibside Woods. On arriving by train at Swalwell, the members proceeded by way of a shady lane overlooking the River Derwent to old Axwell, the foliage of the Beeches and Oaks being very noticeable at this season of the year. Here a pair of Lapwings with their usual jealousy and courage were seen chasing a Kestrel from their breeding ground.

In the dark recesses of the beautiful Gibside woods the harsh cry of the Jay and the tapping of the Woodpecker were heard, two very interesting birds to be so near busy haunts of men. Other birds including the Willow Wren, Wood Wren, Black-headed Gull, Cuckoo and Magpie were seen or heard. Lepidopterists were busy collecting different species, and an interesting list of 7 imagines including the Dingy Skipper and 17 larvæ were identified by Dr. Harrison and recorded by Mr. W. Carter as follows :—

Imagines

Dingy Skipper
Green-Veined White
Flame Carpet
Clouded Magpie
Least Emerald
Common Heath
Clouded Border

Larvæ

Dotted Border
Pale Brindled Beauty
Small Brindled Beauty
Scalloped Oak

Larvæ—continued

Mottled Umber
Hebrew Character
Common Quaker
Small Quaker
Clouded Drab
July High Flyer
November Moth
Autumnal Moth
Green Brindled Crescent
Light Emerald
Scarce Umber
Spring Usher
Feathered Thorn

A comprehensive list of the more interesting flowers in bloom were noted, including a pure white variety of the Bugle.

The Third Field Meeting was held on June 15th, the locality chosen being the Middle Reaches of the River Derwent. Leaving the train at Blackhill, the party made their way down to Allansford. Along the hedgerows were brilliant patches of Wood Geranium, Herb Robert and Stitchwort. In a wayside copse a remarkable instance of the wholesale damage which can be done by caterpillars was observed in the case of a Bird Cherry Tree. The foliage was entirely destroyed by the larvæ of the Ermine Moth and the branches festooned by the webs enclosing the pupæ.

The Allansford Woods were now entered and additional ravages of different caterpillars were seen and many species were taken or recorded by the entomologists. The Lady's Smock, White Helleborine and the Red Rattle were found in the boggy parts of the Woods. The Columbine was also noted growing in profusion, but whether wild or an escape, could not be determined. Approaching the Sneap, a rugged bastion jutting out over the river afforded a panoramic view of wild beauty. Bees of various kinds were seen on the wing and a dragon fly, *Cordulegaster annulatus*, was added to the captures. Beautiful blue masses of the Milkwort intermingled with the delicate purple of the early flowering heather.

Our return route to Shotley Bridge was made by Mosswood, ending a pleasant and profitable excursion.

Owing to the dense foliage birds were not seen in any numbers, but the following were recorded :—Willow Warbler, Wood Wren, Black Cap Warbler, Cuckoo and Jay. Amongst the Lepidoptera the Painted Lady, sombre Small Heath butterflies and some of the grass moths were taken. Large numbers of Millepedes, Centipedes and Homoptera were observed and many gall insects were collected from their host plants and identified.

A goodly list of flowers in bloom was compiled by the botanists, who had quite a busy and enjoyable afternoon's work.

The Riding Mill district was chosen for the Fourth Field Meeting held on the 27th June. Some of the entomologists proceeded to Corbridge Station to work the Dipton Woods, rejoining the other members later in the day. The main party on alighting from the train at Riding Mill, made their way by the old bridge spanning the Riding Mill burn. Here the Greater Celandine easily recognised by its acrid yellow juice was noted. Crossing a heathery stretch of ground with a wealth of different grasses and plants usually found in such places, we descended to the stream proceeding from the Dipton Woods. Here we were met by Mr. J. H. Burn, of Dipton House, who kindly took us over his grounds and a fine patch of golden Cyprus together with quite an interesting collection of Conifers were pointed out. On arriving at "Kilbryde," the residence of Mrs. James Cooke, the members were kindly entertained to tea and shown a fine assortment of rock plants in the garden and the adjacent disused quarry.

The following species of Lepidoptera were observed :— *P. brassicæ, P. rapæ, E. janira, C. pamphilus, P. phloeas, C. icarus, B. piniaria, C. bilineata, T. atrata,* also two larvæ of the Emperor Moth, *S. carpini,* were obtained by the ladies of the party. Few birds were seen, but as they were not specially sought for this was only to be expected at this time of the year. This district is rich in bird life and I was informed that such interesting species as the Green Woodpecker and the Greater Spotted Woodpecker had been noted in this locality.

The following notes on the wild roses were supplied by Dr. Harrison :—

Rosa canina L. The remarkable absence of the Common Dog Rose on all sides was the outstanding feature of the Rose Flora of the district: only the variety *lutetiana* served to recall its abundance in Durham and at stations in the lower portions of Northumberland.

Rosa sarmentacia (Woods)—*dumalis* Bech. As elsewhere in the two counties this occurred in fairly typical forms.

Rosa dumetorum (Thuill). The type and variety *urbica* were observed at various points in the walk. These forms coincide with one's usual experience in Durham and Northumberland.

Variety *frondosa* was rare.

Rosa caesia Sm—*coriifolia* Fr. Only the variety *pruinosa* was gathered, this being of somewhat historic interest as some of Baker's original specimens were collected in the neighbourhood years ago.

Rosa tomentosa Sm. Exceedingly and unexpectedly rare; only one bush and that bearing white flowers streaked with pink was observed.

Rosa omissa Dés. Again we encounter a species quite unexpectedly rare or wanting, Ley's variety *submollis* of this species, was the sole representative of the Villosæ other than *Rosa tomentosa.*

Rosa micrantha Sm. This was the only member of the Rubiginosæ or Sweet Briar group found. Variety *permixta* was the form observed.

The Fifth Field Meeting was held on Saturday, July 20th. Making their way from Beamish Station down towards Beamish Hall, the members were interested in the beautiful woodlands seen on each side of the road, the beeches being exceptionally fine. The entomologists of the party here commenced their work principally on leaf galls, and a great many specimens were secured in the course of the afternoon. Proceeding by way of the Home Farm, a small herd of Fallow Deer were seen peacefully grazing in the adjacent Parks; and here the Bladder-nut tree, *Staphylea pinnata,* with inflated fruit and pinnate leaves, a native of Southern Europe, was observed. On reaching the front of the Hall our way led us along the Banks of the Beamish flowing onward towards the Tyne. A

great many of the midsummer flowers were seen in all their beauty—masses of the dark purple Betony, mingling with the stately Foxglove, and the sweet-smelling Meadow Sweet. The Hare Bell rearing its dainty head was a sign of approaching autumn. The Hemp Nettle, both white and pink, was found. Crossing to the south side of the stream, the *Claytonia sibirica*, a North American species naturalised in many places in Britain, was noticed growing luxuriantly. Bird life in July is not much in evidence. The songsters are silent, being too much engaged in their domestic duties. The Swift, Coot, Waterhen, Sandpiper, Black-headed Gull, Willow Warbler, Whitethroat, and a family of Fly Catchers, were however seen, and the harsh note of the Jay were heard in the adjoining woods. Most of the bloom of the Wild Roses had vanished, but this gave an opportunity of recognising the various species by the differences in parts of the fruit and leaves, which were pointed out and explained by Dr. Harrison, who was of the party.

The following moths were taken :—The Satellite, *Scopelosoma satellitia*, the Mottled Umber, *Hybernia defoliaria*, male and female, November Moth, *Oporabia dilutata*. The walk proceeded down the Beamish Valley, the excursion being ended after a pleasant and instructive ramble. The ground gone over yielded pleasant surprises to the members unacquainted with this locality. Although situated in the midst of busy coalfields, this district is unexpectedly rich in botanical and entomological specimens, and also of interest to the students of Ornithology.

Notes on the Wild Roses by Dr. Harrison :—

Rosa canina Microgene *lutetiana* Lem. Everywhere plentiful.

Rosa canina Microgene *flexibilis* Dés. Rather rare.

Rosa dumalis Bech. Typical forms only found sparingly.

Rosa dumetorum Thuill—*urbica* Lem. One of the commonest roses.

Rosa glauca Vill—*reuteri* God. This rose is somewhat typical of upland areas and had flowered plentifully in ordinary

forms. A few blossoms were left. It is a very shy flowerer in low lying districts with us.

Rosa mollissima Wild—*tomentosa* St.

m *scabriuscula* Winch. Far from uncommon and easy to recognise by means of its white flowers with staring pink streaks.

m *cuspidatoides* Crep. Encountered rarely.

Rosa omissa Dés.

m *resinosoides* Crep. Not uncommon.

Rosa villosa L.

m *cærulea* Woods. Somewhat sparingly observed.

By the kind permission of Sir Lindsey Wood, the sixth and last Field Meeting was held on October 5th in the Hermitage Grounds, Chester-le-Street.

The study of the different species of Fungi was the principal object of the Meeting. In view of the increasing need for food production and home-grown timber, research connected with the study of mycology, together with that of economic entomology is now becoming of greater importance.

Entering the grounds a number of Wild Duck were seen on a piece of ornamental water, together with a beautiful display of Water Lilies. The woods here were clad in all the different hues of autumnal beauty. Proceeding to the glen adjoining the grounds, attention was chiefly directed to the undergrowth and decayed holes of trees, the searchers being rewarded by the finding and identification of many forms of Fungi. Belated specimens of Foxglove, Milfoil, Tormentil and Devils-bit Scabious were also obtained, and a few of the commoner birds were observed. Following the upward course of the burn, the edge of Waldridge Fell was reached, from thence the party made their way to Chester-le-Street after a useful and enjoyable outing.

In addition to those I have described, two informal meetings were held.

The first took place at Winlaton Mill and Lockhaugh, the object being principally the examination of the wind pollination of catkin-bearing trees. Eleven members assembled at Swalwell, and made their way along Axwell Park, with its fine array of beeches, to Winlaton Mill. From thence the party proceeded up the River Derwent, the entomologists keeping to the higher banks. The Townley Woods where the river makes a horse-shoe bend, were found to have been cut down for commercial purposes. Some of the early spring flowers were found including Primroses, Violets, &c. The members were pleased to see the woods near the railway viaduct had escaped the woodman's axe. Here glacial deposits carrying out the banks in bold outline were examined with interest. A pleasant and instructive ramble ended at Rowlands Gill.

By permission the second informal meeting was held in Gosforth Park on Saturday, the 25th day of October, a dozen members comprising the party.

Passing through the handsome gates leading to the 18th Century house of the Brandlings, the route lay across the well kept sward, which affords health and recreation to the golfers of the district, towards the lake, which was found to be deeply fringed with the common rush, *Phragmites communis*. This affords excellent shelter for the wild fowl which frequent the lake in large numbers. The woods were clothed in russet brown and yellow, their autumn dress. On the surface of the water the duckweed, *Lemna minor*, was floating. Here and there the isolated heads of Knapweed, Helleborine and Hawkweed were still to be seen, but the chief interest was centered in the search for Fungi, for it was the season of the Agaric, Boletus and Puffball type. Many others, however, of less noticeable appearance were found on the decaying leaves and bark of trees. Various species of Millepedes, Beetles, Spiders and a few Moths were also taken by the entomologists of the party. The work was continued along the north side of the lake, the waning daylight bringing our labours to an

end. Gosforth lake is certainly the most favoured place for wild fowl in the vicinity of Newcastle, and I regret that no list of the birds seen there has been kept. The Bittern was taken here some years ago and the Gargany, Teal and Shoveller have been shot quite recently. I am quite certain that if the lake and surroundings were made into a Bird Sanctuary it would become an interesting acquisition to the ornithological features of Northumberland.

In conclusion, I may remark that it is thirteen years since I addressed you in the capacity of Field President. In the meantime I have attended many of the Field Meetings, and I am pleased to say that I have noticed a growing interest in Natural History, shown not only by the increase of Naturalists, but by that of a larger class which I might term lovers of Nature.

The meetings held last year were well attended, and it was encouraging to find more activity amongst entomologists and mycologists.

Finally, I should like to see more of the younger members take an active part in the Field work, and thus relieve the older members who have worked so long in promoting the interests of this Society.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1919.

READ MARCH 26TH, 1920, BY MR. GEORGE SISSON, CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1919.

I have pleasure in presenting the report on our Field Meetings held during the summer and autumn of 1919. The season was particularly fine and dry; consequently there was a good attendance at the meetings.

The year 1919 was remarkable as regards weather, and it may be worth while to note that the rainfall in Northumberland for the five months, May to September, was less than half the average. For example, at Cockle Park a total of 5·75″ against a 21 years average of 12·72″. However, in October, the weather made an attempt to recover lost time, for during the last week of that month nearly 5″ fell, that is to to say, in one week a rainfall nearly as much as the five previous months. We have to go back to 1905 to find a rainfall as low as last year.

After a wonderfully fine summer we had a hard frost somewhat earlier than usual, on November 13th and 14th a minimum of 23° F. or 9° of frost, and on the 16th 13° of frost. From then onwards we had mild weather to the end of the year.

Most branches of natural history were represented by the members attending, for example, birds, plants, the various sections of insects, spiders, etc., but the land and freshwater shells were somewhat neglected, there being only one record relating to land shells.

The aquatic insects and crustaceans also perhaps deserve more attention, although the opportunities for this are somewhat limited. The various stages of development of such insects are of grea interest. For many years past there has been no dredging expedition. This work is now done by the Marine Laboratory Staff at Cullercoats. At the same

time a repetition of the Field Club's dredging cruise of 1895 might be of great interest to our members, if it could be arranged. Dried or pickled marine specimens give little idea of the beauty of such forms brought up by the dredge or tow net, alive.

With these few remarks I shall now read the reports of the various meetings.

The First Field Meeting was held on Saturday, May 17th, when the Chopwell Woods were visited by the kind permission of Mr. J. F. Annand of the Armstrong College Forestry Department, which has now these woods under its control.

Walking from Lintz Green Station the members visited the nurseries and grounds devoted to afforestation. These nursery plots afforded quite a good field for the botanists of the party, such plants as the Vernal Whitlow-grass, Lady's Mantle, and *Viola tricolor* being in abundance.

Notwithstanding the season being a late one, many of the summer migrant birds were nesting. Among the birds noticed were a pair of Kestrels, the Tawny Owl, Cuckoo, Sandpiper, Willow Wren, Wood Wren, Common Wren, Chiffchaff, Redstart, Gray Wagtail, etc.

At the invitation of the officials of Chopwell Colliery, some of the members walked up to the offices, where they inspected and examined a collection of minerals and some fossils of the Coal Measures. Particularly interesting were the seeds of carboniferous trees, and stalactites and stalagmites formed recently in the underground workings. The minerals were chiefly from the lead mining districts and included barytes, gypsum, and some fine specimens of coloured quartz crystals. Tea was hospitably provided by the officials in their club dining room.

Dr. J. W. H. Harrison noted the following occurrences of insects:—The Engrailed Moth, *Tephrosia bistortata*, in great numbers; the small Engrailed *T. crepuscularia*; this constitutes the only certain record of the species in Co. Durham;

eggs of the vapourer moth, *Orgvia antiqua*, also *Taeniocampa gothica*, *T. stabilis*, *T. incerta*; larvæ of the the winter moths *Cheimatobia brumata* and *C. boreata*, also of the larch case-bearer, *Coleophora laricella*. Amongst the Hymenoptera were *Bombus lapidarius*, *B. pratorum*, *B. terrestris*, *B. muscorum*; three species of ants, Black ant, *F. fusca;* Horse ant, *F. rufa*; Red ant, *Myrmica rubra*; the queens of two species of wasp, *Vespa vulgaris* and *V. rufa*.

The Second Field Meeting was held on June 7th, and took place at the Northumberland Lakes. Walking from Bardon Mill Station by way of Chesterholme, the site of the Roman Camp at Vindolana was inspected.

From here the party walked on through the steep upland meadow to Crag Lough. The early afternoon was spent in rambling round the lough, a good deal of attention being devoted to the marsh plants, among which Butterwort, Fragrant Orchis, Marsh Orchis, and Water Avens were conspicuous, together with belated flowers of the Marsh Marigold.

One section of the party walked to Borcovicus and examined the celebrated Roman Camp, while a smaller number visited Broomlee and Greenlee Loughs. All re-assembled at Bardon Mill Station in the evening for the return train.

Of the birds, which are always a specially interesting feature of a visit to the Northumberland Lakes, a total of 49 species were noted. On the lower ground many birds were in song, Blackbirds, Willow Wrens and Skylarks contributing most noticeably to the chorus. A few Corn Buntings were singing in the hedges, and a single Wood Wren at Chesterholme. As the high ground was reached, characteristic moorland birds such as the Curlew, Titlark and Wheatear became conspicuous. Looking down on to Crag Lough the party had good views of Cuckoos flying across the water, and of two Wild Ducks, one of them swimming through the weeds followed by a curious dark wake, which proved to be a numerous brood of ducklings. Many Jackdaws were nesting

in the crags; and among the sallows at one end of the Lough a Red Bunting and a Sedge Warbler were singing.

But as far as birds were concerned much the best luck fell to those who walked round after tea to the other loughs, Broomlee and Greenlee. Among the birds seen there and on the adjacent ground were Sandpipers and Redshanks, four Herons, a large flock of Blackgame and a few Red Grouse, a pair of Golden Plovers, a Snipe "drumming," and a Kestrel. Blackheaded gulls were to be seen all day; they breed not far away and forage all over the countryside; but Lesser Black-backed Gulls, which also have a colony on the moors, were seen only at Broomlee.

One pleasing point about the bird life was the unusual abundance of House Martins; after the steady falling-off in their numbers that has occurred during the last 20 years, any sign of recovery is welcome.

The Third Field Meeting took place on Saturday, June 28th, at Alnmouth, the members walking from there along the coast to Warkworth.

This coast region is particularly rich in plants and a large number of species were noted. Among the bracken the Bloody Crane's-bill flowers in great profusion, also the less conspicuous pink and white Stork's-bill. The fine blue flowers of the Viper's Bugloss were beginning to show. The Hound's-tongue, Wild Thyme, and Ragwort (not yet in bloom) were abundant. In the marshy parts of the estuary of the Aln, the soda plant and the ice plant were interesting, while a large patch of Yellow Iris in full bloom had a fine effect.

As regards birds the prevailing wind made observation somewhat difficult on that exposed coast. The cry of the Redshank attracted attention to its young among the sedges, as also the Green Plover and Sandpiper. Of the smaller birds the Wheatear, Meadow Pipit, Willow Warbler, Pied Wagtail, Whitethroat, Swift and Skylark were noticed.

On arrival at Warkworth some of the party visited the salmon weir on the river Coquet. During recent years the Coquet has become a notable salmon river. When Mr. Frank Buckland was Inspector of Fisheries, this river was infested with bull trout, and contained no salmon. He made vain attempts to destroy the bull trout and stock with salmon.

Along the riverside path the scent from the large patches of the Sweet Cicely was strongly in evidence, the Mimulus fringed the bank here and there, and the Knotted Figwort reared its sentinel-like head.

The Fourth Outdoor Meeting was held at Blackhall Rocks on July 12th.

Leaving Horden Station the party walked along the coast and the banks to the Rocks. A great feature of this coast is the Magnesian Limestone formation, masses of this rock being intersected by channels filled up with boulder clay deposited by ancient glaciers.

The Rocks themselves are good examples of the effect of weather and sea causing huge caverns and pinnacles, the whole of the coast line showing strong evidence of erosion, which is still taking place.

As regards bird life most of the sea and wading birds were at their nesting grounds, on the rocky islands, or on the moorlands. There were noticed, however, Scoter duck, Sandpiper and Dunlin. Further inland, the Spotted Flycatcher, Willow Warbler, Whitethroat, Greenfinch and Yellowhammer were seen.

The sunny thyme-clad banks were alive with various butterflies, the most attractive being the Common Blue and the Brown Argus, the Small Heath and Meadow Brown.

The limestone soil is specially favourable to leguminous plants, as evidenced by the fine growth of restharrow, vetches, clovers, trefoil, etc. The geranium family was well represented by the Bloody Crane's-bill, Stork's-bill and Herb Robert.

Perhaps, however, the rarest plants observed were the Birdseye Primrose and the Round-leaved Wintergreen found at certain points in great abundance.

Other interesting plants noted were the Privet, Juniper, Butterwort and Rock-rose. Considerable attention was paid to the wild roses and many fine forms belonging to the *Rosa glauca* and *R. coriifolia* groups were collected, as well as more ordinary forms of *Rosa mollis* and *Rosa tomentosa*. Amongst these more important species the various forms which are commonly called the dog roses passed almost unnoticed.

The Fifth Field Meeting took place on July 26th in the Riding Mill district.

Leaving the train at Riding Mill Station the party walked by way of the field paths and woods to Healey.

In the sheltered district of Riding Mill a profusion of plants and flowers luxuriate in the woods and stream courses. Patches of the Giant Bell-flower, *Campanula latifolia*, were seen on the railway cutting approaching the station. The sloes showed a great quantity of fruit. The dried leaves of this shrub were at one time largely used to mix with tea. The handsome blue Field Scabious grew in great profusion on the railway banks, as also the wild snapdragon or Toad-flax. Several plants of the Centuary *Centaurium umbellatum* were found; this is still collected by the country people for medicinal use.

On the moors the heather was not yet in flower, but the cross leaved and fine leaved heaths were in full bloom. We must not omit to mention the *Trientalis europæa*, one of our beautiful north country flowers, with its dainty white blooms, held on slender stems above a tuft of green leaves. In the marsh burn the handsome yellow Monkey-flower, *Mimulus luteus*, has established itself. Of North American origin, this plant when found wild is probably an escape from gardens. A fine specimen of the Greater Broom-rape, *Orobanche major*, was found parasitic on a broom plant. Also worthy of

note were the Bladder Campion, *Silene inflata*, Musk Mallow *Malva moschata*, the Petty Whin, *Genista anglica*.

The dense foliage hid most of the birds, which had now passed from the joyous song of the mating and nesting season to the more silent occupation of leading their young broods from view. The Kestrel, Wood Pigeon, Whinchat, Whitethroat, Meadow Pipit and Pied Wagtail were seen chiefly on the open moorland.

The Sixth Field Meeting was held on September 13th at Newbiggin and on the adjacent coast.

The day opened with storm and rain which no doubt prevented a full attendance, afterwards the weather cleared and a very pleasant day was spent. The route followed was from Widdrington Station by way of Druridge Bay, through Cresswell to Newbiggin.

Hips and haws were plentiful but not yet in their ripened brilliant colour. The end of this lane gives on to the sand dunes, and the bleak inhospitable nature of the climate was evinced in the appearance of a cluster of coniferous trees struggling for existence.

Across the marram grass the route led to the middle of Druridge Bay. Many interesting sea birds and waders were noticed. Some Gannets were fishing a little way out to sea and gave the opportunity of watching their bold graceful dive in pursuit of their prey. Kittiwakes and other gulls digging for sand eels were fairly numerous, and a little way apart the conspicuous plumage of the Oystercatchers betrayed their presence, and further off was a specimen of the Greater Black-backed Gull.

Nearing the southern end of Druridge Sands, where the rocky reef runs out and forms a lagoon, the tidal edge and the rocks were seen to be crowded with numbers of sea birds, feeding and resting. Climbing to the village of Cresswell, a fine view of the old Edwardian Pele Tower against the thick sombre background of woods at once arrests the eye, and the

tradition of the White Lady haunting the ruins is recalled. Leaving Cresswell by the beach, a good example of the weathering of the rocks is clearly seen, and in the carboniferous sandstones of the cliff several fine examples of Stigmaria are embedded. The tide was now racing in as the members pushed along to the Lyne Burn, whose banks were decked by the fading bronze of the bracken, and whose edge was fringed by a luxuriant growth of the Sea Clubrush, *Scirpus maritimus*, while near at hand was found the Sea Lymegrass, *Elymus arenaria*. The route was now across the bleak Newbiggin Moor to the well known fishing village, where the day's outing ended.

An Extra Field Meeting was held on Saturday, August 16th, in order to visit Hawthorn Dene, situated about $2\frac{1}{2}$ miles to the south of Seaham Harbour, permission to explore the same having been kindly granted by J. S. G. Pemberton, Esq.

Ascending the hill to the south of the Dene a fine view of rock and verdure is obtained, though somewhat marred by the railway arch of the coast line thrown over the entrance to the Dene. A bold projecting crag occupies the very mouth of the creek bearing on its summit the ruins of what was known as Sailors' Hall (built by Admiral Milbanke) almost overhanging the waves at high water. Descending to the beach the Dene is entered by a narrow rocky ravine, through which the path winds in tortuous fashion for some distance.

The first object that meets the eye of the botanist is a fine and vigorous growth of Alexanders, *Smyrnium olusatrum*, at this stage of the season in fruit, and on the opposite side of the brook a lofty and precipitous wall of magnesian limestone bears an abundant growth of the Hart's Tongue fern, flourishing in a habitat so congenial to it.

In the late afternoon the party left the Dene, and wending their way westward soon arrived at the ancient village of Hawthorn.

The Last Field Meeting was held by kind permission of Mr. Ralston of Streatlam Castle, agent to the Earl of Strathmore, on Saturday, October 11th, in Gibside Park. The outing, a "Fungus Foray," was organized to encourage the study of one of the less known groups of plants. The fungi afford ample scope for botanists wishful to pursue research and investigation, fascinating in their variety and interesting because of their bearing on problems of the supply of food and timber.

The party soon reached the entrance to the Park and

"Brushing with hasty steps the dews away,
To meet the Sun upon the upland lawn."

wended their way towards the private Chapel, whence a magnificent view is obtained of the uplands and the green level of the Race Course, which latter stretches between two fine rows of Turkey oaks; their foliage was still green and the mossy cups holding the acorns, commanded inspection and comparison with the simpler forms of the native tree.

On all sides "the flame of autumn" held the eye—golden sycamore, lemon-yellow lime, russet-brown beech, crimson rowan and cherry—all glinting under the sunshine with rich glow of colour. Truly to-day:

"Earth's crammed with Heaven
And every common bush afire with God."

From overhead came the insistent "pink-pink" of the Chaffinch, the accentuated song of the Robin, and the harsh note of the Jay. Passing along, the fine structure of the Jacobean Hall with its mullioned windows was prominent in the landscape.

At the northern corner stand three stately cedars, their sombre green branches bearing the beautifully modelled brown cones.

Along one of the many grassy glades bordered by the ripening brambles, the route led upwards to the monument erected to Victory by a former Countess of Strathmore. Many

stately trees are doomed to death by the action of fungi, whose fibrils pierce the cellular tissue and suck their food juices. Eventually weakened near the base the giant of the forest falls to the gale.

On the bark and amongst the leaves many species of fungi were found, chiefly of the Agaric and Boletus group, the following being gathered: *Pholiota squarrosa* (shaggy scaly cap), *Boletus edulis* (edible boletus), *Boletus subtomentosus* (cracked cap), *Polyporus betulinus* (birch bracket), *Hypholoma fascicularis* (sulphur tuft), *Panaeolus campanulatus*, *Russula emetica* (the emetic), *Stereum hirsutum*, *Hypocrea ochracea*. The Stinkhorn, *Ithyphallus impudicus*, curious but repulsive, was also included.

Although at this late period of the year the humble wayside plants were not looked for, Harebell, Devil's-bit Scabious, Red Campion, Nipplewort, Yellow and Imperial Hawkweed, Buttercup and Ling were yet seen in belated bloom. Nor was the time favourable for active insect life, but the larva and imago of the November moth were taken, also the larvæ of the Dusky Skipper and Spotted Skipper.

Striking along the path towards Snipe's Dene, the sad cooing note of the Wood Pigeon was heard, the cawing of the Crow and the squawk of the Jackdaws, and later the Magpie and a pair of Spotted Flycatchers were watched with interest

Bole and leaf of tree bore evidence of the great activity of the army of insects which has been so marked this year. Scarlet berry of holly and rowan, purple of elder and barberry, brown beach nut and great horse chestnut were conspicuous.

The passing showers besprinkled the blades of grass with crystal drops, which under the later sunshine blazed no less brilliantly than richest gem, and thus the homeward path was retraced. The field work of the Society, productive of good material for indoor work in the coming winter in solving nature's problems, being happily and pleasantly brought to an end for another season.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1920.

READ MARCH 18TH, 1921, BY MR. RANDLE B. COOKE, CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1920.

The Opening Meeting was held on Saturday afternoon the 15th of May at Ovingham Dene, which in all its springtime freshness looked as charming as ever. Of flowering plants seventy-nine were seen in bloom, among which were the Globe-flower, *Trollius europæus*, L.; the Bird's-nest Orchis, *Neottia nidus avis*, Rich.; a beautiful white variety of the Wood Forget-me-not, *Myosotis sylvatica*, Hoffm.; the Chickweed, *Stellaria media*, var. *neglecta*, Weihe.; and on a dry bank on the way to the Dene the little Forget-me-not, *Myosotis collina*, Hoffm., interesting as being a scarce plant away from the coast in this district. Of ferns and their allies seen, the Oak Fern, *P. Dryopteris*, Fée., and the Horse-tail, *Equisetum hyemale*, L. were the most noteworthy.

Though only 30 species of birds were noted, there was a fine spring chorus to be heard, in which resident birds were joined by such fresh arrivals as the Whitethroat, Garden Warbler and Blackcap. In one stretch of the Dene where the banks were covered with low scrub several Sedge Warblers were singing. In the wood itself among other birds were a few Goldcrests and Wood Warblers. Redpolls were more numerous than they have been in most places since the hard winter of 1916-17.

The Society was indebted to Mr. Riddell for leave to ramble in the Dene and to Mr. Carins for acting as guide.

The Second Field Meeting, on Saturday, June 5th, was a whole day one between Bardon Mill and Staward. The route taken was by the Ridley Hall grounds—by the kind permission of the Hon. F. Bowes-Lyon—and Staward-le-Peel.

Botanically this was a very successful day, 115 species of flowering plants being seen in bloom. Although there was nothing rare among these it was interesting to find such

plants as the Meadow Saxifrage, *S. granulata*, L.; Lesser Wintergreen, *Pyrola minor*, L.; Bistort, *Polygonum Bistorta*, L., rather a rare plant in the Tyne valley though plentiful in some adjacent districts; the Bird's-nest Orchis, *Neottia Nidus-avis*, Rich.; and in association on the banks of the South Tyne the Alpine Penny-cress, *Thlaspi alpestre*, L, Spring Sandwort, *Arenaria verna*, L., and Thrift, *Statice maritima*, Mill. On the banks of the Allen masses of the Mountain Pansy, *Viola lutea*, Huds., in shades of purple and violet were a very beautiful sight. Some Yews were noted growing on the crags below the Peel with every appearance of being indigenous. The Wood Vetch, *V. sylvatica*, L., on the steep slopes below the Peel was still only in bud. The ornithologists too had an interesting day and recorded over 50 species of birds, including Bullfinches, Tree Creepers, Goldcrests and Long-tailed Tits, and on the crags some Stock Doves. One Chiffchaff, a curiously scarce bird in this district, was heard near Ridley Hall.

The Third Field Meeting on Saturday, June 19th, was to the moorland north of Stanhope, then across the Derwent and through the Allansford woods (by kind permission of Sir Arthur Middleton) to Blackhill. After leaving Burnhill Station the party proceeded towards Waskerley. Few flowers were to be seen on the moor, but at the Sneap the botanists were glad to find the Chickweed Wintergreen, *Trientalis europaea*, L., the Lesser Wintergreen, *Pyrola minor*, L., and the Greater Broomrape, *Orobanche Rapum-ginistae*, Thuill., still flourishing in their old situations. Few birds were seen or heard throughout the day.

The Fourth Field Meeting, after being twice postponed on account of the weather, was finally held on Saturday the 24th of July. The ground covered was the coast between Horden and Black Hall Rocks, and by kind permission of Colonel Burdon, the main footpath through the Castle Eden Dene. On the cliffs a clump of the Hoary Ragwort, *Senecio erucifolius*, L., was seen, together with the other plants usually found on the magnesian limestone. In the Dene the only

plants noted were the Spurge Laurel, *Daphne Laureola*, L., and the Winter Heliotrope, *Petasites fragrans*, Presl., this latter as an established plant. Three Angler Fish were observed stranded on the shore. A lizard which was caught was taken to the Museum where it gave birth to a number of young.

The Fifth Field Meeting was held on Saturday afternoon the 14th of August, at Prestwick Carr, by kind permission of Major Sir Geo. J. W. Noble. Special attention was paid by the botanists to the flora of the drainage ditches with the object of finding if any of the rarer plants that used to grow on the Carr before it was drained still survived, but out of a list of twenty taken from Baker and Tate's Flora of Northumberland and Durham not one was found. Some of the more interesting marsh and water plants seen were:—

Ranunculus sceleratus, L
Potentilla palustris, L.
Œnanthe fistulosa, L.
Apium inundatum, R. F.
Veronica scutellata, L.
Polygonum Hydropiper, L.
Sparganium simplex, Huds.

On the higher part of the Carr where there is a thick deposit of peat the rare bog plant, the Marsh Andromeda, *Andromeda Polifolia*, L., was found to be still healthy and vigorous. The Round-leaved Sundew, *Drosera rotundifolia*, L., was seen in fair numbers, but the Long-leaved Sundew, *Drosera anglica*, Huds., which used to grow here was searched for in vain. The Ling, *Calluna vulgaris*, Hull, was in full bloom and very fine, as also was the Cross-leaved Heath, *Erica Tetralix*, L. In a cultivated field the large flowered Hemp-nettle, *Galeopsis speciosa*, Mill., an uncommon plant in this district, attracted attention. The Creeping Bellflower, *Campanula Rapunculoides*, L., an alien in Northumberland, was found to be well established at the base of a hedge bordering a field north of the keeper's cottage.

Some of the birds seen were, a Nightjar, which was disturbed from the heather and flew round two or three times; the Whinchat, Sedge Warbler, Long-tailed Tit, Tree Pipit, King-fisher, Tawny Owl, Stock and Ring Dove; and on the keeper's gibbet a Magpie. Evidence of Black Game was seen, but no birds.

The Sixth Field Meeting was held on Saturday the 18th of September. The route taken was from Long Houghton to Christon Bank via the Howick burn mouth, Dunstanburgh Castle and Embleton. Owing to a heavy shower of rain on arrival at Long Houghton, the Parish Church was visited, where Mr. Nicholas Temperley pointed out its principal architectural features, and told some anecdotes connected with the history of the building. On reaching the coast the wading birds attracted attention; Redshanks were almost everywhere, both on rocks and sands, and Curlews were nearly as common, while here and there an Oystercatcher lent variety. Several Hawks were seen, and summer migrants such as Swallows and Wheatears were still in fair numbers. Few flowering plants were seen in bloom. The Henbane, *Hyoscyamus niger*, L., in its old situation, near Dunstanburgh Castle, and the Lesser Water Plantain, *Alisma ranunculoides*, L., in a pond near, were the most noteworthy. The Sea Buckthorn, *Hippophae Rhamnoides*, L., growing near the Howick burn mouth was examined and thought to have been originally planted there.

The Seventh and last Field Meeting of the season was held on Saturday the 9th of October, in the neighbourhood of Seaton Sluice. On the way to the coast Seaton Delaval Hall was visited by kind permission of the agent of the property, Mr. Gandy. On the links a number of interesting plants were seen in bloom and fruit, which are rare or absent elsewhere in the county, except in similar situations along the coast. Among these were, the Purple Milk Vetch, *Astragalus danicus*, Retz., Wild Parsnip, *Peucedanum sativum*, B. and H., Blue Fleabane, *Erigeron acris*, L., Wormwood, *Artemisia Absinthium*, L., and a viviparous variety of the Knotted Spurrey, *Sagina nodosa*, Fenzl. Some fine ergots were collected from the Jointed Couch Grass, *Agropyron junceum*, Beauv., and special attention was paid to hybrids of the Burnet Rose, *R. spinosissima*, L. At the close of the day Mrs. J. W. Thompson of Holywell Grange very hospitably entertained the party to tea, and afterwards those interested inspected Mr. Thompson's fine collection of butterflies and moths, and their association with various places and times recalled happy memories of many outings spent together.

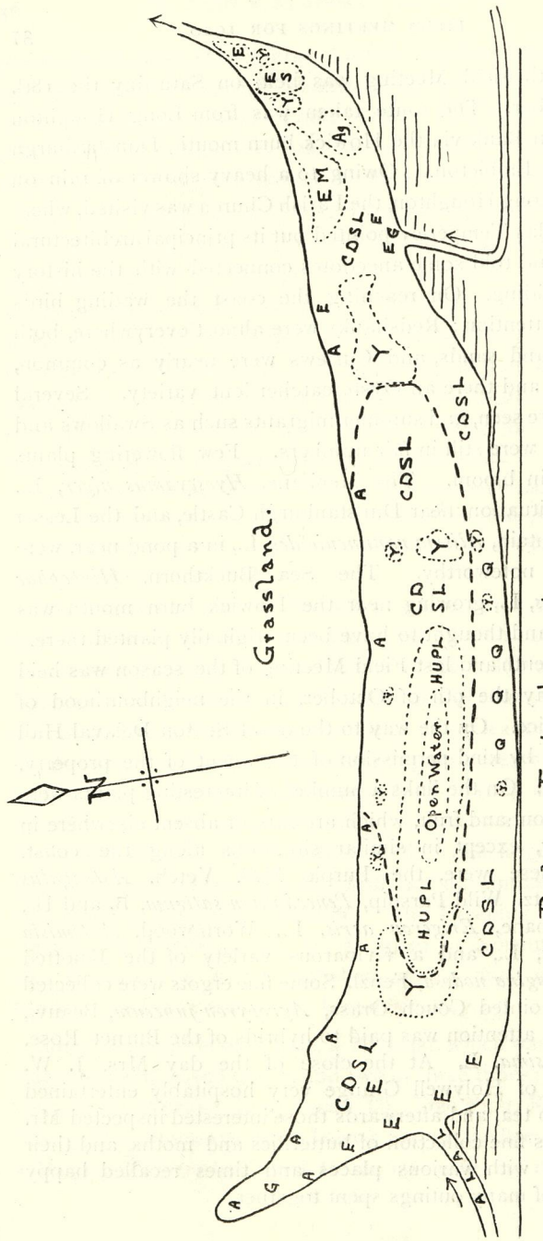
Ryton Willows Pool.

By B. Millard Griffiths, D.Sc., F.L.S., and Randle B. Cooke.

The effects of agricultural and industrial operations upon the flora and fauna of the country are only too strikingly shown in the counties of Northumberland and Durham. Prestwick Carr in Northumberland has for the most part disappeared under the extensive drainage work of the last few decades, and though the gain to agriculture is no doubt great, the operation has for ever destroyed what was once a botanical treasure-ground. The coast-line near Castle Eden Dene in Durham was similarly a choice hunting ground for both entomologist and botanist, but within the last few years the hand of industry has fallen heavily upon it.

Among the interesting spots, of perhaps minor importance, is the small pool on Ryton Willows, lying just on the Tyneside border of County Durham. It is notable as being the most northerly station for the Frogbit *Hydrocharis Morsus-ranae* Linn., associated with which are the Bladderwort *Utricularia vulgaris* Linn. and the Ivy-leaved Duckweed *Lemna trisulca* Linn. As in many other places around Newcastle and Gateshead, the pool is suffering from its close proximity to a large industrial area, and from the fact that the land on which it lies is what might be termed a public playground within easy reach of the city. Until 1918 the pool had escaped wonderfully well, but since then pleasure boats have been introduced, much of the vegetation has been cleared away for the convenience of the rowers, and there is no doubt that the flora is suffering irretrievable damage. It is therefore advisable that some permanent record of the flora should be made before it is too late. By good fortune a list of the flora and a sketch map of the vegetation were made by the late Mr. Nicholas Temperley and Mr. Randle B. Cooke in the summer of 1918, only a short time before the pool was turned into a rowing-lake and the vegetation disturbed. The results

VEGETATION MAP OF RYTON WILLOWS POOL, 1918.



Ag Agrostis alba.
A Apium nodiflorum.
C Carex inflata.
D Carex acutiformis.
E Equisetum limosum.
G Glyceria fluitans.
H Hydrocharis Morsus-ranae.
L Lemna minor and L. trisulca.
M Myosotis palustris.
N Nasturtium officinale.
P Potamogeton natans.
Q Potentilla palustris.
S Sparganium ramosum.
U Utricularia vulgaris.
Y Iris Pseudacorus.

The dotted lines enclose groups within the general *Carex inflata—C. acutiformis—Sparganium—Lemna* association (CDSL).

Isolated letters indicate sporadic plants. The heavy broken line shows the present extent of open water (1924).

of this survey are given below, together with an account of the present state of the pool, and a list of the filamentous and free-floating algæ compiled by Dr. Griffiths from his continuous records since January, 1923.

THE TOPOGRAPHY OF THE POOL.

The majority of the small pools met with in the lowlands of this country are artificial, and usually of no great age. They owe their existence mainly to the requirements of agriculture, either as shallow marl-pits (especially in the Midlands) or as water supplies for cattle.

Ryton Willows Pool is not of this type but is of very considerable antiquity, in spite of the fact that it is scarcely more than an acre in area and reaches a depth of some six feet at only one spot.

The pool lies on the gravel, sand, and clay of the river-plain of the Tyne, just at the base of the steep escarpment of the river-valley. Dr. Woolacott is of the opinion that the pool is the last remnant of an "ox-bow" or old cut-off loop of the river, which originally ran at a considerably higher level before the dredging operations of 1860 onwards had deepened the present channel. The pool was in being in 1828, where it is shown on the "Plan and Section of intended railway or tramroad from . . . Newcastle-upon-Tyne to . . . Carlisle, surveyed under the direction of Benj. Thompson by T. O. Blackett and T. Studholme. August, 1828" (Map in Library of Lit. and Phil. Soc., Newcastle-upon-Tyne). In that map the railway line is shown passing through the pool, but when the railway was made during 1833–9, the track was deflected southwards to skirt the pool, as shown in the original plan of the line, a copy of which was supplied to Mr. Cooke by courtesy of Mr. B. W. Fletcher, District Engineer, L. & N.E. Railway, Newcastle-upon-Tyne.

The above records show that the size and shape of the pool have remained substantially the same for at least a hundred

years, and there is no reason to doubt that the pool is therefore much more ancient than that. The map of 1833-9 is on a scale of two chains to the inch, and the pool is about 1,100 feet long and 118 feet wide at the broadest part, but as no details are given it is not possible to ascertain how much of the area was occupied by marsh at that date. At present, the water-area is about 500 feet long by 60 feet broad, and the rest is marsh. The depth is about 2-ft. 6-in. over the eastern two thirds but at the west end there is a fairly steep-sided depression running to 5-ft. 6-in. or slightly over. On the north bank is the grassland of the Willows, on the south bank is a marsh about as wide as the present water-area, and marsh occupies both the east and west ends of the pool. A small stream supplied from springs in the steep escarpment trickles into the marsh at the west end, and at the east end the water drains into a shallow ditch which carries the flow of another slightly larger stream which rises in the escarpment further east.

THE MACRO-FLORA.

