# TRANSACTIONS

OF THE

# HERTFORDSHIRE NATURAL HISTORY SOCIETY.

---

VOL. II.

# TRANSACTIONS

OF THE

# HERTFORDSHIRE NATURAL HISTORY SOCIETY

AND

# FIELD CLUB.

*EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.*

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# PROCEEDINGS

OF THE

# HERTFORDSHIRE NATURAL HISTORY SOCIETY.

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ORDINARY MEETING, 25TH OCTOBER, 1881, AT WATFORD.

GEORGE ROOPER, Esq., F.Z.S., President, in the Chair.

Mr. George Brightwen, The Grove, Stanmore; Mrs. James Currie, Hill Side, Watford; Mr. Marlborough R. Pryor, M.A., F.Z.S., Weston Manor, Stevenage; and Miss Rooper, Nascott House, Watford, were proposed as Members of the Society.

The following lecture was delivered:—

"The Movements of Plants." By the Rev. George Henslow, M.A., F.L.S., F.G.S.

The Lecturer commenced by remarking that the old distinction between Animals and Plants, that the former could move, but not the latter, was no longer tenable; for many animals such as sponges and oysters were fixed, but innumerable minute algæ could move freely in water; and that all plants, though fixed in the soil, were constantly in motion as far as their aërial parts were concerned.

Commencing with germinating plants, he described how the radicle first protrudes, and then immediately "circumnutates," circumnutation being the word which has been adopted to express a variety of movements of different kinds as specially modified for different organs. It was a kind of "bowing around." Simultaneously with this, geotropism or a tendency to turn in the direction of the earth comes into play; so that the radicle invariably turns towards the soil. This downward force only acts upon the extreme tip of the radicle, which is sensitive; an influence, however, is communicated to a point higher up, where the radicle bends. The means by which the radicle penetrates the soil is neither of these forces, but as soon as its root-hairs are formed, they become fixed to the particles of earth, and so furnish a *purchase* to the radicle, which now penetrates by force of growth alone.

The tip of radicles is also sensitive to moisture, so that it grows in the direction of it, and this explains the so-called habit of roots to "seek" for water. Its most remarkable property, however, is its sensitiveness to contact, so that if it meet an obstacle a radicle deviates from it. This being the only known instance of any plant-organ turning *away* from an irritant. As soon as the radicle gets past the obstruction—say a stone—geotropism then causes it to go downwards once more. Geotropism only acts with full influence on the central axial root. Secondary roots are inclined at an angle to the first. If, however, this latter be cut away, then the secondary ones turn downwards; the tertiary rootlets are uninfluenced by it, the result being that the entire mass of roots is spread out in the best way for searching the ground for nourishment and water.

The lecturer then described the downward motion of the peduncles of *Trifolium subterraneum*, which succeed in burying their fruits for the sake of nourishing them independently of roots.

The circumnutation of the young stems of seedlings as they issue from the ground was described, their ascent being the combined action of apogeotropism, or the tendency to turn away from the earth, and circumnutation.

The motions of leaves were then considered. The most interesting and pronounced being the so-called Sleep of Plants. Mr. Henslow selected several instances described in Mr. Darwin's book on the 'Movements of Plants,' which clearly showed that the object gained by the folding of the leaves together, which takes place in so many plants, is to prevent injury from radiation at night.

The lecturer finally described several cases of motion in flowers, such as in the corolla of many flowers which opens and shuts, the stamens which move forwards, as in barberry, and even of the pistil as in *Stylidium* and *Maranta*, the purpose in every case being connected with insect-fertilisation.

For further details the reader is referred to Mr. Darwin's work mentioned above; and an abstract of it by the lecturer in the last volume of the 'Popular Science Review.'

Specimens and diagrams were exhibited by the Author in illustration of the lecture.

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## Ordinary Meeting, 22nd November, 1881, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

Mr. George Brightwen, The Grove, Stanmore; Mrs. James Currie, Hill Side, Watford; Mr. Marlborough R. Pryor, M.A., F.Z.S., Weston Manor, Stevenage; and Miss Rooper, Nascott House, Watford, were elected Members of the Society.

Mr. William Hill, jun., The Maples, Hitchin; Mr. Robert May Christopher James, Clarendon Lodge, Watford; Mr. Francis Ransom, Fairfield, Hitchin; and Mr. John Weall, Rutland Lodge, Watford, were proposed as Members.

The following communications were read:—

1. "On Some of the Effects of the Recent Gale in Hertfordshire." By Alfred T. Brett, M.D.*

2. "On a Whirlwind between Watford and St. Albans." By John Hopkinson, F.L.S., F.M.S. (*Transactions*, Vol. II, p. 95.)

3. "On Methods of Prevention of Insect-Injury." By Eleanor A. Ormerod, F.M.S. (*Transactions*, Vol. II, p. 1.)

4. "Note on a Cloud of Butterflies." By John E. Littleboy. (*Transactions*, Vol. II, p. 96.)

5. "Note on a Cuckoo laying in a Swallow's Nest." By George Rooper, F.Z.S. (*Transactions*, Vol. II, p. 96.)

* Incorporated in the Rev. C. W. Harvey's paper on the "Gale of the 14th of October, 1881," 'Transactions,' Vol. II, p. 17.

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## Ordinary Meeting, 24th November, 1881, at Hertford.

Henry Gilbertson, Esq., in the Chair.

Lady Frances Bushby, Wormley Bury, Hoddesdon; Miss Alice Murray, Epcombs, Hertford; and the Rev. Frederick Rudge, M.A., Meesden Rectory, Buntingford, were proposed as Members of the Society.

The following papers were read :—

1. "Notes on the Flora of Hertfordshire." By R. T. Andrews.

Mr. Andrews stated that *Epipactis latifolia* had been found growing in Black Fan Wood, Bayford, by the Rev. C. C. Thornton, on the 10th of August; that *Dianthus Armeria* had been seen growing plentifully by the roadside near Wadesmill, by his (Mr. Andrews') children; and also that *Polypodium calcarium* had been gathered at one of the Field Meetings of the Society, growing on the wall at the farm-entrance to Broxbournebury, where it had apparently established itself as an escape, with *Scolopendrium vulgare* and *Asplenium adiantum-nigrum*. He also drew a comparison between the state of flowering of plants in Hertfordshire and Devonshire in October, showing, as would naturally be expected, that vegetation was in a much more forward state in Devon than in Herts.

2. "Notes on a Microscopical Aquarium." By Isaac Robinson. (*Transactions*, Vol. II, p. 112.)

3. "On *Chlorodesmos hispida*, a new Flagellate Animalcule." By F. W. Phillips, F.L.S. (*Transactions*, Vol. II, p. 92.)

The remainder of the meeting was devoted to the examination of microscopic objects, of which the following may be mentioned :—*Anacharis alsinastrum* showing the circulation of sap, exhibited by Mr. Gilbertson; "Collared Monads," by Mr. Robinson; *Stentor Müllerí*, by Mr. Phillips; and *Protococcus pluvialis* (resting-spores), *Palmella cruenta*, and *Bacteria*, by Mr. Croft.

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## Ordinary Meeting, 20th December, 1881, at Watford.

Alfred T. Brett, M.D., Vice-President, in the Chair.

Lady Frances Bushby, Wormley Bury, Hoddesdon; Mr. William Hill, jun., The Maples, Hitchin; Mr. R. M. C. James, Clarendon Lodge, Watford; Miss Alice Murray, Epcombs, Hertford; Mr. Francis Ransom, Fairfield, Hitchin; the Rev. F. Rudge, M.A., Meesden Rectory, Buntingford; and Mr. John Weall, Rutland Lodge, Watford, were elected Members of the Society.

Mr. Henry Wood, Woodside, Watford, and Mr. Thomas Hoade Woods, Durrants, Watford, were proposed as Members.

The following paper was read :—

"Hertfordshire Deer-Parks." By James Edmund Harting, F.L.S., F.Z.S. (*Transactions*, Vol. II, p. 97.)

Mr. Sydney Humbert, referring to the disparked park at Walkern, said that he should think that it was originally a forest rather than a park, for both Walkern Bury farmhouse and Walkern Park Farm were moated. When the

moat was dredged some years ago, large quantities of deers' antlers were found in it, and they would, he thought, afford some evidence that there was an extensive deer-park or deer-forest there at one time.

Mr. Littleboy remarked that for several years in Ashridge Park the red-deer and fallow-deer had been allowed to mix freely.

Dr. Brett said that he had been told by an old park-keeper that when he first went to Cassiobury in 1815 there were between 700 and 800 deer there. The number was now kept down to about half. Three years ago, as well as in the present year, a large number had been lost by disease.

Professor Attfield referred to the large number of deer-parks in the neighbourhood of Watford—Moor Park, Rickmansworth, Cassiobury, The Grove, Ashridge, Gorhambury, and Hatfield being within a walking-distance or a short ride by rail. There was probably no other Society so interested in deer-parks as the Hertfordshire.

Mr. Harting replied that there was no doubt the red-deer and the fallow-deer did agree, notwithstanding the assertion by Gervase Markham. He believed that the disease in the deer at Cassiobury was caused by a liver-fluke analogous to that in sheep. In both deer and sheep the licking of soda had been found to be a remedy.

Mr. Sydney Humbert then read some notes on the destruction of wild birds, advocating that the Society should take steps to enforce the observance of the "Wild Birds Preservation Act" in the county.

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### Ordinary Meeting, 22nd December, 1881, at Hertford.

C. E. Shelly, Esq., B.A., M.B., in the Chair.

The following papers were read:—

1. "The Gale of the 14th of October, 1881, and its Effects in Hertfordshire." By the Rev. C. W. Harvey, M.A., F.M.S. (*Transactions*, Vol. II, p. 17.)

2. "Izaak Walton and the River Lea." By R. B. Croft, R.N., F.L.S. (*Transactions*, Vol. II, p. 9.)

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### Ordinary Meeting, 24th January, 1882, at St. Albans.

Alfred T. Brett, M.D., Vice-President, in the Chair.

The following paper was read:—

"The Migration of Birds." By John E. Littleboy. (*Transactions*, Vol. II, p. 25.)

Mr. Frederick Littleboy and Mr. John Weall were appointed Auditors of the accounts for 1881.

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### Ordinary Meeting, 26th January, 1882, at Hertford.

R. B. Croft, Esq., R.N., F.L.S., F.R.M.S., in the Chair.

Mr. William Stanforth Harrison, Fore Street, Hertford, was proposed as a Member of the Society.

The following paper was read:—

"Notes on the Protozoa of Hertfordshire: Section Pantostomata." By F. W. Phillips, F.L.S. (*Transactions*, Vol. II, p. 115.)

The paper was illustrated by a number of drawings shown by the magic-lantern.

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ANNIVERSARY MEETING, 21ST FEBRUARY, 1882.

(AT WATFORD.)

GEORGE ROOPER, Esq., F.Z.S., President, in the Chair.

M. C. Cooke, M.A., LL.D., A.L.S., Editor of 'Grevillea,' etc., 147, Junction Road, London, N., was elected an Honorary Member of the Society.

The Report of the Council for 1881, and the Treasurer's Account of Income and Expenditure, were read and adopted, and the thanks of the Society were accorded to the Auditors.

The President delivered an Address. (*Transactions*, Vol. II, p. 40.)

The balloting-glass having been removed, and the lists examined by the Scrutineers, the following gentlemen were declared to have been duly elected as the Officers and Council for the ensuing year.

*President.*—George Rooper, F.Z.S.

*Vice-Presidents.*—Professor John Attfield, Ph.D., F.R.S., F.C.S.; F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.; the Right Hon. the Earl Cowper, K.G.; John Evans, D.C.L., LL.D., F.R.S., F.S.A., F.L.S., F.G.S.; J. Gwyn Jeffreys, LL.D., F.R.S., F.L.S., F.G.S.; John E. Littleboy.

*Treasurer.*—Sydney Humbert.

*Honorary Secretaries.*—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.M.S.; Richard B. Croft, R.N., F.L.S., F.R.M.S.

*Librarian.*—E. M. Chater.

*Curator.*—Frank W. Silvester, F.M.S.

*Other Members of the Council.*—The Rev. Canon Bradby, M.A.; Alfred T. Brett, M.D.; Alfred J. Copeland; Arthur Cottam, F.R.A.S.; H. George Fordham, F.G.S.; the Rev. C. W. Harvey, M.A., F.M.S.; Charles F. Humbert, F.G.S.; J. Logan Lobley, F.G.S., F.R.G.S.; Joseph Pollard; W. Lepard Smith; the Rev. E. T. Vaughan, M.A.; William Verini.

It was then resolved—

That the thanks of the Society be given to the Rev. Canon Bradby, M.A., and Dr. A. T. Brett, retiring from the office of Vice-President; to Mr. C. F. Humbert, F.G.S., retiring from the office of Treasurer; and to the Right Hon. the Lord Ebury, the Right Hon. the Earl of Essex, and the Rev. H. R. Peel, M.A., retiring from the Council.

The thanks of the Society were also accorded to the Honorary Secretaries.

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## Report of the Council for 1881.

The Council of the Hertfordshire Natural History Society and Field Club, in presenting the seventh Annual Report, has again the pleasure of stating that the Society maintains its hitherto prosperous and vigorous condition, the work done by the members at least equalling in value that of any previous year.

During the year twenty-two ordinary members have been elected, and one honorary member; five members have compounded for their annual subscription; thirteen members have resigned; five have been excluded from the Society for non-payment of subscription for three years; and the Council regrets to have to record the loss of four members by death—Mr. W. T. Eley, Mrs. Gwyn Jeffreys, Mr. Jonathan King, and Mr. Reginald A. Pryor, B.A., F.L.S.

The census of the Society at the end of the years 1880 and 1881 was as follows:—

| | 1880. | 1881. |
|---|---|---|
| Honorary Members | 14 | 15 |
| Life Members | 31 | 36 |
| Annual Subscribers | 225 | 220 |
| | 270 | 271 |

Five parts of the Society's 'Transactions' have been published during the year, being a greater number than in any previous year. This has added considerably to the year's expenditure, but has enabled your Editor to overtake the arrears which had accumulated, and the present volume, containing the proceedings of the last two sessions, will shortly be completed.

The following are the principal papers and lectures which have been read or delivered during the year 1881:—

Jan. 25, at Hertford.—Note on the Schwendenerian Theory of Lichens; by R. B. Croft, R.N., F.L.S., Hon. Sec.

—— On a Species of *Chætospira* found near Hoddesdon; by F. W. Phillips.

Feb. 15, at Watford.—Anniversary Address; by the President, J. Gwyn Jeffreys, LL.D., F.R.S., etc.

—— 22, at Ware.—The Life-history of a Monad; by Isaac Robinson.

—— On the Occurrence of Red Snow in Hertfordshire; by R. B. Croft, R.N., F.L.S.

March 15, at Watford.—The Formation and Arrangement of Provincial Museums; by John Hopkinson, F.L.S., F.G.S., Hon. Sec.

—— On Local Museums; by H. George Fordham, F.G.S.

—— 22, at Hertford.—The Frost of January, 1881, as experienced in Hertfordshire; by the Rev. C. W. Harvey, M.A., F.M.S.

—— Meteorological Observations taken at Throcking, Herts, during the year 1880; by the Rev. C. W. Harvey.

—— Report on the Rainfall in Hertfordshire in 1880; by the Rev. C. W. Harvey.

April 12, at Hoddesdon.—Notes on Aphides; by F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.

—— 19, at Watford.—Meteorological Observations taken at Wansford House, Watford, during the year 1880; by John Hopkinson, F.L.S., F.M.S.

—— Report on Phenological Observations in Hertfordshire in 1880; by John Hopkinson.

—— Notes on Birds observed during the year 1880, and the first three months of 1881; by John E. Littleboy.
—— On the presence of Cilia on the Tadpole of the Common Frog; by R. B. Croft, R.N., F.L.S.
Oct. 25, at Watford.—The Movements of Plants; by the Rev. George Henslow, M.A., F.L.S., F.G.S.
Nov. 22, at Watford.—Methods of Prevention of Insect-Injury; by Eleanor A. Ormerod, F.M.S.
—— 24, at Hertford.—On *Chlorodesmos hispida*, a new Flagellate Animalcule; by F. W. Phillips, F.L.S.
—— Notes on a Microscopical Aquarium; by Isaac Robinson.
Dec. 20, at Watford.—Hertfordshire Deer-Parks; by James Edmund Harting, F.L.S., F.Z.S.
—— 22, at Hertford.—The Gale of the 14th of October, 1881, and its Effects in Hertfordshire; by the Rev. C. W. Harvey, M.A., F.M.S.
—— Izaak Walton and the River Lea; by R. B. Croft, R.N., F.L.S.

A Bye-meeting was held at Hertford on the 26th of April, and was devoted to microscopical study and the exhibition of natural-history collections.

It will thus be seen that the number of papers read during the year is considerably larger than in any previous year, and that a very wide range of subjects has been discussed.

The reports on the rainfall and on phenological phenomena for 1880, the former now drawn up by the Rev. C. W. Harvey, have been published in your 'Transactions,' and to those for 1881, shortly to be presented, will be added a report on injurious insects observed in Hertfordshire, which Miss Ormerod has undertaken in future to present annually to the Society.

Following a suggestion in the previous report, several members have offered to undertake the duty of recorders in various branches of Natural History. This subdivision of labour will eventually, it is hoped, be productive of good results, especially in the intended compilation of a Cryptogamic Flora of the County, for which recorders for the Mosses and the Characeæ are much needed.

The Council may also suggest the compilation of monographs of the rivers of Hertfordshire, on the model of Mr. Littleboy's "Bulborne and Gade," as a method of working for the Society which may be undertaken by members who do not make a study of any special branch of Natural History.

An unusually large number of Field Meetings has been held during the year, in fact about twice the average number of former years. The following are the dates of these meetings and the localities visited:—

May 7.—The Bourne Valley, Boxmoor.
—— 12.—Broxbourne and Brickendon.
—— 19.—Buntingford.
—— 28.—Stanmore Common.
June 2.—Panshanger, Hertford.
—— 8.—Munden Park, Watford.
—— 18.—Hoddesdon.
—— 25.—Totternhoe, Kensworth, and Luton.
July 9.—Hunton Bridge and Watford.
—— 21.—Epping Forest.

Three of these meetings were held in conjunction with other societies. In the annual whole day meeting, on the 25th of June, the Geologists' Association and the Luton Natural History Society participated. The meeting on the 18th of June was held in conjunction with the Quekett Microscopical Club, and that on the 12th of July with the Epping Forest and County of Essex Naturalists' Field Club.

For hospitality kindly afforded at the Field Meetings the Society is indebted to Mr. H. Demain Saunders, Brickendon Grange, Hertford; Mr. George Brightwen, The Grove, Stanmore; Mr. A. H. Holland Hibbert, Munden Park; Mrs. Warner, The Woodlands, Hoddesdon; Mr. Henry Brown, Highfields, Luton; and Dr. A. T. Brett, Watford House. The thanks of the Society for permission to pass through private grounds are also due to Earl Cowper, Panshanger; Mr. S. T. Holland, Otterspool; the Earl of Clarendon, The Grove; and the Earl of Essex, Cassiobury Park.

To plan and arrange such a number of Field Meetings entails a considerable amount of work, and the Council wishes to point out how greatly individual members may relieve your secretaries by organising, conducting, and reporting upon such meetings.

In the Report for 1880 the announcement was made of the donation to the Society of the late Rev. R. H. Webb's botanical library and herbarium. The herbarium, then stated to be in the hands of Mr. R. A. Pryor, has since been received, and as Mrs. Webb has also presented to the Society Messrs. Coleman and Webb's manuscripts and botanical correspondence, the Society is now in possession of nearly the whole of the material from which the 'Flora Hertfordiensis' was compiled.

It is now the duty of your Council to announce a most valuable bequest. Amongst the members the Society has lost by death, will have been noticed the name of Reginald A. Pryor. Mr. Pryor had for the three years preceding his death been a vice-president of the Society, and had contributed several valuable papers to the 'Transactions.' At the time of his death he was engaged in the completion of a new 'Flora of Hertfordshire,' in compiling and collecting material for which, he had for several years devoted the greater part of his time. The MS. of his 'Flora,' his botanical library, his herbarium, and the sum of £100, he has bequeathed to the Society. The following are the terms of the bequest:—"I bequeath to the Hertfordshire Natural History Society all my botanical books, manuscripts, and collections, together with £100 to enable the Society to keep and preserve the same as one collection; such £100 to be paid exclusively out of my pure personal estate, and the receipt of the treasurer of the said Society to be a sufficient discharge for the said legacy."

The botanical library consists of about 400 volumes, including many valuable and rare works. The herbarium is not extensive, for Mr. Pryor did not collect with the view of forming an herbarium, and seems to have retained in his possession only such specimens as were necessary to solve doubtful points, either in the discrimination

of species and varieties, or in questions relating to distribution. The manuscript of the 'Flora,' though apparently complete, had not been finally prepared for the press, nor is there any introduction, which Mr. Pryor, with his intimate knowledge of the whole of the county, would have so ably written.

The Council has decided to publish the 'Flora' by subscription, and, on the solicitation of the author's relatives and executors, the MS. has been entrusted to Mr. James Britten, F.L.S., assistant in the Botanical Department of the British Museum and editor of the 'Journal of Botany,' to edit for the Society. Mrs. Pryor, the author's mother, has most generously undertaken to bear the expense of Mr. Britten's editorship.