The accompanying sketch-map showing the distribution of the vegetation in July-August, 1918, was made by Messrs. Temperley and Cooke. The broken line shows the present area of open water.

At the above date, the pond's greatest attraction from the botanical point of view was the presence of the Frogbit, *Hydrocharis Morsus-ranae* L. in considerable quantity. This pretty and interesting water-plant here reaches its most northerly station in Great Britain, or perhaps we must now say "here reached," as Dr. Griffiths reports he saw no trace of it last summer. In the second edition of Watson's Topographical Botany, its northern limit is given as Durham on the east coast, and West Lancaster on the west. As Watson gives records for this plant for 46 vice-counties, and the London Catalogue 10th edition gives the number of vice-counties as 48, Watson's stations can be taken as approximately correct.

Strange to say, Winch in his Flora of Northumberland and Durham published in 1832, makes no mention of Ryton or the near neighbourhood as a habitat for the Frogbit, nor does he mention Ryton for two other locally interesting plants that are to be found in the pond, viz.: Common Bladderwort *Utricularia vulgaris* L. and the Ivy-leaved Duckweed *Lemna trisulca* L. Was this a case of neglecting ground near at hand for that further afield, or have these plants appeared in the pond since his flora was published? Considering the indications we have that the pond is an old one, and knowing that the Tyne valley is the boundary for several other southern species, and that the Frogbit is native further south in Durham, it seems reasonable to suppose that these species were all here in 1832.

The following lists and notes for the sketch-map were made in the field. They were originally intended to be revised at some future date, but other things came in the way and now the flora of the pond is so changed that it seems advisable to give the lists as they were made and run the risk of any slight inaccuracies there may be.

The open water surrounded by the close "reed-swamp association" contained the following:—

Utricularia vulgaris L.	c.d., l.d.*
Hydrocharis Morsus-ranae L.	c.d., l.d.
Potamogeton natans L.	c.d., l.d.
Lemna trisulca L.	a.
Lemna minor L.	a.

Towards the end of July when the Frogbit was in bloom, its large delicate white blossoms interspersed here and there with the rich yellow spikes of the Bladderwort, made a very pleasing picture. One regrets now not having photographed such a scene as this in order to have a permanent record.

* Frequency symbols are:—d. dominant; s.d. sub-dominant; c.d. co-dominant; a. abundant; f. frequent; o. occasional; r. rare; l. local; l.d. locally dominant. Groups enclosed with dotted line in the sketch-map, indicate species that were dominant, or two or more species that were co-dominant in the enclosed areas.

The "reed-swamp association" consisted of the following:—

Sparganium ramosum Huds.	d.
Carex inflata Huds.	s.d.
Carex acutiformis Ehrh.	s.d.
Iris Pseudacorus L.	a., l.d.
Equisetum limosum L.	a., l d., c.d.
Potentilla palustris L.	a., on south side only.
Nasturtium officinale R.Br.	a., l.c.d.
Myosotis palustris Hill	a., l.c.d.
Apium nodiflorum R.f.	a.
Agrostis alba L.	a., l.d.
Glyceria fluitans R.Br.	a.
Galium palustre L.	a.
Ranunculus aquatilis L.	a.
Veronica Beccabunga L.	a.
Callitriche sp.	a.
Utricularia vulgaris L.	a.
Hydrocharis Morsus-ranae L.	a.
Lemna trisulca L.	a.
„ *minor* L.	a.
Alopecurus geniculatus L.	a.
Stellaria uliginosa Murr.	f.
Rumex conglomeratus Murr.	f.
Caltha palustris L.	f.
Ranunculus Flammula L.	f.
Alisma plantago-aquatica L.	f.
Juncus conglomeratus L.	f.
„ *effusus* L.	f.
„ *glaucus* Ehrh.	f.
„ *articulatus* L.	f.
Equisetum palustre L.	f.

As the sketch-map shows, the *Sparganium ramosum*, *Carex inflata*, *C. acutiformis* and *Iris pseudacorus* monopolised the deeper water of the reed-swamp, but floating between them there was a quantity of *Utricularia*, *Hydrocharis* and *Lemna*. In this situation it was noticed that neither the *Utricularia* nor the *Hydrocharis* was flowering.

On the margin of the pond and in the boggy ground on the east and west sides, indicated in the map by horizontal shading, were:—

Holcus lanatus L.	a.
Epilobium palustre L.	a.
Cardamine pratensis L.	a.
Ranunculus hederaceus L.	a., on west side only.
Senecio aquaticus Hill.	a., on south-east side only.
Carex hirta L.	f.
Ranunculus repens L.	f.
Polygonum amphibium L.	f.
Poa annua L.	f.
Eleocharis palustris Br.	o.
Triglochin palustre L.	o.
Stellaria graminea L.	o.
Holcus mollis L.	o.
Mentha aquatica L.	o., south-east and east side only.
Trifolium repens L.	o.
Epilobium hirsutum L.	o., east side only.
„ *parviflorum* Schreb.	o.
Rumex obtusifolius L.	o.
Sagina procumbens L.	o.
Arrhenatherum avenaceum Beauv.	o.
Angelica sylvestris L.	r.
Lotus uliginosus Schk.	r.
Deschampsia caespitosa Beauv.	r.
Cirsium palustre Scop.	r.
Valeriana dioica L.	r.
Spiraea Ulmaria L.	r.
Juncus bufonius L.	r.
Lathyrus pratensis L.	r.
Veronica scutellata L.	r.
Polygonum aviculare L.	r.
Hypericum quadrangulum L.	l.
Geum rivale L.	l

Alchemilla vulgaris L.	l.
Carex Goodenowii Gay	l.
Montia fontana L.	l.
Apium inundatum R.f.	v.l.
Œnanthe crocata L.	v.l., one plant only.

THE STATE OF THE POOL IN JANUARY, 1924.

The pool presents a very different appearance from that recorded by Messrs. Temperley and Cooke in their survey of 1918. The whole of the central area in which formerly flourished Frogbit, Bladderwort, Ivy-leaved Duckweed and Floating Pondweed is now open water. The fringe of *Sparganium* has been almost completely removed right back to the eastern row of Iris clumps, and the reed-fringe on the northern edge has been eradicated almost entirely.

There is now no Floating Pondweed visible in the pool, but in its place is a copious growth of Curly-leaved Pondweed, *Potamogeton crispus* which covers the bottom over the whole of the central parts of the eastern end and middle, and also occurs between the deep hole and the west end. The growth is removed each season by the lessee of the pool.

A small remnant of the once abundant Bladderwort maintains a precarious existence among the stems of Iris at either end of the pool, but the plants are drifted from one end of the pool to the other with every change of wind and are buffeted roughly wherever they may be. No specimen was observed to flower during 1923.

Ivy-leaved Duckweed fares slightly better and still occurs among the stems of Iris and Carex but not in great quanrity.

Frogbit seems to have vanished completely, and no specimen was seen during 1923 although Dr. Griffiths visited the pool every week.

The submerged aquatic vegetation is now as follows:—

Ranunculus aquatilis, occupying all the shallow water down to about 2-ft. 6-ins.

Potamogeton crispus, from about 2-ft. 6-ins. to 3-ft. or 3-ft. 6-ins.

Callitriche sp., surrounding the deep hole at the west end, from about 3-ft. to 5-ft.

The deepest part of the hole at a depth of about 5-ft. 6-ins. or a little over, is practically devoid of vegetation.

The bottom at the west end is covered with a deep deposit of odorous black mud consisting mainly of very finely divided vegetable remains. Towards the east end the deposit thins out or becomes lighter in colour and the odour less pronounced, and the furthermost eastern end is mainly a clay bottom covered with rather coarse fragments of vegetation.

THE MICROFLORA, 1923.

The following list gives the algae observed during weekly collections taken throughout the year.

Littoral Algae, occurring in shallow water attached to vegetation.

Spirogyra gracilis, *Rhizoclonium hieroglyphicum*, and sterile species of *Spirogyra* and *Mougeotia*.

Phytoplankton, free-floating microscopic algae of the open water.

Euglena sp., *Mallomonas* sp., *Trachelomonas* sp., *Synura Uvella*, *Dinobryon sertularia*.

Peridinium aciculiferum, *P. anglicum*, *P. cinctum*, *Ceratium hirundinella*.

Stephanodiscus Hantzschii var. pusillum, *Fragilaria capucina*, *Nitzschia acicularis*, *Asterionella formosa*, *Tabellaria fenestrata*.

Chlamydomonas spp., *Sphaerella lacustris*, *Gonium sociale*, *Gonium pectorale*, *Pandorina Morum*, *Eudorina elegans*, *Volvox globator*.

Tetraedron bifurcatum, *Scenedesmus quadricauda*, *Lagerheimia Wratislaviensis*, *Richteriella botryoides*, *Dictyosphaerium pulchellum*.

Pediastrum Boryanum, *Pediastrum duplex var. clathratum*.

Cosmarium Turpinii, *Closterium Ehrenbergii*.

Botryccoccus Braunii.

ALGA-FLORA OF THE MUD.

Stauroneis Phaenicenteron.

Hillhousia mirabilis (Achromatium oxaliferum).

THE MICROFAUNA.

Rotifers abound in the open water practically throughout the year, and Entomostraca are also moderately plentiful during the summer. In a single collection Mr. F. E. Cocks identified the following Rotifers:—

Brachionus angularis Gosse.

„ *calyciflorus* Pallas=var. *B. dorcas* Gosse.

Keratella quadrata (Mueller).

Synchaeta tremula (Mueller).

„ *oblonga* Ehrnb.

Testundinella patina (Hermann).

Bats.

By George Bolam.

As our own nearest wild relatives in this country, it might fairly be inferred that Bats would at least attract some degree of attention on the part of the great public, and that naturalists in particular would not be content almost entirely to ignore them. Yet the fact remains that less is known, locally, about the *Chiroptera* than any other Order of mammals, indeed it might almost be said than any other group of created things! How true this is may be gathered from the extreme paucity of any reference to Bats in the pages of our Transactions; while during something like forty years, despite unceasing endeavours, I have never been so fortunate as to enlist the active sympathies of more than a mere handful of friends in procuring specimens for examination and identification.

Meagre though the results of such prolonged efforts have been, they have sufficed to establish the occurrence of six species of bats on Tyneside, which is just half the number admitted to the British list by Barrett-Hamilton and other recent authorities. That a little closer attention devoted to the family might result in the addition of at least one or two more species to the local list may be taken as almost certain. There are large tracts both in Northumberland and Durham that, so far as bats are concerned, may be regarded as virgin soil; while both the Barbastelle and the Lesser Horseshoe Bat have been taken no further away than Carlisle (1) and Yorkshire (2).

To take the species seriatim, the Pipistrelle, *Pipistrellus pipistrellus*, ought probably to be regarded as the commonest and most universally distributed bat in our counties. It

(1) Macpherson's *Fauna of Lakeland, &c.*

(2) Mr. H. B. Booth in the *Naturalist* for December, 1920, and November, 1921.

certainly is so in the northern parts of Northumberland, and it has been identified more often than the next in various places in the southern portion of that county, as well as in Durham. It is the only bat that I have seen on Holy Island. About Alston it is less numerous than *M. mystacinus*, and apparently also at Houxty.

Bats are subject to a good deal of individual variation, in colour as in size and some other details; perhaps even more so than most other creatures. Barrett-Hamilton gives tables of measurements for each species, and since his work began to appear (1), I have carefully noted the similar dimensions of those bats passing through my hands. As these accumulate, they tend to become more instructive; I therefore venture to give some of them below. In colour our Pipistrelles are usually of a rich deep brown, almost "seal-skin" colour, but some are so dark as to be nearly black, while others again incline to a reddish mousy hue. The under side is usually rather paler than the back, but occasionally just the reverse holds good.

The inner lobe of the ear, or *tragus* as it is called, is a diagnostic feature in most bats. In the Pipistrelle it is, typically, rounded at the apex and short; but in one individual which used to live under the eaves above my bedroom window at Alston, and which came into the room one night and was caught (but liberated again next day), it was so much elongated as very closely to approach in shape the tragus of a Serotine.

In May, 1918, a white bat occurred at Haltwhistle. It was knocked down, but unfortunately lost amongst the rank herbage. It was presumed to have been a Pipistrelle as another individual, of normal colour, obtained about the same place, and brought to me by Mr. John Lightfoot a few days later, proved to be of that species. Just six years earlier,

(1) *A History of British Mammals*, pt. I., issued October, 1910.

I myself frequently saw a similar albinistic bat on the wing at Hornsea Mere in Yorkshire. It was not handled, but from the company it kept it also was presumed to have been a Pipistrelle. It was rather buffish than white in colour, and was referred to in my brochure on *The Natural History of Hornsea Mere*, published in 1913, p. 10.

PIPISTRELLES. Dimensions in Millimetres.

Locality and Date.	Sex.	Head and body.	Tail.	Forearm.	Lower leg (tibia).	Foot, without claw.	Longest digit.	Meta-carpal iii.	Meta-carpal v.	Ear.	Tragus.	Thumb, with claw.	Alar expanse.
Alston ... 16-8-17	M	?...	32	32	13	5	55	28	28	10	4	...	225
Haltwhistle 9-5-18	M	42	31	31	11·5	6	53	29	29	10	5	...	222
Ninebanks 12-6-20	F	48	35	35	12	5	56	29	29	11	5	4	225
Lowlynn ... 26-6-22	F	50	32	33	12	6	53	30	30	9	3	5	217
Sidwood ... 27-6-22	M	50	32	27	12	6	52	29	29	10	4	4	223
Sidwood ... 14-7-22	M	43	31	31	11	5	53	30	30	10	4	4	217
Lee Hall... 17-4-23	F	43	31	31	12	6	55	30	30	10	4	4	222
For comparison add Barrett-Hamilton's averages.													
For 9 males		42	31·8	29·5	(10·5)	5·6	50	25	25	..	...	...	208
For 6 females		43·3	30·5	30·2	(11·3)	7·1	50	25	25	...	...	...	213

It may be of interest to add that the fourth on the list was sent to me alive from Lowlynn. It had been caught on June 23rd and reached me on 26th. It squeaked a good deal when handled (as is usual with this species) and bit my fingers, but refused food of any kind. It was transferred to a more comfortable box with the intention of letting it go at dark, but when dusk arrived it was found to have brought

forth a young one, which clung tenaciously to its mother's body, clasped about the thighs and sheltered by the tail-pouch. I gave the mother a little water on a leaf, which she drank greedily, and the leg of a Golden Plover chick which happened, meanwhile, to have been brought in for identification. This she soon began to eat, tearing the flesh from the bone in very business-like manner, and by next morning nothing but the bone remained, all nibbled and clean picked. But the baby lay dead and disregarded on the floor of the cage: it is now in the Museum beautifully set up in spirit by Mr. Gill. It was quite naked, and appeared very large for so small a mother to have carried so comfortably before birth. Length of head and body 27 millimetres, of which the head accounted for 11 mm. The mother flew off, strong on wing, that night.

The Whiskered Bat, *Myotis mystacinus*, was, until some thirty or forty years ago, always looked upon as one of the rarer species in the British Islands; but, during the interval, has been shown to be one of the commonest bats over a large portion of England and Wales. It has also proved to be of frequent occurrence in Ireland; but for Scotland there are as yet not more than two or three records (1).

In the north of England it has been observed to be far from rare in several localities in Yorkshire and Cumberland; but the only published record for Durham that I have been able to trace is that contained in Mennell and Perkins' *Catalogue of the Mammalia of Northumberland and Durham* (2); wherein (p. 164) it is dismissed with the brief statement "Shotley Bridge (Darlington?), W. Backhouse." That record was

(1) Vide *The Mammalian Fauna of the Edinburgh District*, by William Evans; as well as a note by the same author in *Scottish Naturalist* for 1893, p. 146.

(2) Published in the *Transactions of the Tyneside Naturalists' Field Club*, 1864.

never regarded as quite above suspicion of error (1), a scepticism which subsequent knowledge has proved to have been quite unfounded, the Whiskered Bat having now been found to be one of the commonest species in Co. Durham.

For Northumberland, there are no old records, and the first Whiskered Bat to be recognised in that county is now (in spirit) in the Museum. I chanced to find it lying dead amongst the grass close to Mr. Abel Chapman's residence at Houxty, North Tyne, on the morning of 24th May, 1915.

Since that date it has been proved to be one of the most numerous bats in that neighbourhood, as well as at Redesmouth, Sidwood, Beaufront, and Stocksfield; but I have not yet seen a specimen from any locality north of the Tyne watershed.

The Whiskered Bat differs scarcely at all in colour from the Pipistrelle, than which it is only slightly larger. The genus *Pipistrellus* has only two premolars in each jaw, while *Myotis* has three, but these teeth are all so small that they are not likely to be very helpful as means of identification to any casual observer. The easiest mark of distinction between the two genera lies in the size and shape of the ear, and more especially of the tragus. This in *Pipistrellus* is short and rounded, in *Myotis* it extends to half the length of the ear, and is narrow and tapering to a point.

(1) See an article by Mr. J. E. Harting in the *Zoologist* for 1888, p. 165

WHISKERED BATS. Dimensions in Millimetres.

Locality and Date.	Sex.	Head and body.	Tail.	Forearm.	Lower leg (tibia).	Foot, without claw.	Longest digit.	Meta-carpal iii.	Meta-carpal v.	Ear.	Tragus.	Thumb, with claw.	Alar expanse.
Houxty 24-5-15		45	31	33	15	7	54	28	28	13	6	5	218
Do. ... ... Aug., '16		45	30	34	15	7	55	31	30	13	6	5	219
Do. ... Aug., '16	F?	32	28·5	30	12	6·5	44	25	25	11	...	5	183
Beaufront ... 9-11-16		40	30	34	14	5	47	26	26	13	8	5	213
Do. ... 15-9-16	M	41	30	31	15	...	44	25	26	9	5·5	4	210
Alston ... 20-9-16					(Allowed to fly again)								(230)
Do. ... 7-5-18	M	45	32	34	14	6	53	30	30	11	5	5	238
Stocksfield 9-1-17	F	36	30	34	15	6	53	29	29	12	7	5	220
Houxty ... 29-6-18	M	45	37	35	15	7	55	31	28	15	8	5	237
Do. ... 25-7-18	M				(Allowed to fly again)								235
Ebchester 28-10-18	M	46	33	33	15	6	55	31	30	14	9	6	235
Houxty ... 12-8-19 (young)	F	34	30	32	13	6	43	24	24	12	8	5	200
Do. 12-8-19 (young)	M	37	28	31	13	6	42	24	24	11	6	5	198
Ebchester 8-5-20	M	45	32	33	15	7	52	28	27	14	7	5	238
Alston ... 1-10-21	M	44	34	33	14	6	52	29	27	14	8	6	234
Sidwood ... 28-7-22	M	46	38	33	15	6	56	31	30	14	7	5	231
Chester-le-St. 27-10-03	(34)	35	32	13	6·5	50	26	26	9	...	5	212	
	(A skin from Charles Robson, killed in 1903 and preserved as a Pipistrelle, sent to me in 1918, now in museum).												
Burley-in-Wharfdale 11-10-16	M	42	38·5	32	15	5	44	27·5	26	14	7·5	3	220
Do ... 27-10-16	F	36	30	32	14	6	50	26	26	12	6	5	218
Do. ... 7-12-16	F	35	30	34	15	6	55	28	29	12	7	5	220
Hornsea .. 27-6-12	M	47	37	34	15	...	54	...	...	13	7	...	239
And for comparison add Barrett-Hamilton's averages.													
For 6 males	M	(46)	(32)	34	15·5	(7·5)	(53·5)	(29)	(28)	...	...	...	228
NATTERER'S BAT. (*c.f.* Noctule at foot of table page 57).													
Alston ... 13-9-16	M	47	41	38	15	7	66	35	33·5	15	9	5	250

Though not, apparently, less adroit upon the wing than its relatives, the Whiskered Bat seems to be more prone than most of them to alight in order to take a prey. Before the Big Wood at Houxty fell into the insatiable maw of the Great War, we used frequently to watch them hawking round the tops of the tall spruces, and to see them settle for a second or two, evidently to secure some insect, near the tips of some of the out-spreading branches. While on the evening of March 26th, 1923, Mr. Chapman and I observed four or five of the bats working a sallow bush, then in bloom upon his lawn, and repeatedly noticed one or another of them alight momentarily amongst the catkins to pick off an attracted moth.

Natterer's Bat, *Myotis nattereri*, is another species which it fell to my lot to add to the Fauna of the district some few years ago. It is a near relative of the last, and bears a strong resemblance to it, but may, by close attention, be distinguished from it, even upon the wing, by its larger ears, and especially by its habit of frequently raising its head above the plane of the body as it flits past, thus emphasising the feature. When seen thus, the bat has often struck me as bearing a curious similarity to a small Barn Owl upon the wing.

Natterer's Bat has been found in many parts of England (in some of them commonly) as far north as Yorkshire on the east side, and to near Carlisle on the west (1); but for Scotland there are, I think, only two records, one from Dalkeith about 1880, the other from Argyllshire in 1858, and neither was regarded by William Evans as quite satisfactory (2). So far as known to me, there is only one record for County Durham—that contained in Mennell and Perkins' *Catalogue* already referred to—and for Northumberland or Tynedale there are none, excepting that now to be mentioned.

Towards the end of summer, 1916, my attention was first drawn to a suspicious pair of bats feeding about the foot of

(1) Macpherson's *Fauna of Lakeland*, p. 3.

(2) *Mammalian Fauna of the Edinburgh District*, pp. 22-23, *and Annals of Scottish Nat. Hist.*, 1901, pp. 129-131.

Nattrass Gill about a mile above Alston; but owing to absence from home, or one cause or another, it was not until September 13th that their identity was solved. On that evening my sister's cat brought a newly killed bat into the house which proved to be an adult male of *Myotis nattereri!* This led to more systematic observation nearer home, with the result that at least a pair of Natterer's Bats were discovered to be established about our buildings, where on many occasions I had opportunities of watching them on the wing, several Whiskered Bats present at the same time giving good opportunities for the study of the differences in flight between the two species.

This little colony, I am glad to be able to report, continues to thrive, while those at Nattrass Gill are also generally in evidence on fine nights. During the summer of 1921, I found the species hawking over a pool on the river below Kirkhaugh Bridge, say three miles below Alston (and in Northumberland), and some weeks earlier was fairly certain of the identity of a bat seen on the wing near Lambley Station. If that identification were correct (it has not yet been proved beyond cavil) it would carry us another eight miles or so into Northumberland.

For the sake of comparison the measurements of the Alston specimen of 13th September are appended to those given of the Whiskered Bat—as will be seen *M. nattereri* is slightly larger, with longer tail and phalanges which give a considerably larger surface of flying membrane.

Daubenton's Bat, *Myotis daubentoni*, is probably well distributed, and not uncommon throughout the district where suitable conditions prevail. I have found it to be so in most such places in Northumberland that have been investigated. Its partiality for ponds and pools has earned for it the name of the Water Bat, but the designation, if taken too literally, is somewhat apt to be misleading. Many other bats like to hawk over water in a similar way; while there are places (such as Alston) where there are no ponds and only brawling burns incapable of maintaining pools of the accepted

character, but where there are still Daubenton's Bats. At Alston all our bats are frequenters of the river side, but here *M. daubentoni* (along with the rest) must, perforce, obtain most of its food otherwise than by "skimming the surface of the water."

About Alston no bat can be called numerous, but I have identified *M. daubentoni* here on several occasions during the past ten years. Other localities from which specimens have been examined are noted in the table of measurements, and these, I have no doubt, could be largely increased over both counties, if only more observers who take an interest in bats could be found.

On Tweedside, on both sides of the Border, Daubenton's Bat may be said to be numerous in many places, and the same holds good of Tillside, and of the Aln. In July, 1880, my then boy-brothers brought home one night a fishing-creel full of bats which they had extracted from a hole in an old willow on the banks of the Tweed a mile or two above Berwick, where they had been on a birds'-nesting expedition. Fifteen of them were available for inspection next morning, eight of them adults, the remainder "unfledged" young ones in varying degrees of development. The hole in the tree was described as being "full of bats, two or three times as many making their escape as were captured." All proved to be *M. daubentoni*. A few of them were kept alive for some days, showing as usual but little fear and taking insects freely from our fingers; but most of them were ultimately taken back to their nursery and set at liberty, only one or two being kept as specimens.

As the measurements show, this species is a little larger than either Natterer's or the Whiskered Bat; it is also lighter in colour, being mousy-grey above, paler beneath. The readiest means of distinguishing it, however, is its much larger foot, to which the flying-membrane is only attached above the ankle, leaving the whole foot clear, while in the others the attachment is closer to the base of the toes.

DAUBENTON'S BAT. Dimensions in Millimetres.

Locality and Date.	Sex.	Head and Body.	Tail.	Forearm.	Lower Leg (tibia).	Foot, without claw.	Longest digit.	Meta-carpal iii.	Meta-carpal v.	Ear.	Tragus	Thumb, with claw	Alar expanse.
Seaton Delaval 1917		47	34	38	17	7	60	33	33	10	5	4	245
Seaton Delaval 1917		57	33	35	17	7	58	32	32	10	5	6	235
Chopwell 28-8-17		47	27	32	14	8	48	27	27	11	6	6	213
Houxty ... 22-6-20	F	55	34	38	17	7	61	33	33	13	6·5	6	254
Houxty ... 2-7-20	F	50	35	36	15	8	60	33	31	14	7	6	256
Nessfield ... (Yorks) 15-10-10	M	50	35	35	16	...	60	...	...	13	5	9	247
And for comparison add Barrett-Hamilton's averages.													
Of 19 (sex not given).	... ...	45·5	33·5	36·5	16·4	9·1	59·8	32·2	30 2	...	...	...	233·8

The Long-eared Bat, *Plecotus auritus*, is one of the most generally distributed species over the whole British Islands, in some localities apparently outnumbering all the others. In our counties it seems to be everywhere common, though not noted anywhere as occurring in such numbers as either the Pipistrelle, Daubenton's, or the Whiskered Bats.

It needs no description, the remarkably large ears being always sufficient to distinguish it at a glance from any other species. Round Alston we occasionally see it, and it has been found as high up the valley as Skydes. whence a young friend brought me one as a special prize one day, a few years ago, graphically describing it as "a bat with ears like a rabbit." He had found it hiding during the day in a crevice in the "Jackdaw Rocks" when looking for the nests of these birds. Other localities may be gathered from the table of measurements: they might be almost indefinitely extended by a reference to my old journals, were any good purpose to be attained by such reiteration.

LONG-EARED BAT. Dimensions in Millimetres.

Locality and Date.	Sex.	Head and body.	Tail.	Forearm	Lower leg (tibia).	Foot, without claw.	Longest digit.	Meta-carpal iii.	Meta-carpal v.	Ear.	Tragus.	Thumb, with claw.	Alar expanse.
Beaufront 30-9-16	M	52	38	36	16	6	66	31	31	36	16	6	270
Shambellie (Dumfries) 12-6-16	F	45	40	36	15	7	60	33	31	35	16	6	240
Seaton Delaval 1917		44	38	37	18	6	61	33	31	33	13	7	240
Seaton Delaval 18-10-17		45	33	37	22	6	60	31	31	32	13	7	238
Bridgeford, Bellingham 3-8-18	F	44	38	35	17	8	57	30	30	35	17	8	246
Armathwaite 6-8-18	M	50	43	37	19	8	63	32	32	35	17	10	264
Armathwaite 6-8-18 (young)	M	42	39	34	18	9	57	30	30	35	15	10	226
Armathwaite 6-8-18	F	42	43	37	18	8	60	32	32	37	15	9	256
Houxty ... 2-6-20	M	46	43	37	20	6	65	35	35	34	15	6	250
Whitfield... 12-7-20	F	50	40	37	18	8	63	32	30	34	15	10	253
Catcleugh 20-7-22	M	47	42	38	17	7	65	33	32	34	16	7	260
And for comparison add Barrett-Hamilton's averages.													
For 10 males		48·2	41·6	37·5	17·3	8·8	62·2	31·3	30	}	...	...	255
,, 17 females		45·7	42·2	38·8	18·3	8·8	65	32	30·9	}			
NOCTULE. Barrett-Hamilton's averages.													
For 5 males		77·5	49·5	50	17·5	12	91·5	48·2	38				
,, 7 females		77	49	51·5	17·5	12	92·5	50	40				

Our sixth local bat is the Noctule, *Nyctalus noctula*, and so far as present information goes, it can hardly be regarded as more than a rare accidental visitor. For, though it has been reported as resident in one or two places in the south of Durham, all attempts to confirm the reports have so far only been productive of negative evidence. A specimen in the Museum, taken at Cleadon in 1836, is, I believe, the only locally-obtained example in existence, and probably it was no more than a waif—possibly lost on migration. It was for many years labelled as a Serotine, and as such appears in Mennell and Perkins' *Catalogue*, but the error was set right by W. Denison Roebuck in 1884.

In Yorkshire, the Noctule occurs, sometimes not uncommonly, well to the north of the West Riding; and I have at different times also noticed a pair or two on the wing in the Eden Valley in Cumberland, about Penrith and Eden Hall. The few sporadic occurrances in Scotland are very suggestive of a wandering habit, and that has been the impression left by the only two individuals that I have seen in the Tyne Valley.

The first of these was in the early twilight of June 14th, 1914, and the bat was flying very high (even for so habitually high-flying a creature) above a party of hawking Swifts. It was all alone and pursued a steady southerly course as long as the eye could follow it—a course which if continued for a few minutes would take it direct over the top of Cross Fell. The second flew low over my head near Kirkhaugh, at dusk, on October 17th last year, 1923, and as I know well that no Noctules are native here I was again puzzled to account for its appearance unless by the theory that it might be on migration, and had perhaps become separated from its companions. There are no other records known to me for our counties.

I have no measurements of local Noctules, but to the end of the table of dimensions of the Long-eared Bat have been added Barrett Hamilton's averages for this species. They may act, in some sort, as a guide to local observers.

In size, the Noctule is only approached by the Serotine and the Greater Horseshoe Bats, both very distinct animals when examined; while its dashing flight and power of wing are alone almost sufficient to insure identification. The fur is of a bright chestnut colour, finely contrasting with the dark wings, especially if the creature happens to be viewed from above and in a good light. When handled, a Noctule has a rather rank and peculiar smell.

All our bats hibernate: but a fine day may sometimes tempt one or two of them to break their sleep for a few hours. It is, therefore, not so rare as is generally supposed for a bat to be seen on the wing, in bright sunlight, even in winter. In summer one may quite often be met with during daylight. Nor are these habits confined to a single species. We all know that it is not conducive to the well-being of other hibernating creatures (butterflies for example) to be awakened from their winter's sleep; what the effect may be upon bats is a point upon which more information is required.

It is a common habit for bats to congregate in large numbers in some specially favoured resort, and such assemblies have often been observed to be composed of more than one species. My journals contain notes of the discovery, locally, of several concentrations of this kind, the number of individuals sometimes running into several hundreds. Frequently the note is only in the form of a newspaper cutting, and too often the information has come too late to admit of any investigation. At Dilston Castle, for example, it was reported a few years ago that during some alterations, or repairs, "more than a barrow-load of bats" had been removed from a certain part of the old building! How shall one express one's regret that no naturalist was present at such a séance as that?

In many cases it has been observed that crowded winter-quarters are forsaken on the approach of summer for more desirable lodgings elsewhere; and considerable summer-gatherings have been recorded in which but a single species, and of one sex only, was present. One such nursery has already been referred to in treating of Daubenton's Bat; another may now be mentioned. On 1st July, 1912, I took twenty-one Noctules—three others escaping—out of a hole in a tree in which I had seen a brood of Starlings reared only a week or two previously. Of the bats caught, fifteen were adult females, either giving milk or shortly about to become mothers, the remaining six being young ones, one or two of them nearly able to fly.

To what extent (if at all) bats may indulge in regular migration in this country we have little present information, and, apparently, but meagre opportunities of increasing it To a considerable extent, perhaps, the development of the habit of hibernation may have discounted the need to seek warmer winter-quarters; but in America, where it is claimed that regular migrations, and for long distances, have been established in regard to more than one species, it appears to be accepted as a fact that the bats go into hibernation after their winter-quarters have been reached.

On the other hand there are species, such, for example, as *Vespertilio murinus*, *Myotis emarginatus*, and *M. myotis*, which, though common on the adjoining coasts of France, have been so rarely found in this country that they are excluded from the British list by most modern authorities, on the grounds that their appearance here was probably due in some fashion to "assisted passages." Such bats could have no difficulty in crossing the Channel were they so minded, yet they evidently do not come, or at most only do so on extremely rare occasions (1).

The whole subject of migration still bristles with paradoxes, but the sum total of our ignorance is being steadily reduced year by year, and regular and methodical movements are now recognized along channels and amongst families scarcely even suspected a decade or two ago. Much of this increased knowledge, amongst birds and fish, has been gained by the marking of subjects and laborious study in the laboratory and on lighthouses and lonely islands. The marking of bats may be fraught with still further difficulties, and still more, perhaps, their recovery. Lighthouses have neither terrors nor attraction for creatures that habitually seize bewildered moths in the beam of an entomologist's lantern, and have been seen effecting captures even in the glare of an electric motor-lamp!

That some of the local movements, above referred to, postulate at least a limited migration is sufficiently obvious;

(1) It is perhaps pertinent to bear in mind, however, that there are birds—the Crested Lark for example—which behave in a precisely similar manner.

and that some such movement may be the regular custom in upland districts such as Alston Moor (a thousand feet and upwards above sea-level) I have long suspected. The casual appearance of Noctules is suggestive, and my efforts to find bats of any kind here in winter have so far been fruitless. At Alston the vast majority of all our birds leave us for the winter; their presence or absence is obvious enough; but the finding of bats' hibernacles is a dreigh skein to unravel.

That bats are, at least occasionally, preyed upon by owls may now and then be proved by the finding of their remains in the pellets ejected by the birds. I have myself so found the skulls of Pipistrelles, but only rarely and at long intervals. Upon a single occasion only do I recollect so finding remains of any other bat. This happened to be in Devon on 24th December, 1907, when, from a handful of *exuviæ* gathered beneath the roosting place of a Barn Owl, I picked out the skulls of three or four Pipistrelles and one Noctule, the latter it may be added being a common bat in that neighbourhood. How and when the bats are captured must largely remain a matter of conjecture, so seldom can an opportunity occur of our witnessing scenes enacted in the dark. Only once has it been my good fortune to see an owl chasing a bat, a full description of the encounter being given in my *Wild Life in Wales*, p. 312, where those interested will find some other details given regarding both bats and owls. In Vol. II. of *The Glasgow Naturalist* p. 137, will be found an interesting account of the capture of a Pipistrelle by a Kestrel on the wing in broad day-light, as witnessed by the members of the Society at a meeting in Ayrshire on 26th March, 1910.

And, finally, it may not be out of place to remind members that all the bats of this country are strictly insectivorous and, therefore, not only perfectly harmless but actually beneficial to man. If amongst my readers I am so fortunate as to number any members of the fair and frailer sex, they may also rest in perfect assurance that, whatever lack of appreciation may thereby be indicated, no bat will ever, under any provocation, incur the risk of allowing itself to become entangled in a lady's hair.

Experimental Legislation with reference to the Crab Fisheries of the East Coast of Britain.

By Alexander Meek, D.Sc., F.Z.S.

The crab fisheries may appear to have little consequence compared with the fisheries of the larger ports, but they are important to the inshore fisherman. As will be seen presently the catches of crabs on the East Coast gradually declined from about the end of the nineties. This was particularly evident on the East Coast of Scotland and in Northumberland and I was asked to make enquiries with the view of discovering the cause, and if possible, a remedy.

In a few years I ventured to suggest that an improvement would probably result from imposing a close time during the last three months of the year when the fishing was admittedly destructive. The period of ecdysis, or casting, comes to a height in the autumn, and from September, and especially from October to December and involving also January, large numbers of crabs are caught in a soft or unmarketable condition. A full account of the observations and experiments was published in the Report of the Marine Laboratory, Cullercoats, which was presented to the Northumberland Sea Fisheries Committee in 1904. Further facts and arguments were given in subsequent papers and at length a by-law was passed and came into operation in 1914. The fishermen were also consulted and agreed to give the proposed restriction a fair trial and I should like to thank the fishermen for so loyally supporting the by-law. It has had a trial of ten years and it is now worth while enquiring whether such a measure has been productive.

Before submitting the figures it is necessary to point out that after the enquiries of Buckland and Walpole 'The Oyster, Crab and Lobster Act' of 1877 was passed. It gave protection to crabs measuring less than $4\frac{1}{4}$-in. across the back or carapace, to soft and to berried crabs. Already therefore, protection seemed to be given to a full degree. The young are

protected, the berried crab is seldom captured and is thus naturally protected. In the Northumberland region the autumn fishing was prosecuted vigorously, and while soft crabs were not landed except inadvertently the fishing during the period was accompanied by a great deal of destruction. So many soft crabs, or crabs not yet completely recovered from ecdysis are liable to be captured in the latter months of the year in comparison with the marketable ones, that the Act may be said to have failed in what will be seen to be an important feature.

Migrations.

The most relevant of the earlier enquiries which have been referred to, the results of which have already been published in the reports of the Dove Marine Laboratory, is the one relating to migrations.

The migration experiments gave further proof of the seasonal migration outwards for winter and inwards for summer, and such movements were found not to be accompanied by any marked alteration of position with reference to the coast. The females approaching maturity however make a distinct and significant migration northwards. The results of the last experiment which was made on my behalf by Mr. John Douglas, Beadnell, not long before he died, will illustrate this. There were marked 400 females and 100 males, and there were recovered 108 females and 27 males, 27 per cent. in each case. Of the 108 females, 56 migrated to the north, mainly to the Eyemouth District on the south side of the Forth and 52 did not migrate.

Thus of the females, 14% left the district and 13% together with 27% males remained in the region where they were marked. Further consideration of the results showed that the females remained in the locality of marking only until such time as they became mature when they also migrated contranatantly. There is therefore an important and interesting correlation between Northumberland and the east coast of Scotland. While the majority only moved to the south side

of the Forth a number were impelled to migrate to other parts of the east coast of Scotland and two were recaptured as far north as Banff. The district to the north of Northumberland and to a less extent the greater part of the east coast of Scotland enjoy some degree of benefit from Northumberland and may be said to participate in any improvement resulting from an act of self denial of the Northumberland fishermen. It is not likely moreover that the crabs concerned return for after coming into berry or spawning, and subsequently hatching, the shell is cast, pairing takes place, and they are once more in the condition for a contranatant migration.

It has since been demonstrated that the crabs on the east coast of Scotland behave in the same manner; likewise those of Yorkshire. But the Norfolk crabs did not indicate any distinct migration. The migrations thus may be said to be directly related to current. The obvious effect of such a migration is to move the females into a situation which will compensate for the early southerly drift of the larvæ.

The districts on the other hand are intimately related to the south for the currents carry the larvæ from a district to the north, or to put it more generally the larvæ are derived from a region on the contranatant side of the district. We have thus to consider the benefit likely to be derived from a by-law which protects the berried females and thus provides for a greater supply of larvæ.

It may be desirable at this point to attempt to put these considerations into figures.

Population.

The average catches of crabs on the Northumberland Coast were as follows:—

1895-1904	...	...	1,437,136.
1905-1914	...	...	1,042,887.
1915-1923	...	...	941,205.

The average catch is say—1,140,000. From the facts presented in the paper of 1904 the proportion of sexes is

48 males to 52 females. So that the 1,140,000 consists of say 550,000 males and 590,000 females. If 14% of the females leave the district then 82,600 is the loss to Northumberland and the gain to Scotland.

If we assume furthermore that the fishermen capture each year 27% of the population of the Northumberland crabs (with the further assumption that the income of mature females from the south equals the loss to the north) the population of crabs above gauge size may be said to be over 4,000,000. The annual contribution of mature females to the east coast of Scotland may be roughly estimated therefore to be about 300,000, and they are mature adult crabs.

If the districts have this important relationship contranatantly they are also intimately related denatantly, as has been said, for each district depends for its annual contributions of young crabs on the larvæ carried into the region by current. I have already pointed out in a paper—"On a Law of Distribution of Inshore Fishes" (1)—that crabs were distributed along the coast in a succession of maxima and minima. It is natural to suppose that the regions of maxima are regions more suited to the crabs than the regions of minima. But it is also evident that the maximal regions cause a greater number of mature females to migrate a certain distance contranatantly and that the distance is correlated with the drift of the larvæ. They are not merely regions peculiarly adapted to the requirements of the crab, but they are regions which are liable to receive larger numbers of young. The protection of a section of the coast like Northumberland, during the last three months of the year, may be supposed therefore to preserve the females about to spawn which have migrated into the district, and the result therefore ought to benefit the district to the south. A slight degree of benefit may result on the contranatant side from the migrants which press to a distance far from the locality of origin, but the main benefit will affect the district which is protected and the district to the south.

(1) Rev. d. ges. Hydrobiol. u. Hydrog., 1914.

From these considerations the expectations are that the migrations of the mature females will produce a benefit on the contranatant side of the protected district, and that the production of an increased supply of larvæ will bring about an improvement on the denatant side. To keep up the numbers above estimated for the Northumberland district a few berried females would be sufficient if all the young survived. A reasonable and probably too low estimate of the larvæ hatched from a berried female is 1,000,000. It is plain as has so often been indicated, that the death rate of the young is commensurate to the productivity. A survival of one or two is all that is necessary to keep up the population.

Other points necessarily will have to be considered, but it will be better to postpone the discussion until the facts are before us.

The Legislation and its results.

The tables which have been prepared from the statistics kindly supplied by the Scottish and English Boards and the Fishery Officers of the districts considered, it is not proposed to give. The diagrams are sufficient to indicate the results.

Chart I. shows the catches of crabs in thousands for the whole of the east coast of Scotland and England.

There is evidence of a rise at the beginning of the period of years under consideration, of a general decline beginning in Scotland in 1899 and in England 1903, of a rise in Scotland in 1908, in England in 1911 and 1912 of a transient nature, the falling away continuing to 1917 in England and 1918 in Scotland, since when there has been a recovery. The end of the decline is associated with the period of the war, but all districts would be equally affected. It will be obvious that Scotland has declined more distinctly than England. Also that unless the conditions have materially altered the east coast of Britain is capable of sustaining a heavier population of crabs than it does now.

The reason for the discrepancy between Scotland and England will be seen to be due to the fact that while Scotland has been contented to work under the Act of 1877, the more important districts of the east coast of England have attempted by by-law to give greater protection to the crab fisheries.

The North Eastern Committee passed a by-law which was in operation from 1896 to 1906, and was then repealed. This by-law imposed a close time each year from 1st September to 31st January. The fishing was thus suspended each year for five months—a very severe restriction; yet in spite of the fact that fishermen from the Tyne to the Humber were fishing for crabs during only seven months of the year, the numbers gradually increased until in 1904 the fishermen of the district were actually catching more crabs than those of the rest of the east coast of England (chart II.). It has to be realised that during the years of the by-law all the districts to the north of the Tyne were without any other protection than that given by the Act and that during the time of the increase shown by the North Eastern they were undergoing a decrease.