A memoir of Mr. Pryor, written by Mr. Britten, was issued to each member of the Society with the December part of the 'Transactions.'

The Council being of opinion that the presence of the Society's library in the room in which the Watford meetings are held would conduce to more use being made of the books, and the acquisition of Mr. Pryor's botanical books having nearly doubled the Society's library, necessitating greatly-increased accommodation, the necessary arrangements have been made with the Public Library Committee, and two handsome bookcases, the design of which was approved by that Committee, have been purchased at a cost of £40, and have been placed in the room in which your meetings will in future be held.

The amount for which the Society's property contained in the Watford Public Library is insured has been increased from £150 to £300.

The Council regrets to have to announce the resignation of your Treasurer, Mr. C. F. Humbert, F.G.S., who has held this office for the last five years, to the great benefit of the Society. The Treasurer has latterly been ably assisted by his son, Mr. Sydney Humbert, to whose energy and perseverance the large number of subscriptions received during the past year is due. At the present time no arrears of subscriptions remain for collection. To this is due the very satisfactory financial position of the Society. After the unusually large expenditure of £180, being £50 more than in any previous year, there is a balance of £8 in favour of the Society, in addition to the subscriptions received for 1882.

The Council desires, in conclusion, to express the thanks of the Society to the Committee of the Watford Public Library, for the continuance of the accommodation hitherto afforded, and the ready permission accorded for the carrying-out of the new arrangements which have been made for your library and meeting-room; and also to the members of the Hertford Literary and Scientific Institution for the free use of their rooms for the Hertford meetings.

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## *INCOME AND EXPENDITURE FOR THE YEAR ENDING* 31*st DECEMBER*, 1881.

| Dr. | £ | s. | d. |
|---|---|---|---|
| To Balance brought forward | 26 | 14 | 11 |
| ,, Subscriptions for 1879 | 3 | 0 | 0 |
| ,, ,, ,, 1880 | 15 | 10 | 0 |
| ,, ,, ,, 1881 | 94 | 0 | 0 |
| ,, ,, ,, 1882 | 6 | 0 | 0 |
| ,, Entrance Fees | 15 | 10 | 0 |
| ,, Life Compositions | 25 | 0 | 0 |
| ,, Dividend on £203 4*s.* 6*d.* Consols | 5 | 19 | 4 |
| ,, Sale of 'Transactions' | 3 | 2 | 6 |
| | £194 | 16 | 9 |

| Cr. | £ | s. | d. |
|---|---|---|---|
| By Stationery | 3 | 18 | 9 |
| ,, Printing 'Transactions' | 75 | 10 | 3 |
| ,, Miscellaneous Printing | 11 | 18 | 6 |
| ,, Expenses of Watford Meetings | 5 | 17 | 6 |
| ,, ,, Hertford Meetings | 3 | 16 | 8 |
| ,, ,, Hoddesdon Meeting | 0 | 15 | 0 |
| ,, Library | 16 | 19 | 3 |
| ,, Addressing Notices and 'Transactions' | 1 | 7 | 6 |
| ,, Postages | 16 | 7 | 2 |
| ,, Sundry Small Expenses | 1 | 1 | 1 |
| ,, Expenses incurred for bookcases, etc., on account of the late Mr. Pryor's bequest | 43 | 5 | 0 |
| ,, Balance | 14 | 0 | 1 |
| | £194 | 16 | 9 |

To amount invested in the purchase of £203 4*s.* 6*d.* Consols ..... ..... £198 15*s.*

Audited and found correct, 17th February, 1882. { FREDERICK LITTLEBOY. JOHN WEALL.

## Donations to the Library in 1881.

| Title. | Donor. |
|---|---|
| Ansted, Prof. D. T. Geologists' Text Book. 8vo. London, 1845 . . . . . | *Mr. J. Hopkinson.* |
| ——. The Correlation of the Natural History Sciences. 8vo. London and Cambridge, 1863. . . . | *Mr. R. B. Croft.* |
| Beale, Dr. Lionel. Descriptive Catalogue of Microscopical Specimens, illustrating the Structure of certain Tissues and Organs . . . in Health and Disease. 8vo. London, 1868 . . . . . | *Dr. A. T. Brett.* |
| Carpenter, Dr. W. B. Principles of General and Comparative Physiology. 8vo. London, 1839 . . | *Mr. J. Hopkinson.* |
| Clarke, W. E., and W. D. Roebuck. A Handbook of the Vertebrate Fauna of Yorkshire. 8vo. London and Leeds, 1881 . . . . . | *Mr. J. E. Harting.* |
| Crosskey, Rev. H. W. Notes on some of the Glacial Phenomena of the Vosges Mountains. 8vo. 1879 . | *The Author.* |
| ——. Eighth Report of the Committee [on] . . . Erratic Blocks. (*Rep. Brit. Assoc.* 1880.) 8vo. . . | *Mr. H. G. Fordham.* |
| Daniell, J. F. Meteorological Essays and Observations. 2nd ed. 8vo. London, 1827 . . . . . | *Mr. J. Hopkinson.* |
| Davis, J. W. Report of the Raygill Fissure Exploration Committee. (*Proc. Geol. Soc. Yorks.* 1880.) 8vo. . | ,, |
| Edinburgh, Royal Society of. Proceedings. Vol. viii. 8vo. Edinburgh, 1875 . . . . . | ,, |
| Etheridge, R. Address delivered at the Anniversary Meeting of the Geological Society of London. Feb. 1881. 8vo. London, 1881 . . . . . | *The Author.* |
| Evans, Dr. John. On Portions of a Cranium and a Jaw in the Slab containing . . . . . Archæopteryx. 8vo. London, 1881 . . . . . | ,, |
| Gosse, P. H. Omphalos: An Attempt to untie the Geological Knot. 12mo. London, 1857 . . . | *Mr. R. B. Croft.* |
| Hind, Prof. H. J. Essay on the Insects and Diseases injurious to Wheat Crops. 8vo. Toronto, 1857 . | *Mr. J. Hopkinson.* |
| Hinde, G. J. Fossil Sponge Spicules from the Upper Chalk. 8vo. Munich, 1880 . . . . . | *The Author.* |
| Lee, J. E. Botany of the Malvern Hills. 12mo. London and Malvern, 1843 . . . . . | *Mr. J. Hopkinson.* |
| Leighton, Rev. W. A. The Lichen Flora of Great Britain, Ireland, and the Channel Islands. 12mo. Shrewsbury, 1872 . . . . . | *Mr. R. B. Croft.* |
| Lewis, E. W. Lectures on the Geology of Leighton Buzzard and its Neighbourhood. 8vo. Leighton, 1879 | *Mr. J. W. Walker.* |
| Linnean Society, Journal. Botany, Vol. xviii, Nos. 106–113. Zoology, Vol. xv, Nos. 82–88. 8vo. London, 1880–81 . . . . . | *Mr. R. B. Croft.* |
| Lubbock, Sir John. Address [to the British Association, York, 1881]. 8vo. 1881. . . . . | *Mr. J. Hopkinson.* |
| Macpherson, J. On the Origin of the Serpentine of the Rhonda Mountains. 8vo. Madrid, 1876. . . | ,, |
| Marriott, W. Hints to Meteorological Observers. 8vo. London, 1881 . . . . . | *The Author.* |
| Mining Magazine and Review. Vol. I, Nos. 1–6. 8vo. London, 1872 . . . . . | *Mr. J. Hopkinson.* |
| Nicholson, Prof. H. A. On the Silurian Rocks of the English Lake District. (*Proc. Geol. Assoc.*) . . | ,, |

| Title. | Donor. |
|---|---|
| Ormerod, Eleanor A. Notes of Observations on Injurious Insects. Report, 1880. 8vo. London, 1881. | *The Authoress.* |
| ——. On "Cane-Borers." (*Proc. Entom. Soc.* 1880.) 8vo . . . . . | ,, |
| ——. Manual of Injurious Insects. 8vo. London, 1881. | ,, |
| Owen, Prof. R. On the Extent and Aims of a National Museum of Natural History. 2nd ed. 8vo. London, 1862. . . . . | *Mr. J. Hopkinson.* |
| Preston, Rev. T. A. Wiltshire Rainfall, 1880. 4to. Marlborough, 1881 . . . . . | *The Editor.* |
| Prestwich, Prof. J. On the Geological Conditions affecting the Construction of a Tunnel between England and France. (*Proc. Inst. Civ. Eng.* 1874.) 8vo. . . . . | *Mr. R. B. Croft.* |
| Siebold, Prof. C. E. von. On a True Parthenogenesis in Moths and Bees. Translated by W. S. Dallas. 8vo. London, 1857 . . . . . | *Mr. C. Heaton, jun.* |
| Spottiswoode, W. Sunlight, Sea, and Sky. 8vo. 1872. | ,, |
| Stephenson, Robert. On the Supply of Water to London. 8vo. . . . . | *Dr. A. T. Brett.* |
| Symons, G. J. British Rainfall, 1880. 8vo. London, 1881 . . . . . | *The Editor.* |
| ——. Monthly Meteorological Magazine. Vol. xvi. 8vo. London, 1881 . . . . . | ,, |
| Thomas, Capt. F. L. W. On the Primitive Dwellings and Hypogea of the Outer Hebrides. 8vo. 1869 . | *Mr. R. B. Croft.* |
| Thomson, Sir William. Address to the Mathematical and Physical Science Section of the British Association, York, 1881. 8vo. . . . . | *Mr. J. Hopkinson.* |
| Wiltshire, Rev. T. On the Ancient Flint Implements of Yorkshire. (*Proc. Geol. Assoc.* 1862.) 8vo. . | ,, |

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## Received in Exchange, 1881.

Barnsley Naturalists' Society. Quarterly Transactions. Vol. i, parts 1–3. 8vo. Barnsley, 1881.

Belfast Naturalists' Field Club. Proceedings. Series II, Vol. i, part 7. 8vo. Belfast, 1881.

Birmingham Philosophical Society. Proceedings. Vol. i, Nos. 1, 2. Vol. ii, parts 1, 2. 8vo. Birmingham, 1880–81

Brighton and Sussex Natural History Society. Annual Report for the year ending Sept. 1881. 8vo. Brighton, 1881.

Bristol Naturalists' Society. Proceedings. New Series. Vol. iii, parts 1, 2. 8vo. Bristol, 1879-80.

Cardiff Naturalists' Society. Transactions. Vol. xii. 8vo. Cardiff, 1881.

Conchology, Journal of. Vol. iii, Nos. 4–7. 8vo. Leeds, 1880-81.

Croydon Microscopical and Natural History Club. Proceedings and Transactions, 1878-81. 8vo. Croydon. [1881.]

Eastbourne Natural History Society. Papers. Session 1880–81. 4to. Eastbourne, 1881. Transactions. Vol. i, part 1. 8vo. Eastbourne, 1881.

Edinburgh, Botanical Society. Transactions and Proceedings. Vol. xiv, part 1. 8vo. Edinburgh, 1880.

Epping Forest and County of Essex Naturalists' Field Club. Transactions. Vol. i, parts 2, 3. Vol. ii, part 4. 8vo. Buckhurst Hill, 1880-81.

Geological Society. Abstracts of the Proceedings, Session 1880–81. 8vo. London, 1881.

Geologists' Association. Proceedings. Vol. vi, Nos. 8, 9. Vol. vii, Nos. 1–3. 8vo. London, 1880–81.

Glasgow, Natural History Society of. Proceedings. Vol. iv, part 2. 8vo. Glasgow, 1881.

Glasgow, Philosophical Society of. Proceedings. Vol. xii, No. 1. Vol. xiii, No. 1. 8vo. Glasgow, 1880-81.

Grevillea. Vol. ix, Nos. 51-54. 8vo. London, 1881.

Irish, Royal, Academy. Proceedings. Science, Ser. II, Vol. iii, Nos. 5, 6. Polite Literature and Antiquities, Ser. II, Vol. ii, No. 5. 8vo. Dublin, 1880-81.

———. Transactions. Science, Vol. xxviii, parts 1–5. Polite Literature and Antiquities, Vol. xxvii, part 4. 4to. Dublin, 1880-81.

Liverpool Geological Society. Proceedings. Vol. iv, part 3. 8vo. Liverpool, 1881.

Manchester Field Naturalists' and Archæologists' Society. Proceedings, 1880. 8vo. Manchester, 1881.

Manchester Geological Society. Transactions. Vol. xvi, parts 2-10. 8vo. Manchester, 1881.

Marlborough College Natural History Society. Report for the year 1880. 8vo. Marlborough, 1881.

Meteorological Society. Quarterly Journal. New Series. Vol. vii. 8vo. London, 1881.

———. The Meteorological Record. Nos. 1, 2. 8vo. London, 1881.

Microscopical, Royal, Society. Journal. Ser. II, Vol. i. 8vo. London, 1881.

Midland Naturalist. Vol. iv. 8vo. London and Birmingham, 1881.

Naturalist. Vol. vi, Nos. 64–72. Vol. vii, Nos. 73–77. 8vo. Huddersfield, 1881.

New York Academy of Sciences. Annals. Vol. i, Nos. 9-13. 8vo. New York, 1879-80.

Norfolk and Norwich Naturalists' Society. Transactions. Vol. iii, parts 1, 2. 8vo. Norwich, 1881.

Norwich Geological Society. Proceedings. Vol. i, part 5. 8vo. Norwich, 1881.

Northern Microscopist. Vol. i. 8vo. London, 1881.

Quekett Microscopical Club. Journal. Vol. vi, Nos. 46–48. 8vo. London, 1881.

Rugby School Natural History Society. Report for 1880. 8vo. Rugby, 1881.

Science Gossip. Vol. xvii. 8vo. London, 1881.

Scientific Roll and Magazine of Systematised Notes. Climate. Vol. i, part 1, Nos. 1–5. 8vo. London, 1880-81.

Scottish Naturalist. Vol. vi, Nos. 41–44. 8vo. Edinburgh and London, 1881.

Smithsonian Institution. Annual Report . . . . for the year 1879. 8vo. Washington (U.S.A.), 1880.

Somersetshire Archæological and Natural History Society. Proceedings. N.S., Vol. vi. 8vo. Taunton, 1881.

Wiltshire Archæological and Natural History Society. Magazine. Vol. xix, Nos. 56, 57. 8vo. Devizes, 1880-81.

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## Bye Meeting, 27th February, 1882, at St. Albans.

This meeting was devoted entirely to the exhibition of microscopic objects.

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## Ordinary Meeting, 21st March, 1882, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

Mr. W. Stanforth Harrison, Fore Street, Hertford; Mr. Henry Wood, Woodside, Watford; and Mr. Thomas Hoade Woods, Durrants, Watford, were elected Members of the Society.

Dr. John Morison, St. Peter's Street, St. Albans; Mr. William Ridding, Leiston Lodge, Rickmansworth; and Mr. Edward Charles Ryley, Lang Syne, Watford, were proposed as Members.

A letter was read from Dr. M. C. Cooke thanking the Society for his election as an Honorary Member.

The following papers were read:—

1. "Meteorological Observations taken at Throcking Rectory, Buntingford, during the year 1881." By the Rev. C. W. Harvey, M.A., F.M.S. (*Transactions*, Vol. II, p. 49.)

2. "Meteorological Observations taken at Wansford House, Watford, during the year 1881." By John Hopkinson, F.L.S., F.M.S., etc. (*Transactions*, Vol. II, p. 57.)

3. "Report on the Rainfall in Hertfordshire in 1881." By the Rev. C. W. Harvey, M.A., F.M.S. (*Transactions*, Vol. II, p. 64.)

4. "Report on Phenological Phenomena observed in Hertfordshire during the year 1881." By John Hopkinson, F.L.S., F.M.S. (*Transactions*, Vol. II, p. 71.)

5. "Notes on Insects observed in Hertfordshire during the year 1881." By Eleanor A. Ormerod, F.M.S. (*Transactions*, Vol. II, p. 80.)

6. "Notes on Birds observed in Hertfordshire during the year 1881." By John E. Littleboy. (*Transactions*, Vol. II, p. 83.)

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## Ordinary Meeting, 30th March, 1882, at Ware.

F. M. Campbell, Esq., F.L.S., F.Z.S., Vice-President, in the Chair.

Mr. Hamilton Fane Gladwin, Watton House, Watton, Hertford, was proposed as a Member of the Society.

The following papers were read:—

1. "Notes on the Upper Portion of the River Rib and its Affluent the Quin." By R. P. Greg, F.S.A., F.G.S., and R. B. Croft, R.N., F.L.S. (*Transactions*, Vol. II, p. 126.)

2. "Notes on the River Rib from Standon to its Junction with the Lea." By Arthur Giles Puller, M.A., F.S.A., F.Z.S., F.R.G.S. (*Transactions*, Vol. II, p. 131.)

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### Bye Meeting, 13th April, 1882, at Watford.

This meeting was devoted entirely to microscopical study.

Several species of "cluster-cups" (microscopic leaf-fungi), including *Æcidium ranunculariaceum*, were exhibited by Mr. E. M. Chater; *Hydra viridis* and *Volvox globator*, from ponds near Bricket Wood, by Mr. J. Watson Walker; a number of pathological (injected) preparations by Dr. A. T. Brett; and rock-sections by Mr. J. Hopkinson.

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### Special Meeting, 18th April, 1882, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

This meeting was convened, in accordance with Rule XVII, for the purpose of making a few alterations in the Rules of the Society; and, on the recommendation of the Council, the following alterations, formally proposed by the President, were unanimously passed.

In Rule I *for* "and Zoology" *to read* "Zoology, and Pre-historic Archæology."

In Rule III *after* "Anniversary Meeting" *to omit* "which shall be held at Watford in February in each year."

Rule IV *to read* "The Anniversary Meeting of the Society shall be held at Watford in February; and Ordinary Meetings (not fewer than eight in each year), Bye Meetings for microscopical study and other purposes, and Field Meetings shall be held at such times and places as the Council may direct."

In Rule V *for* "five Members" *to read* "four Members."

In Rule VI *for* "one Visitor" *to read* "two Visitors"; *and before* "publications" *to insert* "ordinary."

In Rule IX *after* "membership" *to add* "; and the election of any Member shall be deemed void whose Entrance Fee is not paid before a second year's subscription becomes due."

In Rule XI *after* "admission" *to add* "as an Ordinary Member."

In Rule XII *for* "30th of November" *to read* "31st of December."

In Rule XIII *after* "Ordinary Meeting" *to omit* "at Watford."

In Rule XVII *for* "ten days" *to read* "seven days."

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### Ordinary Meeting, 18th April, 1882, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

Mr. Hamilton Fane Gladwin, Watton House, Watton, Hertford; Dr. John Morison, St. Peter's Street, St. Albans; Mr. William Ridding, Leiston Lodge, Rickmansworth; and Mr. E. C. Ryley, Lang Syne, Watford, were elected Members of the Society.

General Douglas Hamilton, Woodside, Leavesden, Watford, was proposed as a Member.

The following communications were read :—

1. "Notes on the Earth-worm." By Alfred T. Brett, M.D. (*Transactions*, Vol. II, p. 143.)

2. "On a Brood of Pochards reared by a Diver-Duck." By Henry Manser. (*Transactions*, Vol. II, p. 144.)

3. "On the Death of a Duck caused by a Leech." By Henry Manser. (*Transactions*, Vol. II, p. 144.)

Mr. John E. Littleboy made some remarks on a stuffed specimen of Richardson's Skua which had been given to him by Mr. W. Jones Loyd, and which he exhibited; and Dr. A. T. Brett referred to our want of knowledge as to whether the fruit of *Aucuba Japonica* was poisonous or not, and also gave an account of Dr. Siemens' new theory as to the origin of the sun's heat.

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## Ordinary Meeting, 27th April, 1882, at Hertford.

F. M. Campbell, Esq., F.L.S., F.Z.S., Vice-President, in the Chair.

Mr. Hellier Gosselin, Blakesware, Ware, was proposed as a Member of the Society.

The Chairman said that there was a subject he wished to draw the attention of the meeting to before the ordinary business was proceeded with. Within the last few days this country had lost its greatest naturalist and philosopher, Mr. Charles Darwin, who was one of the earliest Honorary Members of the Society. Mr. Darwin's books formed in themselves a whole library of Natural History, teeming with facts which he had himself ascertained, as well as those he had gathered from others with whom he had come in contact. His admirers were not confined to this country, his death being lamented in all places where civilization had reached. As members of the Herts Natural History Society, therefore, he thought that at the first meeting after Mr. Darwin's death it was only right that they should pay some slight tribute to his memory. Although they might feel that the theories of Mr. Darwin were open to discussion, all must agree that he was a man of extraordinary perseverance, of most wonderful talent, gifted with remarkable critical acumen, and at the same time with wonderful powers of generalization.

The following papers were then read :—

1. "Notes on the River Ash." By Hellier Gosselin. (*Transactions*, Vol. II, p. 137.)

2. "Methods by which Members can assist the Recorder of the Arachnida." By F. M. Campbell, F.L.S., F.Z.S., F.R.M.S. (*Transactions*, Vol. II, p. 141.)

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## Bye Meeting, 25th May, 1882, at Ware.

This meeting was devoted to the exhibition of objects of interest in Natural History, and to microscopical study.

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## Field Meeting, 27th May, 1882.

### HARPENDEN AND WHEATHAMPSTEAD.

On assembling at Harpenden at about three o'clock, the members and their friends, numbering between twenty and thirty, first inspected a section of the Upper Chalk in a deep roadside cutting on the ascent of the hill between the Midland and Great Northern railway stations, but no fossils were found and the section did not prove to be of much geological interest.