The district to the south of the North Eastern, that of the Eastern Committee, is a restricted one but it has had more legislation than any other, as may be seen by consulting the Report of the Fisheries of Norfolk by Frank Buckland (1875), Report on the Crab and Lobster Fisheries by Buckland, Walpole, &c. (1877), Report of the Inspectors respecting an application for an order restricting the taking of crabs and lobsters on a portion of the coast of Norfolk, Buckland and Walpole (1880); and Huxley's report on an application for the renewal of the order (1883).

Not long after the Committee was instituted a close time was passed prohibiting the catching of soft or white footed crabs from 1st November to 30th June; and the fishermen co-operated heartily knowing how detrimental it is to market crabs which tend to lower the quality. The effect of the legislation is that during the winter practically no crabbing takes place and the crabpots as a rule are not brought into

use until February or March. This by-law was passed in 1894 and has thus been in operation over the whole of the period under review. It will at once be apparent from Chart III. that the numbers captured are remarkably uniform.

The Northumberland close time, prohibiting crab fishing in October, November and December, began in 1914. Northumberland was in 1914 in a declining state with respect to the fishery, and the fall continued until 1918. A rise began in 1919 and continued until 1922. But it was a rise shared in by the rest of the East Coast. It will be seen, however (Chart IV), when the Northumberland figures are deducted from those of the East Coast of England that until 1922 the districts to the South were stationary and that for the four years of the increase the gain was due to Northumberland.

But the above considerations indicate that a clearer result will be obtained by contrasting the two districts which at widely separated periods have had a close time. We thus eliminate the Eastern Committee and its legislation. The catches of the two districts are displayed in Chart V., and from this it will be apparent that the legislation on each occasion has been productive.

To complete the evidence it is necessary to present an analysis of the district to the north of Northumberland. This is given in Chart VI. It will be seen that the general trend of the curve, especially for Eyemouth, is very similar to that of Northumberland.

Discussion.

1. Turning to Chart I. it is clear that during the years under consideration England presented on the whole an improvement, whereas Scotland suffered a fairly regular decrease to the year 1918. There is no sign of any natural fluctuation affecting the one region more than the other. Chart II. bears witness that had it not been for the North Eastern district the records for England would not have been so widely different from Scotland. At the same time the Eastern Committee's legislation was maintaining a level

condition to the South. Again, near the end of the period an improvement beginning in 1918 has affected both England and Scotland, and we see from Chart IV. that up to 1922 Northumberland was responsible for the increase on the East Coast of England. It is safe to conclude, therefore, that the improvement in England has been due to the legislative efforts of the Sea Fisheries Committees.

2. So far as Northumberland is concerned, we can estimate that the three months protection saves about 1/30 of the catch, basing the estimate on statistics of the catches before the by-law was passed. This would amount to about 38,000 crabs, but in addition there are saved say 60% soft crabs, and this raises our total to 95,000. The question of the possible recovery of the soft crabs in past years is not considered, for all the crabs, hard and soft alike, are now protected during the close time. The estimate is probably too large, for a percentage of the females during the period or shortly afterwards perform their migration to Scottish waters, leaving the residue to swell the population during the ensuing crabbing season. Instead of a gain in Northumberland there was a loss until 1918, and it is reasonable at least to infer that the small numbers captured have reference to the years of the war. Since 1918 the annual gain has been 230,763. But if we take the other years of the period into consideration the annual gain is only 49,681, say 50,000, which is less than that calculated.

It may with reason be urged, however, that the gain in Northumberland is not due to the actual preservation of adults, but to the increased numbers of larvæ from an increased number of berried females, and had the earlier years of the legislation been normal it could have been said that the advent of the improvement five years after the restriction went far to prove such a conclusion.

We therefore turn to the evidence yielded by the North Eastern experiment in the years 1896–1906. The improvement began after a lapse (shared by the rest of England and

the southern part of the east coast of Scotland) in 1897 and may be said to have been progressive to 1906. It is perfectly evident that the improvement was confined to the North Eastern district. A comparison of the charts for the period of the protection will show this to be the fact. It cannot be said then that the benefit which accrued was due to an increase in the number of larvæ, but rather that it came about by the accumulation of the stock on the grounds during the five months of the close time.

The subsequent history of the North Eastern district is interesting, since after an ominous decline, an increase took place. This was shared in by the whole East Coast in 1912–13, after which period the North Eastern has declined to a state which brings its figures to about the same as those of Northumberland although its coast line is so much greater. During the latter part of this period of decline the Northumberland district enjoyed its phase of improvement. And it will be seen that until the year 1923 the returns for the districts to the south of Northumberland were stationary. Chart IV.

The conclusions are warranted, then, (1) that the preservation of the soft crabs is productive. (2) that the increase is caused by the preservation of adult stock on the ground. (3) that the fluctuations do not measure the numbers which a given area is capable of supporting.

As a corollary it appears to be already established from the experiments in legislation in the North Eastern and Northumberland districts that the ample protection already given to the berried female and the young does not prevent the fishery from declining.

3. The results of the Northumberland marking experiments gave rise to the expectation that the annual large contribution of mature females would steadily affect the neighbouring region of Scotland, and to a less extent, the east coast to the north of the Forth. The close time at the end of the year protects not only the soft crabs but the hard crabs and more

importantly perhaps, the females about to spawn as well as those about to migrate. It was estimated that on the average during the years in question the female crabs gained by Scotland numbered 300,000, and it was pointed out most of them migrated to the Eyemouth district. We see from Chart VI. that the Eyemouth fishermen are now catching more crabs than at any time before; the inference is, then, that the increase is due to the Northumberland close time and the improvement in Northumberland which has resulted. On the east coast of Scotland the increase since 1918 has been 120,000 per year on the average.

The contrast on the southern side of the Northumberland district is striking. During the period when Scotland, and especially the Forth region was improving coincidently with Northumberland, the North Eastern district was suffering a decline. The experiment in this case may be said to have lasted long enough to prove that the protection of the mature females derived to some extent at least from the region south of the Tyne by Northumberland, has not benefited the North Eastern district.

But on the other hand neither can it be said that there is any evidence of a benefit to Northumberland from the earlier protection of the North Eastern district. If it be assumed that the crabs liable to be received by Northumberland from the South are equal in number to those lost to the North it is difficult to understand this. It has been shown, however, that in the Norfolk region the marked crabs did not indicate any marked tendency to migrate. Indeed, if anything, the migrations were southerly rather than to the north. The migrations are related to current and it may be the fact that they diminish in intensity with the current. It is more than likely that the gain to Northumberland from the South is not nearly so great as the loss.

An improvement in the Eastern district of a temporary nature might be looked upon as indicating the influence of the larvæ, but it will be seen to have been a general fluctuation. There is no need to labour this point. It is universally

admitted that the resources are immense, but it is also true that the destructive agencies at work naturally are equally great. The resources are called upon when some dire calamity visits the adult population. But in fishery legislation it is evidently more important to protect the adult than the young.

It is acknowledged that the benefit to be derived from such legislation must reach a limit. But so long as the fishermen continue to fish during the open season, the rest enjoyed during the close season will have the effect of keeping the population up to a high, if not always the same, level of efficiency. Seasonal variation is inevitable. The protection as given in Northumberland and in a different way in the Eastern district, has the advantage of preventing destructive fishing when prices are low, and the crabs marketed liable to be poor in quality. It provides a larger catch with less labour, and the crabs are marketed at a time when the quality is good and the prices high.

Figures.

1. The numbers of crabs, in thousands, landed on the east coast of Britain and on the east coasts of Scotland and England. The vertical lines at 1896 and 1906 indicate the duration of the North Eastern close time, and the vertical line at 1914 the commencement of the Northumberland close time.

2. The numbers of crabs, in thousands, landed on the east coast of England, less those landed in the district of the North Eastern Committee, which latter are also shown.

3. The numbers of crabs, in thousands, landed in the district of the Eastern Committee.

4. The numbers of crabs, in thousands, landed on the east coast of England, less those landed on the Northumberland coast, which latter are also shown.

5. The numbers of crabs, in thousands, landed in the Northumberland and the North Eastern districts.

6. The numbers of crabs, in thousands, landed on the east coast of Scotland, less those landed in the Eyemouth District, which latter are also shown.

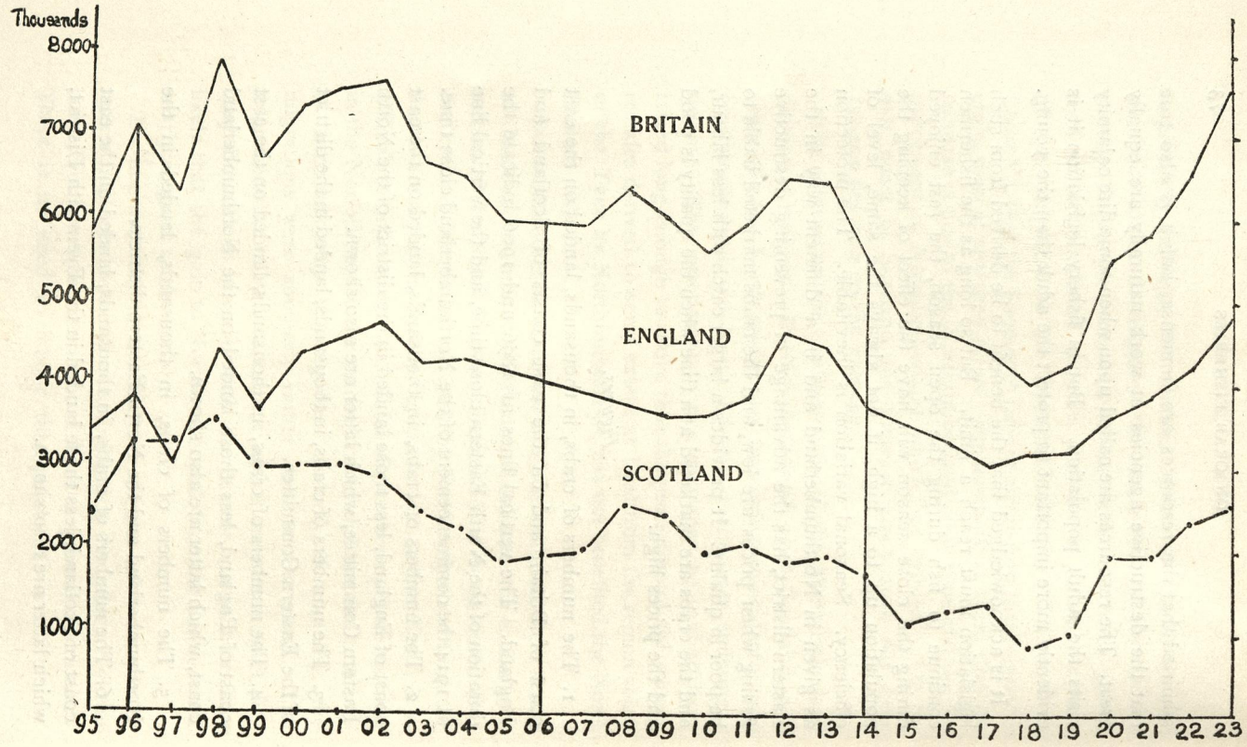


CHART I.

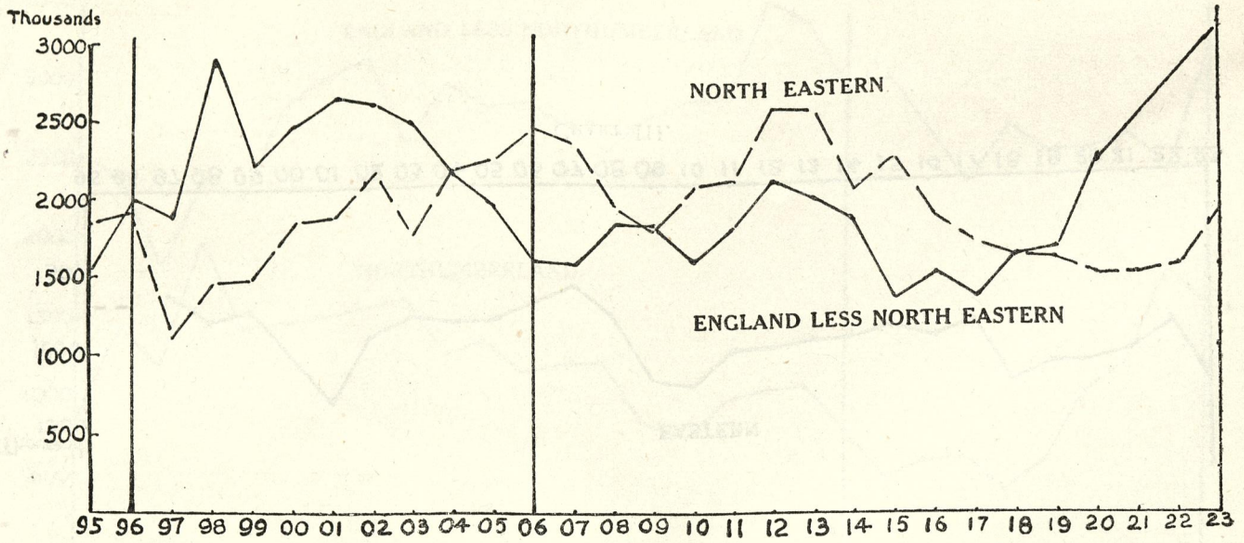


CHART II.

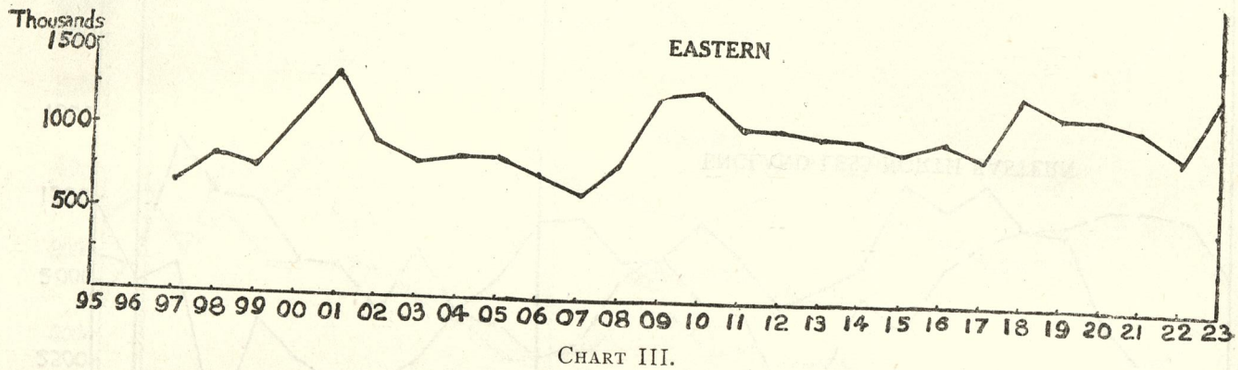


CHART III.

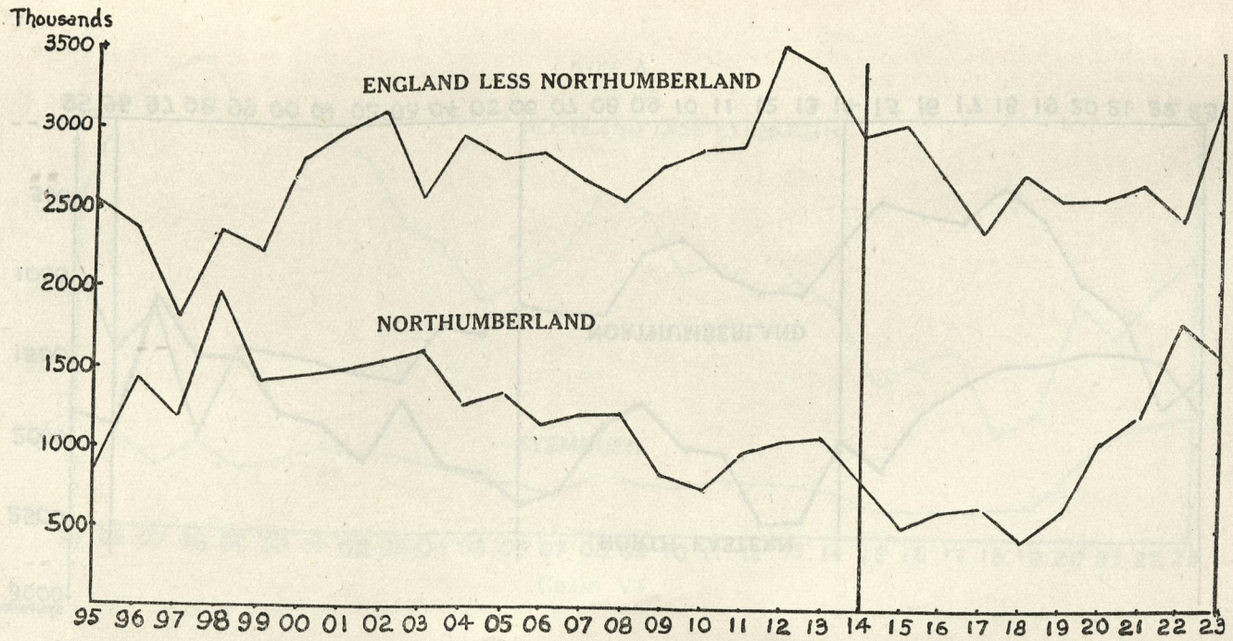


CHART IV.

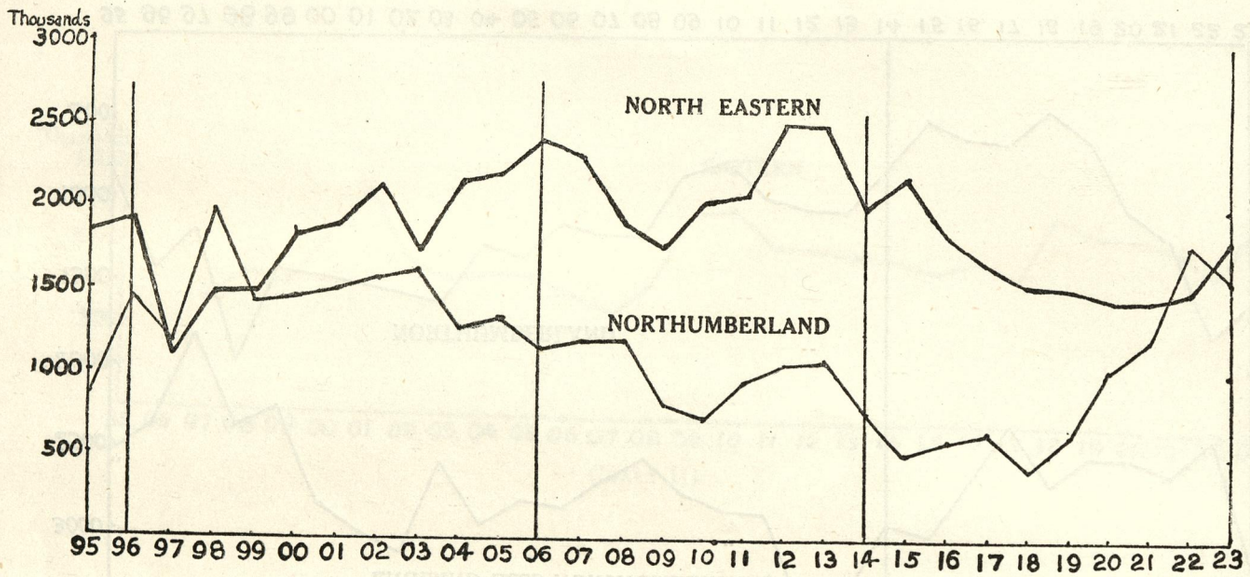


CHART V.

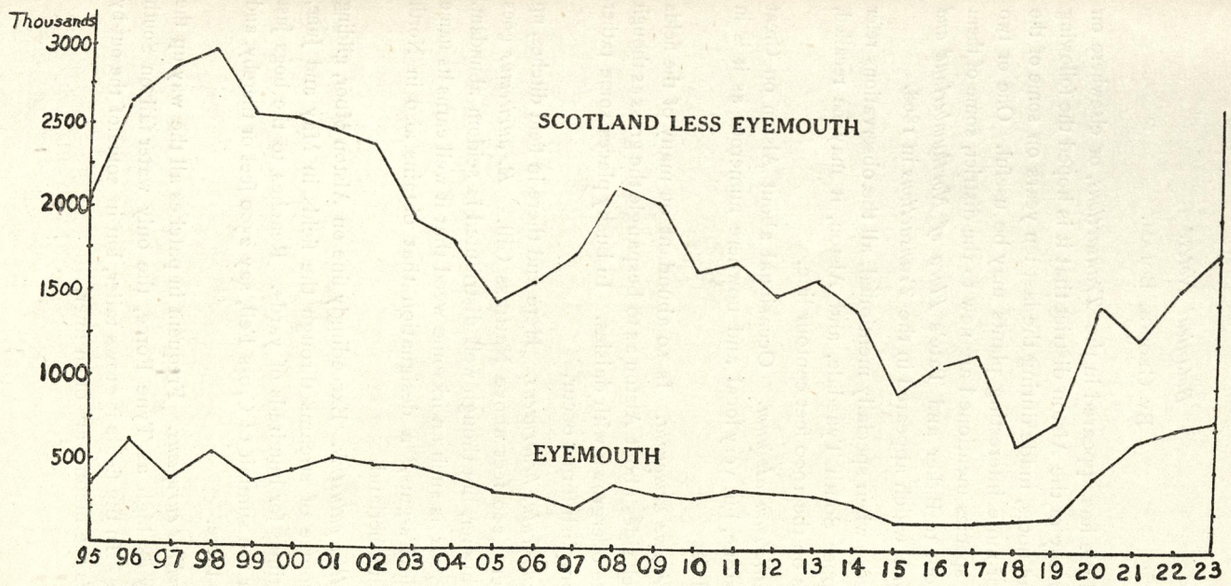


CHART VI.

Botanical Notes.

By George Bolam.

So little has appeared in the *Transactions*, or elsewhere on the botany of the Alston district that it is hoped the following random notes, made during the last ten years on some of the rarer or more interesting plants may be useful. One or two of the species mentioned are new to the district, some of them additions to Baker and Tate's *Flora of Northumberland and Durham* which appeared in the *Transactions* in 1868.

Except when specially mentioned, all the observations refer to Upper South Tynedale, and Alston, it may be recalled, stands on tbe 1000 feet contour line.

Thalictrum alpinum. Occasional about Alston on Great Limestone, but very local and nowhere numerous as it is in Teesdale.

Anemone nemorosa. Is so abundant on many of the fields and fell sides about Alston as to bespangle the grass as though it were overgrown with daisies. In bushy places some rather fine purplish forms occur.

Ranunculus hederaceus. Here and there in field ditches, up to over 1,200 feet above Nattrass Gill. *R. auricomus* goes even higher, but though well distributed is seldom abundant. *R. repens* is such an irksome weed that it well earns its name of "devil's-guts," a designation that obtains also in North Northumberland.

Caltha palustris. Exceedingly fine on Alston Moor, gilding the course of streams through the fields in May and June, sometimes for hundreds of yards. Reaches to the bogs just under the summit of Cross Fell, say 2500 feet or thereby, and fruits there.

Trollius europæus. Frequent in patches all the way up the valley as high as Tyne Force, the only water fall on South Tyne In the fields it grows taller, but in some of the out-by places the blooms are often finer.

Aquilegia vulgaris. Common on Tyne banks above Garrigill, and, as a straggler, on gravel-beds down to Alston and even to Kirkhaugh.

Aconitum napellus. A garden escape which takes very kindly to its new-found freedom, for it forms glowing masses of purple by some of the burn sides, as for example, under Ashgill.

Fumaria officinalis. Said not to have been known at Alston until deep-digging was resorted to when "war allotments" came into cultivation, then it appeared on the new-turned soil as a common weed. It is frequent further down the valley, as at Eals, Featherstone, &c.

Corydalis claviculata. Banks of North Tyne about Houxty, and in Countess Park, 1918 and later.

C. lutea. A thriving alien on some walls at Alston.

Thlaspi alpestre. Well known as a lover of old lead-mine heaps, sharing with *Arenaria verna* and *Cochlearia alpina* the distinction of being the first weeds to beautify such blots on our landscape. The glaucous form is almost as common as the green and is sometimes very glaucous indeed. Common also on the gravel-beds along most of the streams both above and below Alston. It ascends our hills to about 1800 feet and comes into bloom as early as March.

Teesdalia nudicaulis. Plentiful on one gravel-bed high up Rowgill burn, but I have looked for it in vain lower down in the Tyne Valley, although it seems curious that the seed which must be carried down the burn every year should not find a footing on some of the many apparently suitable sites. As this is a plant which does not seem to have been previously recorded for this district, it may be well to add that I first noticed it in Rowgill in May, 1914. On June 24th, 1922, I had the pleasure of revisiting the station with Mr. Randle Cooke when we found it still in abundance at the one spot, but nowhere else. In June, 1915, I noticed it in equal plenty at one spot quite high out on Cross Fell by the side of one of

the heads of Tees which would also seem to constitute a new record. On many of the Cheviot burns it is not uncommon.

Draba incana. Seems also not to have been often recorded from this district although mentioned by J. G. Baker in his contribution to the *Naturalist* in 1888 (p. 35). It grows plentifully on many of the limestone scars in Upper South Tynedale, especially those in the higher gills, and may be found on walls and gravel beds down to Alston Bridge, and more rarely, as far as Kirkhaugh. In May, and again in June, 1918, I found it on the banks of West Allen, near Whitfield.

D. verna. Abundant on sod-capped dykes about Alston where it was in bloom in 1922, as "early" as December 7th, its usual time of flowering being early in February. The round-podded variety (*Erophila (Draba) brachycarpa*, Jord.) is frequent here; as also is *E. virescens*, Jord. A most variable plant in size. It has found an ideal habitat on top of the Roman Wall, forming wide white patches of flower in March and April above Borcovicus.

Alyssum calycinum. This seems a strange alien to find its way to Alston, but in 1919, a very flourishing plant sprang up in some newly taken in potato ground adjoining Miss Blackett-Ord's garden at Brownside, and was in both fruit and bloom when my attention was drawn to it in August.

Cardamine amara. Not rare about some of the burn sides.

C. pratensis. The form with double flowers is very frequent in several places about Alston; Brownside, the old "Green Road" leading over Parkside, at Slaggyford, etc.

C. trifolia has sown itself abundantly and "gone wild" about the grounds at Bonnyrigg Hall.

C. flexuosa (=sylvatica) occurs at Ashgill, Blackburn Banks, etc.; and *C. hirsuta* is one of our most troublesome garden weeds, though an engaging little plant both in foliage and flower when met with far out in some rocky gill.

Arabis hirsuta. Common in gills and on walls about Alston; and the same may be said of *Turritis glabra*, *Sisymbrium Thalianum* and *Barbarea vulgaris.* The latter a frequent garden weed.

Dianthus deltoides. The form *glauca* on Gold Island, Houxty, August 18th, 1916.

Silene inflata. Tyne banks at Lintley, but not noticed higher up the valley.

Lychnis diurna x *L. vespertina*, a hybrid between these has persisted on the river bank at Kirkhaugh, to my knowledge, since July, 1916.

Sagina nodosa. Frequent, and ascending the fell sides to considerable heights, say 1600 and 1800 feet, round Alston. The viviparous form is not rare, and reproduces both form and type freely from its off-shoots on my garden walk.

Spergula arvensis comes up as a weed in allotments, and is found, very dwarfed, on the sides of the railway below Alston station. Perhaps introduced with hen corn.

Arenaria verna. Embellishes with its pleasing tufts of verdure, bespangled in spring with bloom, all old lead mine heaps that disfigure our fells, up to close on 2000 feet. Possibly it goes even higher, and it is equally at home on river-side gravels. It has gained the name of "physic" from the common practice of mothers making tea for their children by pouring boiling water upon its dried flowers; and "taalk about senna," added my informant, "man, senny's no' in't!"

Cerastium vulgatum. Common on roadsides, etc., and ascends up to at least 1500 feet. In August, 1922, Mr. Randle Cooke and I found the curious glomerate form at Lintley.

Malva moschata. Not uncommon on north bank of Houxty Burn, North Tyne. It is frequent lower down the Tyne, but does not come up to Alston.

Hypericum quadrangulum, H. perforatum, H. hirsutum and *H. pulchrum*, all common about Alston.

Geranium sanguineum, var. *lancastriense*, was gathered by me on the links at Cheswick thirty years ago, and long survived in the garden.

G. sylvaticum. Empurples our hay-fields as far up as Tyne Head. The blooms on various individuals vary in size from fully normal down to that of a threepenny-piece, and in hue from reddish-purple to very blue.

G. pratense. Very local on Alston Moor, more frequent up Nent than Tyne. It begins to be common after Slaggyford is reached.

G. lucidum. Frequent, and ascends to Little Gill in Priorsdale and Tyne Head. *G. Robertianum* is frequently white-flowered here. *G. molle*, *G. pusillum* and *G. dissectum* are occasional weeds in gardens, etc. *G. columbinum* much scarcer in similar places.

Genista tinctoria. About Houxty and Lee Hall, North Tyne, which is a little higher than given in Baker and Tate.

Ononis repens. Very local in Upper South Tyne, above Gilderdale Bridge, Howburn, and below Kirkhaugh.

Anthyllis vulneraria. Frequent on river-gravels up to Garrigill, and on limestone outcrops up to Nenthead.

Vicia sylvatica. Tyne Banks, Slaggyford, and West Allen, above Whitfield.

Lathyrus hirsutus. I gathered this on refuse heap behind the pier at Berwick in July, 1889, and in August, 1915, Capt. Norman, R.N., sent me a specimen he had just found on the same spot. No doubt an "escape," but whence came it? Its persistence (or re-introduction) is interesting.

P. alpestris. Occurs freely here and there on the higher escarpments, both in Tyne Valley and Teeshead.

Epilobium hirsutum. Flourishes in some places close to Alston.

E. alsinefolium. In many of the upland gills, far up Cross Fell.

E. alpinum. Cross Fell, on sides of road over Priorsdale, and at Houxty, North Tyne. Small plants transferred from some of these stations to the garden, seed themselves, and increase to such an alarming extent that one wonders why it does not spread in like manner in its native habitats.

Lythrum salicaria. I found this growing on Tyne banks above Bywell in 1917. Apparently a hitherto unrecorded locality.

Clatonia virginica. Is on the way to naturalizing itself about Slaggyford—1921. *C. perfoliata* had in like manner established itself about Hoselaw (Roxburghshire) in 1903, coming up from self-sown seed all over the garden and even straggling outside it.

Sedum telephium. By railway side opposite Kirkhaugh Church, 1915. Also about Nent Force.

Sedum villosum. Frequent in fell ditches above Alston, ascending to the watershed above Tynehead, and in Priorsdale.

Saxifraga umbrosa. Used to grow in large patches in Ashgill Wood before the trees were cut during the war, and also does so by side of Clargill burn near Tynehead—quite "gone wild."

S. stellaris. Abundant on Cross Fell and some of the other higher hills, ascending almost to their summits. Varies considerably.

S. granulata. Quite rare about Alston, wall top near Leadgate.

S. tridactylites. Frequent on sod-topped walls, on Hartside to about 1500 feet.

S. hypnoides. Common on most of the higher fells to 2000 feet or more, and varying much in habit, some of the forms being beautifully compact in growth. Carried down Tyne, it may be found occasionally on gravel-beds as far as Kirkhaugh—probably even lower. Occurs on the Northumbrian side of Gilderdale. Also above Crag Lough on the Roman Wall.

Adoxa moschatellina. Frequent about Alston, up as high as Ashgill, say, 1500 feet. Also at Houxty, North Tyne, &c.

Œnanthe crocata and *Chærophyllum temulentum.* Both frequent about Alston.

Peucedanum ostruthium. About Garrigill and on roadside at Rotherhope.

Viburnum opulus. Frequent about Tyne Banks as high as Garrigill. Blooms, generally rather sparingly, and few berries ripen.

Galium erectum. This is a new record for Northumberland and the district, although it has since been found I am told, near Carlisle. I discovered a thriving patch of it by the banks of Tyne at Lintley, some three miles below Alston in August, 1915, and have frequently seen it there since. In August, 1922, I took Mr. Randle Cooke to see it, and he submitted specimens to Dr. G. Claridge Druce, who vouches for its correct identification as *G. erectum*, Huds.

Galuim mollugo. So abundant further down the Tyne, is only represented by odd plants about Alston, Gilderdale Bridge, Leadgate Road, a mile and a half above Alston, &c. It becomes prevalent about Slaggyford. *G. verum* is abundant and fine, ascending to some 2000 feet on Cross Fell. *G. cruciatum*, *G. palustre*, *G. saxatile*, *G. uliginosum*, *G. pusillum*, *G. boreale* and *G. aparine*, are all more or less common around Alston.

Sherardia arvensis. Does not commonly, so far as I have noticed, approach us nearer than Slaggyford, though an occasional plant may be found on the railway sides as high as Kirkhaugh.

Scabiosa succisa. Empurples whole acres of our hay-fields in the valley, in August and September, and occurs far up the hill sides, to 1800 or 1900 feet if not even higher. *S. arvensis* ceases to be abundant higher than about Kirkhaugh, though odd plants appear about Alston, and up the Nent nearly to Nenthead. One may be surprised to come upon similar

stragglers blooming, though in much dwarfed stature, between the third and fourth milestone on the Hartside Road, and may speculate as to how they got there.

S. columbaria. Is local, but apparently more at home than the last by roadsides and outcrops of rock above Alston.

Leontodon palustre. Common about river-beds as far up as Ashgill, Tynehead, etc., and in fine variety.

Gentiana verna. Very local on Alston Moor; had not, I believe, been recorded for Cumberland when I first found it here in 1912. Since that date it has been noticed in one or two other stations.

G. amarella and *G. campestris.* Are both common, but occasionally produce such exceptionally fine flowers in our valley that they cannot be passed unnoticed.

Lathræa Squamaria. Frequent about Alston where it must be parasitic on several other roots than hazel; also in Houxty Wood, North Tyne and other places.

Euphrasia officinalis. Common almost to the tops of our hills, but in the valleys (as above Garrigill) often so remarkably large and handsome of bloom as to merit special mention.

Linaria minor. Frequent amongst the cinders ballasting the railway, and occasionally along dry road-sides.

Pinguicula vulgaris. Common in many places, on damp rocks, etc., almost to the tops of our highest hills, where it is often much dwarfed, and does not bloom freely. Perhaps from lack of insect-food.

Utricularia intermedia. Still maintains itself in its old recorded stations at Bromlee and Crag Loughs, where I have seen it from time to time for many years past.

Primula farinosa. Fairly plentiful locally, in upper Tynedale, occasionally seeding itself on river-gravels down to below Kirkhaugh, but never luxuriating as it does in Teesdale.

Lysimachia vulgaris. On the banks of Wooler Water below the town, on Tweedside under Horncliffe, Stocksfield, Park End, and Houxty on North Tyne. Still fairly plentiful in all these stations, and in some others.

Samolus Valerandi. Well known on Holy Island and the coast, but an unexpected find in upper South Tynedale. I found a single plant in bloom below Lintley in July, 1915, and sent the flower to my friend, the late Capt. F. M. Norman, R.N. Since then I have noticed it there on several occasions, down to the present time, but have searched for it in vain some years.

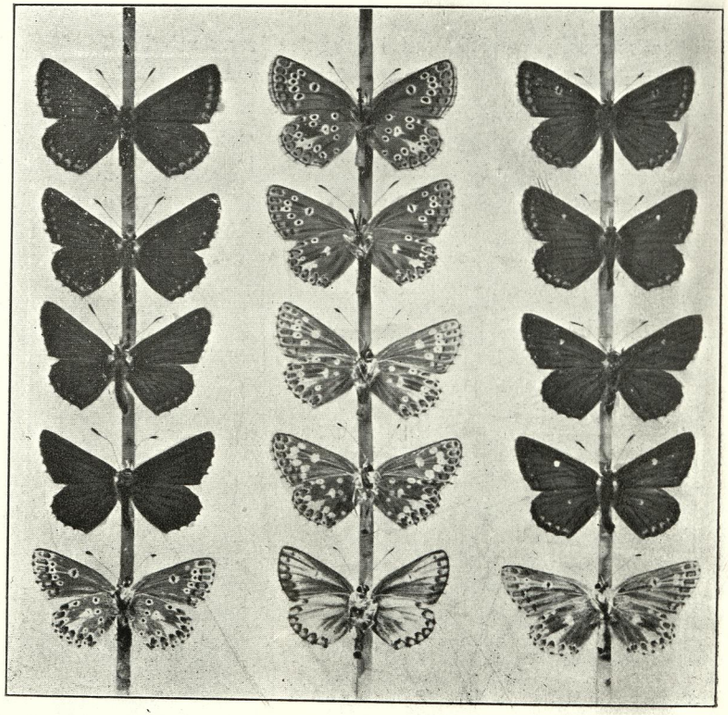
Polygonum viviparum. Common by the sides of Tyne down as far as Kirkhaugh, probably much further, and ascending very high up some of the glens where it grows on the limestone outcrops in a much dwarfed form, up to 1800 feet or so.

P. convolvulus. Has found its way as a garden weed up to Alston and Brownside, say 1200 feet.

Rumex Hydrolapathum. On the banks of the Aln from Eslington Park to Broome Park, perhaps as an escape from the former where I believe it was introduced, but has become well established.

Euphorbia lathyris. Has been treated as a weed for nearly thirty years in the garden at Sidwood, North Tyne, though never noticed to flower until July, 1922, when Mr. W. G. Watson sent me a full-blown plant. Mr. Randle Cooke finds it flowers and increases very freely at Corbridge.

Corylus avellana. Frequent enough along the burn sides up to and above Alston, but the nuts seldom develop kernels here, although squirrels persist in gathering dozens of them in the hope of finding a good one. Their industry must, I suppose, meet with some reward—more than seems apparent—else, surely, it would not be continued.



A Series of Upper and Under Side Varieties of A. Medon.

1.	Upperside.	Type *Medon.*	Durham.
2.	,,	*Semi-allous.*	,,
3.	,,	,,	,,
4.	,,	*Allous.*	,,
5.	Underside.	*Discreta.*	,,
6.	,,	Type *Medon.*	,,
7.	,,	*Vedrae.*	,,
8.	,,	*Salmacis.*	,,
9.	,,	*Artaxerxes.*	,,
10.	,,	*Cuneata.*	,,
11.	Upperside.	*Albiannulata.*	,,
12.	,,	*Salmacis.*	,,
13.	,,	,,	,,
14.	,,	*Artaxerxes (Quadripuncta).*	Scotland.
15	Underside.	*Deleta.*	Durham.

The British Races of Aricia Medon (Esper) with Special Reference to the Areas in which they overlap.

By J. W. Heslop Harrison, D.Sc., F.R.S.E. and William Carter.

I. INTRODUCTORY AND GENERAL.

The butterfly *Aricia medon* Esp. better known perhaps as *Lycæna astrarche* Bergstrasser, possesses an extraordinarily wide range, for it inhabits the whole of the Palæarctic area, including the Mediterranean and other islands but excluding the regions actually within the Polar circle. Not only is this so, but in addition, colonies are met with in the North of India and in the Canary Islands. This enormous range over a territory not admitting of free communication between the various parts, except under geographical and geological conditions far removed from those of to-day, points to a very ancient origin for the species.

Naturally enough, as a result of its great age, and the wide expanse it occupies, the species has broken into a vast number of local races, seasonal varieties and the like. However, we have no intention at the present juncture of dealing with the latter, for most of them differ in the quantitative expression of certain characters to be regarded in the absence of actual experiment as being ontogenetic in origin. Even in the case of the former we propose in our present communication to confine ourselves to the variation exhibited within the British Islands—where the most unexpected of the geographical races occur.

In Great Britain, considering the species as a whole, it covers a considerable extent of country between the English Channel and a line drawn from the Cromarty Firth to Islay, inhabiting every suitable station where the food plants *(Helianthemum vulgare** and *Erodium cicutarium)* grow in plenty, although it exhibits a marked preference for maritime habitats in its more northerly localities. In Ireland, on the contrary, it seems restricted to the County of Galway.

* The Common Rock Rose, *Helianthemum vulgare*, is the preferred food plant in the North.

But it must not be supposed that it is homogeneous throughout its British range, for it exists in two distinct races; races—if ever such deserve the name—worthy of being termed subspecies. The two subspecies in question are the forms respectively assigned to the Central European type and to the variety *artaxerxes*. Roughly, the area covered by the type may be said to be England and Wales whilst the habitats of *artaxerxes* are, in general, confined to Scotland and Ireland. This being the distribution, it was only natural that in the early days, in the apparent absence of intergrades, the two forms should have been accorded full specific rank.

How then do the two sub-species differ? They differ appreciably in many respects, best exhibited in tabular form thus :—

* *Type medon.*	*Var. artaxerxes.*
(1) Often bivoltine	(1) Always univoltine
(2) Discoidal point black	(2) Discoidal point white
(3) Submarginal row of red lunules well developed	(3) Submarginal row of lunules obsolescent on both wings
(4) Ocelli on wings beneath with well developed pupils	(4) Ocelli with pupils obsolete or obsolescent
(5) Ground colour beneath tending to lighter	(5) Ground colour darker

With the differences listed under (1), (3) and (5), we need concern ourselves but little. Whether a species is single or double brooded clearly depends upon the climate, and from observations made on our series collected throughout the Palæarctic area, the state of the red lunules is, so to speak, a function of latitude or altitude; or, alternatively, where the species just succeeds in being double brooded, it marks the

* The case of *artaxerxes* and *medon* is not unique, for *Lycæna xerces* and *antiacis* occurring in California provide a complete analogy, and further the intermediate *mertila* with its satellites agree with the *albiannulata-salmacis* group. Curiously enough the *xerces* form occurs on hills near the coast whilst *antiacis* is more widely distributed. The inference is strong that whatever explains the development of *artaxerxes* accounts for *xerces* likewise.

difference in climatic conditions obtaining when the larvæ producing the two broods were developing. And much the same holds true of the ground colour beneath. Thus we are brought to the consideration of two distinguishing features only, the disappearance of the black discoidal point and its substitution by a white one, and the obsolescence of the black pupil to the eyespots beneath. In spite of the few characters to be submitted to critical examination, it must be emphasised that the differences between typical *medon* and the local race *artaxerxes* are such as are encountered nowhere else in the millions of square miles over which *medon* flies in Europe, Asia and Africa.

Nothing happened to disturb the general opinion as to the distinctness of the so-called species *artaxerxes* until 1830, and even then the value of the new observations was not appreciated. At that date, when the entomologists of Northumberland and Durham were first reaping the fruits of their activities, a colony of *medon* was discovered on those portions of the coast of the two counties between Bamburgh and Hartlepool. Unfortunately, however, when the discovery was announced, a selection of insects, wholly unrepresentative of the population, was sent to Stephens. That writer, fixing his attention on the obvious differences between the specimens before him and the two forms previously detected, rather than on their similarities or even their suggestive markings, forthwith erected on the strength of this material a "new" species which he called *Lycæna salmacis*. This species he characterised as follows :—

Alis fusco-nigris subtus fuscescentibus, maculatis subocellatis anticis supra in masculis puncto discoidali atro, in fœminis albo, posticis utrinque fascia submarginali rubra.