A short distance farther on, in the direction of Pickford Mill, the botanists of the party detected the toothwort (*Lathræa squamaria*) growing on the roots of some large elm-trees; and in some damp meadows by the side of the River Lea, *Thalictrum flavum*, *Menyanthes trifoliata*, and other marsh-plants were found; and numerous specimens of *Cardamine pratensis* with flowers which appeared to be double, from petaloidy of the ovules, attracted much interest.

Leaving the river at Batford Mill, the road leading to Mackery End was followed, the botanists, conchologists, and entomologists assiduously collecting on the way. A small chalk-pit by the side of the road next attracted the attention of the geologists; and here Mr. J. Saunders, of Luton, made a few observations on the origin of the valley of the Lea.

The valley of the Lea was, he said, of comparatively recent formation, having been formed subsequently to the Cretaceous epoch, for it was excavated in the Chalk. On the elevation of the bed of the Cretaceous sea, a plain of marine denudation would be formed, the undulations or irregularities of the surface of which doubtless gave the initial direction to the principal valleys. Vegetation being at first scanty, the denuding power of the rain would be greater than it is now. The deepest part of the valley would become the bed of the incipient river, which would be constantly removing earthy material, the amount of which would be determined by several causes, such as the size of the river, the inclination of its bed, and the intensity of the rainfall. Then during the Glacial period for a time the whole of this part of England was submerged beneath the waters of a sub-arctic ocean, through which floated huge icebergs which when dissolved parted with the boulders and earthy material attached to them, and which are now found in the boulder-drift. The formation of the valley having been going on from a pre-historic period to the present time, it might, Mr. Saunders said, be supposed that in some of the river-gravels flint-implements and other articles of human manufacture would be found, and also fossil remains of animals which co-existed with the primitive races of man. Whether such had been found or not, he could not say, but in the adjoining county of Bedford the gravels of the Ouse valley had yielded many flint-implements and remains of the higher Mammalia.

On leaving this chalk-pit, the party proceeded to Mackery End, the residence of Mr. Luke Howard, grandson of the celebrated meteorologist of that name. Mr. Howard, on receiving the

members, first conducted them round his grounds. Two very fine tulip trees (*Liriodendron*) on the lawn attracted much attention, affording a more evident illustration of resupinate vernation than is frequently to be met with; and in a shady part of the grounds *Lathræa squamaria* was found growing in most unusual profusion.

After partaking of refreshments which Mr. Howard very kindly provided, the members left for Wheathampstead, a considerable number going direct to the railway station, and the rest visiting the church, which is dedicated to St. Helen. The Rev. Canon Davys, the Rector, here met the party, now much reduced in numbers, and gave an interesting account of historical events connected with his church, as evidenced by its monuments and brasses. The Rectory grounds were then visited, and a very fine collection of ferns, including several of our rarer British species, growing luxuriantly in positions as nearly as possible like their original habitats, and also rock-plants seldom seen away from their mountain-homes, were inspected with much pleasure.

Other places of interest in the neighbourhood of Wheathampstead were to have been visited, but most of the party now hurried to the station to take a train; others re-joined their conveyances; and only the writer and another member carried out the programme by inspecting the Devil's Dyke and the Moat between Wheathampstead and Coleman's Green, walking from there by No Man's Land Common to St. Albans.

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## Field Meeting, 15th June, 1882.

## HERTFORD HEATH AND HODDESDON.

The members met at the church on Hertford Heath under the leadership of Mr. R. T. Andrews.* Pryor's Wood was first visited, and here Mr. Whitley pointed out where pottery, coins, etc., had been found in digging for gravel, and he stated that the portion of the Roman road running north from the Townshend Arms was called the Jews' Lane, but it was not known for what reason.

The party then walked along the Ermine Street, a Roman military way, and Mr. Whitley stated that from information in old deeds, and from the fact that from this part of the Heath, which is called Beacon Heath, the ancient city of Verulam could easily have been seen, he believed that here was one of the four beacons which the Romans are known to have had in the county of Hertford. In Box Wood were found *Orchis maculata*, *Listera ovata*, and *Habenaria chlorantha*; and on arriving at Goose Green the members inspected at the public-house on the Green a stem of maple which had grown completely through a hollow flint, the landlord stating that he had obtained it from a hedge near Epping Green, Bayford.

Mr. Warner now led the members through the woods to a picturesque nook known as the "Pollards," and then by the

* I am indebted to Mr. Andrews for the report from which this is condensed.—Ed.

Brocks-bourne to Rose Hill, where they were most kindly received and entertained by Mr. and Mrs. Campbell. Mr. Andrews then read a paper on the Natural History and Archæology of the district visited, and Mr. Whitley gave an account of the evidence he had collected which proves that Hoddesdon and its neighbourhood had once been a district of great note, the Romans having had here beacons, fortresses, tumuli, barrows, and other earthworks.

After tendering their thanks to Mr. Campbell the members left for the Rye House station.

The following plants were noted as being in flower, and many were gathered:—

*Briza minor.*
*Melica nutans.*
*Milium effusum.*
*Carex axillaris.*
*Scirpus sylvaticus.*
*Luzula sylvatica.*
*Habenaria chlorantha.*
*Listera ovata.*
*Orchis maculata.*
*Digitalis purpurea.*
*Melampyrum cristatum.*
*Pedicularis sylvatica.*
*Scrophularia nodosa.*
*Lamium purpureum.*
*Stachys sylvatica.*
*Galium verum* (white).
*Epilobium montanum.*
*Bunium flexuosum.*
*Geum urbanum.*
*Potentilla anserina.*
*Rubus Idæus.*
*Tormentilla officinalis.*
*Ervum tetraspermum.*
*Orobus tuberosus.**
*Vicia cracca.*
*V. sepium.*
*Lychnis diurna.*
*L. flos-cuculi.*
*Silene inflata.*
*Ranunculus Flammula.*

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## Field Meeting, 17th June, 1882.

### RICKMANSWORTH.

The Harefield chalk-pits, close to the river Colne below Rickmansworth, expose as fine sections of the Upper Chalk as any to be met with on the northern side of the London Basin, and nowhere can better examples of "pipes" in the Chalk be seen than in one of these pits, while the absence of any vestige of a pipe in the other affords an instructive lesson in physical geology. But scant notice, however, of these sections has hitherto been taken.

To examine these pits, and also sections of the Tertiary beds at Woodcock Hill, under the guidance of Mr. William Whitaker of the Geological Survey of England, and Mr. John Hopkinson, the members of the Society assembled at three o'clock at Rickmansworth station, where they were met by members of the Geologists' Association of London, the united party numbering between forty and fifty.

Proceeding down the valley of the Colne, a slight detour was made to inspect a small disused chalk-pit on Stocker's Farm, of but little interest, and then a short walk along the towing-path

* Or *Lathyrus macrorrhizus.* In the report of a former field meeting ('Transactions,' Vol. I, p. lxi, April, 1882) this plant is mentioned in error as *Lathyrus tuberosus*, a much rarer species not found in Hertfordshire.

of the canal brought the party to the first of the large chalk-pits to be visited, on the left bank of the river. The Upper Chalk here is bare, and of a pure white, the clayey beds which come on just above having thrown off the water falling upon them, thus preventing it from precolating into the chalk and giving rise to pipes.

The next pit, a field's length farther south, by the old "Copper Mills" which have long ceased working, was soon reached, and formed the principal point of interest. Here the whole section of the chalk, which presents an almost vertical cliff from 90 to 100 feet high, is irregularly capped by gravel, from which pipes, often of most fantastic shape, and of roughly cylindrical form, extend downwards to distances varying usually from 30 to 70 feet. A mass of white chalk, of such a height and extent as, but for these pipes, would here have been exposed, would have had a most dazzling appearance; but the whiteness of the chalk is subdued by the darker colour of the pipes, which appear to occupy almost as much space on the surface of the vertical sides of the pit as the chalk itself.

Here Mr. Whitaker, mounting a tilted truck, explained the mode of origin of these pipes. They were, he said, holes or hollows in the chalk filled in by gravel or sand from the beds above. In old books they were sometimes stated to have been formed by sea-action, but such was not the case. They were caused by rain, which, in passing through air, absorbed carbonic acid, a gas which, in solution, had the power of dissolving the hardest limestone. The water, charged with carbonic acid gas, sank down through some line of weakness in the chalk, along which it gradually dissolved the rock, until at last the overlying gravel and sand sank into the cavity thus formed. Here and there a mass of gravel was to be seen which appeared to be unconnected with the pipe immediately above it, this appearance being due to the chalk not always having been worn away in a vertical line, so that the connecting-link of the pipe was not to be seen; and this was the explanation of the apparently isolated masses of gravel frequently seen in the chalk. Where there was a mass of Tertiary clay on the chalk, there were generally no pipes, for the clay being impermeable prevented water from getting through into the chalk; whereas water percolated through gravel, forming these pipes, in which might frequently be seen angular chalk-flints, not worn at all, and nearly in the position they occupied before the chalk in which they were embedded was dissolved away. The gravel here, Mr. Whitaker stated, forms part of a high terrace that occurs over the plateau above the pits, hiding the junction of the old Tertiary beds and the Chalk, and it is supposed to be of Glacial age, because it is like other gravels near which run under the boulder-clay; for such detached masses of gravel were presumed to be of the same age as the larger masses of which they seemed to be outliers.

After a pleasant walk across the fields the party arrived at the Woodcock Hill Kiln. Here the section exposed was found to be

better than when noted by the Geological Survey some years ago, the beds now seen in the upper pit being as follows:—

Clayey gravel, resting in hollows in the bed below.

| | |
|---|---|
| Basement-bed of the London Clay. | Brown and grey sandy clay, with a ferruginous bed in which a cast of *Panopæa* was found, ? 5 feet. |
| | Line of flint-pebbles. |
| | Brown loam, about 3 feet. |
| Reading Beds. | Mottled plastic clays, thick. |

A lower small pit showed about ten feet of brown sand, with clay above, and some apparently in it. This sand also belongs to the Reading Beds, and must dip under the mottled clays. The surface of the sand was very hard from exposure. The gravel is apparently part of the same bed as that on the top of the chalk near Harefield. This section presents rather an unusual feature in a pebble-bed in the midst of the basement-bed of the London Clay, and none at the bottom. The mottled clays below, Mr. Whitaker stated, were unfossiliferous, there being nothing like them at Woolwich, etc., where the Woolwich beds contain many kinds of fossils.

In crossing the fields from Woodcock Hill to Rickmansworth, on the summit of a hill from which was obtained an extensive view, embracing the valleys of the Colne, Chess, and Gade, a bed of pebbly gravel was examined. This, Mr. Whitaker said, must be as old as Middle Glacial, and might be older than Glacial, and he pointed out the difficulty, and sometimes the impossibility, of definitely fixing the age of such isolated masses of gravel. We have here the usual features of a gravel-capped hill—a flat top and a steep slope. The stones are nearly all water-worn, not angular, mostly of flint, but some of quartz.

From Rickmansworth station the train was taken to Watford, Dr. A. T. Brett having kindly invited the party to tea at his residence, Watford House. Refreshments were served under a large tree on the lawn, after which votes of thanks to Dr. Brett and to the Directors were proposed and heartily responded to.*

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## Field Meeting, 24th June, 1882.

### LEAVESDEN WOODS, WATFORD.

A considerable number of the members and their friends assembled at the Watford railway station, and thence proceeded, some in carriages and some on foot, to the entrance to that portion of the Leavesden Woods known as Long Spring Wood.

At the lodge-gate they were met by the President of the Society, Mr. George Rooper, who conducted the party through the glades and avenues which constitute the special attraction of these woods. The foliage of both beech and elm was everywhere observable in its natural beauty, but it was noticed that many of the oaks had been

* I have to thank Mr. Whitaker for revision of this report and for the addition of the section at Woodcock Hill.—Ed.

nearly stripped of their leaves by small caterpillars—presumably the larvæ of the winter-moth. Several other trees were also seen to have suffered considerably, but the oak to much the greatest extent.

From these woods the fields were crossed to the woods under which is the Watford tunnel, and here a number of wild flowers were collected, but no species of any rarity was found. The wood was traversed to the point where it nearly adjoins the Langley Road, and, after a short walk along the main road, the members arrived at Nascott House, where they were hospitably entertained by Mr. and Miss Rooper in the beautiful grounds which surround their residence.

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## Field Meeting, 15th July, 1882.

### ROYSTON.

The elevated tract of country on the extreme north of Hertfordshire, which forms the watershed of the two main river-basins of the Thames and Ouse, presents very different natural features from those which pertain to the greater part of the county. Hertfordshire as a whole is richly wooded, gently undulating, with highly-cultivated farms freely interspersed with beautiful parks; but on this, its northern boundary, the Chalk rises to the surface, free from the glacial and other superficial deposits with which it is mostly covered in other parts of the county, and forms extensive downs chiefly devoted to sheep-pasturage. Beyond, to the north-east, is the level tract of country so characteristic of Cambridgeshire and the Fens.

On this northern boundary and near its eastern end, where the Ermine Street crosses the Icknield Way, Royston is situated, that half of the town which lies to the south of the Icknield Way being in Hertfordshire, and the northern half being in Cambridgeshire. The neighbourhood of Royston is interesting alike to the naturalist, the geologist, and the archæologist, and were it not somewhat difficult of access from the greater part of Hertfordshire, it would probably have been visited by the Society long before the present occasion.

Unfortunately the weather on the morning of this day was not propitious. At the time the members had to leave Watford, St. Albans, and Hitchin, from which places, with Royston, the Society was almost exclusively represented, rain was falling heavily, and consequently scarcely twenty members and their frends arrived at Royston station by the mid-day train. Here they were met by Mr. H. George Fordham, F.G.S., the director of the meeting, and other members from Royston.

The rain had now ceased, and, as there was only a single shower in the course of the afternoon, the arrangements which had been made were carried out successfully.

The first place of interest visited was the remaining portion of a

range of buildings used by James the First as a country residence. In the gardens of this once royal residence, the grounds of which were 3¼ acres in extent, was seen an old mulberry-tree, said to be the second planted in England, the first being in the grounds of Christ's College, Cambridge. The leaves of this tree were noticed to be of two kinds, the lower ones being lobed or deeply cut (vine-shaped), and the upper entire, a difference which was conjectured to have been occasioned by grafting.

After leaving this old palace the party proceeded to "The Rookery," where Mr. and Mrs. Henry Fordham kindly provided luncheon, after which Mr. Fordham exhibited an extensive collection of the local flora, including several rather rare species from Royston Heath.

The well-known Royston Cave was then inspected. It is a circular domed chamber, about 25½ feet in height and 17 feet in diameter, excavated in the chalk in the south-east angle of the two main roads, and is entered by steps and a sloping passage from a house at the side of the road. An account of the cave, of its discovery in 1742, and of its probable origin before the Christian era, is given by Cussans in his 'History of Hertfordshire,'* and in greater detail by the late Joseph Beldam, F.S.A., in a pamphlet on 'The Origin and Use of the Royston Cave.'

The position in which the ancient Royston Cross stood, near the Cave at the junction of the Ermine Street and the Icknield Way, was pointed out, but all that remains of the structure is the boulder which formed the footstone of it, a description and brief history of which has already been given in the Society's 'Transactions.'† The boulder is now in the garden of the Institute, where it was inspected. The museum of the Institute was also visited; and a collection of local antiquities, formed by Mr. Edmund Nunn, was examined at his residence.

In a slight shower of rain a start was made for the Heath, some of the party driving (the greater part of the way), and others walking to one of the highest points, distinguished by seven tumuli, from one of which, 391 feet above the sea-level, and commanding an extensive view to the north and west, Mr. H. George Fordham pointed out the main features of the physical geography and geology of the surrounding country.‡

Royston Heath, an area of unenclosed chalk-down of about 400 acres, lies on the slope of a range of hills of the Lower Chalk, on the outcrop of that bed. Along its north-west edge runs the road from Royston to Baldock and Hitchin, a part of the Icknield Way which for about five miles forms the boundary of the county of Hertford. From this road the Heath, varying in width from a quarter to nearly three-quarters of a mile, rises to the south-east, sometimes extending to the summit of a ridge of variable height

* Odsey Hundred, p. 103.

† 'Trans. Watford Nat. Hist. Soc.,' Vol. II, p. 249.

‡ I am indebted to Mr. Fordham for the following summary of his remarks and some other portions of the report of this meeting.—Ed.

which runs roughly parallel to the Icknield Way and to the main ridge of the higher chalk beds lying several miles to the south and south-east. This latter ridge constitutes the water-parting between the valley of the Thames and that of the Rhee, or Cam, in which Royston and the Heath lie. The view across the shallow valley of the Rhee is bounded by a range of hills which dies away to the west, and allows in that direction an extensive view over more distant country.

Looking due west the main source of the Rhee is well marked by the high tower of Ashwell Church, about six miles distant, and a little to the left two large elms, standing on the summit of a hill, the most elevated point of a ridge transverse to the main lines of hills bounding the river-basin, define the head of the valley. From Ashwell the small and sluggish river winds through the valley to join with other streams to form the Cam as it is found at Cambridge.

Although there is no surface-drainage on the south-eastern slope of the valley, where the Chalk absorbs all the rain which falls on it, the water percolating through this pervious stratum at length encounters the more clayey and less pervious beds of the Chalk Marl; and along the outcrop of the Totternhoe Stone, lying on the top of the marl, a number of small streams rise to feed the main river.

Looking back towards the south and south-east, the main line of chalk hill is seen running up to a height of somewhat over 500 feet. This consists of the lower part of the Upper Chalk, resting on the Chalk Rock, and capped by thin beds of boulder-clay, which latter give a supply of surface-water to the villages which lie along the crest of the ridge and on its southern slope. From a little below the crest of the ridge the outcrop of the Lower Chalk, given as 300 feet thick by the Geological Survey, forms the wide band of undulating country sloping to the bottom of the valley. The beds dip generally about four degrees south. The Lower Chalk lies on the Totternhoe Stone, a bed of sandy chalk, quarried for building near Ashwell. This in its turn rests on the Chalk Marl, which is about 60 feet thick, and has at its base the remarkable bed of phosphatic nodules, resulting, as has been shown by Mr. Jukes-Browne, from the denudation of the upper part of the Gault—the nodules of phosphate of lime scattered through that bed having been collected by the removal of the clay of the bed itself into a bed of only a few feet in thickness, forming the base of the Chalk Marl. Beyond this the Gault is found. The range of hills forming the opposite side of the valley being an outlier from the main mass of chalk cut off from this main mass by the wearing out of the valley by the gradual denuding action of the river, gives the same succession of beds in ascending order, as high as the Lower Chalk, viz. Gault, phosphatic-nodule or "coprolite" bed, Chalk Marl, Totternhoe Stone, and Lower Chalk.

Turning to the west and looking over the extensive expanse of country in the valley of the Ivel and Ouse, where the outlier

bounding the valley of the Rhee on the north-west has died out, a greater width of Gault, forming a range of low hills to the north-west of Ashwell, can be seen, and beyond this the well-defined ridge of the Lower Greensand at Sandy is distinguishable, the most distant hills on the horizon being formed by the Oxford Clay of Bedford and the Ouse valley. To the north-east the valley of the Rhee widens out to Cambridge and the Fens beyond.

From these tumuli, an account of the excavation of one of which is given by Cussans,* the party walked along the top of the Heath to Church Hill, near which was noticed the Devil's Hopscotch, as a succession of nearly square enclosures, bounded by low banks and lying in a small valley or depression, is locally called. It was suggested that these enclosures had been used as sheep-folds or pens in early times, and the name of one of the two hills between which they lie—Pen Hill—was considered to favour this view.

At Church Hill, also, the habitat of *Anemone pulsatilla* was pointed out, and here were seen the rather rare *Campanula glomerata* and the very rare *Thesium linophyllum*; while in other parts of the Heath the equally rare *Antennaria dioica* and *Thalictrum minus* were noticed.

The walking-party returned to Royston over the Heath, visiting a chalk-pit near the town in which the dip of the beds to the south is well defined, and joining the ladies, who had driven back, at the Bank House, where Mr. F. N. Fordham kindly entertained the party at tea.

After tea the party divided, some visiting a chalk-pit on the Barkway Road, in which a well-marked bed of flints is shown in a thick-bedded compact chalk, the upper part of the section showing a more thinly-bedded and broken chalk without flints, a clayey band dividing the two beds; while others—the greater number—drove along the London Road (the old Ermine Street) to a point about four miles south of Royston, reaching the summit of the main ridge of the Chalk-outcrop near Reed. Here a brick-field, near the top of Reed Hill, showing boulder-clay and brick-earth, was visited; and also a chalk-pit showing a reverse dip of the beds which are bent over on a line of flexure which has been traced for about five miles along the line of the escarpment, the reverse dip here being about thirty degrees N.N.W. Both the Upper and the Lower Chalk are here seen divided by two bands of cream-coloured chalk-rock with about fifteen feet of white chalk between them. In parts of the pit which are now overgrown with vegetation, *Orobanche elatior*, *Orchis maculata*, and *Orchis pyramidalis* were seen in flower.

The whole party assembled at Royston station at about seven, the members from a distance leaving by the 7·13 train for their various destinations.

* 'Hist. Herts,' Odsey Hundred, p. 99.