Later, with a fuller entomological knowledge, springing from a freer interchange of specimens and investigations into the life history of the form, it was realised that the insects so named by Stephens supplied a transition between the type *medon* and *artaxerxes*. In consequence, pretty tales were

produced to adorn various text books of a gradual change in the *medon* population as one passed northward, how, at this point, the black discoidal point acquired a white border which gradually invaded the black area until at length when Scotland was reached the black was entirely replaced by white, and so with the progressive disappearance of the black pupils to the white ocelli beneath, the modification of the submarginal red band, and the other differences.

As a matter of fact, there is but a modicum of truth in all this wonderful array of statements, purporting to give the exact position, but in reality evolved theoretically on the basis of an assumed relation, in the way of cause and effect, between latitude and gradual changes in the facies of the population. Their only justification lies in the steady change, to which reference has already been made, in the expression of the red band as one proceeds northward, or into mountainous areas not only in Britain, but elsewhere; the other statements are more or less fanciful.

We have had under examination series from every Northern English station, and from very many southern ones in our islands, and we venture to assert that, making due allowance for spring and summer broods, there is but little to differentiate between Lancashire and Westmoreland specimens on the one hand, and southern forms on the other, and still less between Yorkshire examples taken south of Richmond and similar southern sets. For example, just before us now is a very long series of Kendal and other north-western specimens lent us by Mr. Frank Littlewood for our work, and only one of these stands out conspicuously from the rest as possessing a discoidal point more completely encircled with white than our Cornish examples. Even this insect can be matched, in this respect, by specimens captured in Buckinghamshire, or even in Bavaria, Spain or Asia Minor.

Insects answering perfectly to Stephens' description can yet be taken on the Durham coast, but the white spotted forms are not exclusively female, any more than those possessing a

black discoidal are uniformly males. It is quite incorrect to state that the two conditions in discoidal spotting represent the alternative secondary sexual characters; white spotted males are just as plentiful as the corresponding female, and so with the black-pointed form. In addition to these, our Durham colony is quite capable of producing examples of *artaxerxes* more perfect in their presentation of the form than many Scottish specimens we have handled; typical subarctic or alpine *allous* differing in no way from representatives of that variety we have from Norway, the Alps, and the Taurus Mountains, as well as insects with as fiery a red band as Central European specimens selected as showing that character at its best—and so with other features, which according to some books, our local insects have no right to display.

Thus the Durham population is truly mixed, including every form taken at other stations in the British Islands with every combination possible of characters proper to the two main British stocks. Not only is this so, but for reasons developed below, many aberrations occur freely and regularly with us which are lacking elsewhere. In fact, the population stands out as being unique, and the more closely it is studied the more strongly it impresses one. In contrast with it, the variation at Grassington in Yorkshire, at Arnside, Witherslack and Kendal in Westmoreland, seems trivial.

II. THE ORIGIN OF THE BRITISH RACES.

We are now brought to the stage when we can discuss possibilities as to the origin of the two chief races in the British Islands. Allowing for the existence of the heterogeneous Durham population, there are three explanations which seem capable of accounting for the facts, and these are:—

(a). That in the mixed population lies the origin both of typical *medon* and *artaxerxes*.

(b). That successive mutations, orthogenetic in their trend, occurred as the species migrated northward through Britain.

(c). That *artaxerxes* arose as a mutation, casual or otherwise, which by infiltration replaced the main stock in Scotland and Ireland and affected it elsewhere.

A. Possibility of the two races having originated in Durham.

Had the insect been restricted to the British Islands how very tempting to the theoriser would the mixed population be! Here we have the raw material upon which natural selection can work. From a centre of dispersal of this type, by sifting out unsuitable forms, selection has urged one race northward to stations for which it is better fitted, and so with the other contingent. But this simple view meets with a check at once, for climatically the Scottish habitats vary from those approximating the conditions of the South of England to others like, and others more extreme than, those prevailing in Durham.

Dismissing climatic explanations, let us pause to consider any protective value in the peculiarities of the two races. If the modifications are such as to afford a basis for selection in its postulated omnipotence to work, then it could be brought to bear at two periods, (1) when the butterfly is in flight, (2) when it is at rest or asleep. Of these, the second is probably the more critical for the blue butterflies generally (and *Aricia medon* in spite of its colour is a blue!) go to sleep early and rise late; further, they rest and sleep quite conspicuously on the stems of rushes, and grasses, and on flowers of knapweed, geranium, plantain and other plants. More especially they favour rush and plantain, and it must be confessed that, as they rest with undersides exposed and their wings over their backs, the underside pattern and colouration blends admirably with the rush and plantain flowers.

Nevertheless, if our eyes are competent to judge, we can detect no special value in any departure from the type whether in the direction of more heavily pupilled eyespots, or toward the blindest *artaxerxes* form possible. All forms are

equally visible (or invisible, for it is conceivable that we miss many) to us. And, surely, we urge, the appearance of insects of such colouration as they possess cannot be so vastly different to birds—the only enemy which could so exert preferential selection. Of course, the insect has other enemies, only one of which destroys an appreciable number, and that is the spider *Epeira cornuta* which merely conducts indiscriminate slaughter on the butterflies sleeping closest to its snare.

Independently of the evidence of our eyes as to the failure of selection working on the two main forms of a mixed population, two other pieces of direct evidence can be brought to bear (1) birds, except meadow pipits, are very scarce indeed on the Durham sea-banks, and never during the many years we have had it under observation have we seen the birds present touch the insect either in flight or at rest (2) *Lycæna icarus*—and *L. icarus* in its most vulnerable form, fertilised females—rests alongside *A. medon.* Indeed, often enough, we have seen half a dozen *icarus* and two or three *medon* on the same rush. Wherever we have encountered *medon*, there, in the same habitat occurs *icarus.* Thus, if the underside of the creature was decisive in determining the separation of *artaxerxes* from type, since the underside of female *icarus* and *medon* are substantially alike, whenever *medon* yielded to *artaxerxes* there *icarus* should fail. Needless to say, this is absolutely contrary to fact.

Apparently then, when the insect is at rest, neither the one nor the other form is favoured. Since the wings are closed over the back, at that period the white spot above as a determiner of which race succeeds in any given station cannot play any part. But when the butterfly is on the wing this is exposed equally with the underside. Here again, we are confident that neither upper nor underside markings can assist the type to safety and fail with this variety or *vice versa.* The insect in every station, whether producing types only, all forms intermingled, or *artaxerxes*, appears on the wing as a

blackish flickering being, very difficult indeed to follow in the sunshine. Until an insect is actually in the net on the Durham coast one cannot decide whether it is *artaxerxes*, type *medon*, intermediate form, aberration, or even female *icarus!*

Once again the characters as determined directly for our eyes and, inferentially, for bird enemies, have no selective value.

Even if selection, whether acting through birds or other influences, were at work, it is very difficult indeed to see how *artaxerxes* could be the more qualified for the Scottish area, and *medon* for its more southern abodes, when one recalls the varying conditions of either region. Moreover, it appears ridiculous to assume that any agency, birds or otherwise, should act by eliminating type *medon* in Scotland, becoming more or less neutral in Durham, and failing outright elsewhere.

Apart from such considerations, the British Islands form a very minute portion of the range of the species, so that on zoogeographical grounds we know that the species, as found abroad, cannot have originated here, and, for precisely the same reasons, *artaxerxes* cannot be regarded as having proceeded from the North of England.

Lastly, if the present were the correct view, it affords no indications as to how the variety emerged from the type; in any case, therefore, we must seek elsewhere for a full solution of the problem.

Although, as we have already insisted, the transition from *medon* to extreme *artaxerxes* is not the perfectly continuous advance pictured in certain text books on *Lepidoptera*, there is a passage of sorts between the two forms. Admitting this, and allowing for the fact that neither climate nor selection appear to account for the gradation, then the two other suggestions as to the origin of the situation demand careful examination.

B. Is the Position Explicable on a Basis of Orthogenetic Mutation?

Clearly it appears quite possible for a species as it spreads from the central area in which it originated to undergo a series of mutational changes, all pointing in one definite direction, and therefore of an orthogenetic nature. If the spread of the species were steady, and the occurrence of any special mutation depended on the lapse of time since the species commenced its migrations, then the chain of forms would simulate the conditions of an intermediate and transitional population between two well marked forms, the type giving the extreme on the one hand and the last member of the orthogenetic series forming the other. Thus the difference in space between the various members would be directly correlated with the periods at which they appeared.

However, such an explanation, if offered to account for the position of the *medon* forms, breaks down at once for, firstly, the British races fail to fall into their places as links of a genuine orthogenetic chain and, secondly, not the remotest indication of the occurrence of such a series can be detected abroad. Not even in the most northerly stations in Scandinavia, and in stations producing many characteristically Scottish plants and animals, does the species show the slightest approach to the *artaxerxes* form.

C. Did the Durham Population Originate in the Crossing of a Mutational Artaxerxes with the Type?

If *artaxerxes* sprang by mutation or other means from the typical form of the species then it could conceivably arise either (1) whilst the continuity of the species determined during its dispersal yet existed or (2) whilst the contingent amongst which it took its origin was temporarily severed from the main body.

If diffusion occurred in the former case then, since the contact between type and variety remained unbroken, a gradual penetration of the main stock by the new form could

take place the extent of which, in the absence of any preferential assistance given to *artaxerxes*, would depend entirely on the period during which infiltration had been occurring. Further, the facies of the intermediate population so generated would be fixed simply by the blended or alternative nature of the inheritance of the new variety. In any case, there would be a centre from which the novel form would be dispersed and the *artaxerxes* influence should be felt equally on all sides of that centre, always supposing no interference from outside took place.

Once more we can only urge that the observed character of the disturbance, and the extent and position of the areas affected, are such as to cause us to turn in our investigation to the second possibility.

In that case we imagine a section of the species to have been isolated, and therefore able to pursue its evolutionary trend quite unaffected by the course of events in the main body of the species. If during that isolation the divergence of *artaxerxes* from type *medon*, no matter how brought about, took place, when at length the barriers, climatic, geographical or otherwise to which the isolation was due were removed, two forms in place of one would be free to move. Thus, if circumstances were favourable, colonisation of new territory would proceed from two centres, only slowing down when the two contingents once more encountered one another and pressure from behind ceased. Subsequently, if the powers of inter-breeding were retained, mixed populations would appear, the extent of ground affected being regulated by the time during which free inter-breeding was possible and by the total or partial nature of the contact.

This latter may depend upon conditions geographical or others geological. The former, at first sight more drastic in restraining free intercourse, may actually be much less effective than the latter. Casual specimens may effect very difficult passages—as we know from experience with mountain species—but it is a very fortunate insect which will pass

huge stretches of country otherwise favourable, but of geological formation unsuitable for supporting its food plant, and it is the latter difficulty which the more nearly touches *Aricia medon*.

Before proceeding further, we may say, without hesitation, that in our opinion the desired explanation lies in the second alternative. We believe that *artaxerxes* originated during isolation and that branches of one and the same species, severed long enough for very strong racial characteristics to be impressed upon one of them, have come together so that inter-breeding has become possible. We recognize that we are hinting at a Lamarckian elucidation and therefore more or less unorthodox, still we persist.

When then have conditions allowing for the isolation so postulated occurred within the limits of our islands? Certainly they fail now, but nevertheless they have existed.

We know that the populating of our islands with its present flora and fauna has, in the main, taken place in very recent geological times; indeed, if we grant the demands of extreme geologists the whole of our flora and fauna is recent. However, many facts in plant and animal geography are diametrically opposed to this view. Without elaborating the point, we indicate the American elements in the Irish Flora as the critical test, and we offer the Lusitanian group to support their indications. We are certain that, as we have argued elsewhere,* in tracing the history and geography of *Nyssia zonaria*, *Pœcilopsis lapponaria*, *Platyptilia tesseradactyla*, *Anthrocera purpuralis* and others, that these are very ancient inhabitants of our islands.

Whatever wiped out the other plants and animals must have spared the species just mentioned. And what is the agent geologists put forward as the destroyer? They picture for us an inexorable advance of an ice barrier from the north and east, driving or crushing all life before it, until the Thames was reached, and then only allowing in the British

* Naturalist, 1916, page 380.

area, south of this, a survival of purely Arctic forms. Manifestly, under such circumstances, none of the insects to which reference has been made could have survived; nor could *Aricia medon*. But we have urged repeatedly that no allowance was made for the possibility of low lying (or other) islands, stretching out far into the Atlantic west of Ireland, capable of maintaining, even if precariously, some relics of a temperate flora and fauna.

Now geologists are beginning to admit a higher land level during the Glacial Period than they would before, and in all probability, habitable territory, independent of these low islands, existed to the west of the Ireland of to-day. There, then, under conditions ameliorated by their oceanic environment, in stations relatively not far removed from the present day Galway and Clare habitats, the insects mentioned, as well as *Aricia medon*, survived the dominance of the ice.

In the end, both in Great Britain and Ireland, the glaciers waned, and as they did so great movements of plants and animals ensued. Hard on the trail of the melting ice poured northward hosts of forms and amongst them *Aricia medon* but now in two guises, one more or less constant to type streaming northward from the continent into the British area over lands long since overwhelmed by the sea, and the other, the form *artaxerxes*, skirting the Irish Coasts from its western retreats, pressing northward into Scotland *via* favourable limestone and basaltic routes not then burst asunder by the waves.

The Continental section, accompanied by insects of southern proclivities like *Acidalia dilutaria, A. subsericeata, A. inornata, Eubolia bipunctaria, Procris geryon, Depressaria liturella* and *Agdistis bennettii*, pushed ahead until what then represented the Northumberland and Durham coasts was reached, but there it halted. Our area marks the northernmost limits in Britain of numerous southern forms on the east, as do the southern fringes of the Cumbrian mountains on the west.

On the other hand, the *artaxerxes* band, after spreading over Scotland, in its subsequent wanderings followed the path of Boreal forms migrating southward until it had colonised the Durham Coast, where like the northern *Eupithecia constrictata, Emmelesia taeniata, Coremia munitata*, and *Epiblema grandaevana* it lost its momentum.

During these events profound changes in geographical configuration were proceeding rapidly in the west; first the Irish Sea appeared from the south as a land-locked gulf, and then the basaltic link between Ireland and Scotland was fretted away. Very early indeed was the progress of *artaxerxes* in that area impeded, and so effective was the check that any intercourse between the advancing *medon* and *artaxerxes* on that side was of the slightest.

On the east, somewhat later, the North Sea developed along the old Rhine and Elbe valley to be linked up by the formation of the Straits of Dover with the English Channel, and so Britain became an island. Minor adjustments with oscillations in the land level occurred, but finally the British Islands as we know them were carved out. With this a cessation of movement in the colonising hordes was initiated.

Thus were the two stocks of *medon*, type and variety *artaxerxes*, once more brought into contact in regions representing, whilst the carving out of Britain was yet in progress, the limits of our two counties. Interbreeding became possible and with that interbreeding originated the curious medley of forms, taken on the Durham Coast, which we shall now investigate.

III. THE INHERITANCE IN THE OVERLAPPING AREAS TRULY MENDELIAN.

Obviously enough, the two principal forms are germinally fixed, for *artaxerxes* taken southwards always breeds true to its racial characteristics as does the type when brought to the north; further, the form *albiannulata*, in which the black discoidal point is ringed with white, can give rise in Durham to

typical *medon*, *albiannulata* and *artaxerxes*, so that clearly enough segregation occurs; all of which evidence suggests that we are dealing with a case of simple Mendelian inheritance parallel to that of the Blue Andalusian fowl, depending on a single factorial difference. Moreover, it looks as if typical *medon* and *artaxerxes* represented the two homozygous parents and *albiannulata* the heterozygous intergrade.

To test this theory would appear to be easy, but, unfortunately, owing to the impossibility of securing pairings under controlled conditions, and to the enormous difficulty in getting larvæ procured otherwise through the winter, breeding experiments have established nothing beyond the facts already recorded.

However, that this simple explanation is insufficient to account for the facts can easily be demonstrated. If the *albiannulata* form uniformly represented the heterozygote, then, in districts like Arnside and Witherslack, where such forms occur freely enough to ensure casual pairings *inter se*, *artaxerxes* should crop up occasionally; such never happens. Hence all *albiannulata*-like insects are not of the same germinal composition.

That they do differ otherwise can be demonstrated by direct microscopical examination when very many insects, classified under the name of *albiannulata*, are found to possess discoidal circles in which the outer scales are not white but blue. Under these circumstances the chances are great, not only that such insects have no relationship to genuine *albiannulata*, but that the blue scales and the whole or part of the white ones represent, just as they do in the *Agriades coridon* form *albicincta*, vestiges of the long lost ancestral blue vestiture of the species.

So, too, other difficulties are encountered in the fact that rudimentary pupils occur in the eyespots of many insects otherwise extreme, and further, in the observation that the suppression of the black discoidal point does not mean the development of a white one, but a reappearance of the ordinary brown ground colour in the affected areas.

To meet these difficulties one could demand either the appearance of a definite factor for white spotting or, alternatively, one determining pigment inhibition in the ocellar and discoidal areas. On either supposition most of the combinations observed in the mixed Durham population, as well as the segregation present, would be explained but, recognising the presence of so many insects with rudimentary eyespots to their ocelli, the latter appears the better.

Similarly, theories based on multiple factors could be invoked, but none is so simple, or so satisfactory, as those just set forth.

Here we must point out that certain assumptions have been made in the foregoing discussion, and these are that either the same factor determines the disappearance both of discoidal point and ocellar eyespots, or, if the two depend on different factors, the linkage between these factors is so great as to be rarely, if ever, broken. Actually, we think that the former is the correct surmise. If discrepancies appear, and forms are captured with obsolescent pupils and apparently well developed black discoidal points, we assign these without demur to fluctuating variation in the phenotypical expression of the white scaling in the discoidal region, involving a masking effect such as might easily occur in forms heterozygous for either factor considered.

However, this does not account for all the wonderful forms found in Durham; many are beyond such factorial explanation.

Casual observations are easily dismissed, but recurrent and striking forms like the abs. *cuneata* and *vedrae* must have a deeper basis.

If we recognise that the two main types clashing in Durham at the Black Hall Rocks had previously been separated for ages, and that isolation permits of germinal divergence of far-reaching effect, what is more likely than that interbreeding, by the actual breaking up of factors or by the recombination of others, can give rise to new forms or the recurrence of ancestral ones? That such are generated under the conditions set

forth is proved by the production of a fixed mosaic strain * in our *Tephrosia bistortata* x *T. crepuscularia* var. *delamerensis* hybrids, by the abnormalities in our crosses between Canadian and British races of *Oporabia autumnata* and *Orgyia antiqua*, by reversion to rock dove markings when fancy strains of pigeons are mongrelised and so on.

This then would be the Mendelian view of the position and it would account not only for the heterogeneous population of the Durham Coast, but for the position generally in the British Islands.

IV. THE ORIGIN OF THE ARTAXERXES RACE.

The outstanding defect in the preceding arguments lies in their inability to assign any cause for the development of the variety *artaxerxes*. However easy it may appear to assume the existence of an inhibitor interfering with the pigmentation of any particular area or areas in the wings, a sense of dissatisfaction remains for we want to know at once how it arose and why. The fatal ease with which new factors are demanded, and old factorial systems extended to cover unconformable cases, has brought more ridicule upon, and caused more discontent with, Mendelism than any other objection. Nor does the mere statement that the "inhibitor" originated by mutation prove any more satisfactory; again we ask for reasons.

Fortunately, in the present instance, much pertinent experimental evidence, backed up by facts derived from other species, exists. Krodel,† Lange‡ and Bretschneider, working it is true with *Agriades coridon* and not with *Aricia medon*, have submitted pupae at the so called critical point, when scale pigmentation and form can be affected, to low temperatures. So treated, when the conditions of the experiment were carefully regulated, the butterflies emerged freely, but all displayed tendencies, sometimes extreme in their expression, to obsolescence of the black pupils beneath. Should *medon*

* Journal of Genetics, Vol. XIII., page 333.

† Allg. Zeitschr. für Ent. Bd., IX., p. 106.

‡ Deutsch. Ent. Zeitschr. "Iris," Bd. XXXIII., p. 26.

respond similarly to refrigeration, then, admitting as we did above, that the black discoidal point and black ocellar pupils are linked in their manifestation, both features should be influenced simultaneously, and tend to vanish. Thus the insect would be thrown toward the *artaxerxes* form.

Now, if the views put forward above as to the habitats of the British stocks during the Glacial period are correct, what is more likely than that *artaxerxes* emerged then under the influence of the same agency working under natural conditions?

That it is now a form germinally fixed could be assigned to the long continued yearly application of the inciting cause affecting countless generations, until the characteristics distinguishing *artaxerxes* from the type were impressed on the whole colony. In much the same way we would endeavour to account for not only analogous specific and racial characters in *Aricia idas*, *A. psylorita* and *Lycæna antiacis*, but also for aberrational forms, closely approximating these, found not uncommonly in *Aricia eumedon*, *A. donzelli* and even *Lycæna icarus*.* Further, even without the long isolation of the Ice Age, if the *artaxerxes* insignia were inherited at once the circumstances would agree with Fischer's† results with iced *Arctia caja* when the new "character," scale darkening, was inherited, and that fact explained, to harmonise with Weissmann's views, on the "parallel induction" basis.

In all such instances as these, whether we are dealing with *artaxerxes*, *coridon* or the rest, it seems by far the most reasonable position to regard the whole of the phenomena as explicable on chromosomal, or more broadly, germ plasm disturbance, brought about by the cold, in which those portions especially concerned with the development of black pigment in eyespots and discoidal points are the more strongly influenced. This would bring the case of *artaxerxes* into line with the current views of MacBride and Johnannsen and, moreover, except that it avoids the words "unit character" or

* Aberrational forms, exactly parallel to *artaxerxes* are known in *icarus*.

† Allg. Zeitsch. für Ent. Bd. VI.

factor, does not clash with Mendelian conceptions as to the inheritance of the *artaxerxes* peculiarities. If the germ plasm of *artaxerxes* differs in this way from that of the type, naturally when insects so endowed interbreed with type *medon* inheritance, typically Mendelian in its character, with segregation and other points complete, would be observed. The F_1 generation would, in all probability, appear as a perfectly intermediate *albiannulata* whilst in the F_2 we should have a reappearance of parental conditions and, in addition, further *albiannulata*. If the germ plasm disturbance were not uniform in all the *artaxerxes* individuals, and it is obvious that such could readily be the case, the name *albiannulata* would cover not one but a series of aberrations.

In any case but little difference exists between the Mendelian and the other interpretation of the facts; one gives names and offers no explanation as to origins whilst the other attempts the latter, but, perhaps justly, when experimental results are considered, has no use for what it regards as mere words.

V. SUMMARY.

(1) In the British Islands *Aricia medon* exists in two distinct races, the Central European type and the form *artaxerxes*.

(2) The latter is almost confined to Scotland and Ireland and the former to England and Wales.

(3) However, on the Durham Coast, the two races overlap.

(4) The population there shows true intermediates to which the names *albiannulata*, *salmacis*, etc., are applied but segregation occurs for pure *medon* and *artaxerxes* are to be taken constantly and in goodly numbers.

(5) Similar populations fail in the West of England because the contact between *medon* and *artaxerxes* has been but slight.

(6) The inheritance in the over-lapping areas is Mendelian.

(7) If factorial differences are involved they are but few.

(8) *Artaxerxes* originated, in all probability, in a contingent of *medon* isolated during the Glacial Period.



Map of the British Islands showing the distribution of *Aricia Medon*.

Shading descending obliquely from right to left indicates the range of type *medon*, that from left to right of *artaxerxes*, and the black that of our mixed local population.

Nicholas Temperley.

By the death of Nicholas Temperley, in the month of October, 1923, the Natural History Society has lost one of its most enthusiastic members. The records of the Tyneside Field Club show that he was elected in 1869. With a keen love of the country—after retiring from an active business career—he devoted the evening of life to closer study of Nature in her many moods and forms, and directed his energies to persuade and teach others to interest themselves in nature study. It would be difficult to find one who had a finer sense of the responsibilites and privileges of citizenship. In addition to the fulfilment of civic life as Councillor and Magistrate, Mr. Temperley served his fellow men in many directions. Amongst the societies in which he took an active part may be mentioned: The Savings Bank, Tyneside Sunday Lectures, Literary and Philosophical, Antiquaries, Archæologists, Natural History, Mycological and Aboricultural, his catholic taste finding interest and scope in the work of each of these. At an age when most men seek rest and comfort in their well earned leisure, he applied himself with energy to promote the welfare of his fellow men, and spared nothing in his endeavour to increase their happiness. Out of a wealth of experience, with unusual vitality of body and of mind, he was able to the last to keep in touch with many activities, and his sympathetic help was always at the disposal of those who sought his assistance—indeed he made the opportunity to help those less fortunately situated than himself.

Thoroughness was the keynote of his character and no subject which came to his notice was too insignificant to claim his kindly interest. As a past Field President, and for some years an active member of the Council, his varied experience and clear outlook were of great help in the affairs of the Society. With a sound knowledge of the flowering plants and trees, his later years were devoted to the study of mosses and fungi. Somewhat diffident and shy by nature, the challenge

to truth or justice found in him one who never flinched in courage, and he was fearless in upholding the cause of the weak. The lives of the children of the very poor claimed his sympathy, and for them he was largely instrumental in forming play centres, and could oft be seen of an evening or on Sundays acting as guide to Park, Museum or Picture Gallery. The cause of education was dear to his heart, and many have reason to remember his helpful work in connection with the Cambridge University Extension movement.

It is not the place here to speak of his private life, but one may be allowed to say that his retentive memory, his wide acquaintance with men of letters and of science and his sense of humour, all combined to make him a delightful companion in the field, or the home where he loved to welcome those with kindred tastes and interests.

C. E. R.

MISCELLANEA.

Golden Eagle.

An immature specimen of the Golden Eagle was shot by a miner on Mr. Beal's farm at Newsham, Northumberland, on December 2nd, 1923. The skin was set up by M. J. Cuthbertson of 11, Jubilee Terrace, Bedlington, where it was seen and identified by W. Raw and J. S. Lock, of the Ornithological Section Committee.

W. Raw.

Farne Islands.

A meeting was convened by the Ornithological Section of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne on January 18th, 1923, to consider the position of bird life on the Islands in the face of present conditions.

The meeting was attended by the following representatives of the various societies interested in bird preservation:—Lord Armstrong, Collingwood F. Thorpe, Lancelot Smith, Mrs. T. E. Hodgkin and Col. R. Scott, representing Farne Islands Association; E. G. B. Meade-Waldo, representing National Trust, Zoological Society of London, and Society for Promotion of Nature Reserves; A. H. Evans, representing National Trust, British Ornithologists' Union and B.O. Club; J. R. B. Masefield, M.A. and Mrs. Frank E. Lemon, representing Royal Society for Protection of Birds; Miss M. G. S. Best, representing British Ornithologists' Union and B.O. Club; S. Foggin, representing Selborne Society; J. H. Craw, representing Berwickshire Naturalists' Club; Capt. Fullarton James, Chief Constable of Northumberland; C. E. Robson, Professor A. Meek, Randle B. Cooke, G. W. Temperley, W. Raw, W. E. Beck and T. Russell Goddard representing Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne.

The chair was taken by Lord Armstrong, and it was announced that the inner group of the Islands was then in

the market for sale at a price of £1,200. Lord Armstrong agreed to include the outer group of Islands in the sale should it be found possible to raise the necessary money.

The desirability of the Islands falling into suitable hands was agreed upon, and after a full discussion W. Raw proposed, and J. R. B. Masefield, M.A., seconded:—

"That steps be at once taken to ascertain the amount for which the whole of the Islands can be purchased, and if a purchase can be effected, the Islands be vested in the National Trust."

The motion was carried unanimously.

It is gratifying to record that as the result of the efforts of F. Collingwood Thorpe, the Hon. Secretary of the Farne Islands Association, the necessary purchase price has been secured, and it is anticipated that by the time this note is in print the entire group of the Islands will have passed into the safe keeping of the National Trust. Consequently, one of the most interesting places where birds foregather for the purpose of breeding will remain for all time inviolate, and the feathered inhabitants continue to breed in safety and security.

W. Raw.

Bird Sanctuary.

Following closely upon the foregoing it is interesting to record that, thanks to the kindness and interest of a respected and well-known member of the Natural History Society, Gosforth Park woods and lake have been turned into a bird sanctuary. This gentleman whose modesty demands that he remain anonymous, has rented the shooting rights of the entire park, and given strict instructions to the police and keepers that no guns are to be used within the precincts and that the birds are not to be molested in any way. It would be difficult, if not altogether impossible, to duplicate this ideal locality for a sanctuary within easy reach of the city of Newcastle, and the generosity and kindly thought expressed in this magnificent effort should be highly appreciated by the members of the Society, and indeed, the public at large.

Various species of Duck in large numbers, and other water birds have made the lake their headquarters during the winter, and it is hoped that their freedom from molestation will entice some of them to remain and breed there. It is hoped and expected that the members of the Natural History Society will do everything within their power to further the effort to make Gosforth Park a Bird Sanctuary in name and reality.

W. Raw.

The Miller's Thumb, Cottus gobio.

We have to thank Mr. John Allen, Bellingham, for specimens which show that the Miller's Thumb occurs in Northumberland. They were obtained by him on August 10th, 1922, from the Swilder Burn, a tributary of tbe Wansbeck. This is the first time we have had a definite record for Northumberland, and it is the more interesting as the fish occurs in a tributary, and probably tributaries, of the Wansbeck, and not in the rivers immediately to the north and south namely the Tyne on the one hand and the Tweed on the other.

A. Meek.

Limax cinereo-niger, Wolf.

When Mr. J. S. T. Walton was with me, on 21st June, 1922, he picked up in Nattrass Gill Foot, Alston, a large, dark, lead-brown coloured slug, with faintly traced darker lines on sides, and conspicuous pale dorsal stripe along its strongly keeled back; tail tapering to a point, sole of foot a soiled white; the whole animal, when extended in crawling, reaching to close upon four inches in length.

I sent it to the Museum for identification, when Mr. Leonard Gill found it to be the typical form of *Limax cinereo-niger* figured in J. W. Taylor's "Monograph of the Land and Freshwater Mollusca of the British Isles," vol. 2. Though there are records for Westmoreland in that work, there are none for Cumberland, Durham, or Northumberland, so that this seems to constitute an addition to the Fauna of Cumberland.

In September, 1923, I found a second example, almost as large and equally well marked, at Kirkhaugh, Northumberland, which gives us another new County record.

George Bolam.

Pyramidula rotundata f. alba. Moquin-Tandon.

On June 14th, 1924, I was fortunate in coming across a small colony of this interesting greenish-white shelled form of a very common snail in the magnesian limestone quarries at Fulwell, County Durham. This form is described by Alder in his "List of the Mollusca of Northumberland and Durham"* as "very rare," and the only two localities he mentions are Benwell Lane and Tanfield. There are only three specimens in the Alder Collection and they are collectively labelled "Benwell Lane and Tanfield." Apparently, therefore, the white form of *P. rotundata* was very rare in the two counties in Alder's time. In his "Monograph of the Land and Freshwater Mollusca of the British Isles,"† J. W. Taylor under the heading of *P. rotundata* var. *alba* says:—"This pretty variety is frequently found in colonies, and was formerly considered a very rare form; the absence of decaying wood about its haunts has been advanced by Herr Clessin as a cause of the variation."

I have visited Fulwell Quarries twice subsequently with the special object of learning something further with regard to the frequency of occurrence and distribution of the white form of *P. rotundata* there. I have found it abundantly under stones and logs of wood in one of the old workings, but not in any other part of the quarries. It is interesting to note that wherever I have found the white form the type is intermingled with it. In addition, there occurs an interesting series of intermediate forms ranging from those in which the blotches are just perceptible on a greenish-white or yellowish-white ground right down through a graded series to the type.

* Transactions of Tyneside Naturalists' Field Club, 1848.

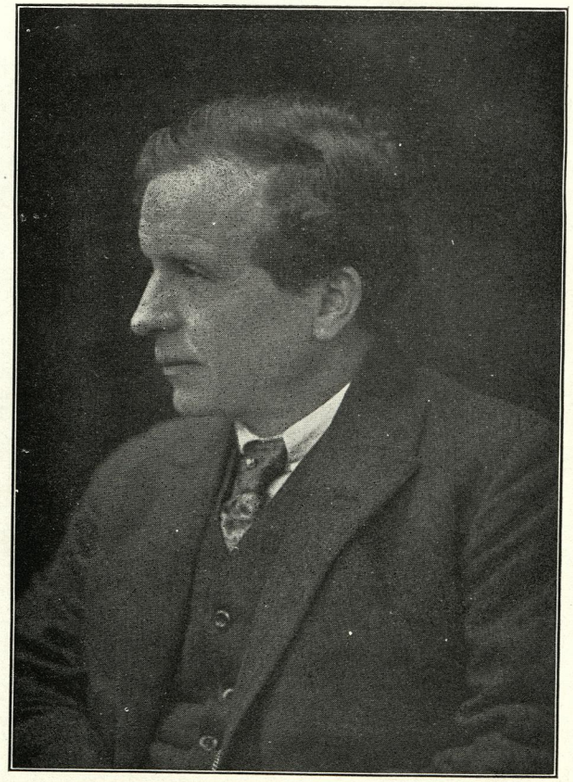
† Vol. III., page 188.

So far as Fulwell Quarries are concerned the presence or absence of decaying wood does not appear to influence the variation. In some parts of the old working in which the white form occurs there is a considerable amount of decaying timber and much vegetation of many years standing, such as elder, bramble, nettle, colt's-foot, and a quantity of moss growing on a rich humus. Upon turning up a block of the magnesian limestone it is no uncommon occurrence to find in a space which might be enclosed in a circle of two inches diameter, two specimens of the type and one or two of the white form. Under a decaying log of wood, on the other hand, I found nine specimens of the white form and seven of the type or intermediate forms. Furthermore, in a list of localities in which the white form has been taken, published in J. W. Taylor's "Monograph of the Land and Freshwater Mollusca of the British Isles" woods are frequently mentioned, and one would not expect an absence or even a shortage of decaying timber in such situations. It seems evident therefore, that lack of decaying wood is not a cause of this variation in *Pyramidula rotundata*.

T. Russell Goddard.

ERRATA.

Page 239, line 16, for "Johnson" read "Johnston."
Page 239, line 27, et seq., for "Warren" read "Waren."



THE LATE DAVID WOOLACOTT.

David Woolacott.

BY J. A. SMYTHE, D.Sc.

David Woolacott, D.Sc., F.G.S., was born at Sunderland on July 1st, 1872. Of his early life there is but little to record. His father died when he was only a year old, and the care of his upbringing devolved entirely upon his mother, a shrewd, well-informed woman, who exercised great influence on her son and who lived long enough to see him widely esteemed for his sterling worth and attainments.

Entering Armstrong College in 1891, he graduated in 1895 and, after spending some years as Science Master at the Valley Road School, Sunderland, was appointed Demonstrator of Geology at his old College. The appointment at first was a part-time one; in 1905 it was made a full-time post, and this, with promotions, eventually to Readership, he held until his untimely death on August 4th, 1924. He was awarded the degree of Doctor of Science of the University of Durham in 1904, and the Murchison Fund of the Geological Society of London in 1921.

Woolacott's original scientific work falls mainly into two categories, Glacial and Permian, and his choice of subjects for investigation is very intimately related to his birthplace and life-long town of residence. Sunderland was the centre of his scientific activities, which spread out in ever-widening circles, until they embraced the greater part of the two north-east counties. He cut his scientific wisdom-teeth in the early nineties of the last century on the gravel deposits about Fulwell and on the famous section of the Permian beds at Claxheugh, on the Wear, and his early papers on these subjects are the types of most of those which followed, in a steady stream, for the next twenty years.

The early observations of Howse (1878) had disclosed old caves, apparently sea-worn, on the Cleadon Hills, and the

sands and gravels associated with these were generally regarded as ancient sea-beaches, dating from a time at the close of the Glacial period when the land stood at a lower level than at present. The interpretation of these deposits as raised beaches was maintained by Woolacott and applied later to the similar deposits at Cleadon and Easington. In the latter, he was fortunate in finding a great abundance of marine shells.

These gravels rest, in part, on the boulder clay and associated deposits, which cover parts of the pre-glacial rock surface, often to a great depth (over 200 feet) and Woolacott's attention was naturally directed to the study of these. Ground had already been broken in this field by Wood and Boyd (1863) who, in a classical paper on the "Wash" of the Durham coalfield, had proved that the Wear, in pre-glacial times, continued its course northwards, past Chester-le-Street, in the direction of the Team and emptied its waters into the Tyne at Dunston. With the advent of the ice, this old channel became blocked with glacial drift and the new Wear, re-born after the melting of the ice, was constrained to leave its old course at Chester-le-Street and to cut a passage for itself through the Permians to the sea at Sunderland.

The extension by Woolacott of the methods of Wood and Boyd to the whole of the Northumberland and Durham coalfield, in which the necessary data, supplied by borings and sinkings for coal, are available, led to the elucidation of the main features of the pre-glacial drainage over this area. From the detailed consideration of the pre-glacial contours, he concluded that the pre-glacial Tyne was the main drainage outlet and that the pre-glacial Wansbeck ("Sleekburn") and Coquet ("Druridge Bay" or Chevington stream) were its tributaries, joining the mother-stream some distance seaward of the present shore-line. Later (1906), a re-survey of the Wash, in the light of many fresh data, enabled the course and slope of the ancient Wear to be determined with much more accuracy than was possible to Wood and Boyd.

To a geologist, living at Sunderland, the call to study the Permian rocks would seem to be almost imperative, granted that the moral courage to tackle such an amazingly complicated formation were not lacking. Woolacott's early work on Claxheugh (or Clack's Heugh) section had familiarised him with the structural characteristics of the Magnesian Limestone and prepared his mind for the reception of new ideas concerning the tectonics of this formation. On extending his observations further afield, his trained mind and eye were not slow to detect order in seeming chaos and his speedy recognition of differential movement or thrusting in the beds gave him the clue to many baffling phenomena. At the same time, the correlation of brecciation with thrusting, and the full realisation that the concretionary structure is a secondary one, not peculiar to a particular horizon, gave him valuable criteria in his critical survey of the stratigraphy of the formation, and led him to reject the classifications then current and to develop one more in consonance with his own observations.

This initial success paved the way for many years of unremitting toil on the stratigraphy and tectonics of the Permian rocks, the results of which are recorded in two important memoirs, abounding in new observations which extend over the greater part of the Permian outcrop in Durham, and include also the isolated patches in Northumberland. The time is not yet ripe to appraise this work. Some of it is, necessarily, of a controversial nature, for the phenomena are very complex and the agencies invoked to explain them are sometimes not uniquely applicable. Woolacott himself, for example, in a later paper (1919) lays much stress on the chemical components of the rocks and the possible effect of these on the production of breccias. Still, whatever modifications of interpretation the future may show to be necessary, one cannot but admire the patient accumulating and critical assorting of such a mass of information in a field of exceptional difficulty, and one feels that the work will endure and form a monument *(aere perennius)* to the name of Woolacott.

The Carboniferous beds which underlie the Permian of Durham come in for incidental treatment in several papers. One (in collaboration with Dr. Trechmann) is devoted entirely to these rocks and describes the highest Coal Measures in the Durham coalfield, which are exposed near Claxheugh. The more recent examination of borings at Sheraton and Cotefield Close, and especially the great one at Roddymoor directed Woolacott's attention afresh to Carboniferous geology and, combined with his field knowledge of the subject, enabled him to draw many important conclusions as to the range and variation of particular beds over wide areas.

Woolacott had many activities beside those just described. He was an active member of our Society and did much valuable work in the naming and arranging of specimens and in the provision of diagrams illustrating the local geology. He lectured widely on his own subject and the allied one of Geography, and did much work in this way and by writing popular articles to stimulate general interest in geology.

In his geological make-up he was essentially a disciple of Lebour—a field geologist first and foremost, who looked upon the specialised branches of his subject, petrology and palæontology, rather as handmaids or helps in the elucidation of the story of the rocks. He was at his best in the field, cheerful and untiring and always ready for any exertion in order to see things of interest or to clear up field difficulties. The writer has many vivid memories of long tramps, at home and abroad, with Woolacott as companion, and has often marvelled at his physical endurance and the equanimity with which he met extremes of weather, hunger and thirst, and the usual trials of the naturalist in the wilds; the prospect of a night in the open did not dismay him and the last mile of the day was usually the best. He was a student and an investigator and he gave up much in the pursuit of his ideals. One feels it is not inappropriate to apply to him the words of the poet:

> Here's the top-peak! the multitude below,
> Live, for they can, there.
> This man decided not to live but know.

List of Publications by David Woolacott.

The following contractions are used:—

N.H.T.	Transactions of the Natural History Society of Northumberland and Durham.
U.D.P.S.	Proceedings of the University of Durham Philosophical Society.
Q.J.G.S.	Quarterly Journal of the London Geological Society.
G.M.	Geological Magazine.
P.G.A.	Proceedings of the Geologists' Association.
G.J.	Geographical Journal.
V.	Vasculum.

On a Portion of a Raised Beach on the Fulwell Hills, near Sunderland. N.H.T., 1900, vol. 13, Pt. 2, 165.

On the Boulder Clay, Raised Beaches and Associated Phenomena of the East of Durham. U.D.P.S., 1900, vol. 1, Pt. 4, 247.

An Explanation of the Claxheugh Section, Co. Durham. N.H T., 1903, vol. 14, Pt. 2, 213.

The Geological History of the Tyne, Wear and Associated Streams. U.D.P.S., 1903, vol. 2, Pt. 3, 121.

Sections in the Lower Permian Rocks at Claxheugh and Down Hill. N.H.T., New Series, vol. 1, Pt. 1.

The Landslip at Claxheugh, September, 1905. N.H.T., New Series, vol. 1, Pt. 3.

Superficial Deposits and Pre-Glacial Valleys of the Northumberland and Durham Coal Field. Q.J.G S., 1905, vol. 61.

The Pre-Glacial Wash of the Northumberland and Durham Coal Field. U.D.P.S., 1906, vol. 2, 205.

The Origin and Influence of the Chief Physical Features of Northumberland and Durham. G.J., 1907, 36.

An Exposure of the 100-Foot Raised Beach at Cleadon. U.D.P.S., 1907, vol. 2, Pt. 6, 243.

The Physical Geography of Sunderland and District. Sunderland Antiquarian Society, 1907.

A Recently Formed Conglomerate near St. Mary's Island. N.H.T., 1908, vol. 3, Pt. 2.

A Case of Thrust and Crush-Brecciation in the Magnesian Limestone, Co. Durham. U.D.P.S., Mem. 1, 1909.

On Borings at Derwenthaugh and Dunston. U.D.P.S., 1909, vol. 3, Pt. 3, 153.

Note on the Structure and Surface Features of a Portion of the Rocky Mountains. U.D.P.S.. 1910, vol. 3, Pt. 5, 327.

The Stratigraphy and Tectonics of the Permian of Durham (Northern Area). U D.P.S., 1912, vol. 4, Pt 5.

Geology of North East Durham and South East Northumberland. P.G.A , 1912.

The Magnesian Limestone of Durham. G.M., 1919, vol. 6, 452, 485.

Physiography and Geology of Penshaw Hill. V., 1919, vol. 5, Nos. 1 and 2.

Borings at Cotefield Close and Sheraton. G M., 1919, vol. 6, 163.

The Highest Coal-Measures in the Durham Coal Field (with C. T. Trechmann). G.M , 1919, vol. 6, 203

Exposure of Sands and Gravels containing Marine Shells at Easington. G.M , 1920, vol. 57, Nos. 672, 307.

The Inter-Glacial Problem and the Glacial and Pre-Glacial Sequence in Northumberland and Durham. G.M., 1921, vol. 58, Nos. 680, 21, 60.

On the 60-Foot Raised Beach at Easington. G.M., 1922, vol. 59, Nos 692, 64

A Boring at Roddymoor Colliery, near Crook, Co. Durham. G.M., 1923, vol 60, Nos. 704, 50.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1921.

READ APRIL 10TH, 1922, BY J. W. HESLOP HARRISON, D.Sc., F.R.S.E., CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1921.

In view of the heavy cost of printing at the present time I do not intend to follow the usual plan of giving detailed lists of the plants, insects, etc., observed on our outings. For the most part I shall confine my remarks to forms noteworthy either because they are new or rare or because they need confirmation of their present existence in our counties.

The First Field Meeting was held at Finchale Abbey on April 30th, when about 30 members took part. Leaving Plawsworth Station we walked to the Abbey, noting as we went that all of the spring flowering shrubs and trees were at their very best. Of these we paid most attention to the three species of Sallow, *Salix aurita*, *S. cinerea* and *S. Caprea*, all occurring in great plenty on the moist road sides accompanied by their three possible hybrid combinations, here recorded for the first time for Durham.

After we had reached and explored the Abbey, we assembled for tea at the farm, when Mr. Nicholas Temperley gave an extremely interesting account of its history. This function over, we rambled along the banks of the river and through the adjacent woods looking for plants and insects. The most noteworthy of our finds was the Scented Violet, *Viola odorata*, a plant with but a feeble hold in our area. Growing with it was the Rest Harrow, *Ononis spinosa*, which with us generally favours the coast. Odd plants of the Hairy Violet, *Viola hirta*, were also seen; this likewise is more of a coast and limestone plant with us in Durham.

Amongst the insects the solitary bees of the genus *Andrena* received most of our attention. *Andrena albicans*, *A. wilkella*, *A. trimmerana* and *A. fulva* being taken. The last named with its parasitic *Nomada* was quite common, and formed a

particularly welcome record, as its previous status as a native of Durham rested on a few captures of single individuals.

The detection of a further willow hybrid *Salix ambigua*, a cross between *S. repens* and *S. Caprea*, on some heathery land near the river was the closing event of the day.

The Second Field Meeting took place at Ravensworth on May 21st. Owing to the miners' strike the projected expedition to Hawthorn Dene was declared off, and instead we spent a half-day at Ravensworth. Here, since the plants present were simply those noted on former occasions, our attention was especially directed to the wonderful display of foreign trees and shrubs in the Arboretum. Oaks of many kinds—Cork, Red, White, Turkey, Spanish—Weeping Willows, Robinias, Cryptomerias, Wellingtonias, Rhododendrons and the like were all carefully examined. In particular the various oaks were searched for their special galls, but none turned up, although the two English oaks swarmed with *Andricus curvator*, *Spathegaster baccarum*, with a few of *Spathegaster albipes* and *S. vesicator* by way of variety.

Despite our careful work, the American Robinia Sawfly must have eluded us, for its larvæ showed themselves in some plenty later.

A little Snowyfly was discovered, but for a long time all our efforts to detect its food plant proved futile until a lucky stroke found it in thousands on the bramble, and it stood revealed as *Aleurodes rubicola*. Rather distant relations of this in the form of the somewhat rare Coccids *Physokermes abietis*, *Lecanium ciliatum* and *Asterolecanium variolosum* were also seen.

Another welcome find was the little Geometrid Moth, the Yellow Barred Brindle, *Lobophora viretata*, hitherto only known to us from Gibside.

The Third Field Meeting took place at Stocksfield on June 4th. Our route took us from Stocksfield Station via Wheel Birks and Whittonstall to Ebchester. Except one

plant, a cross between the Field Poppy and the Opium Poppy, nothing of great variety was seen until Wheel Birks was reached. Here the first wild roses of the season were found in flower, and all proved to be the bright rose flowered form of *Rosa glauca* var. *subcristata*. In the woods we were pleased to see the Oak Fern flourishing, whilst not far away Solomon's Seal, the Japanese Primrose and London Pride seemed quite at home, the first in particular looking deceptively like a native.

The weather was too dull for insects; nevertheless a moth new to Northumberland, *Fumea intermediella* to wit, was found on birch, whilst the pretty little Clouded Border, *Lomospilis marginata*, was disturbed in numbers from the sallows along the stream.

After tea had been taken at the Wood House, Whittonstall, we walked through the woods to Ebchester, taking examples of the spring larvæ as we went. These included the usual assemblage of winter moths like the Dotted Border, the Mottled Umber, the Spring Usher, the two November moths *Oporabia autumnata* et *O. dilutata*, the Satellite and *Tortrix viridana*, but nothing really worth taking.

These oaks likewise provided the same Cynipids as we had seen at Ravensworth, with the addition of a few of the leaf turning Oak Gall Gnats, *Macrodiplosis dryobia* and *M. volvens*. Probably these oaks would have yielded rarer species had the rain not prevented closer search.

We closed the day with an examination of the sites of the Roman Road and Camp.

The Fourth Field Meeting was held at the Devil's Water on June 10th. Almost immediately we left Corbridge Station great masses of the Hedge Bedstraw, *Galium mollugo*, met us—a plant perpetually puzzling one as to its absence from the lowlands of Northumberland and Durham. Passing on we entered the woods sloping down to the stream and examined the foliage of the various trees for galls. At once the lime yielded numberless *Contarinia tiliarum* on its flower

stalks and the oak trees the usual oak galls, but little else gladdened our eyes. On the whole the woods seemed hopelessly barren, the only saving feature being the Bird's Nest Orchis, *Neottia nidus-avis*. This barrenness we assigned to the prevalence of beeches. However, when we managed to cross the stream and to enter the fields matters improved, for on the hazels we captured the Snowy Fly, *Asterochiton avellanæ*, and on the Honeysuckle, *Aleurodes loniceræ*. In a swamp near by Green Veined Whites and Common Blue Butterflies fluttered about. Besides these the same marshes produced the Marsh Forget-me-not and the Orchid, *Orchis latifolia*, with *Carex hirta* and other sedges. On the slope from the marsh another Forget-me-not, *Myosotis versicolor*, grew.

Once more entering the woods, a change in the vegetation to oak, alder, pine and larch gave us more moths, the Beech Green Carpet, the Bordered White, the Common Carpet, the Argent and Sable, the Silver Ground Carpet and the May High Flier.

Proceeding we reached Linnold's Bridge to admire the beautiful water garden with its wonderful tiers of *Primula japonica* and similar plants. Last, but not least, we saw here an enormous eel, by far the longest any of us had ever seen. On the road side masses of wild roses scrambled over the hedges, most of them appertaining to the *glauca-coriifolia* fraternity, although *R. mollis* and *R. omissa* were not wanting. Nor, of course, were the usual dog roses popularly grouped under the names *Rosa canina* and *R. dumetorum*.

From Linnold's Bridge we retraced our steps somewhat and passed on to Hexham. On the road the same roses as before delighted our eyes, but more noteworthy was the abundance of *Geum intermedium*, the cross between the Wood and the Water Avens. This hybrid occurred in multitudinous forms.

The Fifth Field Meeting was held at Billingham and Greatham on July 9th. Of this very enjoyable meeting I need say but little here, for I have described the marshes

fully in my paper in the Transactions for 1918. Perhaps, however, I should mention that our party had the pleasure of observing a magnificent flight of herons on Holme Fleet. Mr. Cooke, too, added a plant to the flora of the fleets in the shape of the Mare's Tail, *Hippuris vulgaris*.

The Sixth Field Meeting took place at the Sneap on August 13th. On this occasion we varied our route by beginning and ending our walk at Shotley Bridge Station. Strolling along the river side we plucked the usual riverside plants reported on earlier rambles in this pleasant district, but in addition we collected the Common Bistort, *Polygonum bistorta*, the Variegated Horsetail, *Equisetum hiemale*, and a strange looking St. John's Wort, possibly only the Common Perforated St. John's Wort, *Hypericum perforatum*, but still well off type. After we left the fields we kept to the road, noting endless wild rose forms, now long past their best as flowers, but in first rate order for determination. These comprise *R. Reuteri*, *R. fugax*, *R. subcristata*, *R. intricata*, *R. Lintoni*, *R. Bakeri*, *R. frutetorum* and *R. coriifolia*, with other minor forms of the *glauca-coriifolia* group. With them grew *R. sylvestris*, *R. omissa* and *R. mollis*.

A clayey horsepond by the road side was dragged, and in it we were fortunate enough to discover that curious fresh water polyp the Green Hydra, *Hydra viridis*. Not far away over the hedge a swamp drew our attention, and in it we found growing huge masses of the Marsh Cinque Foil, *Comarum palustre*, mixed with Red Rattle, *Pedicularis palustris*.

Close to the Crooked Oak Farm where we lunched we found a new habitat for the Lesser Winter Green, *Pyrola minor*, whilst not far away flourished the Melancholy Thistle, the Chickweed Winter Green, *Trientalis europaea*, the Broom Rape, *Orobanche major*, with the same sedges as reported on an earlier visit. Noteworthy, too, was a dense thicket of aspens.

On the bridge at Allansford we were very pleased to encounter Pellitory-on-the-Wall, *Parietaria officinalis*, still holding its own, more especially on the side of the bridge facing the garden.

As our time was now very limited, we pressed homeward through the fields, striking the woods just above the station for the Columbine, *Aquilegia vulgaris*, now ripening its seed, although its companion, the Wild Pansy, still rejoiced in stray blossoms.

This day, save for caterpillars of the Aspen Sawflies, was an absolute blank in the matter of larvæ. Nor were any butterflies or moths seen. However, a few galls like *Mikiola fagi* and *Oligotrophus annulipes* on beech, *O. capreae* on sallow, *Contarinia betulina* on birch, various Eriophyid mite galls on alder, and the Common Oak Spangle galls were of general occurrence.

The Seventh Field Meeting was held at Chopwell on September 3rd. Little that was new manifested itself on this occasion, but still it was rendered noteworthy by the curious second flowering of many spring flowers like the Dog Violet, Herb Robert, Red Campion and Ivy-leaved Speedwell. Equally curious were the colour varieties seen in the flowers of the Devil's Bit Scabious, pink, white, cream and blue forms being observed. In the nursery devoted to forest trees the Wild Pansy grew in a large and handsome guise.

The lepidopterist had here a little better luck with larvæ, the Coxcomb Prominent, *Lophopteryx camelina*, the Iron Prominent, *Notodonta dromedarius*, the May High Flier, *Ypsipetes trifasciata*, the Broken Barred Carpet, *Cidaria corylata*, and the two White Waves falling into the beating tray; whilst on the nettles the spiny larvæ of the Red Admiral were quite common.

Homopterous larvæ likewise were freely taken, those of *Aleurodes loniceræ* and *Asterochiton avellanæ* occurring on honeysuckle and hazel respectively. However, the neighbouring group the Psyllids or Leaf Hoppers had long since

attained maturity, with the result that the tray received myriads of *Psylla peregrina*, *P. alni*, *P. försteri* and *P. mali* replaced, when nettle and bedstraw were shaken by representatives of the allied genus *Trioza*, *T. urticæ* and *T. galii*. After tea we retraced our steps to find but little new but empty cocoons of *Fumea intermediella*, which we had taken on an earlier occasion at Stocksfield.

Some attention, too, was paid to the nests of the Ant, *Formica rufa*, in the hope of finding some of its guests, but with no success.

Our last captures were quite interesting, for on the poplars at the station diligent search was rewarded by the taking of several larvæ of the Poplar Hawk, *Smerinthus populi*, and the Swallow Prominent, *Pheosia dictaea*, with less important fry in the shape of the Grey Dagger, *Acronycta psi*.

The Eighth Field Meeting was held at Holywell on September 17th, where, by the courtesy of Mr. Thompson, we were allowed to descend the mine. There, both above and below ground, everything of interest was pointed out by Mr. Thompson and Mr. Clephan.

Many of us were agreeably surprised at the comparative comfort of the mine workings, and, needless to say, were very pleased to see the coal-cutters of various types left at work for our inspection. We all, of course, hewed the proverbial piece of coal, and brought away the usual piece of mussel band as a souvenir.

On reaching daylight once more we proceeded to Bates' Cottages, when we were delighted to inspect the rich insect collections, as well as the birds, of the veteran worker Mr. Proudlock. After this we returned to Mr. Thompson's house for tea, and subsequently examined his butterflies and moths. Next he took us round his garden to display his collection of trees specially planted for food purposes.

All too soon the shriek of the whistle from the engine, provided by Mr. Thompson, warned us that the time for departure had arrived.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1922.

READ MARCH 27TH, 1923, BY F. C. GARRETT, D.Sc.,
CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1922.

To be selected for the Chairmanship of your Field Meetings Committee is an honour which no member could fail to appreciate, but the recipient's pleasure is tempered throughout the summer by the knowledge that at the end he must attempt the writing of a report, and as the Society has been exploring these counties, and its doings have been chronicled for nearly a hundred years the task is now far from easy. I submit that the increase of knowledge, and the daily press have rendered this report unnecessary, and that our Council might consider the desirability of releasing my successors from this arduous task.

The Opening Meeting was at Whitburn on May 6th, and from a Natural History standpoint barren: the season was, of course, unusually backward (I gather from former reports that it usually is) and the day being cold and sunless, life of all kinds was exceedingly scarce. Those who attended the meeting were amply repaid, however, by spending an hour in Mr. Sewell's beautiful rock garden—one of the best in the kingdom—and by the kind and hospitable manner in which our host exhibited its beauties.

On May 27th was the second and most successful of our expeditions, to Gibside. The weather was perfect, the attendance large, and students of every branch found sufficient to interest them, though nothing of such novelty as to be worth putting on record. The Red Admiral *V. Atalanta* and the Painted Lady *V. Cardui* were seen, and as these spring migrants rarely come so far north, the prospect for the autumn seemed good.

The third expedition was to Burnhill on June 17th, and the hopes raised by the month of May were dashed, for there was little sunshine and a cold east wind tried the travellers

and kept the moorland insects in hiding. On assembling at the Moor Cock Inn for tea it was found that there was plenty to see on the moors, but the animals and plants reported were all familiar and widely distributed, and the only novelties were obtained at the last minute, Mr. J. R. Johnson finding a specimen of the Glaucous Shears *H. glauca* and Dr. J. W. H. Harrison the Twin-spot Carpet *L. salicata*, the former moth is not in Robson's list, and the latter has not been recorded for many years.

The fourth was a week-end meeting at Holy Island, the party assembling on June 30th; I was unfortunately unable to go down and I am indebted to Mr. N. Temperley for a report of the trip. Friday evening was given to exploring the basalt ridge to the south of the village and the discovery of such unusual plants as Field Garlic, English Stone Crop and the three trefoils—haresfoot, soft-knotted and rough. In spite of a rising wind and a lowering sky the party adventured on Saturday to the Farne Islands and the birds. "The complete absence of Terns was noted with regret. The vast flocks of Terns which hitherto have nested annually on the islands have this year completety deserted their usual haunts. Various reasons have been given to account for this, but there is no doubt that one principal cause is the increased and increasing traffic of visitors. The motor boat with its crowd of pic-nicing sightseers has violated the sanctuary enjoyed by the birds and they have gone away to seek safer quarters. . . They may return another year, but not unless some drastic steps are taken to prevent their nesting places from being trampled upon and raided by pic-nic parties." Sunday was spent upon Holy Island where, of course, numbers of plants and birds rarely seen elsewhere were noted.

The fifth venture on July 15th took us to Hexham to the comparatively new ground of Birkey Burn and Fallowfield; Mr. Michael Green kindly acting as guide. Some 60 or 70 years ago a rifle range was prepared alongside Birkey Burn for the use of the Sandhoe Volunteer Company, and the

adjoining plantation is still known as Target Wood. When the range was no longer required Mr. C. Henderson converted it into a wild garden, and there is now a pleasant walk over turf with flowering shrubs and the broad burn on the right and ornamental trees and rising ground on the left. Mid July is of course late to see much of the birds, and few of the plants are natives of the spot, but under better conditions insect life would have been abundant, but once more we had to contend with a sunless sky and an east wind, and everything was in hiding. From the upper end of the burn a pleasant lane with beautiful views of the Tyne valley led past the old lead mines, to Fallowfield and so via Brunton bank to Chollerford and the The George Inn.

After this the weather grew hopelessly bad, and the next three Field Meetings had to be abandoned on account of the incessant rain, so Hown's Gill, Prestwick Car and Ebchester were not visited.

On September 23rd a small party—seven in all—set off for the coast at Boulmer, and I have again to thank Mr. N. Temperley for a record of its doings. The weather was kinder than on most days and the little party made good use of its time, some examining the geology of that piece of coast, while others studied its bird life with such success as to observe 44 different species! Perhaps the botanists were the most fortunate, as they found among other things, two ferns—the Common Ceterach and the Sea Spleenwort—which are very rare in this county.

The last meeting was at Gibside on October 7th, and the season at least finished up well; it is curious that the two really satisfactory meetings of the year should both have been at that park. As a "fungus foray" the meeting was most successful, Mr. and Miss Temperley collecting no less than thirty-four species of fungi, but for the botanist and entomologist also it was of great interest. Late as the date was, the beautiful autumn weather ensured an uncommon wealth of flowers and plants, among them the Angelica which

is such a feature of Gibside, while a white "ragged robin" and specimens of the Great Pendulous Sedge and the Beautiful St. John's Wort also attracted a good deal of attention.

The only butterfly seen was a Small Copper, but the autumn moths were appearing in greater numbers than were expected after so wet a season. Peculiarly valuable was the discovery by Dr. Harrison of large numbers of the minute fly *Leptella fusciceps* Reuter. This Psocid fly has twice been found in England and reported as *R. helvimacula* Enderlein; it spins webs on the lichens and hides underneath, only emerging to feed. The eggs are laid singly and anchored by threads of silk, but after a brief period are overgrown by the lichen and remain through the winter sheltered in this way.

To write a report of our field work is a difficult task, for technical scientific details are out of place in it, and in truth the increase of knowledge is not the object of these meetings. Their chief advantages are that at them we strengthen old friendships and make new ones, and that those who, like myself, are but beginning the study of natural history can watch the veterans at work, study their methods, lay before them our difficulties, and doing this make the pleasing discovery that those whom we looked up to as our teachers have become our friends, and are eager to welcome us as comrades in the army of workers for the advancement of knowledge.

REPORT ON THE FIELD MEETINGS OF THE NATURAL HISTORY SOCIETY FOR 1923.

READ DECEMBER 15TH, 1924, BY J. R. JOHNSON, CHAIRMAN OF THE FIELD MEETINGS COMMITTEE FOR 1923.

In accepting the post of Chairman of the Field Meetings Committee of the Natural History Society, which honour you so kindly conferred upon me, I felt there were many members much better fitted to undertake the duties pertaining to that office. It is, however, very gratifying to have been placed in a position which enabled me to be of some little assistance in furthering the aims of this Society and to be of some help to the rising generation of naturalists amongst the members. The outings have been a source of great pleasure and interest to me, for as the leader of them I have been drawn out of the section to which I am devoted and made to take a more general interest in Natural History.

The First Field Meeting of the season was held on May 12th in Chopwell Woods (by kind permission of Captain J. D. Hopkinson) where a party of about forty members assembled. These woods which are Government property have been under the control of Armstrong College for the study of forestry for a number of years. They present a splendid opportunity to the student of Natural History for studying plants and insects on account of the felling and clearing of parts which allows new plant life to grow and the distribution of insect life to take place. It has been and still is very interesting to note the changes which have taken place in the insect life. Formerly some insects were only found in restricted areas in the woods, but since these places have been cut and replanted certain species have disappeared whilst others have distributed themselves over a wider area.

The Ornithological Section was in great force for many of the leading ornithologists were present and their record was a good one. Among the birds that were noted were the Great

Spotted Woodpecker and nest, Long-tailed Tit and nest, Marsh Tit and nest, Great Tit and nest, Cole Tit and nest, Pied Fly-catcher, Tree-Pipit, Wood-Wren, Redstart, Jay, Sandpiper, Water Ouzel, Grasshopper-warbler, Tree-Creeper and a Thrush with unspotted eggs. The colony of Sand Martins in the sand bank close to the station was also examined.

The Botanical Section spent a very satisfactory time amongst the flowers, many kinds being at their best. The Whin *Ulex europæus* and Broom *Cytisus scoparius* made a glorious patch of colour in many parts. Some very fine examples of mosses were obtained such as *Polytrichum commune* (in male and female form) and *Funaria hygrometrica*. A few fungi were also observed.

The list of insects taken was rather short, the spell of cold weather which spread over the previous few weeks probably accounting for the non-appearance of many moths. The Engrailed *Tephrosia biundularia* and The Brindled Pug *Eupithecia abbreviata*, however were seen and larvæ were obtained of the following—Orange Underwing *Brephos parthenias*, Large Emerald *Geometra papilionaria*, November Moth *Oporabia dilutata*. A number of Scale insects were found, amongst them were, *Fonscolombia fraxini*, *Orthesia cataphracta*, *Chionaspis salicis* and *Asterodiaspis quercicola*.

The Second Field Meeting was held at Ovingham Dene (by kind permission of Mr. T. Riddle) when a party of 32 members assembled. It is worthy of note that when the Tyneside Naturalists' Field Club was formed in 1848, this dene was the scene of the first meeting under the presidency of the late Mr. R. Carr-Ellison and an anniversary meeting was held there 50 years later when the Tyne was crossed by a bridge and the members were no longer laboriously conveyed by ferry. Although such rarities as the Bird's-eye Primrose, the Moonwort and Adder's Tongue fern are no longer to be found there, yet there is still a wealth of flowers and birds to charm the eye and please the ear.

On leaving Prudhoe Station the party crossed the bridge to Ovingham Church where Thomas Bewick is laid to rest. The church itself claims the attention of the historian and archaeologist, particularly by reason of the Saxon characteristics which the square built tower displays. A fine description was given on the spot by the late Mr. N. Temperley. The botanists were delighted with the display of Alyssum, Aubrietia and Gentian which gave a glorious amount of colour to the path leading up to the church.

On arriving at the Dene the party were met by Mr. Riddle who pointed out the various parts which he thought worth exploring. The botanists and entomologists spent a long time in the lower part of the Dene. The weather was not all that could be desired at this particular stage, for a slight rain began to fall and with a close atmosphere made the woods anything but pleasant.

On coming out into the open the eye was at once arrested by the steep bank covered from top to bottom by the golden glory of the Broom, and the botanists present soon noted the overlapping of the seasons (owing to the long continuance of cold, dull weather) early spring flowers such as the Cowslip, Wood Sorrel and Lady's-smock being observed.

However, the rain passed off and things began to get much better, although the undergrowth did not dry very quickly, and many places were very wet for the rest of the afternoon. When the party arrived at the farm where tea was served and notes compared a fair amount of work had been done. After tea the party visited the upper part of the Dene where much more work was done by all sections.

The Ornithological Section observed the following birds :—Grey Wagtail, Pied Wagtail with nest, Tree-Creeper, Garden-Warbler, Gold-crested Wren, Redstart, Jay, Magpie, Swallow with nest, and Blue Tit with nest.

The Botanical Section reported that some very rare plants were found including the Globe Flower and the Bird's Nest Orchid.

In the Entomological Section a very poor record for the time of the year was made, everything being in a very backward condition due to the late summer.

The following were the chief insects captured in the larval stage :—Scarce Umber *Hybernia aurantiaria*, Dotted Border *Hybernia progemmaria*, Mottled Umber *Hybernia defoliaria*, Light Emerald *Metrocampa margaritaria*, November Moth *Oporabia dilutata*, Small Quaker *Tæniocampa cruda*. The following were captured on the wing, Green-veined White *Pieris napi* and the Barred Carpet *Emmelesia tæniata*.

The Third Meeting was held at Gibside (by kind permission of Mr. W. C. Ralston) when a party of about 30 members assembled at Rowlands Gill Station. On arriving at the woods the party divided into various sections, some taking the lower part of the wood while others visited the higher reaches, the parties afterwards meeting near the Hall.

The weather was very wild at first, but in the woods shelter was obtained from the wind, but not from the heat, which was a severe handicap to those who were beating for larvæ. In the woods there was still evidence of the lateness of the season, Primroses and many of the earlier flowering plants being still in bloom—nothing like what might be expected for mid June. The walk back to the Chapel House was very refreshing after the heat which was experienced in the woods. A fine breeze was blowing, and tea which was provided by Mrs. Cheeseman was very welcome. After tea the party visited the other parts of these fine woods. Altogether a very enjoyable day, although not a very profitable one, was spent.

The Botanical Section was probably the most successful, and a long list of plants was obtained. The Laburnums *Cytisus Laburnum* and the Rhododendrons made a fine show in places, and a fair number of Fungi were seen including some fine specimens of *Polyporus sulphureus*.

The Ornithological Section observed the following birds:—Jay, Wood-wren, Willow-wren, Gold-crested Wren, Great Tit, Blue Tit, Swift and Swallow.

The Entomological Section still had a poor list for the middle of June. Owing to the scarcity of insects on the wing, the insect hunters turned their attention chiefly to beating for larvæ, when the following rewarded their efforts: - Scarce Umber *Hybernia aurantiaria*, Mottled Umber *Hybernia defoliaria*, Dotted Border *Hybernia progemmaria*, Pale Brindled Beauty *Phigalia pilosaria*, Small Quaker *Tæniocampa cruda*, Orange Underwing *Brephos parthenias*, Minor Shoulder Knot *Epunda viminalis*, Dun-bar *Cosmia trapezina*.

The Fourth Meeting was held at Blackhall Rocks when a party of 23 assembled. The weather was cool, with an easterly wind blowing which, bringing a thick haze over the whole district from the sea, was the cause of so few insects being seen on the wing. This was a great disappointment to the entomologists. Some members of this section had never seen the Durham Argus at home, and made the journey for the first time in the hope of securing a few specimens.

The day is not far distant when the banks at this part of the coast, covered from top to bottom with the flowers of Geranium, Bird's-foot Trefoil and Rockrose will be buried by the pit heaps which are rising and advancing down the denes towards the sea, and the home of the Argus and Orchids and many other rare plants will be covered by the refuse from the mines. In future articles dealing with the haunts of *Salmacis* the reference which has stood so long—"abundant on the Durham coast"—must be modified by the sad word "formerly." The party began the day's ramble by visiting the denes north of the Rocks. Each dene was explored by all sections, and about two miles up the coast a halt was made for lunch.

The report of the Botanical Section was in every sense a record, thirty-nine species of plants in flower being recorded. The list included the Butterwort, Purging Flax, Bird's Eye

Primrose, Grass of Parnassus, Round-leaved Winter Green, Fragrant Orchid and Marsh Helleborine.

A very beautiful variegated form of Wild Rose was found, and proved to be of a very interesting nature. The whole plant was variegated, and many versed in roses stated that they had never seen such a thing before.

A very interesting find was *Perrisia Bedickei*, a gall on the Burnet Saxifrage, this being the second record for the United Kingdom, while a very pretty Plume Moth which feeds on Devil's-bit Scabious was plentiful.

The following were the principal birds noticed:—Skylark, Titlark, Yellow Hammer, Blackbird, Thrush, Whitethroat, Herring Gull and the Lesser Black-backed Gull. Tea was served at Blackhall Rocks Hotel, and afterwards some of the party had a short ramble along the cliffs until train time, which brought one of the most successful days to a finish.

The Fifth Meeting was to be held at Rothbury, but on account of so many members being on a holiday it was decided to cancel the meeting.

The Sixth Meeting was held at Urpeth Bottom where a party of twelve assembled. The weather was at the outset very wet with a rather cold wind, but after the rain came the sunshine, which continued for the rest of the afternoon. Insect life began to appear on the wing and the Entomological Section got busy among the day-flying moths and butterflies. In fact all the party were delighted with the beautiful Small Copper Butterfly which was seen in fair numbers. In many cases thistle heads bore two or more examples.

The Ornithological Section were busy observing the many birds that were about and picking out this season's birds from the older ones by the difference in the colour of their plumage, also noticing that many species were making south to a warmer climate, the colder weather of late reminding them that it was time they were off to their winter quarters. The

further the party proceeded up the valley the warmer it became and in the woods was even hot.

After tea, which was provided at the Paper Mills, the higher reaches were explored, and here the party lingered, admiring one of the most beautiful and delightful spots to be found within a short distance of the busy haunts of industry. The higher part which rises almost perpendicularly from the river Team at this place is covered with birch and purple heather, this mingled with the brown and golden hues of an early autumn, made one of the finest sights that members had seen for a long time.

The reports from the different sections made up a very useful afternoon's work. Nothing of outstanding importance was recorded, but many interesting specimens were seen, The Botanical Section reported many fine examples of Fungi, some of which had to be taken home for identification. The more interesting ones were the following :—*Phallus impudicus, Herneola auricula-judæ, Collybia maculata, Amanitopis vaginata, Sclerodendron vulgare, Boletus subtomentosus, Russula ochraleuca, Lactarius quietus, Calocera viscosa, Agaricus campestris.*

I am indebted to the late Mr. Nicholas Temperley for the identification of the Fungi. He was ever ready to help in the identification of anything collected in the field. In the death of Mr. Nicholas Temperley the Society has lost an ardent nature-lover who tried to inspire others with his own enthusiasm, and was ever ready to help fellow students in their studies. Anyone going to him for advice found him in possession of a store of knowledge on a wide and varied range of subjects.

The Ornithological Section reported the following birds :— Wood Sandpiper, Kestrel, Common Whitethroat, Cole Tit, Tree-creeper, Magpie, Snipe, Green Plover.

The list of insects taken was poor, those observed were:— The Ear Moth, *Hydræcia nictitans*, The Antler, *Charæas graminis*, Small White, *Pieris rapæ*, Small Copper, *Chryso-*

phanus phlæas. Larvæ of the Red Admiral Butterfly *Pyrameis atalanta* were seen on almost every patch of Nettle, while in the stems of Ragwort and Thistle were found the pupæ of the Frosted Orange, *Gortyna flavago.*

The Seventh Field Meeting was held at Greatham Marshes on September 29th. The party met at the Central Station, Newcastle, and took the 1.17 p.m. train to West Hartlepool and then by bus to the scene of operations. The meeting was arranged primarily for bird observation, therefore, as was to be expected the ornithologists were in the majority, however, there were a few entomologists present.

The weather was rather misty at the outset but improved early in the afternoon, and as long as daylight remained visibility was good. The records for the afternoon were rather poorer than was expected for such a renowned bird haunt, and this was due to a variety of causes, principal amongst them being the presence on the marshes of several sportsmen who were busy with their guns. Several large flocks ot Curlews and Lapwings were seen and a few Greenshanks. A few Godwits were observed and other records were Dunlin, Ringed Plover, Redshanks and Snipe.

The pools of brackish water were tried for Mollusca and although all were well stocked with specimens they could be placed within the confines of at most three species. It is interesting to note, however, that they were all slightly brackish water species and were living in company with the edible marine shrimp.*

It was too late in the year to expect to see many flowering plants in bloom, but a few of the common species were observed.

The Entomologists had rather a blank day, but were quite content to observe the birds. A few beetles and two moths were taken. Although very few records were made the whole party spent a very enjoyable day.

* Mr. T. Russell Goddard records the capture in these pools of *Paludestrina ventrosa* (Montagu). This snail is a new county record, its previous northern limit having been Lincolnshire.

The Eighth Field Meeting was held at Gibside by kind permission of Mr. W. E. Ralston. The meeting was set apart as a fungus foray, autumn being the best time of the year for studying this particular form of plant life.

Gibside Woods are particularly suited to the growth of Fungi, being somewhat damp and shady, and plentifully supplied with hollows or shallow depressions. The dead leaves are blown into the depressions by the wind, and becoming rotten form a good rich humus upon which many species of Fungi grow. Many other species grow upon fallen and decaying timber, and Gibside being a sporting estate rather than a commercial plantation, there is a fair amount of such material lying about. Other species of Fungi grow upon living trees or at their roots, and a large group known as "rusts" are to be found thriving upon dead leaves.

The Botanists were naturally in the majority, and all likely spots were investigated. Tea was provided at 4.30 p.m. on the estate, and by this time more than 50 species had been observed or collected. The list included several species each of *Russula*, *Polyporus*, *Polystictis*, *Stereum* and *Trichia*, a large number of *Agarics*, *Pluteus servinus*, *Stropharia æruginosa*, *Lacaria lacata*, *Rhytisma acerinum*, *Sphærobolus terrestris*, *Nectria cinnabarina* and *Xylaria hypoxylon*.

Entomological records were rather sparse, and the only butterfly seen on the wing was a Red Admiral; however, a few moths were observed and one or two larvæ were collected. Several plant galls were noticed such as *Contarinia steini*, *Cynips kollari*, *Neuroterus numismatus* and *Biorrhisa renum*. A white variety of the Red Campion *Lychnis dioica* was found and the Ragged Robin *Lychnis flos-cuculi* was observed still in flower.

The Ninth Field Meeting was held at Ravensworth by kind permission of Mr. W. Johnson.

Owing to the late period of the year the number of flowering plants observed was small. However, the list included Common Groundsel, Sticky Groundsel, Red Campion, Money-

wort, Canadian Fleabane, Foxglove, Self Heal, White Dead Nettle and Three-nerved Sandwort.

Those interested in Fungi had a much longer list to their credit. The more interesting species being *Polystictis versicolor*, *Stereum hirsutum*, *Nectria cinnabarina*, *Sphærobolus stellatus*, *Tremella mesenterica*, *Physarum* sp., *Poria vaporaria* all on dead or decaying wood, *Puccinia menthæ* on *Mentha aquatica*, *Cylindrium flavo-virens* on dead leaves, *Hypomyces chrysospermus* on decaying *Boletus*.

The Entomologists succeeded in taking the November Moth *Oporabia dilutata*, and observed far too many of the injurious scale insects upon the trees. The commonest scale insects were the Felted Beech Coccid, Felted Ash Coccid, the Willow Scale and the pit making Oak Coccid. The Snowyfly of the Honeysuckle, *Aleurodes loniceræ*, was observed as well as three species of the Psocidæ.

On the Crustacean Fauna of a salt water pond at Amble, with some remarks on its bearing on the Problem of the Inheritance of Acquired Characters.

By Alexander Meek, D.Sc.

The late Professor G. S. Brady published a list of the Crustacea * which he found in the material obtained by netting a salt water pond at Amble in November, 1905. He prefaced his paper by giving an account of the history of the pond, and I also described the pond with notes as to the fish-life which had been observed in it.† It was stated in these papers that the pond originated about 50 years before. By the kindness of Mr. J. Earnshaw, J.P., Amble, I am now able to give further particulars as to the origin of the pond. The quarry which occupied the site was opened about the year 1838 to provide stone for the building of the piers of the harbour, but the stone proved too soft for the outer blocks of the piers and a harder stone had to be obtained from Queensferry. Nevertheless a considerable quantity of stone was removed from the quarry for the purposes of the harbour and for building operations, and the excavations went down to 60–70 feet. On the completion of the piers, the pumping engine was removed and the quarry was allowed to fill with water. This was about 1849–50. At first, therefore, the water would be fresh, but as the sea at high tide is separated from the pond by a shell of the original sandstone, salt water was added by every successive storm. It was found that it was liable by fresh water drainage on the one hand and heavy seas on the other, especially the former during heavy rains, so to gain in height of water as to endanger the gardens in the vicinity and a hole was pierced through the rocky wall which separates the pond from the sea. The pond in consequence is maintained at a fairly constant level. As has already been manifest the water contained in the pond is

* 1907 Trans. Nat. Hist. Soc. of Northumberland, etc. New Ser., V. 1., p 330.

† 1905. Report Cullercoats Laboratory, p. 106.

derived from land drainage and from the sea. According therefore to circumstances of rain and storm it may be supposed to vary in salinity. But the following analyses show that the variation is not very great, and indeed indicate that the pond is gradually becoming less saline. I owe the first analysis to Professor Bedson and the other three to Miss Meek, M.Sc. :—

	1905.	1922.	1924.	1924.
	16th Nov.	22nd Aug.	12th July.	6th Sept.
Cl. per 1,000 ...	18.21	16.46	15.605	15.37
Salinity	32.90	29.74	28.20	27.77
Sp. gr. at 17.5° C.	1.02513	1.02271	1.021535	1.02121

The bottom appears to be mainly sand with a coating of mud and some stones, but our hauls in the deep water end on 6th September, 1924, showed that the bottom there is covered with fine coal dust—a modern feature.

From the nature of the pond it is not surprising that marine life of various kinds has been carried into it—has managed to grow to maturity and even to reproduce there. I was attracted to the pond by being told that herrings had been captured in its waters and also dabs, flounders and eels, and I found by the netting now to be referred to that other marine life as Pleurobrachia gained at least a temporary existence in the confines of a pond which is about an acre and a quarter in area.

The material reported on by Brady from the hauls made in 1905 included several common littoral and marine species of Copepoda, and in addition species new to the district, viz., *Isias clavipes*, *Cyclopina gracilis* and *Pseudobradya minor*, a new species of Ectinosoma, *E. brunnea*, and a new genus of Ostracoda, Proteocypris, *P. salina*. This pond with a history of some 55 years yielded three rare species not before known in the region, a new species and a new genus.

In August, 1922, an accident to the engine of the "Evadne" compelled us to pass a few days in Warkworth Harbour, Amble, and I took the opportunity, with the help of Mr. Storrow, to obtain another sample of the more minute life by the use of a plankton net. A moiety of the material was sent to Mr. Andrew Scott, who was good enough to examine it. The results were as will be seen disappointing, and more samples were got in July and September, 1924. These were again submitted to Scott and show very little change at least qualitatively. The successive results will be plain from the following table :—

1905.	1922.	1924
Macromysis flexuosa (Müller)	X	X
Melita palmata (Mont.)	—	—
Isias elavipes, Boeck.	—	—
Temora longicornis (Müller).	—	—
Acartia longiremis (Lillje).	X	X
Cyclopina gracilis, Claus.	X	X
Ectinosoma brunnea, Brady.	—	—
Pseudobradya minor, T. and A. Scott.	—	—
Harpacticus chelifer (Muller).	—	—
Tisbe furcata (Baird)	X	—
Proteocypris salina (Brady).	—	—
Daphnia pulex (L)	—	—
—	*Amphiascus debilis* (Giesbrecht).	X
—	*Laophonte curticauda* (Boeck).	X
—	*Crangon vulgaris* (L).	X
—	—	*Cletodes limicola*, Brady.
—	—	*Corophium bonelli*, Milne-Edwards.
—	—	Barnacle nauplii.
—	—	Carcinus ? zoea.
—	—	Copepod nauplii.
—	—	Crangon zoea.

The pond evidently has become poorer in species since it was first sampled. In 1922 the Crustacea were not numerous and included only four of the 1905 list, one of the four being *Cyclopina gracilis*, new to the district. If many species had disappeared in the meantime new ones were added, viz., the common *Crangon vulgaris*, and two Copepods, one of which *Amphiascus debilis* again proves to be new to the district; the other is a common littoral species. The pond also contained numerous specimens of *Gobius ruthensparri*.

In 1924 three of the 1905 species were still present, but *Tisbe furcata* has apparently been eliminated. The three new Crustacea of 1922 were present in fair numbers, but the goby had apparently disappeared. The Amphipod *Corophium bonelli* was added and many specimens of this species were obtained in the shallow part of the pond. The Copepod *Acartia longiremis* which has persisted in the pond throughout the period of sampling was present in enormous numbers especially over the deeper part; the three hauls of the net furnishing over 250,000 specimens. The larvæ of this Copepod and of *Crangon vulgaris* were found also in large numbers. There is abundant evidence therefore that many of the organisms which have been introduced have managed to reproduce, and it is more than probable that the fish were introduced in the egg or larval state. It is interesting to note that the species of *Acartia* which has been so successfully acclimatised is according to Brady not the common one of the coast which is *A. clausi*.

A second visit was made in 1924, in September, with a view to determining if the missing new species lurked at the bottom of the deep part of the pond. The material got from the hauls was with difficulty separated from coal dust, which since 1905 has accumulated there, and the material yielded not a single example of either. *Acartia longiremis* was found again pelagically in great numbers, but was apparently not quite so numerous as in July. A species of Copepoda, *Cletodes limicola*, was recorded for the first time from the bottom of the deep region.

These facts show that since 1905 the crustacean life of the pond has undergone a remarkable change; not only the crustacean but the fish life. Flounders have been known to occur nearly all the time evidently and they may probably manage to reproduce in the pond. But the others are able to live only for a year or two. Two species of Copepoda have become acclimatised including one new to the district. The Ectinosoma and Proteocypris have apparently perished, thus yielding a record of two species which have had a temporary existence. If they occur only in this pond and we have failed to catch them again still they are doomed for sooner or later the pond will be filled in by the authorities at Amble. It is noteworthy also that the mysid which has been found on each occasion is the common littoral form and not the estuarine Neomysis so common in the Coquet. Crangon also appears to have obtained a satisfactory footing. The young *Gobius ruthensparri* have apparently found the conditions impossible, and we have to note again that the goby is the common littoral species.

Not long after describing the new genus Proteocypris from Amble, Brady came across it again in samples sent to him from Natal, and two more species were registered.* No information was given as to the nature of the two ponds from which the two new species were obtained, but their association with a pond in Northumberland by means of this genus is remarkable.

With the exception of Daphnia and Proteocypris the crustacean fauna of the pond is marine. Among the marine species moreover are rare forms recorded for other regions but never before or since from Northumberland. How had they reached a pond which had been in existence only 55 years?

The Amble pond does not stand alone in this respect. The old quarry pond at Granton which communicates with the

* 1907. Annals of the Natal Government Museum. V. 1., p. 176.

Firth of Forth yielded to Dr. T. Scott † a large number of rarities and one or two new species. The investigation of marshy pools and fresh water ponds has brought to light in addition to common and widely spread types rare and even new species, some of which in fact have not been met with afterwards. There are found in such places well-established species and in addition, when lists are compared, so large numbers of species ranged under nearly allied genera that we are led to enquire whether after all they are not of local origin. It has been shown that certain Cladocera of Continental lakes pass through a series of morphological changes during a season, and many of these rare species may be due to fluctuation induced by the conditions.