## Field Meeting, 20th July, 1882.

### TEWIN AND WELWYN.

The members present, nearly all of whom were from Hertford, went to their destination in two conveyances. On leaving Hertford they drove along the Hertingfordbury road through Panshanger Park to the Poplar's Green Lodge, halting in the park to view the Panshanger Oak. This fine old tree is nearly twenty feet in circumference at the height of ten feet from the ground, and in 1825 was calculated to contain twenty loads of timber.

Proceeding by the Holly Bushes to Tewin, at the junction of the road leading to Marden Hill, Mr. Andrews, who made arrangements for and had the guidance of this meeting, gave an account of the trees to be found in the neighbourhood, specially mentioning the holly as forming a prominent feature, holly-bushes reaching from Bramfield and Tewin to Bengeo and Hertford, and growing to a large size. Tewin Church was then visited, and also the celebrated tomb of Lady Anne Grimston. Of this Mr. Cussans says: "Issuing from beneath the tomb are seven ash-trees growing from one root, and three sycamores in like manner connected. These trees have lifted up the solid stone-work of the tomb; and the iron railings, which enclose it, pressing against the stems of the trees, are, in some places, so completely embedded in the wood that it is impossible to sever them."*

The party then drove through Tewin Water Park, leaving the conveyances for a short time in order to take the woodland walk by the bank of the Mimram, and here *Epipactis latifolia* and *Listera ovata* were found. On arriving at Welwyn, the church was visited, the Rev. Canon Wingfield (the Rector) and the Rev. W. d'A. Crofton pointing out and explaining its more interesting archæological and architectural features. From the church the members proceeded to the Grange, the residence of Colonel Smyth, and, in the unavoidable absence of the Colonel, they were received and entertained at tea by Mrs. Smyth. Some time was then spent in the library in the examination of Colonel Smyth's natural-history collections and books, and after the thanks of the party had been expressed to Mrs. Smyth for her kind hospitality, Dr. Young's room in the Old Rectory, his avenue under the trees of which he is said to have composed his "Night Thoughts," and the stone erected to his memory by his successor "next but one," were successively visited. Canon Wingfield then accompanied the members through the Rectory grounds and to Mr. Blow's bee-hives, which form quite an extensive "model-village" in a damp wood by the river-side in his (Canon Wingfield's) grounds.

After thanking the Canon for the time and attention he had given to the members, the conveyances were again brought into requisition and the party reached Hertford at about eight o'clock.

* 'Hist. Herts,' Hertford Hundred, p. 22.

## Field Meeting, 4th November, 1882.

### CASSIOBURY PARK, WATFORD.

Until the present occasion all the Field Meetings of the Society have been held during the later spring or earlier summer months, from near the end of April to about the middle of July. Some of these meetings have been devoted entirely to botanical investigation, and at most of them the collection and identification of plants has formed a prominent feature. But, with a few exceptions, these have been flowering plants and ferns only, the time of the year not having been that at which the greater number of cryptogamic plants are met with.

In walking through Cassiobury Park in the early part of October, the writer of this report was struck with the number and variety of the larger fungi growing in certain parts of the park, and, after some correspondence with the eminent cryptogamic botanist Dr. M. C. Cooke, an Honorary Member of the Society, who kindly consented to take part in a "Fungus Foray," and to name any fungi met with, the present meeting was announced.

A few of the members of the Society assembled at the principal entrance to Cassiobury Park at half-past two, meeting here Dr. M. C. Cooke and Mr. H. T. Wharton. After collecting several species of fungi near the entrance, the party went direct across the park by the road over the river and canal, and, through the avenue beyond, to the low ground, mostly overshadowed by trees, which extends from Whippendale, by the side of Rouse Barn Lane, to the watercress beds near Cassio Bridge. From this part of the park most of the species of fungi and mosses collected were obtained. The park was left at the point where Rouse Barn Lane crosses the canal, and the party returned to Watford by the high road from Cassio Bridge.

Appended is a list of the fungi collected, identified by Dr. Cooke and Mr. Wharton, which is of special interest as being the first published list for any part of the county of Hertford; and also a list of the mosses identified by Mr. A. E. Gibbs, the only previous county list of this tribe of plants being that given, without localities, in an Appendix to the 'Flora Hertfordiensis.'

### Fungi.

#### Hymenomycetes.

*Agaricus* (*Lepiota*) *rachodes*, Fries.
,, ,, *granulosus*, Batsch.
,, (*Armillaria*) *mucidus*, Schrad.
,, (*Tricholomia*) *saponaceus*, Fr.
,, ,, *nudus*, Bull.
,, (*Clitocybe*) *clavipes*, Fr.
,, ,, *geotropus*, Bull.
,, ,, *cyathiformis*, Bull.
,, ,, *dealbatus*, Fr.
,, ,, *fragrans*, Sow.
,, ,, *tuba*, Fr.
,, ,, *brumalis*, Fr.
,, ,, *laccatus*, Scop.
*Agaricus* (*Collybia*) *butyraceus*, Bull.
,, ,, *velutipes*, Curt.
,, (*Mycena*) *rugosus*, Fr.
,, ,, *polygrammus*, Bull.
,, ,, *sudorus*, Fr.
,, ,, *flavo-albus*, Bolt.
,, ,, *purus*, Pers.
,, ,, *corticola*, Schum.
,, ,, *saccharíferus*, B. & Br.
,, ,, *galericulatus*, Scop.
,, ,, *lineatus*, Fr.
,, (*Omphalia*) *pseudo-androsaceus*, Bull.
,, (*Pleurotus*) *ostreatus*, Jacq.

*Agaricus* (*Pluteus*) *nanus*, Pers.
,, (*Entolomia*) *nidorosus*, Fr.
,, ,, *sericeus*, Bull.
,, (*Nolanea*) *pascuus*, Pers.
,, (*Pholiota*) *mutabilis*, Schœff.
,, (*Inocybe*) *asterosporus*, Quel.
,, (*Galera*) *tener*, Schœff.
,, (*Psalliota*) *campestris*, Linn.
,, (*Stropharia*) *squamosus*, Fr.
,, ,, *semiglobatus*, Batsch.
,, (*Hypholoma*) *sublateritius*, Fr.
,, ,, *fascicularis*, Huds.
,, (*Psilocybe*) *semilanceatus*, Fr.
,, ,, *spadiceus*, Schœff.
,, (*Panæolus*) *fimiputris*, Bull.
,, (*Psathyrella*) *gracilis*, Pers.
*Coprinus niveus*, Fr.
,, *micaceus*, Fr.
*Cortinarius castaneus*, Fr.
*Hygrophorus hypothejus*, Fr.
,, *coccineus*, Fr.
,, *puniceus*, Fr.
,, *pratensis*, Fr.
,, *chlorophanus*, Fr.
,, *virgineus*, Fr.
*Lactarius piperatus*, Fr.
,, *subdulcis*, Fr.
,, *serifluus*, Fr.
*Russula cyanoxantha*, Fr.
,, *heterophylla*, Fr.
,, *emetica*, Fr.
,, *fellea*, Fr.
,, *fragilis*, Fr.
*Marasmius fuscopurpureus*, Fr.
*Polyporus annosus*, Fr.
*Fistulina hepatica*, Fr.
*Hydnum repandum*, Fr.
*Craterellus cornucopioides*, Fr.
*Stereum hirsutum*, Fr.
,, *purpureum*, Fr.
*Peniophora quercina* (Fr.) Cke.
,, *cinerea* (Fr.) Cke.
*Corticium læve*, Fr.
,, *puteanum*, Fr.
*Clavaria fastigiata*, Pers.
,, *coralloides*, Linn.
*Tremella albida*, Huds.
*Dacrymyces deliquescens*, Dub.

GASTEROMYCETES.

*Lycoperdon saccatum*, Vahl.
,, *gemmatum*, Fr.
,, *pyriforme*, Schœff.
*Lycogala epidendrum*, Fr.
*Trichia* sp. (immature).

HYPHOMYCETES.

*Tubercularia vulgaris*, Tode.
*Trichoderma viride*, Pers.

ASCOMYCETES.

*Helotium citrinum*, Hedw.
*Bulgaria sarcoides*, Fr.
*Nectria cinnabarina*, Tode.
*Xylaria hypoxylon*, Fr.
*Agluospora profusa*, Tul.
*Sphæria acuta*, Hoffm.
*Dothidea Ulmi*, Fr.

## MOSSES.

PLEUROCARPI.

*Neckera complanata*, Br. and Schimp.
*Hypnum velutinum*, Linn.
,, *rutabulum*, L.
,, *prælongum*, L.
,, *serpens*, L.
,, *squarrosum*, L.
,, *triquetrum*, L.
,, *cupressiforme*, L.
*Thuidium tamariscinum*, Br. and Sch.
*Leucodon sciuroides*, Schwæg.
*Fissidens bryoides*, Hedw.

ACROCARPI.

*Mnium undulatum*, Hedw.
,, *hornum*, L.
,, *punctatum*, Hedw.
*Funaria hygrometrica*, Hedw.
*Polytrichum commune*, L.
*Atrichum undulatum*, P. Beauv.
*Tortula ruralis*, Schwæg.
,, *muralis*, Hedw.
*Ceratodon purpureum*, Brid.
*Dicranum scoparium*, Hedw.
*Dicranella heteromalla*, Schimp.

## Ordinary Meeting, 7th November, 1882, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

Mr. Hellier Gosselin, Blakesware, Ware, and General Douglas Hamilton, Woodside, Watford, were elected Members of the Society.

The Honourable Colonel Capell, Lady's Close, Watford; Mr. John Macdonald, The Hall, Bushey, Watford; Mr. George Mowat, Holywell Hill, St. Albans; and Mr. Arthur Stradling, C.M.Z.S., 29, Woodford Road, Watford, were proposed as Members.

The following lecture was delivered:—

"The Importance of Minute Things of Life in Past and Present Times." By Professor T. Rupert Jones, F.R.S., F.G.S. (*Transactions*, Vol. II, p. 164.)

Prof. Rupert Jones exhibited a large number of diagrams in illustration of his lecture.

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## Ordinary Meeting, 16th November, 1882, at Hertford.

F. M. Campbell, Esq., F.L.S., F.Z.S., F.R.M.S., Vice-President, in the Chair.

Mr. Charles Edward Holford, Springfield, Ware, and Miss Woodley, Ware Road, Hertford, were proposed as Members of the Society.

The following paper was read:—

"Notes on the State of Vegetation in the Neighbourhood of Hertford during the Winter and Spring of 1882." By R. T. Andrews.