Although it is universally recognised that life is now, and during its long history and evolution has been in conflict with an adverse environment, the predominant belief is that life is none the better and none the worse for such an experience, that if variation takes place it is germinal in origin and owes nothing to the conflict. The advocates of this view regard life as inviolable and free from any debt to the physical world. There is much to be said for such a conclusion for many species now and in the periods of the past have spread over wide areas of the globe without undergoing any change which the systematist can define. Moreover some species have been proved by geological record to have had a practically changeless history over long periods of time; one or two even from the Cambrian. The contemplation is a comforting one for were it not for what might be termed this toughness of constitution of so many species and genera it would be difficult, if not altogether impossible, to explain their distribution. The belief has gained in strength from the recent work in genetics which has served to indicate that life in general is under strict rules for insuring inheritance.

While this is true it is also true that variation is the rule. The pattern woven into each individual is not an exact reproduction although its general character is maintained.

† 1906 24th Ann. Rep. Fish Bd. Scotland, p 277.

Environment is a factor of importance, however much we may differ in our attempts to explain it. A Verbascum growing on Ben Lawers is a dwarf compared with one grown in the valley, A vine in England cannot be expected to produce like the same plant in Spain. At the Cullercoats Laboratory young plaice reared under exactly the same conditions with respect to food and in the same tank varied in a year in size to the extent of over 100 per cent. Variation in size therefore may result from internal and external causes.

Even fundamental variations may take place in relation to temperature. Tropical reproduction in the sea is characterised by the liberation of larvæ and in colder conditions by the development of embryos in brood chambers. On the west coast of England the same species of starfish, the same species of anemone liberate larvæ, and on the east coast embryos brooded to a much later stage of development. Such changes cannot satisfactorily be referred to germinal factors for currents tend to carry the larvæ into the region of the embryos. The experimental work as to the results of changed conditions described and discussed by Semon,* Kammerer, Tornier and MacBride † and criticised by Bateson ‡ indicate that physiological, even pathological, followed by morphological changes take place and may be inherited. We are familiar already from our own experience with acquired modifications, but it is practically impossible to prove that such are transmissible. An obvious example is the effect produced by dialect. Under the influence of an environment of dialect the physiological peculiarities bring about morphological modifications the effects of which are marked and persistent. But it would be difficult indeed to demonstrate the modification by morphological evidence and the effects are not inherited. Many cases of the subtleties of modifications and their variability were pointed out by me many years

* The Mneme 1921.

† Eugenics Review 1924.

‡ Problems of Genetics 1916.

ago with reference to domesticated and other animals.§ The expectation therefore is not that the characters are fixed but that environment produces an effect in every case, although the effect is not always apparent. The issue therefore is perfectly plain.

In the case of a new species of a marine form and the new genus of a fresh water organism found at Amble we have to choose between two explanations. The one is that the two were already in existence somewhere and were conveyed to the pond somehow. The other is that the species in question originated in the pond, resulting from changes induced by the conditions of the pond to the extent which Brady found. There can be no question as to the accuracy of Brady's observations. The specimens are still preserved and were submitted by Brady to other authorities.

If we prefer the former explanation we shall be inclined to believe that *Proteocypris salina* actually exists in the near neighbourhood and reached the pond by bird or wind or water agency. It is not impossible. The spread of well-known established species is accomplished under seemingly great difficulties, and the type maintained far longer in isolated localities than the history of the Amble pond. Andrew Scott has given me from his experience a striking example; I quote from a letter:—"Thirty-five years ago I was a chemist in a sugar refinery at Greenock. The firm had three works and two had to be closed owing to bad trade. The laboratory was in one of the closed works. At that time it was customary to store the water for the boilers in great iron tanks on the top of the highest building. In course of time the store tank was run off and allowed to dry with the heat of the summer sun. It was next brushed with wire brushes, swept out and finally given a good coat of tar. It

§1897. Post-Embryonal Development—Incisor Teeth of the Horse—The Veterinarian.

1899. Post-Embryonal History of Voluntary Muscles—Journal of Anat. and Phys. V. 33, p. 596.

1900–01. Growth of the Farm Ungulates—The Veterinarian.

was never filled by the pumps again in my time. The only water the tank could get was from the rainfall. The following summer after the thorough cleaning I happened to to go up to the tank which had collected about six inches of rain water in the interval and I noticed that instead of the bottom being black it had a distinct yellow colour. A close examination revealed that the yellow colour was due to an enormous number of a single species of fresh water Ostracod known as *Cypris incongruens*. How had they got up to the tank? The only apparent solution was that the Ostracod had been carried up by wagtails and the conditions proved favourable to a rapid development. The tank was a favourite place with the birds as it was a nice shelter on windy days."

The species is very common, very resistent to conditions, and was found in the post-tertiary deposits of the Edinburgh region.*

The explanation given by Scott is quite feasible, but it is evident unless they lived on one another (and they do) that food was present as well. His father mentions that *Candona candida* was also found.†

Scott also gave me the history of the genus *Scottia* which illustrates a most interesting survival of type and a note on *Cyprois marginata* which indicates how local a species may be. He says—"When my father was at Rothesay with the Scottish Fishery Board he thoroughly explored Bute. In the course of his wanderings he collected a sample of fresh water plankton from a little marshy place that drained into Loch Fadd. When he came to examine it he found an Ostracod he could not identify. He sent specimens to Brady for his opinion. Brady was not sure about them either and sent them to Rupert Jones who had done much work amongst the fossil species. Jones recognised the Ostracod to be identical with a fossil species of his own describing, *Cypris browniana*.‡

* 1889. Bennie and Scott Proc. Roy. Phys. Soc. V. x.

† 1893. Proc. Roy. Phys. Soc. V. xii., p. 45.

‡ It was discovered by Jones in a fresh water deposit at Clacton, in Essex.

Then there was great excitement. More specimens were needed to study the animal which was found not to be a *Cypris* and a new genus was made for it, *Scottia*. After my father was moved to Edinburgh, Brady asked David Robertson to visit Bute and get more specimens. My father sent a plan and Robertson made two or three visits but could not find the exact spot. Finally my father arranged to meet Robertson at Rothesay. He took him to the place and again found the Ostracod. An old Ayrshire friend presented my father with some slides of mounted fresh water Ostracods which had been named by Robertson. They had been collected in an Ayrshire tarn long before the discovery at Loch Fadd, and on looking over the slides my father found *Scottia browniana* among them but wrongly named. These are the only two localities known for the living examples. It occurred in some of the old Scottish lake deposits as a Post-tertiary fossil." The history and references to literature are given in a paper by Dr. T. Scott, † who found it in a deposit at Elie, Fifeshire.

"The Ostracod *Cyprois marginata*, occurred in moderate abundance some thirty years ago in marshy ground at the east end of Duddingston Loch, Edinburgh, but we never found it in the loch itself although there was nothing to stop it migrating when the loch was flooded and the marshy ground became part of the loch."

Such occurrences which illustrate the peculiarities of distribution could be greatly multiplied. In the case of such small fresh water creatures liable to desiccation and to be carried by the wind, isolated communities may be expected and they are met with. In other cases an originally widely spread species may be isolated by the action of adverse conditions in the region round about. This is probably the explanation of the occurrence of a community of the Miller's Thumb *Cottus gobio* in the middle of Northumberland from which it is otherwise absent. It also serves to explain the restricted distribution of

† 1890-91, Pro. Roy. Phys. Soc. v. 10 p. 334.

Scottia browniana, a genus and species, which after a long history appears to be finding it cannot compete with present day conditions and may be said to be doomed to extinction.

But while these facts warn us to be careful they do not help in explaining why the Amble pond and similar ponds and lakes are so productive of rare and new species and genera and we have to consider the other alternative. Mention has been made of the fresh water Cottus. The genus is circumpolar in distribution, has undergone generic modification in the great lakes of North America and a remarkable degree of change in Lake Baikal.* This lake is a very ancient fresh water one; it is believed to have existed as a fresh water lake from the Devonian period. Up to the Miocene it drained into seas in communication with tropical seas but at that period its drainage was directed to the Arctic Ocean. It has therefore been the scene of the history of a succession of faunas, the records of which will be more or less imperfectly enshrined in the deposits of the basin. The present fauna is essentially modern, and may be said to be late Tertiary and Post-Tertiary in origin. But some of the groups have become modified to an extraordinary degree.

The amphipod genus Gammarus † and its allies are mainly fresh water in distribution. Twelve genera are found in springs and wells and fresh waters generally in the Northern Hemisphere. Twelve have been recorded for the Caspian, two are found in Lake Azov, and twenty in Lake Baikal. The twenty genera of Lake Baikal are resolved into 94 species. No other family of amphipods has reached the lake, or if so it has left no successors and the lake has been thoroughly explored. Gammarus itself is represented by two peculiar species; the nearly allied Echinogammarus—21 species of which have been described from the lake—has been found in streams of the Pyrenees, in the sea off the Faroes and the sea of Ochotsk; two genera are common to Lake Baikal and the

* 1916. Meek. Migrations of Fish.

† Stebbing. Das Tierreich Lf. 21.

Caspian and one of them is still more widely distributed; the genus *Pallasea*—nine species of which have been recorded for Baikal—is represented by a species in Europe. The rest are endemic and betoken modification on a liberal scale. Many other examples could be pointed out as the Cardiums in the Caspian region, the Unionids in Lake Tanganyika and the fresh waters of North America. But enough has been said to prove that the peculiar genera and species have not been in existence all the time but have been produced by modification over longer or shorter periods of time in isolated circumstances.

Now let us look once more at *Proteocypris*. Brady said "The long swimming setæ, the rudimentary post-abdomen, bi-sexual character and marine habitat sufficiently distinguish this genus from any of those hitherto described." When he found it amongst the material from Natal he remarked that it was bi-sexual but otherwise nearly allied to the fresh water *Cypridopsis*. If we presume that such changes have had a direct origin in the pond it is to the effect that a typically fresh water cyprid of parthenogenetic habit reverted to a bi-sexual state, and at the same time underwent somatic changes characteristic of the two sexes, involving the production of the highly modified 2nd maxilla of the male. The general changes amounted in the main to a lengthening of the swimming setæ of the posterior antennæ and the shortening of the posterior part of the body. We do not find therefore any great difficulty in accounting for these modifications as the result of environmental action, but the awakening of the duality of sex after probably countless generations of inhibition is most interesting. Yet it is just such a change as might be expected to happen if such a fresh water form was successfully acclimatised to salt water conditions.

The Ectinosoma is distinguished by size and minute details which it takes experts like Dr. Scott and his son to determine. There is no difficulty in the assumption that these features may have arisen environmentally. It is to be noted that the characters are not new acquisitions but the re-

establishment of a dormant quality and the hypertrophy or atrophy of features already present.

The direct explanation appears to be the more satisfactory, and if we admit the evidence in favour of it we are committed to the implication that similar organisms introduced to the same or similar conditions may pass through similar changes. In other words a Proteocypris change may have occurred independently in Natal and in Northumberland. I do not wish it to be understood that I am advocating a general polyphyletic origin of species. But I do wish to submit that while certain genera and species are so controlled by generic and specific factors or a sameness of conditions as to be practically fixed in type or liable to vary only within narrow limits, there are other genera and species which are in a more fluid state and the evidence goes to prove that such are in a constant state of fluctuation, within varied but much wider limits.

The endemic species of islands and the great lakes have originated under circumstances of endemic conditions. And such have had usually the necessary time to become so fixed in type and specialised that a retreat is impossible. But we have also many examples of species which are being successively exposed to alteration and alternation of conditions and the repeated call of physiological requirements in such meets with morphological response, unless the species has become so adapted to the wide range of physiological changes demanded that morphology is not affected.

Of these we have excellent examples from every group of pelagic life of the sea. If we regard the distribution of these with the above considerations in mind we shall see that in many cases the changes are of a temporary nature or more or less permanent according to circumstances, and we have further an explanation of the phenomena which have been so much discussed under the term bipolarity. One example from among a large number will have in the meantime to suffice. The distribution of the genus Clione may be graphically indicated as follows:—

Arctic—*C. limacina.*
Tropical—*C. longicaudata*, *C. gracilis* (N. Alt.), *C. flavescens* (Med.)
Antarctic—*C. limacina.*

This brings us lastly to a consideration of the new and rare species of Copepoda found in the pond. It has already been plain that many of these species are well known, well defined and widely spread and the occurrence of these in the pond does not call for remark, and the same would apply to rare species which can be so defined. But the species which are new to the district and in the case of *Ectinosoma* new to Science are of a different category. The genus in each case is known but the point is, it is not any of the local species which is obtained but some other which is rarely observed elsewhere. It is more than possible that such species are rare because they are limited in origin to such peculiar ponds which discharge into the sea.

A study of the crustacean fauna of the Amble pond leads to the conclusion that the peculiar species are local in origin, due to marine species being introduced to the endemic conditions of a pond with a less salinity than the sea, and to a fresh water species being carried into salt water. When every consideration has been examined the results may be regarded as an experiment on a large scale. The fresh water Ostracod has been so modified as to change from a parthenogenetic to a bi-sexual state. The marine copepod has been changed to an extent which makes it worthy of specific rank. The conditions of the pond have evidently been getting worse. Both the new species have evidently found the subsequent changes in the pond impossible. And the faunistic changes generally point to a limited period of survival of the majority and fresh introductions. Only one or two have managed to survive over the period concerned, since 1905. One of these *Cyclopina gracilis*, was recorded when discovered in the pond as being new to the east coast and rare elsewhere. This is so extraordinary that the suggestion is made that this and other rare species of the kind arise in such local ponds from the

modification of common species. For example, *Cyclopina gracilis* may be the product of *Cyclopina littoralis*, which is found in rock pools in the immediate neighbourhood.

Reasons are given for postulating that in every case a change of environment produces an effect. But the effect, if it be not death, may or may not be accompanied by a morphological change which can be ascertained. In the one case the organism appears to be fixed in character. In the other the changes which may be demonstrated constitute new characters and a new species if not a new genus is registered. The changes at first may not be irreversible, and facts are given which indicate that they are not, but it may be concluded that if the conditions are maintained they will become more and more fixed and inherited.

It is a pleasure to recall this investigation of my respected predecessor and to draw attention to the interesting observations of Dr. T. Scott and his son. This paper would not have been worth publishing unless it had the guarantee of Andrew Scott who practically stands alone now as our authority on microscopic crustacea.

Some Crustacean Larvæ from the Northumberland Plankton.

By Olga M. Jorgensen, M.Sc.

The samples obtained during the course of the plankton investigation which is being carried on at the Dove Marine Laboratory, Cullercoats[1] have yielded quantities of material from which it is possible to describe, in greater detail than has been attempted previously, the early stages in the development of certain Crustacea which, in the adult condition are recognised members of the Northumberland fauna. Two such species will be dealt with in the present paper.

I. EBALIA SP.

Two species of Ebalia occur locally, *E. cranchii* Leach and *E. tuberosa* Pennant. As the material examined had been preserved for some time, and as no attempt has been made to rear the larvæ, it is not possible to say to which species they belong, or even if they are all of one species; but as *E. cranchii* is the commoner adult form it is probable that the majority of our larvæ will be found to be referable to that species.

The larvæ first make their appearance in the plankton catches in July and continue to do so throughout the period of sampling, that is, until the end of September. The megalopa stage is taken from the middle of August, onwards.

The numbers of Ebalia obtained have never been very large, although the larvæ appear to be widely distributed in the area sampled, more particularly towards the south, the highest average number for the three hauls made at each station being fifty-six in the vicinity of the Coquet, in early September.

The larvæ rarely appear in the surface samples, and while they are present in the majority of the hauls made between $1\frac{1}{2}$ miles and 7 miles off-shore, they are absent from the few samples which have been taken farther out.

Tables showing the number and distribution of the larvæ in 1921-23, given in the Cullercoats Laboratory Reports [1, 2] referred to in the appended bibliography, serve to indicate that the numbers tend to decrease with distance from the shore, and that throughout the larval period there is a denatant drift of the young stages from north to south along the coast.

Station.	3 miles E. by S. of Burnmouth.	6 miles E. by S. of Burnmouth.	9 miles E. by S. of Burnmouth.
Average No. of larvæ.	9	—	—

Station.	$1\frac{3}{4}$ miles NNE. $\frac{3}{4}$ E of Coquet.	6 miles NE. by E of Coquet.	6 miles NE. by E of Coquet.
Average No. of larvæ.	56	16	4

A diagram, drawn up from the above-mentioned figures for the three years to indicate the drift of the larvæ already referred to, will be found on Plate I. It shows the beginning of the hatching period all along the coast in July, and the occurrence in August and September of younger stages at the more northern stations and a larger proportion of older larvæ in the Beadnell-Newbiggin region about the same time.

The Ebalia larvæ obtained are divisible into five groups—four zoea stages and a megalopa. These stages are indicated in the diagram by the Roman numerals. The zoea stages are distinguishable from those of other Brachyura present in our plankton samples by (a) their comparatively minute size, (b) the absence of both dorsal and rostral spines and (c) the form of the telson.

1st Zoea.—In the earliest larvæ obtained the carapace is nearly circular in side view and has a diameter of less than

·5 mm. In preserved specimens the abdomen is generally carried curved closely in under the thorax (Plate II. fig. 1). Anteriorly the carapace bears only a minute, blunt, median tooth in place of a rostrum and laterally it is seen to project considerably below the level of the eyes, each projection bearing a blunt protuberance which is found to be the precursor of a short lateral spine which makes its appearance in the next stage (Fig. 2).

The only appendages visible are the very short antennæ and the first and second maxillipedes. The first maxillipede is clearly biramous, bearing a jointed endopodite with a few short terminal setæ, and a bladelike exopodite with four long setæ situated at the distal extremity. The second maxillipede also has the exopodite well developed and bearing similar setæ, but the endopodite is present only as a small bud-like structure at its base (Fig. 3). The characteristic shape and armature of the telson, figured inaccurately by Williamson, [3] is illustrated in figure 4. It is retained unchanged throughout all the zoea stages.

2nd Zoea.—This stage is slightly larger than the preceding one (the carapace now measuring ca .5 mm.) and differs from it in the following particulars:—

(1) the exopodites of the two maxillipedes bear six setæ.

(2) the next two pairs of appendages have appeared as buds beneath the carapace.

(3) the position, on the ventral aspect of the first five abdominal segments, of the pleopods which make their appearance in the next stage, is now indicated (Fig. 5).

(4) the lateral spines on the carapace have the form and position shewn in figure 6.

3rd Zoea.—When this stage is reached the third maxillipede and first pereiopod have lengthened somewhat and become biramous, and the remaining pereiopods are indicated as buds. The first five pairs of pleopods make their appearance as short, undivided rods, as yet devoid of setæ (Fig. 7).

4th Zoea.—This larva has a carapace measuring not less than 1 mm.; the development of the thoracic limbs has continued as is indicated in figure 8 and the five pairs of pleopods are fully formed.

The Megalopa.—This stage in the development of Ebalia is easily distinguishable from the megalopa of other Brachyura taken in the plankton hauls by its small size, the shape of the anterior margin of the carapace, the shortness of the antennae, the absence of the spines on the carapace and the scarcity of setæ on the limbs. The length of the carapace is about 1.5 mm. and is somewhat greater than the breadth. The general characters of the megalopa are indicated in figure 9.

II. THYSANOESSA SP.

Euphausiid larvæ have been found to occur in the majority of the plankton hauls made during the early part of the year.[1, 2] The first samples taken in 1921, on May 18th to 21st, showed them to be present in very large numbers in both the northern and southern parts of our district, the catches made in the latter region, off Newbiggin, being the more prolific in this respect. The stages obtained were, for the most part, the last calyptopis and the earlier furcilia stages while, in the following April, samples were taken which gave younger larvæ, but in much smaller numbers than the previous May samples. The numbers of larvæ increased somewhat in June, and in both years, a few older stages appeared in some of the July material.

The 1923 samples are hardly comparable with the foregoing ones as regards these larvæ, as no catches were made earlier than August. Small numbers of larvæ were, however, obtained all along the coast during that month, and some few cyrtopia and post-larval stages were taken in September.

An examination of all the preserved material thus collected shows the larvæ to be those of *Thysanoessa sp.* On only one occasion were any specimens taken which were referable to another genus. At the last two stations worked in September, 1921, a number of *young* larvæ were obtained which it has now been possible to identify as the earlier calyptopis stages of *Nyctiphanes couchii* Bell.[4]

The present account, therefore, is concerned only with the Thysanoessa larvæ which are believed to be those of *T. longicaudata* Kroyer. In the absence of the only evidence upon which the species could be determined with certainty—that is, of material obtained from the successful carrying out of rearing experiments– it is impossible to do more than to show that there is some reason to believe that the bulk of our larvæ are probably not referable to *T. inermis*, the only other species with which they might be confused.

References to *T. inermis* are here meant in the sense in which Hansen[5] uses the name, that is to say it refers to either or both of the varieties which Lebour has separated again into distinct species[4] using the old names *T. inermis* Kroyer and *T. neglecta* Kroyer to distinguish them.

There is every reason to suppose that larvæ of both *T. inermis* and *T. longicaudata* occur off the Northumberland coast, as young adults of both species have been taken in the plankton—the former only once—and the fully grown adult of the latter species has been taken recently in Cullercoats Bay.

The morphological features on which is based the supposition that the greater part of the material examined belongs to the latter species are (1) the early stage at which the last abdominal segment differs from the others in length and the increase in its proportional length in later stages, and (2) the difference in the arrangement of the chromatophores on the telson, especially in the first calyptopis stage. As Lebour's preliminary account of the life history of *T. inermis* deals with the colour markings only up to the last calyptopis stage, it is possible to compare only the earlier larvæ in this respect. These points will be dealt with more fully in the following analysis of the stages examined.

The descriptions of the colour markings of our specimens have been taken from plankton material killed and preserved in formaldehyde for only three days so that the chromatophores had not begun to lose their colour. It has not yet

been possible to obtain living material for this purpose or for rearing, but it is hoped that it will be possible to carry on the investigation on these lines in the near future.

In the following account it is not intended to give a detailed description of the larval stages, but merely to indicate outstanding characters which serve to differentiate these from one another and to compare them with the corresponding stages of *T. inermis* described by Lebour.

1st Calyptopis.—This, the youngest stage taken in the plankton, has a length of ca 1.5 mm. The two pairs of antennæ are large and are carried in front of the body as shewn in Plate IV., figure 1. The other appendages are scarcely visible in a ventral view of the larva. The abdomen, which as yet is unsegmented, is longer than the carapace and more than one third of its length is occupied by the slightly broader terminal region, which in the next stage is separated off as the telson. The short median spine, which is present on the distal border of the telson in subsequent stages, has not yet appeared.

The body is entirely colourless except for the presence of three red chromatophores on the telson. These consist of a large median one situated near the distal end and a pair of smaller elongated ones more proximally placed and quite distinct from each other. *T. inermis* is described as having only one chromatophore at this stage of development.

2nd Calyptopis.—This stage measures 2.0 mm. The abdominal region is segmented and the sixth segment shows already a distinct difference from the others as regards length. Compared with the preceding segment the proportion is about 3 : 2. The telson has become relatively longer and narrower and the median spine is present. The position of the eyes is indicated by two small aggregations of blackish pigment (Fig. 2). The proximal pigment spots on the telson have the same disposition as before, but the distal one is now broken to form a pair of large branching chromatophores. Apart from these the body is still entirely colourless.

3rd Calyptopis.—In this, the last calyptopis stage, which measures 2.5 mm., the uropods appear but remain small and more or less hidden beneath the telson, as illustrated in figure 3. The red markings on the telson are unchanged and the same colour is now present on the eyes in the form of a small chromatophore in the centre of each together with a faint diffused colour spread completely over the surface of the organ (Fig. 4).

1st Furcilia.—The striking feature of this stage, as compared with the foregoing ones, is the great development of the eyes which are now pedunculate. The first pair of antennæ have the form shown in figure 5, and the second pair are carried at the sides of the body rather than in front. Another noticeable feature is the still greater length of the abdominal region—the increase being found principally in the sixth segment, which is now almost twice as long as the fifth, and in the telson. The uropods have increased in length, and in the size and complexity of their fringes of setæ, but like *T. inermis* the first furcilia of this species has none of the first five pairs of pleopods developed.

The length is 3.0 mm. and the colour markings are as in the previous stage with the addition of two pairs of very small red chromatophores, situated on the ventral aspect of the anterior part of the thorax.

2nd Furcilia.—This stage, which measures 4.0 mm., is characterised by the appearance of the pleopods on segments 1 to 4 (or in some individuals only on segments 1 to 3), as blunt, undivided rods devoid of setæ. The sixth segment is almost or quite as long as the fourth and fifth together, and the telson has a length equal to the sum of the lengths of the fifth and six segments. The pigmentation of the body is more pronounced at this stage, for in addition to the colouration of the eyes and telson which is unchanged, the markings on the thorax have become large red masses situated along the bases of all the thoracic limbs; the course of the alimentary canal is traced in red in the abdominal region, and paired, red

stellate chromatophores are present on the sides of the body above the bases of the pleopods (Fig 6).

3rd Furcilia.—Those pleopods which made their appearance in the previous stage are now more fully developed and fringed with setæ, but are still uniramous. The remaining fifth pair (or the fourth and fifth pairs) are present as buds. There is only a small increase in the length of the body and the colouration is unchanged (Fig. 7).

During the successive furcilia stages the telson becomes narrower and the distal margin changed in shape to the form shown in figure 8, but the number of spines remains unaltered.

Cyrtopia Stages.—Following the third furcilia are the last two larval stages, during which the thoracic limbs and the gills, which have begun to appear, approximate more and more closely to the adult condition as do also the pleopods which become longer and biramous. In the first cyrtopia the endopodite is less than half the length of the exopodite and is furnished with a few short terminal setæ (Fig. 8). In the last stage the two rami are more nearly equal and both are fringed with long setæ. Simultaneously the telson becomes relatively still longer and narrower, particularly distally, and the seven terminal spines become reduced, first to five and then to three. On ecdysis the last cyrtopia, which measures 6.0 to 6.5 mm., gives rise to the first post-larval stage in which the adult form is assumed. When this stage is reached there can be no doubt as to the species. The determining characters are the relative length of the last abdominal segment as compared with the combined lengths of the fourth and fifth segments, and the presence or absence of a median dorsal spine on the posterior margin of this same segment (Figures 9 and 10).

The three years' plankton samples which have been examined in detail have provided sufficient material to make it possible to indicate the distribution of these larvæ along the Northumberland coast during the months April to September, and to show that they exhibit the denatent drift from north to south which is characteristic of the local plankton organisms Plate IV. illustrates these points.

Unlike the majority of Decapod larvæ present in the plankton these Euphausiidæ are not entirely absent from the samples which are taken more than a few miles from the shore. On the other hand they scarcely appear in hauls made at a distance of less than about 2½ miles out to sea and occur at the most remote of our stations, two of which were twelve miles off shore. The larvæ then are evidently widely distributed over the area sampled, and it would be of interest to discover how much farther south *T. longicaudata* occurs.

Thysanoessa is essentially a cold water genus, and of the two species known locally it would appear that *T. longicaudata* is the more restricted in range, at least so far as the eastern side of the British Isles is concerned, for while both larvæ and adults of *T. inermis* are recorded from the English Channel, the former species has not been noted so far south, the most southerly point being "the northern part of the North Sea." [6] Holt and Tattersall refer to *T. longicaudata* as an oceanic species which is to be regarded only as an occasional visitor to the coasts of Britain, but if we are correct in assuming that the majority of the larvæ in our plankton samples are referable to this species, then the regularity with which they have appeared during the five years of sampling, their extended distribution along our coast and the presence of the adult form among them justifies us in regarding it as a regular annual visitor at least and recording it as a constituent of the Northumberland fauna.

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EXPLANATION OF PLATES.

Plate I.—Diagram showing the distribution of Ebalia larvæ during the years 1921–23. Roman numerals I. to IV. indicate the four zoea stages and "m" stands for the megalopa.

Plate II.—Figure 1. First zoea stage of *Ebalia* sp. from the left side.

,, 2 Same stage from the anterior aspect to show the shape of the carapace.

,, 3. Same stage from the left side, the abdomen straightened out to display the appendages.

,, 4. Telson of same stage.

,, 5. Second zoea from the left side.

,, 6. Same stage showing the posterior margin of the carapace and the lateral spines.

,, 7. Third zoea stage from the left side.

,, 8. Fourth zoea stage from the left side.

,, 9. Ventral view of the megalopa.

Plate III.—Diagram showing the distribution of Thysanoessa larvæ during the years 1921–23. The three calyptopis stages are grouped together and represented by "I," the furcilia stages are similarly grouped as "II." and the cyrtopia as "III." Post-larval stages are indicated by the letters p. l.

Plate IV.—Figure 1. Ventral view of the first calyptopis.

,, 2. Ventral view of the second calyptopis.

,, 3. Telson of the third calyptopis from the ventral aspect.

,, 4. Eyes of the third calyptopis.

,, 5. Ventral view of the first furcilia.

,, 6. Abdomen and telson of the second furcilia from the left side.

,, 7. Posterior abdominal segments and telson of the third furcilia from the left side.

,, 8. Telson of the third furcilia from the ventral aspect.

,, 9. One of the pleopods of the first cyrtopia.

,, 10. Posterior part of abdomen of post-larval *T. inermis* from the left side.

,, 11. Posterior part of abdomen of post-larval *T. longicaudata* from the left side.

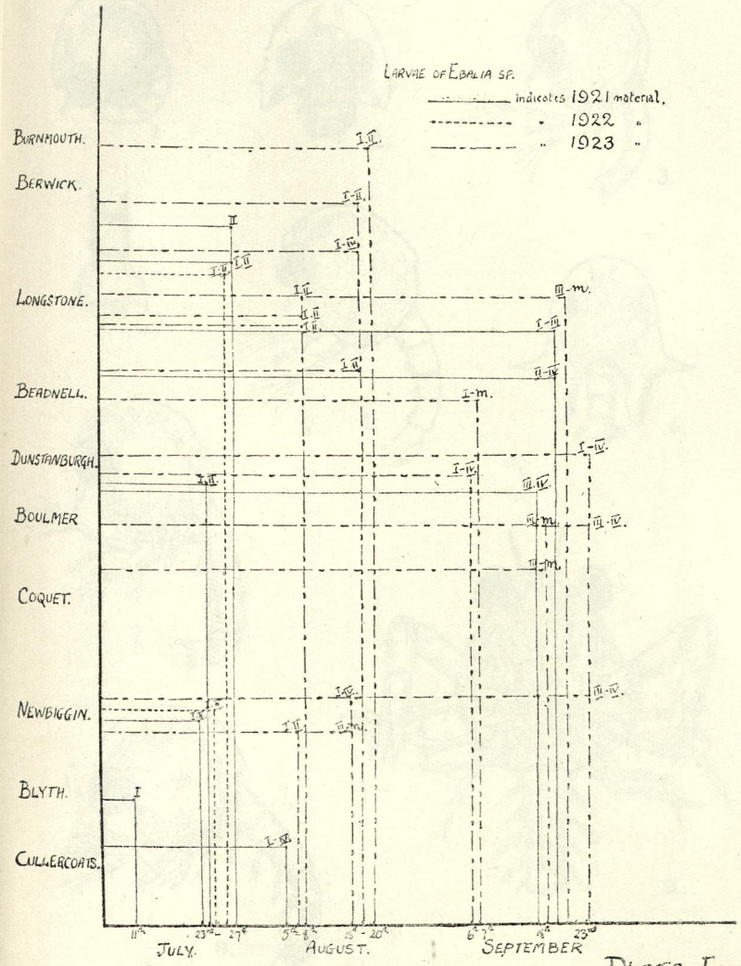

PLATE I.

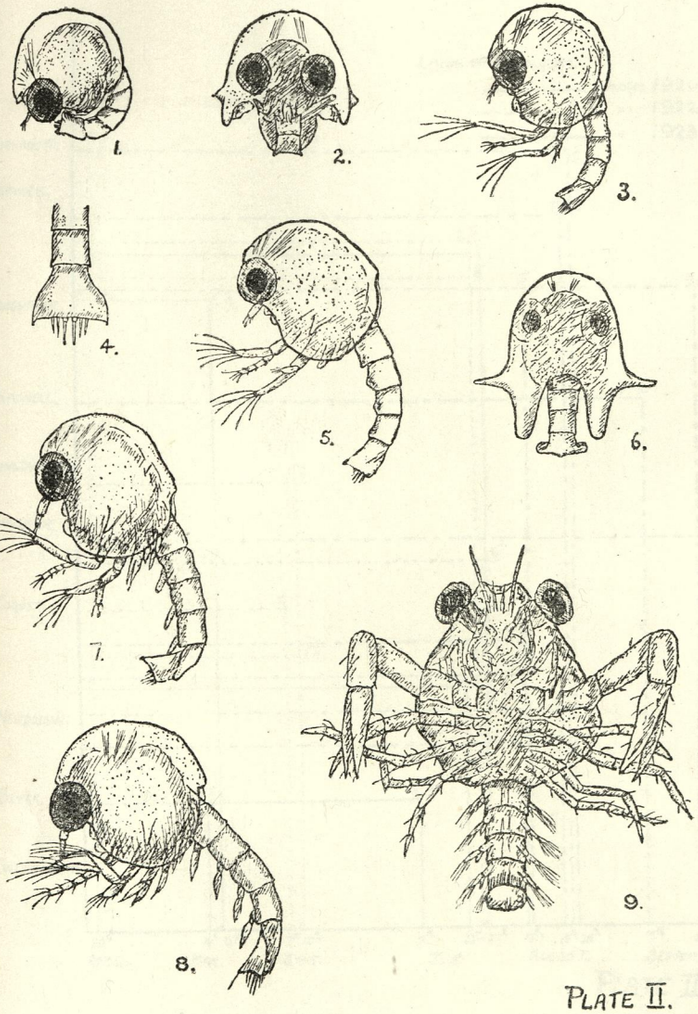

PLATE II.

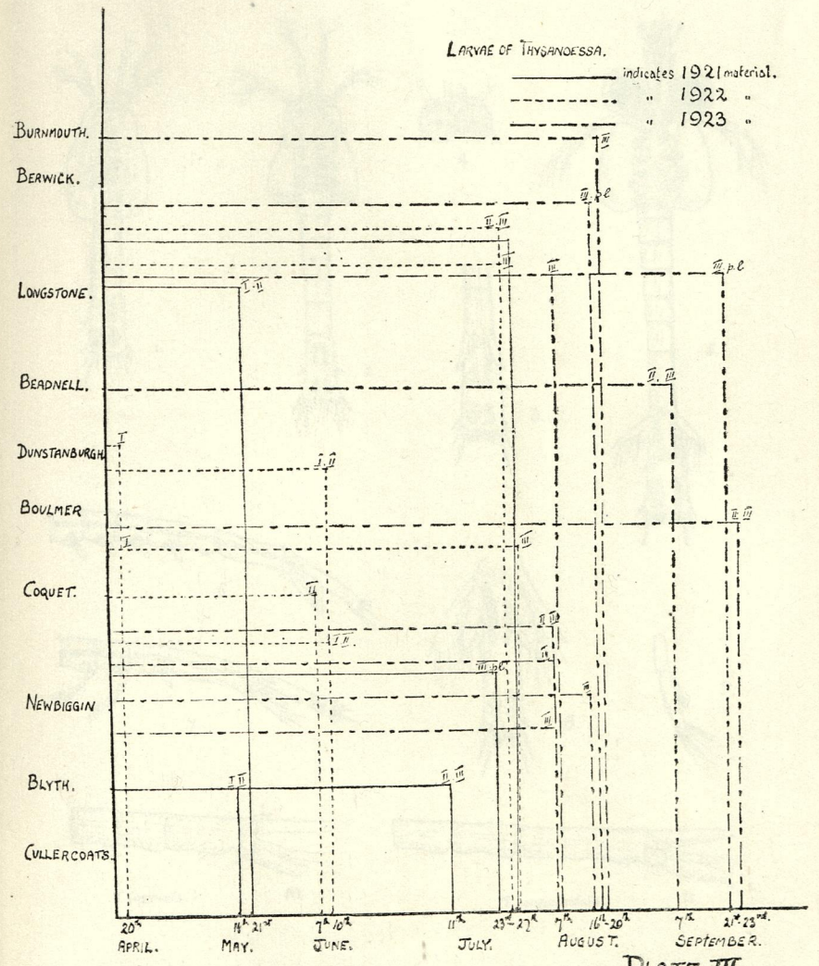
LARVAE OF THYSANOESSA.
indicates 1921 material.
" 1922 "
" 1923 "
BURNMOUTH.
BERWICK.
LONGSTONE.
BEADNELL.
DUNSTANBURGH.
BOULMER
COQUET.
NEWBIGGIN
BLYTH.
CULLERCOATS.
APRIL.
MAY.
JUNE.
JULY.
AUGUST.
SEPTEMBER.

PLATE III.

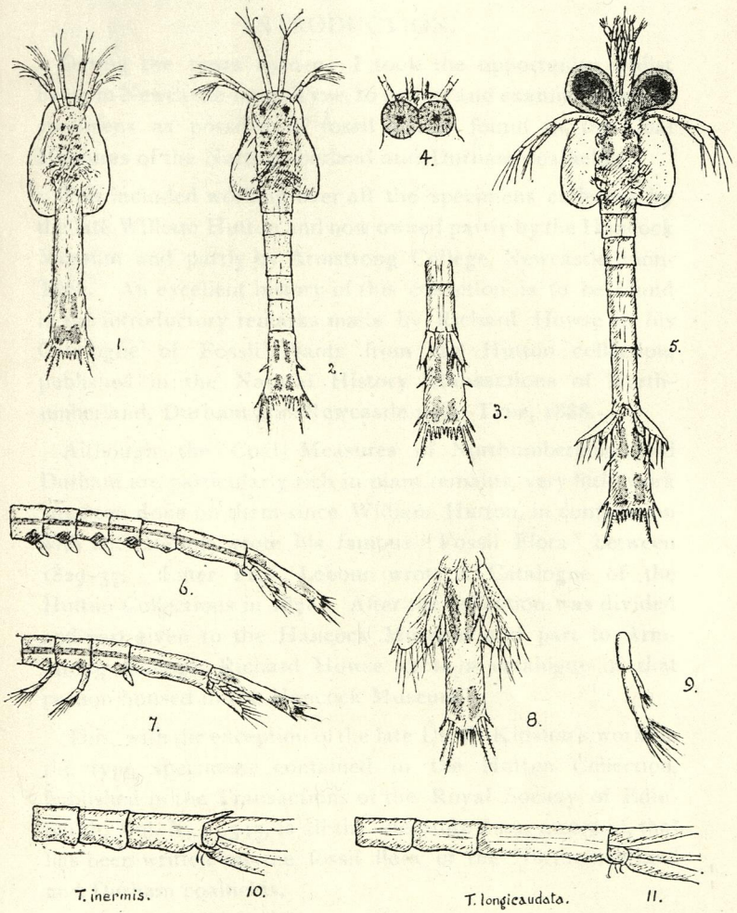

PLATE IV.

Fossil Flora of the Northumberland and Durham Coalfield.

By Edith Bolton, M.Sc., F.L.S.
(Dept. of Botany, Bristol Museum).

INTRODUCTION.

During the years 1920–21 I took the opportunity, whilst living in Newcastle-upon-Tyne, to collect and examine as many specimens as possible of fossil plants found in the Coal Measures of the Northumberland and Durham coalfields.

This included working over all the specimens collected by the late William Hutton and now owned partly by the Hancock Museum and partly by Armstrong College, Newcastle-upon-Tyne. An excellent history of this collection is to be found in the introductory remarks made by Richard Howse in his Catalogue of Fossil Plants from the Hutton collection, published in the Natural History Transactions of Northumberland, Durham and Newcastle-upon-Tyne, 1888.

Although the Coal Measures of Northumberland and Durham are particularly rich in plant remains, very little work has been done on them since William Hutton, in conjunction with Dr. Lindley, wrote his famous "Fossil Flora" between 1829–37. Later Prof. Lebour wrote a Catalogue of the Hutton Collections in 1878. After the collection was divided and part given to the Hancock Museum and part to Armstrong College, Richard Howse wrote a catalogue of that portion housed in the Hancock Museum.

This, with the exception of the late Dr. R. Kidston's work on the type specimens contained in the Hutton Collection, published in the Transactions of the Royal Society of Edinburgh, Vol. X, p. 345, is all the literature I am aware of, that has been written on the fossil flora of the Northumberland and Durham coalfields.

Hutton's compilation of fossil plants was by no means a comprehensive one, as the greater number of his specimens came from the Bensham Shale, while the rest were obtained from the Shales above the High Main and Low Main seams.

These three seams occur in the upper half of the general workable Coal Measures of the area. The rest of the coal-field has hitherto been neglected.

In working over the fossil flora I have endeavoured to obtain material from as many of the coal seams as possible, and thus extend the work begun by Hutton.

GEOLOGY OF THE AREA.

Rocks of Carboniferous age occur over the greater part of the counties of Northumberland and Durham. Along the east coast, from the mouth of the river Coquet to a little south of Bishop Auckland, the Lower Carboniferous are covered by Millstone Grit and the Coal Measures, the former cropping out on the western edge. In the north-west and south-east of Durham the Coal Measures are overlain unconformably by the Permian.

The following table gives the relative thickness of the Carboniferous Series. (Walcot Gibson "Coal and Coal Mining," p. 217).

	Feet.
Coal Measures	3,050
Millstone Grit	400
Bernician	2,000
Tuedian	1,200
	6,650 feet.

The following is a list, in descending order, of the more important workable coal seams of Northumberland and Durham. (See Walcot Gibson "Coal in Great Britain," p. 258).

19. Closing Hill.
18. Hebburn Fell.
17. Five Quarter.
16. Three Quarter, Black or Moorland.
15. High Main.
14. Metal and Stone.
13. Yard.

12. Maudlin or Bensham.
11. Six Quarter and Five Quarter or Brass Thill or Crow (Ryton).
10. Hutton or Low Main.
9. Plessey.
8. Little Wonder.
7. Harvey or Beaumont.
6. Hodge.
5. Tiley.
4. Hand and Stone.
3. Five Quarter, Six Quarter or Busty.
2. Three Quarter or Yard.
1. Brockwell.
1a. Towneley.

CRAWCROOK EXPOSURE.

This is the only locality in which I found ironstone nodules containing plant remains. All the nodules were found in a small clay pit, owned and worked by the Phœnix Brick Company, at Crawcrook, which is about fourteen miles west of Newcastle-upon-Tyne. This outcrop of clay, which occurs in the Coal Measure about the level of the Crow Coal, is full of ironstone nodules varying in size from one inch in diameter up to 8-10 inches in diameter. Almost every nodule broken open was found to contain organic remains, either plant or animal, but chiefly plant. With the exception of a few cases, all the remains were in a good state of preservation and were therefore not difficult to identify. The exceptions were masses of partially decayed and much broken up plant remains.

The fine clayey character of the rock and the perfection of the included fossils suggest that the material accumulated in waters having little movement, such as might occur in lagoons or swamps. A three-foot seam of coal running through one part of the clay pit is very fossiliferous. It appeared to consist, to a large extent, of masses of Sigillarian and Lepidodendroid bark with here and there layers of the

leaves of *Cordaites principalis*, Germar sp. The following species of plants were also identified from the coal band :—

Alethopteris lonchitica, Schl.
Trigonocarpum parkinsoni, Brong.
Neuropteris, sp.
Lepidodendron aculeatum, Sternb.
Sigillaria reniformis, Brongt.
„ *saulii*, Brongt.
„ *principes*, Weiss.
Stigmaria ficoides, Brongt.
Bothrodendron punctatum, L. & H.
Cordaites principalis, Germar sp.

The fossil flora of the ironstone nodules, which was a rich and varied one, was characterised by great numbers of specimens of Neuropteris. No fewer than ten species were recorded, all of which, with the exception of three, were very common. As these specimens form the basis of a paper by me on the genus Neuropteris I will not now go into details. The following is a complete list of all the species from this locality :—

Calamites suckowii, Brongt.
„ *ramosus*, Artis sp.
Calamocladus equisetiformis, Schl.
„ *grandis*, Sternb.
„ *longifolia*, Brongt.
Pinnularia capillaceæ, L. & H.
„ *columnaris*, Artis sp.
Calamostachys, sp.
Sphenophyllum cuneifolium, Sternb. sp.
Sphenopteris obtusiloba, Brongt.
„ *trifoliolata*, Artis sp.
„ *laurenti* (Weiss.)
Mariopteris muricata, Schl.
Alethopteris lonchitica, Schl.
„ „ var. *decurrens*, Artis sp.
Neuropteris heterophylla, Brongt.
„ *loshii*, Brongt.

Neuropteris flexuosa, Sternb.
„ *? ovata*, Hoffm.
„ *gigantea*, Sternb.
„ *rotundifolia*, Brongt.
„ *tenuifolia*, Schl. sp.
„ *obliqua*, Brongt.
„ *rarinervis*, Bunbury.
„ *macrophylla*, Brongt.
Lepidophloios acerosus, L. &. H.
Cordaites principalis, Germar sp.
Artesia transversa, Artis sp.
Cordaianthus pitcairniæ, L. & H. sp.

MATERIAL OBTAINED FROM COAL MINES.

A good deal of material was obtained from the tips and rubbish heaps belonging to various coal mines in Northumberland and Durham. Other specimens were obtained direct from the mines through the kindness of the managers. From this material the following species were identified :—

Calamites suckowii, Brongt.
„ *cistii*, Brongt.
„ *ramosus*, Artis sp.
„ *undulatus*, Sternb.
Calamocladus equisetiformis, Schl.
„ *grandis*, Sternb. sp.
Annularia radiata, Brongt.
Pinnularia capillaceæ, L. & H.
Sphenophyllum cuneifolium, var. *saxifragæfolium*, Brongt.
Sphenopteris obtusiloba, Brongt.
„ *hœninghausi*, Brongt.
„ *furcata*, Brongt.
Neuropteris heterophylla, Brongt.
„ *loshii*, Brongt.
„ *ovata*, Hoffm.
„ *flexuosa*, Sternb.
„ *gigantea*, Sternb.
„ *obliqua*, Brongt.
„ *rectinervis*, Kidston.

Mariopteris muricata, var. *nervosa*, Brongt.
Alethopteris lonchitica, Schl. sp.
„ „ var. *decurrens*, Artis sp.
Lepidodendron ophiurus, Brongt.
„ *aculeatum*, Sternb.
„ *obovatum*, Sternb.
Lepidophyllum lanceolatum, Brongt.
„ *majus*, Brongt.
?*Bothrodendron punctatum*, L & H.
Sigillaria discophora, König. sp.
„ *reniformis*, Brongt.
„ *tessellata*, Steinhauer sp.
„ *lævigata*, Brongt.
„ *scutellata*, Brongt.
Trigonocarpus parkinsoni, Brongt.
Stigmaria ficoides, Brongt.
Cordaites principalis, Germar sp.
Cordaianthus pitcairniæ, L. & H. sp.

BARMSTON BORE HOLE, USWORTH COLLIERY, COUNTY DURHAM.

Through the kindness of the late Dr. Woolacott I was able to examine the material from this bore hole and identified the following plants :—

Calamites suckowii, Brongt.
„ *ramosus*, Artis sp.
Calamocladus grandis, Sternb. sp.
„ *longifolia*, Brongt.
?*Annularia radiata*, Brongt.
Sphenophyllum cuneifolium, Sternb.
Pinnularia capillaceæ, L. & H.
Mariopteris muricata, Schl. sp.
„ „ var. *nervosa*, Brongt.
Sphenopteris obtusiloba, Brongt.
„ *furcata*, Brongt.
Cone of ?*Sphenophyllum*.

Neuropteris heterophylla, Brongt.
„ *loshii*, Brongt.
„ *gigantea*, Sternb.
„ *flexuosa*, Brongt.
„ *tenuifolia*, Schl. sp.
„ *macrophylla*, Brongt.
Lepidodendron ophiurus, Brongt.
Stigmaria ficoides, Brongt.
Cordaites principalis, Germar sp.
Cordaianthus pitcairniæ, L. & H. sp.
?*Bothrodendron minutifolium*, Boulay sp.

The following table indicates the vertical distribution of fossil plants throughout the workable coal seams in Northumberland and Durham, as far as can be made out from the present existing records :—

	High Main.	Yard.	Bensham.	Low Main.	Ryton Ruler.	Beaumont.	Brockwell.	Towneley.
Calamites suckowii, Brongt.	...	N	D	...	D	...	N	...
„ cisti, Brongt.	...	...	D	D	...	...	...	...
„ ramosus, Artis sp.	...	...	D	D	D	...	...	...
„ undulatus, Sternb.	...	...	D	D	...	...	...	...
* „ varians, Sternb.	...	...	D	D	...	...	...	...
* „ verticillatus, L. & H.	...	...	D	...	...	...	...	...
Calamocladus longifolius, Brongt.	...	...	D	...	D	...	...	...
„ equisetiformis, Schl.	...	...	D	D	D	...	N	...
„ grandis, Sternb. sp.	...	...	D	D	D	...	D	...
Annularia radiata, Brongt.	...	...	D	...	...	...	N	...
* „ gallioides, L. & H. sp.	...	...	D	...	...	...	...	...
Pinnularia capillaceæ, L. & H.	...	N	D	D	D	...	N	D
„ columnaris, Artis sp.	...	...	...	...	D	...	...	...
Sphenophyllum cuneifolium, Sternb sp.	...	...	D	...	D	...	...	...
„ „ var. saxifragæfolium, Brongt.	...	...	...	...	...	...	D	...
*Stachannularia ?Northumbriana, Kidston.	...	...	D	D	...	...	...	...
Calamostachya sp.	...	...	...	...	D	...	...	...
*Eremopteris artemisiæfolia, Sternb. sp.	...	...	D	...	...	...	...	...
Sphenopteris obtusiloba, Brongt.	...	N	D	...	D	...	N	D
„ adiantoides, L. & H.	...	...	D	...	...	...	...	...
* „ hœninghausi, Brongt.	...	...	...	...	...	...	...	D
„ furcata, Brongt.	...	...	...	...	...	N	...	...
* „ pseudo-furcata, Kidston.	...	...	D	...	...	...	...	...
„ laurenti, Andræ.	...	...	...	...	D	...	...	...
„ trifoliolata, Artis sp.	...	...	D	...	D	...	...	...

	High Main.	Yard.	Bensham.	Low Main.	Ryton Ruler.	Beaumont.	Brockwell.	Towneley.
Neuropteris heterophylla, Brongt.	...	...	D	D	D	...	D	...
,, loshii, Brongt.	...	...	D	D	D	...	D	...
,, flexuosa, Sternb.	...	...	...	...	D	D	...	...
,, ovata, Hoffm.	...	...	...	...	D	...	...	...
,, gigantea, Sternb.	...	...	D	...	D	...	...	...
,, tenuifolia, Schl. sp.	...	...	D	...	D	...	...	...
,, rotundifolia, Brongt.	...	...	...	...	D	...	...	...
,, obliqua, Brongt.	...	...	...	...	D	...	N	...
,, rarinervis, Bunbury.	...	...	...	...	D	...	...	...
,, rectinervis, Kidston.	...	...	...	...	...	...	D	D
,, macrophylla, Brongt.	...	...	...	...	D	...	D	D
* ,, Soretii, Brongt.	...	...	...	D	...	...	..	..
Mariopteris muricata, Schl. sp.	..	...	D	...	D	...	...	...
,, ,, var. nervosa, Brongt.	...	N	D	D	...	...	N	...
*Pecopteris polymorpha, Brongt.	...	..	...	?D	...	...	...	...
* ,, Miltoni, Artis sp.	...	?N	...	...	...	..	...	...
*Dicksonites Pluckeneti, Schl. sp.	..	...	?D	...	...	...	...	...
Alethopteris lonchitica, Schl. sp.	...	N	D	D	D	...	ND	...
,, ,, var. decurrens, Artis sp.	...	N	D	...	D	...	D	...
,, serlii, Brongt.	...	...	...	D	...	...	...	..
,, valida, Boulay.	...	...	N	...	...	...	...	...
*Megaphyton approximatum, L. & H.	...	...	D	D	...	...	...	...
* ,, Gwynne-Vaughani, Kidston.	...	...	...	D	...	...	...	...
Lepidodendron ophiurus, Brongt.	...	...	ND	D	D	D	...	D
,, aculeatum, Sternb.	N	N	D	...	D	...	...	...
,, obovatum, Sternb.	...	...	D	...	...	N	...	...
* ,, ramosum, Sternb.	...	...	D	D	D	...	...	...
,, longifolium, Sternb.	...	...	D	...	...	D	...	...
Lepidophloios acerosus, L. & H. sp.	...	...	D	...	D	...	...	...
Sigillaria discophora, Konig. sp.	..	...	ND	...	...	...	...	...
,, tessellata, Steinhauer sp.	...	...	D	...	...	...	N	..
,, Scutellata, Brongt.	...	...	D	...	...	...	N	...
,, reniformis, Brongt.	...	...	?N	...	D	...	...	...
,, Saulii, Brongt.	...	...	...	...	D	...	...	...
,, principis, Weiss.	...	...	...	...	D	...	...	..
* ,, lævigata, Brongt.	...	...	?N	...	...	...	...	...
Lepidostrobus variabilis, L. & H.	...	...	D	...	D	...	...	...
Lepidophyllum lanceolatum, Brongt.	...	...	D	...	D	...	N	...
,, majus, Brongt.	...	...	?N	...	...	...	...	...
Bothrodendron punctatum, L. & H.	D	...	?N	...	D	...	...	...
,, minutifolium, Boulay, sp.	...	...	D	...	...	...	...	...
Trigonocarpus parkinsoni, Brongt.	...	...	?N	...	D	...	N	...
			D					
Stigmaria ficoides, Brongt.	...	N	D	N	D	N	N	...
Cordaites principalis, Germar sp.	...	...	D		D	D	N	...
Cordaianthus pitcairniæ, L. & H. sp.	...	...	D	D	D	D	N	...
Artesia transversa, Artis sp.	..	...	...	...	D	...	...	...
* ,, approximata, Brongt.	...	...	...	D	...	...	...	...
*Psygmophyllum flabellatum, L. & H. sp.	...	...	D	...	...	...	...	...

D—Recorded from Durham Coalfield. N—Recorded from Newcastle Coalfield.
* Reported by Hutton only.

NOTES ON THE DISTRIBUTION.

Calamites.—Though occurring throughout the Coal Measures they are not very abundant. *C. Suckowii*, Brongt. is the most common species. Their maximum development both with regard to species and numbers occurs about the middle of the Coal Measure Series (Bensham and Low Main Seam).

Calamocladus.—Only abundant on the horizon of the Brockwell Seam, which occurs lower down in the Series.

Annularia.—The rarity of this genus may perhaps be due to the fact that specimens have not been collected. *Calamite* cones are very rare.

Pinnularia.—*P. capillaceæ*, L. and H., is a very common fossil, but good specimens are difficult to obtain. Only one specimen of *P. columnaris*, Artis sp. has been found.

Sphenophyllum.—*S. cuneifolium*, Sternb. is also somewhat rare, but the variety *S. saxifragæfolium* Brongt. is common at certain horizons, chiefly that of the Brockwell Seam.

Sphenopteris.—Although seven species of Sphenopteris have been recorded, it is not a common genus. Its maximum development appears to be on the horizon of the Bensham Seam. *Sphenopteris hœninghausi*, Brongt. is the only species which up to the present has been recorded from the lowest seams of the coalfield.

Pecopteris.—An extremely rare genus, if found at all. It is only recorded by Hutton and there is some doubt about the accuracy of his records.

Mariopteris.—Pinnules of this genus are frequently found, but pinnæ are rare.

Alethopteris.—Is represented by four species, but *A. Serli*, Brongt. and *A. valida*, Boulay are rare, the records being made on single specimens. The other two species are extremely common. *Trigonocarpus parkinsoni*, Brongt. is common at certain levels, especially forma α and forma β. (See Arber. Annals on Botany, vol. 28, No. 109, p. 84).

Neuropteris.—With the exception of *N. rotundifolia* and *N. rarinervis*, all the species recorded are common.

Lepidodendron.—This is not common, although five species are recorded. *Lepidostrobus variabilis*, L. and H. is fairly common.

Sigillaria.—Is represented by six species of which *S. reniformis* Brongt. and *S. tessellata*, Steinhauer sp., are the most common.

Cordaites.—*C. principalis*, Germar sp. is a very common fossil at some levels, especially in the roof of the Brockwell Seam.

The following table shows the comparison of the Flora of the Coalfields of Northumberland and Durham with that of other coalfields in England (see bibliography 1–7):—

Northumberland and Durham.	1 Yorkshire.	2 Nottinghamshire	3 Staffordshire.	4 Lancashire.	5 Cumberland.	6 Radstock.	7 South Wales.
Calamites suckowii. Brongt.	X	X	X	X	X	X	X
,, cisti, Brongt.	X	X	X	X	X	X	X
,, ramosus, Artis sp.	X	X	X	X	...	...	X
,, undulatus, Sternb.	X	X	X	X	...	...	X
,, varians, Sterub.	X	X	X	X	X	X	X
,, vertillicatus, L & H.	X	X	...	...	...	...	...
Calamocladus equisetiformis, Schl.	X	X	X	X	X	X	X
,, grandis, Sternb.	...	...	X	X	...	...	...
,, longifolius, Brongt.	X	X	X	...	..	...	X
Annularia radiata, Brongt.	X	...	X	...	...	...	...
,, gallioides, L. & H.	X	...	X	...	...	...	...
Pinnularia capillaceæ, L. & H.	...	...	X	X	?	...	X
,, columnaris, Artis, sp.	...	...	X	...	...	...	...
Sphenophyllum cuneifolium, Sternb.	X	X	X	X	X	?	X
,, ,, var. saxifragæfolium, Brongt.	X	X	X	X	...	...	...
Stachannularia ?Northumbriana, Kidston.	...	X	...	...	...	...	...
Calamostachya sp.	X	..	X	...	...	...	...
Eremopteris artemisiæfolia, Sternb.	...	...	X	...	...	...	...
Sphenopteris obtusiloba, Brongt.	X	X	X	X	X	...	X
,, adiantoides L. & H.	...	...	...	...	...	...	...
,, hœninghausi Brongt.	X	...	...	...	...	...	...
,, furcata, Brongt.	X	X	X	X	X	...	...
,, pseudo-furcata, Kidston.	..	...	...	...	...	...	...
,, laurenti, Andræ.	X	X	X	...	...	...	...
,, trifoliolata, Artis sp.	...	X	X	X	...	X	X

Northumberland and Durham	1 Yorkshire.	2 Nottinghamshire.	3 Staffordshire.	4 Lancashire.	5 Cumberland.	6 Radstock.	7 South Wales.
Neuropteris heterophylla, Brongt.	X	X	X	X	X	X	X
,, Loshii, Brongt.	...	..	...	...	...	...	...
,, flexuosa, Sternb.	X	X	X	X	...	X	X
,, gigantea, Sternb.	X	X	X	X	X	X	X
,, ovata, Hoffm.	...	...	X	...	...	X	...
,, tenuifolia, Schl. sp.	X	X	X	X	X	X	X
,, rotundifolia, Brongt.	...	...	...	...	...	X	...
,, obliqua, Brongt.	X	X	X	X	X	...	...
,, rarinervis, Bunbury.	X	X	X	...	..	X	X
,, rectinervis, Kidston.	...	...	...	?	...	X	...
,, Soretii, Brongt.	...	...	...	...	...	...	...
,, macrophylla, Brongt.	...	..	X	X	..	X	X
Mariopteris muricata, Schl. sp.	X	X	X	X	X	X	X
,, muricata, forma nervosa, Brongt.	...	...	...	...	...	...	...
Pecopteris polymorpha, Brongt.	...	...	...	...	..	X	...
,, miltoni, Artis sp.	X	X	X	...	X	X	X
Dicksonites Pluckeneti, Schl. sp.	...	...	...	...	...	X	...
Alethopteris lonchitica, Schl. sp.	X	X	X	X	...	X	X
,, var. decurrens, Artis sp.	X	X	X	X	X	...	X
,, Serlii, Brongt.	...	...	X	X	X	X	X
,, valida, Boulay.	X	X	...	X	...	...	...
Megaphyton approximatum, L. & H.	...	..	X	X	...	...	...
,, Gwynne-Vaughani, Kidston.	...	..	...	...	...	...	...
Lepidodendron ophiurus Brongt.	X	X	X	X	...	...	X
,, aculeatum, Sternb.	X	X	X	X	X	X	X
,, obovatum, Sternb.	X	X	X	X	...	X	X
,, ramosum, Sternb.	...	X	X	...	...	X	?
,, longifolium, Sternb.	...	...	...	...	...	X	...
Lepidophloios acerosus, L. & H.	X	X	...	...	...	...	...
Sigillaria discophora Konig.	X	X	X	X	...	...	X
,, tessellata, Steinhauer, sp.	X	X	X	X	...	X	X
,, Scutellata, Brongt.	X	X	X	...	X	X	X
,, reniformis, Brongt.	...	...	X	...	...	X	...
,, Saulii, Brongt.	...	...	X	...	...	...	...
,, principis, Weiss.	...	...	...	...	...	X	...
,, lævigata, Brongt.	...	...	X	...	...	X	X
Lepidostrobus variabilis, L. & H.	X	...	X	X	...	..	...
Lepidophyllum majus, Brongt.	X	X	X	X	..	X	...
,, lanceolatum, Brongt.	?	X	X	X	...	X	X
Bothrodendron punctatum, L. & H.	...	...	...	...	...	...	X
,, minutifolium, Boulay, sp.	X	X	X	X	X	...	...
Trigonocarpum Parkinsoni, Brongt.	X	X	X	X	...	...	...
Stigmaria ficoides, Brongt.	X	X	X	X	X	X	X
Cordaites principalis, Germar sp.	X	X	X	...	X	...	X
Cordianthus pitcairniæ, L. & H. sp	X	X	X	...	...	...	...
Artesia transversa, Artis sp.	X	X	X	...	...	...	...
,, approximata, Brongt	...	...	...	X	X	...	...
Psygmophyllum flabellatum, L. & H. sp.	...	..	...	...	...	...	...

A summary of the results brought out by this table shows that 74 species of fossil plants have been recorded from the Northumberland and Durham coalfield. Of these—

7 are common to all the coalfields.
44 ,, ,, Yorkshire.
43 ,, ,, Nottinghamshire.
52 ,, ,, Staffordshire.
39 ,, ,, Lancashire.
23 ,, ,, Cumberland Coalfield.
28 ,, ,, Radstock.
35 ,, ,, South Wales.

Six appear to be restricted to the Northumberland and Durham coalfield.

CONCLUSIONS.

The following conclusions are the result of an examination of the Coal Measures of Northumberland and Durham, based upon an extensive collection of material brought together by the author and also of a much larger series on the spoil heaps of a large number of collieries, and of repeated visits to the same colliery.

Researches have been made on the roof shales of several seams below those examined and collected from by Hutton with a view to determine the range of species, the general character of the coal flora as a whole, and the presence or absence of the Coal Measure Divisions in other coalfields.

The late Dr. R. Kidston informed me that he was of opinion that the coal seams down to the three-quarter seam were probably of Westphalian age, a view which I have confirmed. I have sought for but failed to obtain sufficient evidence of the presence of beds of Lanarkian age below that level. The Victoria and Marshall Green Seams yielded no material, whilst what little could be obtained from the lowest seam—the Towneley—was indecisive. One species—*Neuropteris rectinervis*, Kidston—recorded from this seam is regarded as characteristic of the Lanarkian, but in the Northumberland and Durham coalfield I have also recorded it from the roof

shales of the Brockwell Seam. Further research may show that the seams from the Brockwell to the Towneley, and including the former, are Lanarkian.

The census of coal plants which I submit, and my "Notes on the Distribution of the Fossil Plants" will show that six genera and sixteen species of fossil plants have been added to those previously recorded from the Coal Measures of Northumberland and Durham, and ninety-three records added from new horizons.

Of the total list of fossil plants recorded, of which there are seventy-four

25 are common to the Radstockian.
16 ,, ,, Staffordian.
56 ,, ,, Westphalian.
46 ,, ,, Lanarkian.

In conclusion I should like to thank Prof. Hickling and the late Dr. Woolacott of Armstrong College, Newcastle-upon-Tyne, especially the latter, for kindly allowing me to examine the material from the Barmstone Bore Hole, Usworth Colliery, Co. Durham. I should also like to take this opportunity to express my thanks to all who have so willingly given me assistance, and especially to the following: —

The Council of the Natural History Society for granting me facilities for the studying of the Hutton Collection in the Hancock Museum.

To Dr. Seward of the Botany School, Cambridge, and to Dr. Tattersall of the Manchester Museum for allowing me to work over the collections under their care, and to the following for presenting me with material:—Mr. Wm. Eltringham; Dr. K. Blackburn; Rev. M. Fletcher.

The Managers of the following collieries:—Newbiggin-by-the-Sea, Pelton, Woodland, and also to the Manager of the Phœnix Brick Works, Crawcrook.

APPENDIX.

Notes on the Hutton Collection of Fossil Plants in Armstrong College, Newcastle-upon-Tyne.

In 1883 the Institute of Mining Engineers presented the bulk of Hutton's collection of fossil plants to the Hancock Museum as a "Hutton Collection," the remainder of the series being given to Armstrong College, where it still remains.

In working over the latter series a few years ago, I found the type specimen of *Lepidodendron elegans*, L. & H. (Pl. 199 of Lindley and Hutton's "Fossil Flora"). Since all the other types are in the possession of the Hancock Museum, I would like to suggest that this specimen should be transferred to the Museum. The College also possesses most of the original drawings of the plate illustrations in the Fossil Flora and in Lebour's Catalogue. Those drawings, together with Lebour's manuscript list written in 1876 are now in the College Library.

The following is a list of specimens at Armstrong College, duplicates of which do not occur in the Hutton Collection in the Hancock Museum :—

Calamites arenaceus.	Keuper Sandstein, Germany.
Calamites undulatus Brongt.	? Bensham Shale, Jarrow.
Sphenophyllum cuneifolium, var. *saxifragæfolium*, Brongt.	Gosforth.
Hawlea pulcherrima, Stur.	Waldenburg, Silesia.
Pecopteris unita, Brongt.	Somerset.
Lepidodendron elegans, Brongt. (Type of Pl. 199).	Bensham Shale, Jarrow.
Lepidodendron tetragonum.	Waldenburg, Silesia.
Bothrodendron punctatum. Brongt.	Jarrow.
Lepidostrobus comosus, L. & H.	Burdiehouse Limestone, Edinburgh.
Lepidophyllum majus, Brongt.	No locality.

**Psygmophyllum flabellatum.* Brongt.	Bensham Shale, Jarrow.

*This specimen agrees very closely with *P. majus* as described and figured by Arber (Trans. Linn. Soc. Vol. 7, pt. 18, p. 381).

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Fluctuations in Fisheries.

By B. Storrow, M.Sc.

(A lecture given before the Natural History Society, 3rd Dec., 1924.)

The history of our fisheries is a series of fluctuations. Increased catching power may result in a general increase in the quantity of fish landed as in the Scottish herring fishery and in the period from 1903 to 1913 for the fisheries of England and Wales, but sooner or later there comes a decrease in the catches. In the period mentioned the fisheries of England and Wales showed a general increase, but if we take some of the different species we find that, whilst some showed an increase others showed a considerable decrease. The chief of our pelagic fish are the herring, mackerel and pilchard. The herring catches after 1906 increased enormously; the mackerel catches in that year showed a considerable decrease and have continued to do so; the pilchard fishery cannot be said to have had a good year, in the period under consideration, after 1906. The haddock and cod yield the greatest quantities amongst our demersal fish. The former gave decreasing, the latter increasing landings. (Fig. 1).

During the war we had a compulsory closing of our fishing grounds and we can, if we wish to do so, consider it as the greatest experiment ever made in the effect of restricted fishing on future supplies. The result of the experiment cannot be said to be a success. Our chief fish is the herring. The returns from the fishery in 1919 were fairly good; in 1920 the fishery was poor; in 1921 it was a failure. The demersal fish gave good returns after the war and the prospects appeared favourable, but the poor catches made in 1923 were most disappointing and attempts to account for them gave rise to a number of explanations of which the most reasonable appears to be that of natural fluctuation. It is one of those explanations which sound reasonable but, when we wish to isolate its components and state which of them influence our fisheries, and to what extent, the term as an explanation of

the present shortage is unsatisfactory. It is hoped to bring forward data which will be of interest and help, to some extent, to throw some light on what is considered to be one of the most important problems in fishery investigations.

There are three axioms in connexion with fluctuations: –

1 Fish are hatched. 2. Fish die. 3. Fish can swim.

There are limitations in connexion with number three.

Fish produce enormous numbers of eggs which in turn give rise to countless swarms of young, so small and helpless that they fall as prey to many enemies. There are indications that in some years more eggs may be produced than in others —by young fish joining spawning shoals at an earlier age than is usually the case—and we may have also an extended or slightly altered spawning time, a better supply of food for the newly hatched larvæ, possibly a decrease of natural enemies and a greater vitality of the young. When some or all these factors are in force we get what is called a good year-class and the numbers of fish of one age may give increased catches and practically determine, for some years, the yield from the fishery. The good year-class of 1904 influenced considerably the catches of herring and cod in Norwegian waters † and Russell ‡ has shewn that a good year-class of cod made its appearance in the North Sea fisheries in 1909 and gave increased catches of small cod. Figure 2 indicates that this good year-class appeared not only in the North Sea but in the fisheries of Iceland, Faroe, North of Scotland and Westward of Scotland.

We have very little evidence of the death of fish in large numbers influencing the yield of the fisheries. In March, 1882, after a severe gale, the waters off the coast of Massachusetts were covered, over a large area, with countless dead tile-fish. After this the fishery was a failure. During the following ten to fifteen years few tile-fish were caught, but

† Hjort, Fluctuations of Great Fisheries of Northern Europe. Rep. et Proces-Verb, vol. xx.

‡ Fisheries Invest., Ser. ii., vol. v., No. 1.

since then the fishery has gradually recovered. Coinciding with the failure of the haddock fishery of our north-east coast in 1789 vast quantities of dead haddocks were found floating on the surface off the Norwegian coast. †

It is becoming more and more evident that migrations, the swimming of fish, have, perhaps, more to do with fluctuations than any other factor. Whilst the extent and direction of these migrations have been indicated for some fish by marking experiments it is thought that further light may be thrown on the problem by a consideration of data from the catches made by commercial vessels.

Pilchard.—Occasionally odd pilchards are caught as recovering spents during the herring fishery off the Northumberland coast but the Channel can be considered as marking the northern limit for the distribution of this fish. When any sudden drop occurs in the catches, as it did in 1907, and continues for a number of years we may consider the change as being due to either a great decrease in the pilchard population or to a change in the extent of migrations. If coinciding with this decrease from the fishery we have evidence which points to changes in the migrations made by other fish it becomes a reasonable assumption that the low catches were due to migrations and not to any decrease in the pilchard population.

Mackerel.—The greatest quantities of mackerel were landed at South Coast ports and catches from southern waters determined the yield of this fishery. In 1906 the southern fishery suffered a great decrease; in 1907 catches were fairly good but not up to the high quantities of 1904 and 1905; thereafter the fishery yielded poorer returns which in 1913 had fallen to about a quarter of the yield in 1905. (Fig. 3). In contrast with southern waters the North Sea showed a striking increase. The first signs of this increase on the East Coast were in 1906 the year which gave such poor catches in southern waters. In 1907 when catches off the South Coast

† Meek, Migration of Fish, pp. 297, 224.

improved the East Coast catches showed no tendency to improvement, but after that year and with decreasing catches from southern waters the East Coast landings became larger and larger until, in 1913, they were large enough to influence the whole of the fishery for England and Wales and make the curve representing the fishery take an upward direction. It would appear that there was some change in the periodical migrations of mackerel towards our shores and that this change brought more and more mackerel into the North Sea and fewer towards the entrance of the Channel and within reach of the ports of the South Coast.

Herring.—Most of our herrings come from the North Sea and the quantities landed on the South and West Coasts are rarely, if ever, large enough to have much influence on the total taken for the year. The year 1907 showed increased landings when compared with the three previous years. This increase continued generally until 1913 when the yearly take was more than twice as great as that for any year between 1903–06. Coinciding with this general increase for English ports we had a corresponding decrease for the ports of the east coast of Scotland. It is worthy of note that in 1910 when the English catches showed a considerable decrease, compared with the catches of the previous year, the catches landed at East Coast Scottish ports showed a corresponding increase.

There is to the west of the Shetlands a fishery for herrings in May, June and early July. This fishery is very productive and yields considerable quantities of fish, but it shows great fluctuations. In 1905 it failed completely and it was not until a few years ago that the fisherman considered these grounds worth fishing. The opinion was expressed in 1922 † that the recovery of this fishery was due to migrations. Further work has strengthened this opinion.

Following the failure of the fishery to the West of the Shetlands and coinciding with the general decrease in the

† Rept. Dove Marine Laby., New Series xi., p. 66.

landings made at the ports of the east coast of Scotland we had an increase in the landings made at English ports. It would appear that there was a general tendency for a more southerly movement of the herring shoals. In other words there was a change in the migrations. The extent to which the East Anglian fishery benefited by this change is evident from the landings made at Yarmouth and Lowestoft during the years under consideration.† (Figures to the nearest 1,000 cwts).

Year.	Catch.	Year.	Catch.
1903.	2117	1909.	2975
1904.	2249	1910.	2231
1905.	2208	1911.	3258
1906.	2052	1912.	4097
1907.	3013	1913.	5274
1908.	2831		

Haddock.—Most haddocks are caught in the North Sea. Good quantities are taken in the Iceland and Faroe fisheries and smaller quantities from the Westward of Scotland, Rockall and the North of Scotland. The percentages of the total catch from the different grounds in 1913 were :—

Iceland	20	North of Scotland ...	0·7
Faroe	10	North Sea	61
Rockall	1	Westward of Scotland	3·5

These regions differ much in area and this must influence the quantities taken. For purposes of comparison the average catch per day's absence from port is taken. Data are to be found in the Reports of the Ministry of Agriculture and Fisheries.

The total landings of haddocks show a gradual decrease from 1906 to 1913, and the catches from the different regions show considerable variations. (Fig. 4). From 1908 to 1911 the Iceland catches maintained a high standard and during the same period the catches from Faroe showed a steady decrease. In 1912 the Iceland catches decreased and the Faroe catches increased. A somewhat similar relationship is found between the Westward of Scotland catches and those made from the North Sea and North of Scotland which follow

† Bd. Ag. and Fish. Annual Reports.

much the same curve. The North Sea catches decreased from 1907 to 1910 and improved in 1911. The best catches were made to the Westward of Scotland in 1908 and 1909, and the worst in 1911. In 1912 when the North Sea catches showed a decrease those from the Westward of Scotland showed an increase. The year 1913 was marked by decreased landings from all grounds with the exception of Rockall.

Expressing the facts in general terms we had decreasing catches from the Faroe, North Sea and North of Scotland fisheries coinciding with increased catches from the Iceland and Westward of Scotland fisheries. In 1912 the only fisheries which gave increased catches were those of Faroe and the Westward of Scotland. When there was, in practically every region, a general decrease for the year 1913, the only region which showed an increase was that furthest in the Atlantic, viz. Rockall. In this year the Rockall catches and also those from the North and Westward of Scotland were marked by a high percentage of small fish. It is possible that the general decrease in the haddock catches was due to a decrease in the haddock population but, from the above it appears reasonable to conclude that the fluctuations in the fisheries of the various regions were such as could have been brought about by migrations. The abundance of small haddocks, in 1913, on the grounds already mentioned suggests that migrations may vary with size and age.

The agreement between the catches from the North Sea and the North of Scotland and their fluctuations with those from the Westward of Scotland suggest a comparison of the fish of different sizes caught in these regions. (Figs. 5 and 6). In 1906 and 1907 large haddocks were comparatively plentiful to the North of Scotland and poorly represented in the North Sea and to the Westward of Scotland. Afterwards the percentage of large haddocks from the North of Scotland decreased and there was a corresponding increase from the North Sea and the Westward of Scotland. Again in 1911 the percentage of large haddocks from the North of

Scotland increased and there was a sympathetic decrease from the North Sea. This coincided with a small percentage from the Westward of Scotland which region had shewn a tendency to decrease in the previous year. In the following year, 1912, we had a small percentage of large haddocks from the North of Scotland but increased percentages from the North Sea and Westward of Scotland. These three regions appear to have been fluctuating sympathetically for a number of years and the centre so far as large haddocks were concerned appears to have been to the North of Scotland. The change in the Westward of Scotland curve in 1913 could have been brought about by an increase in the quantity of young haddocks on these grounds.

The percentages of small haddocks in the catches from the three regions considered above show likewise a tendency for the catches from the different regions to be influenced by migrations from one region to another and they likewise indicate the North of Scotland as being the centre of these migrations. Further, the catches of small haddocks for 1913 suggest the possibility of young fish making a migration from the North Sea towards the Atlantic. It will be shewn later that for another species such a migration of the comparatively young fish can be considered proved.

In the Iceland and Faroe regions most variation is shewn in the catches of medium haddocks. (Fig. 7). The curves follow somewhat the curves representing the total catches. They indicate that when medium haddocks were most plentiful in Iceland waters, 1909 and 1910, they were least plentiful in Faroe waters, and that before and after this period they were more abundant in the Faroe fishery and less abundant in that of Iceland.

Cod.—The regional distribution of cod in 1913 was as follows:—

Iceland	41	North of Scotland ..	1
Faroe	14	North Sea	34
Rockall	0·4	Westward of Scotland ...	6

The total catches from all these regions (Fig. 8) show a tendency to increase which is least marked for the North Sea. There are indications that a North Sea maximum preceded one for the North of Scotland which in its turn preceded a maximum for the Westward of Scotland. Also there are years in which good catches at Iceland coincided with poor catches from the Faroe grounds and vice versa, but sympathetic fluctuations between Iceland and Faroe are not strongly marked though they may occur in some years. A more striking agreement between fluctuations in two fisheries is to be found in the fishery of Iceland and the Skrei fishery of Lofoten the data for which have been supplied by Dr. Oscar Sund.† The Lofoten fishery is one for mature cod and in that for Iceland the greatest catches were made in March, April and May. The two fisheries are practically coincident. Figure 9 shows that for a period of eight years these fisheries fluctuated sympathetically; increased catches at Iceland coincided with decreased catches from Lofoten and decreased catches at Iceland with increased catches for Lofoten. In 1914 this agreement broke down and there were increased catches in both fisheries but, the increase for Lofoten was not great and may have been due to the good year-class which made its appearance in the catches of small cod in 1909, or, as would appear from the work of Hjort, that of 1904.

The percentages of large cod (Fig. 10) taken from the various fisheries in different years indicate that large percentages of this size are never caught in the North Sea, about the Faroes, North of Scotland and Westward of Scotland in any one year. High percentages from the North of Scotland and Rockall in 1907 coincided with fairly low percentages from the North Sea and very low percentages from the Westward of Scotland. Good percentages from the North Sea and increased ones from the Westward of Scotland (1908) coincided with decreasing percentages from both the North of Scotland and Rockall. The very low percentages

† See also Aarsberetning Norges Fiskerier, 1923, p. 393.

from the North Sea in 1910 coincided with the very high percentages from the Westward of Scotland and slightly increased ones for the North of Scotland and Rockall. The years 1912 and 1913 gave increased percentages from the North Sea and North of Scotland, slightly decreasing percentages from the Westward of Scotland and a considerable fall for the Rockall grounds. Apparently the large cod are able to migrate from one region to another and they do so in sufficient numbers, but not always all in the same direction, to cause considerable fluctuations in their relative numbers. It is possible, though the data do not indicate it, that Faroe grounds may be influenced also in this way.

The percentages of medium cod (Fig. 11) taken from different regions also indicate sympathetic fluctuations between the North Sea, North and Westward of Scotland and also the Faroes. In no one year did high percentages of cod of this size come from all these grounds, nor can we find any one year in which these fisheries all yielded low percentages of medium cod. But we do find two regions giving high percentages when the other two regions gave low percentages. The lowest percentages of medium cod were taken from the Faroe and Westward of Scotland fisheries (1910) when good percentages were caught in the North Sea and to the North of Scotland. The increased percentages from the North of Scotland in 1908 and 1909 which coincided with the decreased percentages from the North Sea and Westward of Scotland suggest that this region may benefit by migrations from both the latter regions. The exceptionally high percentages of medium cod taken from the Westward of Scotland in 1907 are worthy of note and so are the increasing percentages in 1912 and 1913. In these years there is an indication that fish moved from the North Sea and North of Scotland towards the Atlantic.

In the preceding pages an attempt has been made to indicate the possibility of extensive migrations for cod and

haddock and to show the possibility of fluctuations in the catches of these fish from home waters being due to migrations between the North Sea, North of Scotland, Westward of Scotland and possibly Faroe.

If we graph for each month the average catch per day's absence from port, as in figure 12 * we find the concentration of spawning haddocks in the North Sea is almost insufficient to give us a cusp indicating the spawning season and yet one is shewn for the Westward of Scotland. In 1913 the North Sea yielded 61 per cent. and the Westward of Scotland 3'5 per cent. of our haddock catches. From 1906 to 1910 the percentage of large haddocks in the catches varied between 40 and 21 for the North Sea and from 22 to 9 for the Westward of Scotland. It is noticeable also from the same figure that Iceland and Faroe which in 1913 yielded 20 and 12 per cent. respectively of our haddock catches show a similar difference. Schmidt † gives April and May as the spawning season for Iceland and Faroe. It would appear that the spawning of haddocks in the North Sea gives a concentration for part only of the North Sea haddocks, as occurs at Faroe, and that the quantities of large and medium haddocks landed are due to recovered spent fish making a migration which manifests itself in the autumn in the North Sea and at Faroe from June to August.

The graph illustrating the monthly average of catches per day's absence for cod, 1906 to 1910 (Fig. 13) shows that there is a second concentration after spawning in the North Sea, Westward of Scotland and Faroe but this is not so clearly indicated for Iceland. It is noticeable that the secondary maxima for Faroe and Westward of Scotland are earlier than that for the North Sea. Graham‡ has shown that there is an improvement in the condition of mature cod in the North Sea in June and again in September and October and also for immature or medium cod in July and August.

* Data from Statistical Tables, 1906–10, Bd. of Ag. and Fish.
† Rapp. et Proc-Verb., x, 1909.
‡ Fish. Invest., Ser. ii. Vol. vi., No. 6, 193, Ministry Ag. and Fish.

Whilst the condition of North Sea cod may be due to herring feeding as Graham suggests, it is also possible that the difference in time between the secondary concentration in the North Sea and in adjacent waters indicates a movement towards and into the North Sea and the second improvement in the condition of large cod in September and October may be brought about by migrants from outside the North Sea.

The year 1908 is marked by a very poor concentration for spawning on Faroe grounds.

The following figures given to the nearest 1,000 cwts. are from Statistical Tables 1906–1910, Board of Agriculture and Fisheries, and refer to the North Sea catches.

	Haddocks.			Cod.		
	Large	Medium	Small	Large	Medium	Small
1906	433	257	1303	274	220	174
1907	587	326	1198	258	176	144
1908	623	277	846	297	120	164
1909	567	201	682	237	131	370
1910	514	144	633	218	197	336
Total ...	2724	1205	4662	1284	844	1188

Both cod and haddock data are considered to indicate that some change takes place about the time these fish reach medium size. From the work of Graham * and Russell ‡ medium cod are those which are approaching first maturity and the same can be said for medium haddock from the data supplied by Russell.§ The writer has found that in the case of herring the approach of first maturity coincided, 1920–21, with a migration of large numbers of North Sea fish into the Atlantic. It is possible that both cod and haddock, with approaching maturity, make migrations which tend to take them away from the North Sea. Variations in the direction and extent of these migrations would account for the facts to which attention has been drawn and would give some explanation for the fluctuations in the distribution of young fish, especially haddock, which cannot be considered to spawn so abundantly as cod in the North Sea.

* Ministry Ag. Fish., Fish. Invest., Ser. ii., Vol. vi., No. 6.
‡ Ministry Ag. Fish., Fish. Invest., Ser. ii., Vol. v. No. 1.
§ Bd. Agr. Fish., Fish. Invest., Ser. ii., Vol. i., Pt. i., pp. 90, 91.

There is a number of interesting phenomena which tend to group themselves round certain years.

1905.—Failure of West of Shetland herring fishery. A year previous to this the Loch Fyne herring fishery failed.

1906.—Decrease in South Coast mackerel fishery; North Sea mackerel catches increased.

1907.—Pilchard catches decreased considerably. Southern North Sea herring catches began to increase and continued to do so whilst East Coast of Scotland catches decreased. High percentage of medium cod from Westward of Scotland.

1908.—Increased concentration of haddocks to the Westward of Scotland; percentage of large haddocks decreased about the North of Scotland and increased in the North Sea and to the Westward of Scotland. Poor spawning concentration of cod at Faroe.

1912.—The only regions which showed increased catches of haddock were Faroe and Westward of Scotland. Percentages of large haddocks decreased about the North of Scotland but increased in the North Sea and to the Westward of Scotland. Beginning of a possible migration of young haddocks towards the Atlantic.

1912–13.—Increased percentages of medium cod from Westward of Scotland coinciding with decreased percentages from the North of Scotland and to some extent from the North Sea.

1913.—Haddocks decreased generally, Rockall excepted. Further indications of a possible migration of young haddocks from the North Sea towards the Atlantic.

The years 1905–07 may be grouped together for the changes in the fisheries followed or coincided with a series of hydrographic phenomena. Pettersson * has shown that coinciding with maxima in the influence of the moon and sun on the waters of the oceans, we have maxima in the activity of Atlantic waters. The lunar period controlling these maxima

* "Climatic variations in historic and prehistoric times."

is of approximately nine years and there is another of eighteen to nineteen years. Such a maximum occurred in 1903, a year in which Matthews ‡ considered conditions abnormal over the larger part of the northern European area. It was followed by the failure of the herring fisheries of Loch Fyne and the West of Shetland, and the year-class of 1904 for cod and herring in Norwegian waters. The high catches of herring made in British waters in 1907 were probably from the 1904 year-class for it has been shown § that from 50 to 70 per cent. of the herrings in our summer fishery, from Wick to Scarborough, were in their fourth year. It is of interest to note that the recovery of the West of Shetland herring fishery followed the activity of Atlantic waters in 1920–21.

Following the Atlantic activity of 1903 there was an extensive salt water inflow into the North Sea throughout the winter of 1905-06 * brought about by the abnormal conditions existing in the North Atlantic. It may be that these abnormal conditions were sufficient of themselves to bring about the changes noted in our fisheries in the years 1905–07 but, it is also possible that the effect was cumulative and that after the winter of 1905–06 the currents of our seas and the adjacent oceans were altered. Whichever way we consider the matter we have the coincidence of fluctuations in oceanic waters with fluctuations in our fisheries. It may be no more than a coincidence but, if we find further evidence of a similar nature then we may assume, with some reason, that we are considering cause and effect.

In 1908 it would appear that coinciding with an increased concentration of haddocks to the Westward of Scotland the large haddocks left, or were driven from, the North of Scotland and made their way into the North Sea and to the Westward of Scotland. Also it would appear that the usual concentration of spawning cod about Faroe was prevented.

‡ North Sea Invest. Cttee., 2nd Rept, Southern area, Cd. 4641.

§ Rept. Dove Marine Laby., 1920.

* Robertson North Sea Fish. Invest. Cttee., 4th Rept. Northern area, Cd 4893.

There was an abnormal inflow of northern waters into the northern North Sea in the early months of 1908 when cold water reached as far south as Aberdeen.§

The next activity of Atlantic waters was due in 1912. Whilst it is possible that one year only may stand out as regards oceanic activity the years 1920 and 1921 were both marked by waters of high salinity and of Atlantic origin in the North Sea. The lunar pull gradually approaches a maximum. The years 1912 and 1913 appear to be a time when both young cod and haddock migrated to or towards the Atlantic. In the first year increased catches of haddocks were made about Faroe and the Westward of Scotland and these were the only regions which yielded an increase from a fishery marked by gradually decreasing catches. In the following year haddock catches decreased generally with the exception of those from Rockall which can be taken as the most oceanic fishery here considered. The behaviour of large haddocks in 1912 was practically the same as in 1908—decreased percentages from the North of Scotland coinciding with increased percentages from the North Sea and Westward of Scotland. An examination of our herring shoals directly after the war showed that amongst the older fish the year-classes of 1913 and 1914 were the richest.*

Coinciding with changes in marine circulation we have alterations in migrations which may vary in direction and intensity and which appear to indicate, in some cases, a splitting up of the population and the separated portions migrating in opposite directions. We have also a tendency, which would appear to be most marked in those approaching first maturity, for fish to seek the Atlantic. There is also the production of good year-classes to which must be added the young cod which came into our fisheries in 1909 and followed the abnormal activity of Atlantic waters in 1905–06.

§ Robertson, Op. cit.

* Rept. Dove Marine Laby., 1920.

Following the recent activity of Atlantic waters we have had a change in our fisheries. The following data relating to the average catch, in cwts., per day's absence are from figures supplied by the Ministry of Fisheries. They show the unsatisfactory period through which the fishing industry has passed and this is emphasized by the low catches from the North Sea which yields very great quantities of cod and haddock. The figures for Lofoten, supplied by Dr. Sund, are expressed in thousands of fish.

COD.

Year	1919.	1920.	1921.	1922.	1923.
North Sea	5·2	5·3	5·0	3·7	2·4
North of Scotland ...	11·0	7·5	8·7	11·0	8·6
Westward of Scotland	6·1	6·1	6·8	6·1	3·3
Faroe	23·5	11·3	13·4	18·3	15·2
Iceland	30·1	29·7	24·8	27·1	23·2
Lofoten	7,000	12,100	18,600	13,100	17,012

HADDOCK.

Year.	1919,	1920.	1921	1922.	1923.
North Sea	15·8	10·9	9·7	8·6	5·4
North of Scotland ...	12·3	7·6	5·6	4·0	4·8
Westward of Scotland	3·5	4·7	4·7	3·3	3·5
Faroe	12·2	7·4	10·4	6·7	5·2
Iceland	21·4	15·0	12·4	12·2	9·4

The first indications of decreased cod catches from the North Sea appeared in 1921 in which year both the North and Westward of Scotland showed an increase. In 1922 the North Sea catches were poor; those from the North of Scotland and Faroe good; those from the Westward of Scotland showed little sign of decrease. In 1923 the cod fishery of the North Sea was exceptionally poor; those of the North of Scotland and Faroe were less than in 1922 but differed little from the average for 1920–23; that from the Westward of Scotland was poor. It would appear that the cod left the North Sea by way of the North of Scotland and the Faroes.

The Iceland and Lofoten fisheries show the same sympathetic fluctuations to which attention has been drawn and recall the odd and even years found in hydrography.

The haddock catches began to decrease from the North of Scotland in 1921, in which year the North Sea showed a slight decrease and Faroe a decided increase. In 1922 decreased catches were general. In 1923 the returns from the North Sea were very low and both the North and Westward of Scotland gave slightly better returns than the previous year. Whilst it is possible that haddocks left the North Sea by way of Faroe there appears to have been a general movement away from the usual fishing grounds.

Coinciding with the invasion of Atlantic waters in 1920–21 we had some noteworthy phenomena in our herring fishery. The quality of the herrings caught off the east coast of Scotland in 1920 was poor; in 1921 the fish were worse and the deterioration in quality extended as far south as the East Anglian fishery. At Yarmouth the fish were so poor that herrings were brought from the West Coast to make "Yarmouth Reds." In connexion with the quality of fish it is of interest that Hjort * has shown that there is a fluctuation in the yield of cod liver oil from the Norwegian fishery and an examination of his data shows that the smallest yields of oil coincide with the nine year period of Atlantic water activity.

Not only were the North Sea herrings poor in quality in 1921 but the fishery was a failure. In the spring of 1923 samples of herrings from the North of Scotland contained numerous fish which had made a peculiar growth. Most of these fish came from the more distant fishing grounds and a small number had penetrated the North Sea and were caught off the Firth of Forth. Their scales showed abnormal growth in 1921. When the yearly growth was calculated it became evident that previous to 1921 they had grown as North Sea fish and in 1921 and 1922 as Atlantic fish. These fish were

* Fluctuations in the Great Fisheries of Northern Europe.

of the 1918 year-class and had migrated into the Atlantic in 1920. That all the 1918 year-class did not migrate into the Atlantic is clear, for many were taken in the East Anglian fishery and these showed a growth, up to the end of 1920, equal to that made by the migrants.* We have, therefore, evidence not only of a migration into the Atlantic but also of a splitting of the population and the two portions going in opposite directions. Further the migration took place when available data show that these fish would be approaching first maturity.

Other phenomena of interest also occurred in connexion with the herring. In the spring spawning shoals of 1921 about the North of Scotland and the Firth of Forth there were abnormally high numbers of young fish at the end of their third year. New spawning grounds afterwards became established, as that off the Berwickshire coast in March, and there was an increased amount of spawning amongst the shoals of the East Anglian fishery. We had, in addition to extended migrations, accelerated development or early maturity, alteration in spawning times, and the formation of new spawning grounds. There are good grounds for holding that these changes took place and they coincided with Atlantic water activity. It is possible other fish were affected in the same way and this idea is strengthened by the finding of spawning cod in the North Sea by Fulton ‡ in the autumn of 1903.

There may be differences of opinion as to the interpretation of some of the data here given, but there can be little doubt that the Atlantic has considerable influence on our fisheries. The problem of fluctuations needs for its solution a knowledge of the differences between the waters of our seas and those waters adjacent to them. Baltic water extends periodically

* Rept. Dove Marine Laby., 1923.

‡ Pub. de Circ., No. 8.

and probably to varying extent over the North Sea*; cold northern waters may invade the North Sea, but the greatest influence appears to result from variations in the flow of Atlantic waters.

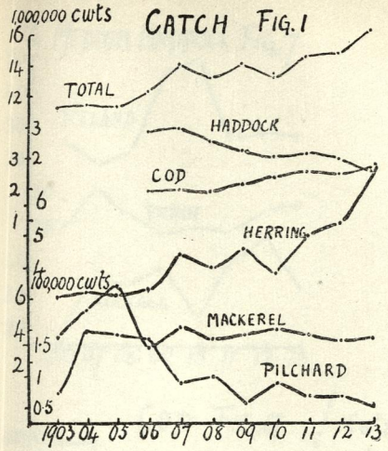
Alterations in migrations which are considered, at present, to be the chief factor in determining fluctuations, may be brought about by changes in the direction and intensity of currents but such changes can not be the fundamental cause which produces changes in the quality of the fish, variations in the yield of oil from cod's liver, and early maturity. It becomes necessary therefore to have a much wider and more detailed knowledge of the waters of the Atlantic. We know the Atlantic waters differ in salinity from North Sea water but we cannot point to any difference which would produce the results noted above. Before we can hope to understand our fisheries we must have data on which to work and these data include as complete a knowledge as is possible of the chemical and physical differences between our seas and the ocean. The change in 1920–21 in the hake grounds off St. Kilda, noted by Howell,§ possibly indicates that a knowledge of surface waters will be insufficient and that the mid-waters coming from over the Azores plateau and the Mediterranean, and which flow in a northerly direction, need to be examined in more detail. The peculiar effects of radiations on life and the finding by Joly ‡ of varying amounts of radio-active matter in marine sediments and sea-water suggest the desirability of further knowledge as to the comparative radio-activity of the waters. Further the invasions of Salps and Pteropods into the North Sea and their subsequent disappearance indicate that there may be some differences which at present can be determined only by, and expressed in terms of, the organisms which live in the different waters, just as in agriculture differences between fields are expressed in terms of what they will grow. Finally, the problem we set out to

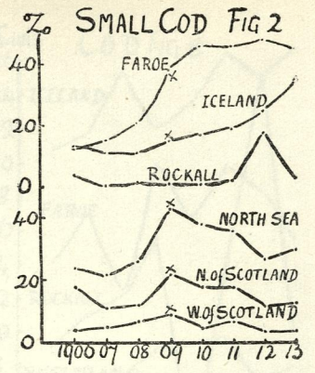
* Jee., Min. Ag. and Fish , Fish Invest., Ser. iii., Vol. iv,, Pt. i.

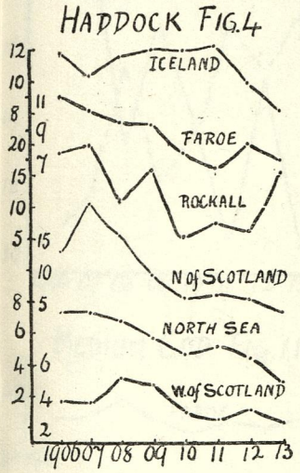
§ Ocean Research and the Great Fisheries.

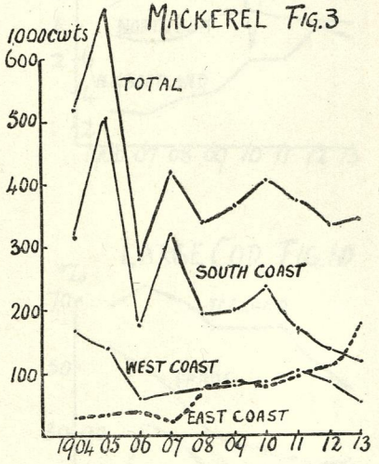
‡ Sc. Proc. Royal Dublin Soc., Vol. xi. (N.S.), Nos. 22 and 26.

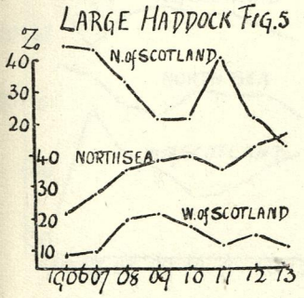
solve is the problem of life and that is why in the opening pages fluctations were referred to as one of the greatest problems to be solved in connexion with our fisheries. The problem of life is one of pure and not applied science and its solution, or steps towards its solution, can be expected from the homes of pure science, though it must be remembered that applied science will have its part to play.

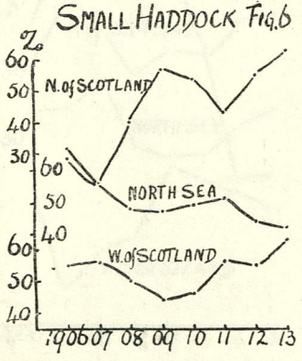


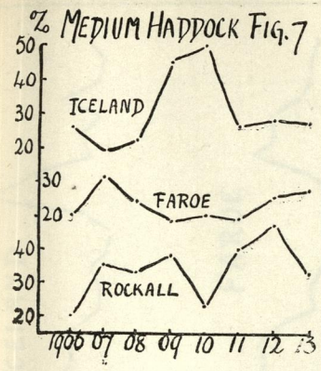


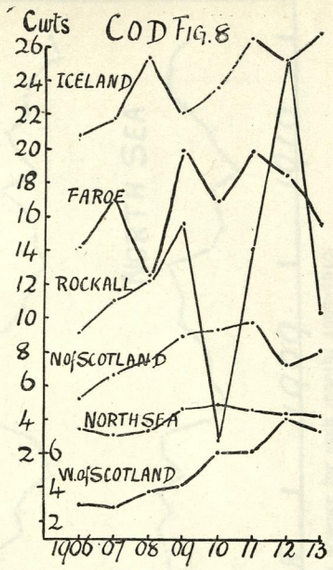


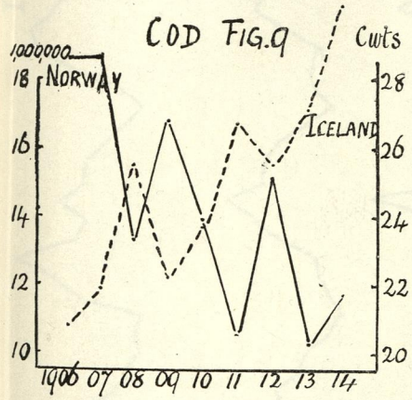


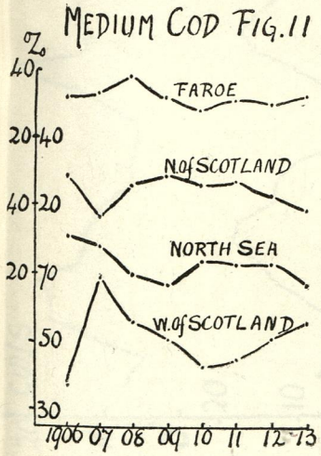


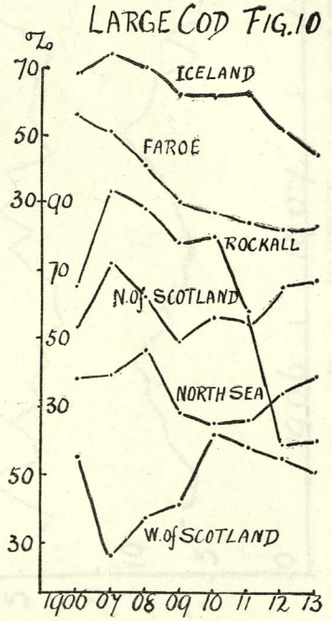



% MEDIUM HADDOCK FIG.7
ICELAND
FAROE
ROCKALL
1906 07 08 09 10 11 12 13


Cwts COD FIG.8
ICELAND
FAROE
ROCKALL
N.of SCOTLAND
NORTH SEA
W.of SCOTLAND
1906 07 08 09 10 11 12 13


COD FIG.9
1,000,000
NORWAY
ICELAND
Cwts
1906 07 08 09 10 11 12 13 14


MEDIUM COD FIG.11
%
FAROE
N.of SCOTLAND
NORTH SEA
W.of SCOTLAND
1906 07 08 09 10 11 12 13


LARGE COD FIG.10
%
ICELAND
FAROE
ROCKALL
N.of SCOTLAND
NORTH SEA
W.of SCOTLAND
1906 07 08 09 10 11 12 13

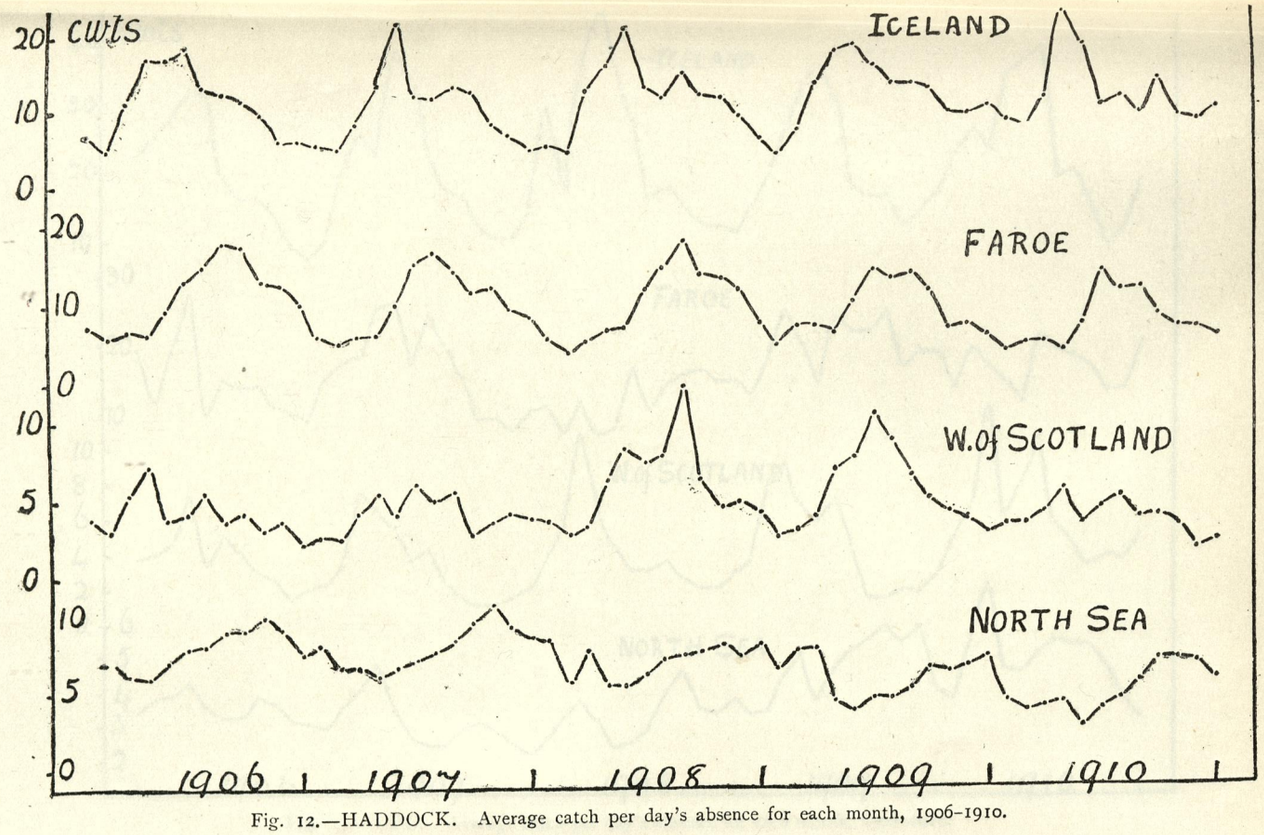


Fig. 12.—HADDOCK. Average catch per day's absence for each month, 1906–1910.

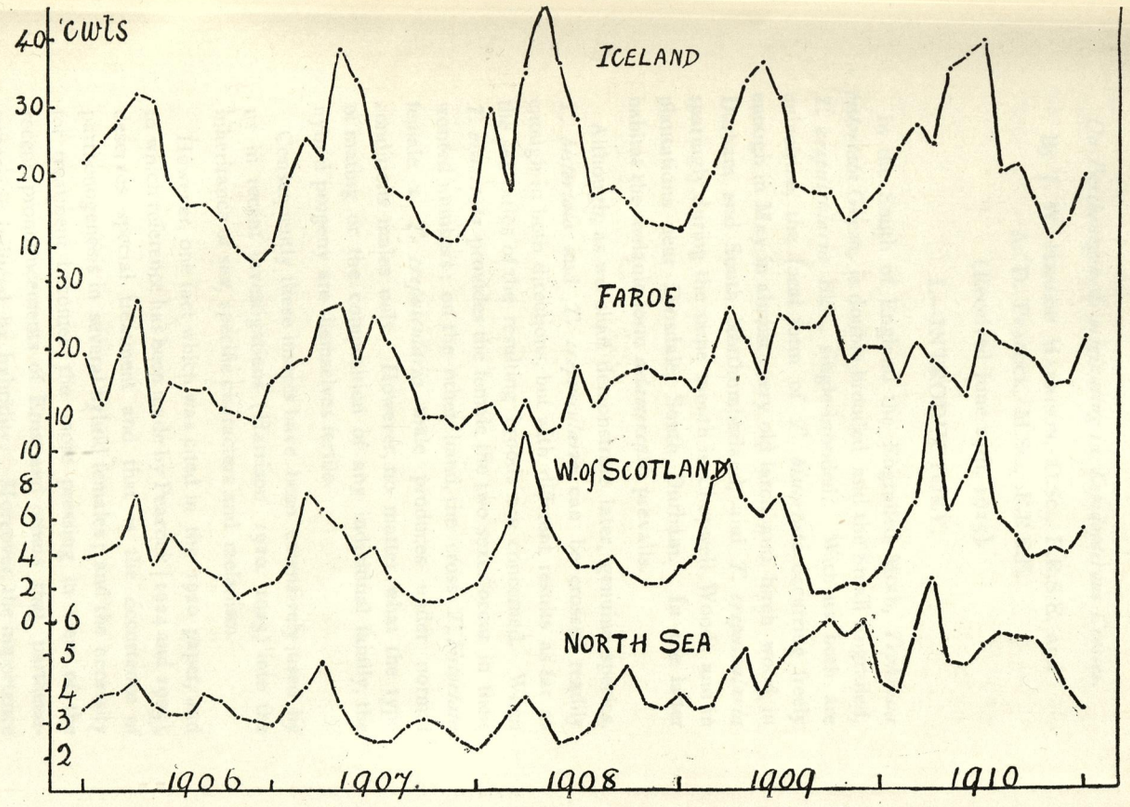


Fig. 13.—COD. Average catch per day's absence for each month, 1906–1910.

On Parthenogenesis originating in Lepidopterous Crosses.

By J. W. Heslop Harrison, D.Sc., F.R.S.E. and
A. D. Peacock, M.Sc., F.R.S.E.

(Received June 24th, 1925).

I.—INTRODUCTORY.

In the South of England the Engrailed Moth, *Tephrosia bistortata* Goeze, is double-brooded and the Small Engrailed, *T. crepuscularia* Bkh., single-brooded. With us both are univoltine, the local form of *T. bistortata* occurring freely enough in May in almost every old larch and birch wood in Durham and South Northumberland, and *T. crepuscularia* sparingly during the same month in Chopwell Woods and in plantations near Dinsdale, South Durham. In the latter habitat the melanic form *delamerensis* prevails.

Although, as we shall demonstrate later, genuine species, *T. bistortata* and *T. crepuscularia* can be crossed readily enough in both directions, but with different results as far as the sex ratios of the resulting broods are concerned. When *T. bistortata* provides the female the two sexes occur in their wonted numbers; on the other hand, the cross *T. bistortata* female x *T. crepuscularia* male produces under normal conditions males only. However, no matter what the type of mating or the composition of any individual family, the hybrid progeny are themselves fertile.

Consequently these insects have been extensively used by us in recent investigations (Harrison 1920, 1923) into the inheritance of sex, specific characters and melanism.

However, one fact which was cited in the 1920 paper, and to which reference has been made by Peacock [1924 and 1925], deserves special treatment and that is the occurrence of parthenogenesis in several hybrid females; and the necessity for treatment becomes the more pressing in view of the recent pronouncements of Ernst and others that parthenogenesis is induced by hybridity. Moreover, the importance

of the results is enormously increased by the fact that, whilst the theory as advanced by Ernst was based on observations made on plants like the Stonewort, *Chara crinita*, in the present instance we see a proof of its validity under experimental conditions and its extension to the animal kingdom.

II.—DESCRIPTION OF THE EXPERIMENTS.

In all, eight females which yielded ova developing parthenogenetically have been encountered, four in June, 1919, one in September, 1919, and after a long interval, a sixth in June, 1924, and two in June, 1925. The paucity of such females must not be assigned to lack of opportunities for their development, for in each year from 1918 to 1925 inclusive many hundred hybrid crossings of varying degrees of complexity have been made, and virgin females of hybrid origin caged up. Furthermore, numbers of virgin females of the two pure species have been treated similarly, but in no case except those mentioned did the resulting eggs hatch.

Experiment 1.

T. crepuscularia var. *delamerensis* female x *T. bistortata* male.

In this cross one F1 melanic female laid eggs which hatched without fertilisation. From this batch eleven larvæ were obtained and three moths, two males and one female, were bred from them. Of these insects the female might be described as a melanic specimen of low grade. On the other hand, one male was so dark as to transgress in degree the melanism of the original female parent, whilst the other, dove grey in colour, was of pattern more nearly resembling a member of the genus *Gnophos* than a *Tephrosia*. Noteworthy here is the evidence of segregation in spite of their parthenogenetic origin.

Experiment 2.

Same cross but with type *T. crepuscularia*.

Here two batches of parthenogenetic ova were obtained but in one case no imagines were bred. The second, however, gave rise to seventeen larvæ and to five male and five female

moths. Once more segregation was noticeable in respect to wing colour and pattern, less obviously in the males, but very markedly in the females. In the latter sex the colouration ranged from pale forms, feebly banded, to heavily barred forms of ground colour approaching that of the *bistortata* from which they originated. Contrasted with the sexually produced F2 insects (their cousins) in respect to size and depth of colouring, the difference was very striking.

Experiment 3.

In this instance a (*crepuscularia* ♀ x *bistortata* ♂) female was paired with a male of reciprocal origin, but involving black *crepuscularia*. Of their progeny one female yielded larvæ without pairing; no offspring was bred.

Experiment 4.

A second female of similar origin to the preceding, save that only typical *crepuscularia* was employed in building it up, produced a female which yielded nine larvæ parthenogenetically. No imagines were reared.

Experiment 5.

T. crepuscularia (type) x *T. bistortata* (black).

In this case an F1 female laid a batch of eggs of which only eight larvæ hatched, two dying almost immediately and four subsequently. Hence only two moths were obtained (and one of them had to be extracted from the pupa), one black female and one black male. Again special attention must be directed to the evidence of segregation in this case, for melanism introduced by means of *T. bistortata*, either within the species or in interspecific crosses with *T. crepuscularia*, behaves as a Mendelian recessive giving wholly typical F1 broods and figures like 30 types and 10 melanics (a result actually obtained in an interspecific cross) in the F2 batches.

Experiment 6.

During the present year, experiments similar to the above have been undertaken, and, in these instances, the species

T. crepuscularia has been introduced in the guise of a double-brooded race from Saxony and the form *bistortata* in one case from cultures containing induced blacks and in the other from an ordinary type strain. Strangely enough, in the former case, no females appeared until a fortnight after the first males, and in the second case the females antedated the males by an average of 10 days. In the latter batch the females had necessarily to be kept isolated in chip boxes awaiting partners. A number of females was so treated, when three proceeded to lay immediately after emergence, thereby excluding any possibility of mating them, even if males had put in an appearance the first day, whilst four more did so after an interval of two days. Acting on this hint, twenty-four females of the second F1 lot were placed singly in boxes when they, too, commenced to lay. In none of these cases did the egg masses, composed of eggs mingled with silk, show signs of the looseness, the scattering of the silk and smallness of the number of eggs present, which characterise the egg batches of virgin females; these were exactly the same as those produced by fertilised insects. Further, in two cases the eggs took on the opaque colouring and underwent the slight yellowing which indicates fertility. Next they darkened to a steely blue, followed by a paling after which they hatched, the incubation period being 17 days. One batch from one female yielded 50 per cent. of emergences whilst in the other practically every egg hatched—the best result up to date. The mortality in the first batch, however, has been heavy but in the second comparatively slight.

III.—DISCUSSION.

Mortality.

In view of the fact that exact statements have been made above in respect to the mortality in any given brood, it is only necessary to emphasise here that in most of the broods the actual number of eggs hatching was small, and the mortality among the larvæ very heavy; but a better appreciation of these facts will be obtained when it is pointed

out that the average size of a batch of eggs in these hybrids is approximately 350. From this we glean that very few of the unfertilised ova are capable of development.

The result of Experiment 6, in which practically every egg in one batch gave a larva, whilst 50 per cent. in the other batch behaved similarly, is of great interest as it contrasts so strongly with what obtained in the other experiments.

Segregation.

One fact stands out pre-eminently in this work, and that is the occurrence, under such conditions, of segregation in F1 gametogenesis in the matters of wing colour, pattern and sex. If the F2 parthenogenetic insects had one melanic grandparent this is emphasised by the occurrence of recessives amongst them, melanics when the melanism is introduced by *bistortata* and types when the original *crepuscularia* parent is black. On the other hand, if both of the original insects are types, the same information is imparted by the spread of variation in wing pattern of the parthenogenetically produced insects.

This clearly implies that a more or less perfect reduction division has occurred, and that we are dealing with a true parthenogenesis, *i.e.*, the development of an egg which is to be regarded as more or less haploid.

But the matter of sex is much more puzzling, for it is very difficult indeed to see how the parthenogenetic offspring can include both males and females. This, however, is no exception to the usual circumstances attending casual parthenogenesis in the Lepidoptera for Goldschmidt [1917] reports both sexes in parthenogenetic broods of *Lymantria dispar* as do Jourdan [1861] and other observers for *Bombyx mori*.*

If the eggs reduce perfectly then, assuming in this case, as has been shown in *Lymantria dispar* and in frogs produced

* For summaries of cases of accidental parthenogenesis in Lepidoptera see Newman [1856] and Tutt [1896].

by artificial parthenogenesis [Loeb 1916], the diploid chromosome number to be restored by some at present unknown method, this would mean that the constitution of the new organism in respect to sex must be either XX or YY. The former are recognised as regular males, but the latter, in the light of present day knowledge, are unlikely to be females and are probably non-viable. Nor is the position any better if no doubling occurs, for then we should have to represent the parthenogenetic insects as of sex formula X and Y respectively, and again, in all probability, one sex would alone appear as in the Tenthredinoidea and in certain other haploid insects produced parthenogenetically.

On the other hand, we must not forget that we are concerned with hybrids, and that in hybrid organisms cytological irregularities are of frequent occurrence. Under these conditions it is possible, although not very probable that, in doubling, further abnormalities occur bringing into being creatures of constitution XX and XY or of recognised modifications of such whereby we have both sexes represented in our cultures. Nevertheless, bearing on this point, we have the very powerful evidence of the parthenogenesis in the pure species *Lymantria dispar* and *Bombyx mori* where nothing in the nature of mitotic or allied irregularities can be invoked.

Obviously, a normal first oocyte division followed by a reunion of the oocyte nucleus with that of the first polar body is excluded, for that again would only yield us one sex, the female, and would distinctly contradict the evidence of segregation in colour. Again, if the nucleus of the second polar body behaved similarly, although the difficulty of the segregation of colour vanishes, the position returns to that considered in dealing with a doubling secured by unknown means. Hence these considerations advance us but little.

Of course it is well to recognise that if YY zygotes are viable they may be females, and then no real difficulty arises; still the chances are against this.

Independently of this, the only further possibility in the way of a chromosome explanation seems to lie in actions set up and maintained by the egg cytoplasm neutralising, and overpowering from the very beginning, the forces set in motion by the chromosome complements. However, to sum up, any explanation of the presence of the two sexes in parthenogenetic lepidopterous broods on a basis involving sex chromosomes seems to demand too many supernumerary theories to bolster it up. We, therefore, like the botanists, are driven to consider the sex chromosome alone as affording a hopelessly inadequate mechanism for securing the sex ratios observed by ourselves and others in such cultures.

Hybridity and Parthenogenesis.

We may now approach the difficult question of the relation between hybridisation and parthenogenesis. An extreme view would be that hybridisation causes parthenogenesis; a less extreme one that hybridisation in some way "sets the stage" for the emergence or resurgence of parthenogenesis. The former view postulates the following:—

1. That the parent forms, by breeding and cytological experiment, have been proved pure species and not hybrids.

2. That the parent forms have been demonstrated similarly to be non-parthenogenetic.

In order to find the necessary data of a character similar to those in these experiments, which data must be marshalled in order to make any judgment, we are compelled to turn to the botanical side as no zoological evidence save ours exists.

The classic work is that of Ernst (1918), and the data and views enunciated therein have been subjected to a fine critical survey by Winkler (1920) to whose work we would refer readers desiring further details; from it we quote freely in the following. As this aspect of the study of parthenogenesis has received but little attention we think it desirable to devote some little space to it.

Ernst's theory is based firstly upon his work on the Stonewort, *Chara crinita*. This plant occurs in two forms, one sexual and one parthenogenetic (apogamic) and outwardly they are scarcely to be distinguished from one another except by the fact that the parthenogenetic* form is somewhat more robust. Cytologically, however, the sexual form possesses 12 chromosomes in its vegetative organs and germ cells whilst the parthenogenetic plant has 24 in all its cells. The parthenogenetic race, therefore, compared with the sexual, has been called "diploid" the term, in view of the cytological conditions existing in this plant, being used in the special sense that one has double the chromosome complement of the other (Winkler 1920, p. 3). Ernst infers two important generalisations as a result. He asserts, firstly, that the "diploidy" is the cause of parthenogenesis, and secondly, that the "diploidy" originated in the first instance through hybridisation between a female *Chara crinita* and a male of another but unknown species of *Chara*.

It cannot be denied that Ernst's theories would explain the case, but, in view of the facts that "diploidy" may arise in other ways than by hybridisation, that one of the parent species is conjectural and that, even granting such a parent, the offspring are maternal only in character, we can only say that our postulates are very far from being satisfied. Without going into details, we may safely assert that the conditions obtaining in *Chara crinita* are easily capable of other explanations, and Ernst's interpretations, as Winkler remarks, involve too many auxiliary hypotheses.

As further evidence for his theories Ernst cites the work of Buser on *Alchemilla gemmia*. This plant, from observations made on it and its relatives in the field, is regarded as a true hybrid between *A. glacialis* and *A. pentaphylla*. It reproduces by apogamy only. Applying the postulates stated above we find that no experimental work has been performed to corroborate the hypothesis, and on this ground alone we must

* It is worthy of note that this agrees with the condition of certain of our parthenogenetic insects.

regard the statement as non-proven. But not content with this justifiable criticism Winkler challenges the nature of the field observations themselves. For instance, he points out that *gemmia* may not be an F1 hybrid at all but a descendant from a F1 hybrid. It would thus appear as merely one of the series of intermediate forms found on the same ground. Further, the reproductive methods of these collateral intermediates have never been investigated and therefore afford no evidence either way touching the theory. In addition, according to the researches of Böös (1917) parthenogenesis exists in all three sections of the Alchemilla group, and therefore it is quite possible that *gemmia* has inherited the parthenogenetic faculty from its forbears.

The second illustration is that of *Antennaria alpina* which is cited by Juel (Winkler, p. 146) and believed by him to be a hybrid between *A. dioica* and *carpathica*. As there are many facultatively parthenogenetic forms in the genus and some exclusively so, if we apply the same argument as used for *alpina* we shall have to regard them all as possibly hybrids. But as no experimental proof of such exists there is no corroborative evidence from them in support of Juel's thesis. Further, arguing from the discoveries of Rydberg (1910) and Fries (1919) etc. that *alpina* has many "sub-species" which are difficult to differentiate, and which cannot be regarded as modifications due to environmental conditions (*i.e.* are not local races), Winkler makes the point that the descendants of a parthenogenetic F1 hybrid should only be of one form, excepting of course supplementary forms produced by mutation. Proceeding to discuss this diversity of *alpina* forms he affirms that such could not arise by parthenogenesis because parthenogenetic reproduction leads to stereotypy of form. To account for the diversity he presents two obvious possibilities, viz.:—(1) That one or both parents must have been hybrids. (2) That the F1 generation was sexual. In the absence of experimental evidence we do not disagree from Winkler's views that these possibilities fit the particular case

of *Antennaria alpina*, but we must point out that our experiments definitely prove that parthenogenetic reproduction from a hybrid does not necessarily preclude the production of forms diverse in many characters, including sex.

In contrast to the foregoing points of view, founded on field work, there is that of the distinguished Swedish worker Rosenberg (1917) who has regarded the matter from the aspect of the cytologist. The hawkweed, *Hieracium umbellatum*, is sexual and has a diploid chromosome constitution of 18, whilst the variety *linearifolium* is parthenogenetic and has a somatic chromosome constitution of 27. This triploid number is shared likewise by the majority of species of the group Archieracium which, furthermore, are parthenogenetic. Arguing then from the facts that diploidy may be associated with hybridity, and that the triploid forms may segregate in various ways, Rosenberg believes, firstly, that these triploid Archieracia are hybrids and, secondly, that the triploidy has determined their parthenogenetic manner of reproduction. Theoretically, the first belief is sound, and possibly likewise the second, but, and here to us is the crux of the matter, Rosenberg gives no experimental evidence in support. In its absence one is justified in pointing out with Winkler that the phenomenon of triploidy can be equally well explained in other ways, and that there is no justification for arbitrarily selecting above all others the one explanation that the triploid Archieracia are hybrids. Briefly, Rosenberg's arbitrary syllogism is as follows:—

hybrids may be triploids;
linearifolium etc. are triploids;
therefore *linearifolium* etc. are hybrids;

whereas the matter ought to be put:

triploids may be hybrids;
linearifolium etc. are triploid;
therefore *linearifolium* etc. may be hybrids.

The hybrid origin of the triploid Archieracia being then in doubt, the second point of their parthenogenesis being a result of hybridity is out of court and, though we by no means deny

the possibility of the association of triploidy with parthenogenesis, we cannot see how the Archieracia can be cited as illustrative of this thesis. The general problems of the relation of polyploidy and parthenogenesis and hybrid polyploidy and parthenogenesis we shall discuss later.

Similar cases, *e.g.* Holmgren's (1919) work on *Erigeron annua* and *Eupatorium glandulosum*, all show the same failing —the lack of experimental work—and we see no reason for labouring the matter further.

We had thought that the hybridisation work of the Hagedoorns (1924) with various species of squashes (Cucurbita) had anticipated ours, but the recent criticism of G. B. Durham (1925) places the matter still *sub judice*. The Hagedoorns claimed that protected female flowers of 18 different kinds of Cucurbita did not set seed whilst certain F1 hybrids produced viable seed by parthenogenesis and, also, that the parthenogenetic offspring from these hybrids showed segregation. Durham, using one of the strains of *Cucurbita pepo* employed by the Hagedoorns could not obtain evidence of parthenogenesis. He points out that the figures on the plates in the Hagedoorn paper "show the receptacle cracks and marks of hermaphroditic fruits" and, later, suggests that their results may be explained on the basis of being direct pure line descendants from hermaphroditic fruit.

In view of our work we do not deny that the Hagedoorn results are theoretically possible, but we are compelled to await further research before expressing a definite opinion upon them.

We have reached this position then: we submit that all the examples hitherto cited as illustrating that hybridity is a cause of parthenogenesis fail for lack of experimental work.

However, cytological work done on material collected in the field throws some, but not wholly satisfying light on the matter. As demonstrated by Dingler (1906), Lundström (1909) and Harrison (1920a) the bulk of polyploid roses are reproduced apomictically.

Moreover, the cytology of such roses as shown by Täckholm (1922), Blackburn and Harrison (1921) closely approximates that of Rosenberg's (1909) classical case of *Drosera obovata*, known to be a hybrid between *D. rotundifolia* and *D. longifolia*. Hence the inference is strong that what explains the circumstances of Drosera also accounts for those of Rosa, and the conclusion seems natural that such roses are F1 hybrids. There is thus developed a very close contact between hybridity and apomixis but still, we must confess, no rigid proof.

We may now consider how our own work stands in relation to the above-mentioned postulates.

Are the parent forms, bistortata *and* crepuscularia, *pure species*?

Bistortata is a Holarctic species, and occurs in North America whilst *crepuscularia* is restricted to Europe. In the British Isles and, in fact, in Europe generally, the ranges of the species differ, *bistortata* extending to the Moray Firth in Scotland and not reaching Ireland, and *crepuscularia* stopping short in Durham but entering the sister isle. Within the territory common to the two insects, curiously enough, some woods produce only one of the species, and others again contain both.

Crepuscularia is uniformly single-brooded in England and Ireland; *bistortata*, on the other hand, is double-brooded in the South and Midlands but becomes single-brooded from Yorkshire northwards. Their times of emergence are different, the former insect appearing in May in the South, and *bistortata* in March and early April and once more in July. In the North both are univoltine, *bistortata* coming forth chiefly in May and early June, this applying even to North Yorkshire in sub-alpine habitats where *crepuscularia* fails. In South West Yorkshire, where *crepuscularia* is the prevalent species, its period of eclosion agrees roughly with that of its northern ally.

Although the two species are readily enough differentiated in the imaginal state by their ordinary specific characters, in a rather extraordinary way their possession of melanic forms peculiar to each gives a further method of separating them in the perfect condition.

Nor are their differences confined to the imagines for they can be distinguished in all the early stages. In the eggs those of *bistortata* possess nearly double the cubical contents of the greener *crepuscularia*; in the second and third stage larvæ the black V on the dorsal area is closed in the former insect and open in the latter, whilst in the pupæ the sexual dimorphism forces itself much more strongly on our notice in *bistortata*.

Again, although we, like others, have reared hundreds of broods of the two insects, never at any time has the one been produced from the ova of the other.

Lastly, as a last critical proof of their specific distinctness we point to the fact that, when *bistortata* females are mated with *crepuscularia* males, in the ordinary course of events only males result, the females being non-viable.

The cytological evidence relating to these species and the F1 hybrids was obtained from the joint work (unpublished) of the late Professor L. Doncaster and one of us (J.W.H.H.) and rests upon the contents of a letter from the former. In this he testified that the number of chromosomes was large, over a hundred in each case. The hybrids likewise had a chromosome count of over 100 and mitotic irregularities were discovered.* The biological evidence points to the probability that *crepuscularia*, as a species, has been evolved from the second brood of *bistortata*, but, despite this phylogenetic relationship, we may conclude that, even according to the critical standards we have set, the two parent forms are in truth pure species.

* The slides whilst in Prof. Doncaster's possession were unfortunately lost during his war service, and have never been recovered; the work, however, is being repeated.