Mr. Andrews commenced by stating that the district in which his observations had been made was comprised within a radius of one mile from the Shire Hall. In this district he said that the varieties of soil were numerous, comprising clay, gravel, chalk, and peat, with high and low lands, grass, arable land and woodland, and abundance of water, the result being that there was a large number of species of plants, upwards of 326 being noted in the 'Flora Hertfordiensis.' The autumn and winter of 1881-82 were favourable to the production of early flowers. The aconite was in flower on Christmas Day in the shrubbery at Bailey Hall, and during the week following it was found in plenty elsewhere. The first week in January brought out flowers of the barren strawberry in warm spots in the fir-grove at Bengeo, and daisies, white and red, in gardens and sheltered fields. The filbert and cob-nut trees flowered about two weeks earlier than the hazel of the hedges and woods, probably from being more protected. Wild snowdrops appeared on the 9th of January, and garden snowdrops on the 15th of the same month. At this date the elder had shoots of an inch in length, the honeysuckle of two inches, and the large blue clematis of the garden of three or four inches. *Ficaria verna* was in flower on the 19th of January, thirty-nine days earlier than in the preceding year. Notwithstanding severe weather, with sharp frosts, experienced in the third week of January, by the 24th of that month snowdrops were very generally in flower, the aconites were almost gone. the garden scarlet anemones were coming into flower, and in several places wallflowers and stocks were in nearly full bloom. The English tea-plant (*Lycium barbarum*) had put out its green shoots, but the frosts experienced about the 23rd of January crumpled and burnt the edges of its leaves. The catkins of the alder and the twigs of the willow assumed a deeper green, and by the 30th the grass became of a brighter hue, the honeysuckle was in full leaf, and the hazel-catkins were long, pendulous, and in full bloom. On the 29th of January some fully-expanded flowers of *Ranunculus bulbosus* were seen. By the 10th of February wallflowers were in full bloom; on the 16th flowers of *Tussilago farfara* (coltsfoot) were obtained, and

*Mercurialis perennis* (dog's mercury) was generally in flower; *Veronica agrestis* and *V. hederifolia* showed their dark and light blue flowers; and the little whitlow-grass put forth its tiny head of blossoms upon some old walls. The date of the last-named appearing last year was April 12. By the 25th of February the woods were generally dotted over with primroses. *Mercurialis perennis* was in full flower, and so were the wild hyacinth and anemone. A wood-anemone (*Anemone nemorosa*) was found in flower in Molewood on the 24th of February, four weeks earlier than in the previous year. At this date *Viola odorata* re-commenced flowering. On the 6th of March the stitchwort was found in flower at Brickendon Green, thirty-seven days earlier than last year. *Ulmus montana* and *U. campestris* were about nine days earlier than in 1881. By the 19th of March plum-trees and the blackthorn were in flower, the latter being thirty days earlier than in last year. The butterbur showed its head of pink, starry flowers twenty-one days earlier than last season. By the 23rd of March, notwithstanding severe frosts and some snow and hail, ground-ivy, hemlock, various kinds of buttercups, the kingcup, and several of the forget-me-nots were in full flower in the fields, and other plants, such as the red nettle, broom, wood-anemone, etc., were in flower in the woods everywhere. The flowering of the sweet violets, yellow daffodils, and palm was nearly over, and the blackthorn flower was rapidly disappearing. Oak and ash buds were rapidly increasing in size, and on several chestnut-trees buds were showing themselves. Poplars were in flower, and "lords and ladies," wall-cress, three-fingered saxifrage, mouse-ear chickweed, ivy-leaved toad-flax, and wallflower were also in flower. April witnessed a large accession to the number of plants in flower, some of them being much earlier than last year, but by the 20th of the month all the spring flowers had disappeared, and many of the summer flowers were in full bloom.

Mr. Gosselin exhibited a latch-lock, which, being found to be unworkable, was taken off a gate, when it was discovered that it had been taken possession of by the mason-bee.

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### Bye Meeting, 21st November, 1882, at Watford.

This meeting was devoted to the exhibition of microscopic objects, amongst which may be mentioned as of local interest the leaf-fungi *Æcidium Sanicula* from Leavesden woods and *Uredo Filicum* from Watford, exhibited by Mr. J. Watson Walker, the former having been collected at the field meeting on the 24th June, and the latter being noteworthy as a very rare species.

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### Bye Meeting, 15th December, 1882, at Watford.

This meeting, like the preceding one, was devoted entirely to microscopical study. The objects exhibited were almost entirely the preparations supplied by Mr. A. E. Cole with his 'Studies in Microscopical Science,' for which the Society subscribes. Of these a number of injected pathological specimens were exhibited by Dr. Brett, and rock-sections with polarised light by Mr. J. Hopkinson.

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### Ordinary Meeting, 19th December, 1882, at St. Albans.

S. Monckton White, Esq., Mayor of St. Albans, in the Chair.

Mr. Frederick George Lloyd, Cranleigh Villas, Watford, and Mr. Henry S. Sherry, Dynmore, Watford, were proposed as Members of the Society.

The following paper was read :—

"The Agricultural Geology of Hertfordshire." By J. Vincent Elsden, B.Sc., F.C.S. (*Transactions*, Vol. II, p. 145.)

Maps of the solid geology, the superficial geology, and the soils of Hertfordshire were exhibited by Mr. Elsden in illustration of his paper.

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ORDINARY MEETING, 21ST DECEMBER, 1882, AT HODDESDON.

RICHARD B. CROFT, Esq., R.N., F.L.S., F.R.M.S., in the Chair.

Mr. John Callaway, Norris Lodge, Hoddesdon, and Mr. Richard Lydekker, B.A., F.G.S., F.Z.S., The Lodge, Harpenden, were proposed as Members of the Society.

The following paper was read :—

"The Colour of Animals in Relation to their Habits." By F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.

Mr. Campbell commenced his paper by pointing out that one of the first principles a naturalist felt called upon to admit was that no single creature lives only for itself. The whole universe is but one chain of mutual dependency. Different animals are called upon from time to time to perform the most various and the strangest functions for others; indeed, the destiny of a great number of them is to provide food for others, and this naturally involves a tremendous sacrifice of life. But the economy of Nature is not based on the success of any single individual or principle, but on the result of a great number of averages taken from a great number of cases; and just in the same way as in mechanism there is no stability without two opposing forces, so stability in Nature is the sum of a great number of antagonistic forces.

Referring to the protective powers of animals, he said that when it was considered that the chances were very much against any single creature surviving to a certain age, and yet that the continuance of its species was necessary to support the life of other creatures, it would be seen that there must be some protection for those animals, and that they must have enormous powers of reproducing themselves. Thus it was found that, roughly speaking, the humbler the creature was in the scale of life, the more rapid was its power of reproduction. The means of protection which animals possess were very various, and were governed to a great extent by their habits. There was the power afforded by weapons of self-defence, involving muscular activity and size, which were not within the reach of every creature. There was the power afforded by great agility or rapid flight, and this again was not within the reach of great numbers. Then there was the power which some creatures have of making themselves disagreeable to others as food; and there was also the power of concealment, which was greatly increased by colour—when the colour of the creature resembled that of its immediate surroundings. Thus, commencing with water-life, he pointed out that the crab, shrimp, lobster, and sole, in their native state, have each a protective power from their colour being similar to that of their surroundings; and that the same can be said even of the roach, dace, and other fish with brilliant scales. A reflected beam of light may attract a pike to its prey, but it is also calculated to produce the momentary dazzling effect which we ourselves experience. The very metallic lustre which gives back the treacherous rays produces, when viewed from other directions, a liquid appearance which is well adapted for concealment in water. In the case of some creatures of brilliant colour—as for instance some kinds of the sea-cucumber, whose bodies are covered with a number of anchor-shaped spicules—their brilliant colour acts as a warning to others which might wish to devour them. Other species allied to these are encrusted with a hard deposit, so that fish will not attempt to eat them; while others

again have the power of placing a disagreeable fluid over their bodies, so as to render themselves unpalatable.

The most extraordinary instances of protection were found among butterflies and caterpillars. For instance, small caterpillars are green, resembling the colour of the vegetation on which they principally feed, but as they grow larger and become more visible to the birds they have longitudinal stripes on their bodies, which make them resemble a blade of grass or the twig of a tree, and so escape the notice of the birds. In the case of the privet-hawkmoth the stripes change from longitudinal to oblique ones, and cause it to resemble the leaves upon which it feeds. Black caterpillars are very visible, but they have a great number of hairy spines upon them, which almost prick the finger as they are touched: and the object of their being so visible is neither more nor less than to tell the birds, "I possess an element of danger for you, and the less you have to do with me the better." This power of protection runs throughout the whole animal kingdom. The caterpillar of the swallow-tail butterfly has a most disagreeable flavour, so that no bird will eat it, and its brilliant colour enables the birds to recognise it, and avoid it. The caterpillar of the elephant moth, although possessing no protective colour, owes its immunity to its ugliness, and there was an interesting experiment made by Weismann, who tried to entice birds with seeds to a tray on which he had placed one of these caterpillars; the birds flew to the tray and would not attempt to touch the seeds until the caterpillar was removed. Brown caterpillars, which are always very visible, have hairs on their bodies which the birds dislike very much; while "geometers" resemble dead twigs upon a tree. The ordinary magpie-moth is not eaten by birds, simply on account of its disagreeable flavour. Some caterpillars and butterflies, although not disagreeable themselves, owe their escape to their resemblance to those which are unpalatable.

Mr. Campbell next went on to consider how far the beautiful colours of one creature are appreciated by others, and said that it would seem that most creatures had a perception of colour, and he referred to the courtship of various animals, and more especially to that of the bower-bird. As a general rule birds of brilliant plumage—which, being very observable, are exposed to a great number of animals, especially in nesting-time—have covered nests when both birds are of brilliant plumage; but when only the cock is brilliant, and the hen is dull in colour—as in the case of the pheasant—the hen sits on an open nest. In some few cases—as in the doterel—the female bird is much more brilliant than the male, but then she neglects her nest, and leaves the male to sit on the eggs. The protective colouring and retreat of one or both sexes of animals during the period necessary for the rearing of their young is but analogous to the close-time of our game-laws.

Although nests were wonderful productions, most of their peculiarities were traceable to the mechanical and physical necessities of the birds. Thus, we find a certain shaped beak capable of doing certain things; a certain length of neck capable of doing other things; while certain shaped feet are necessary for building in certain places; and according to these peculiarities we have the form of the nest, while the size of it is proportionate to the size of the bird. So with the materials of which the nests are composed, it will be found that the materials are collected according to the habits or food of the different birds.

Mr. Campbell next referred to the experiments of Franklin and of Tyndall as to the most suitable colour of clothing for winter wear, and, alluding to black men, attributed their power of enduring hot climates to the pigment on their bodies. Referring to the chameleon, he said it was necessary to disabuse our minds of the popular notion that it has the power of changing the colour of its skin so as to resemble the objects by which it is surrounded. The variability of its colour is due to the presence of two layers of different-coloured pigment, which it has the power of raising or sinking, and according to whichever of them is nearest to the outside of the creature, so its colour varies. Thus the chameleon can only change its colour through natural laws, and when it happens that its colour resembles that of the surrounding objects, so much the better for it; but still it is merely an accident that it is so.

In conclusion, Mr. Campbell remarked that all the beautiful colours in the world, and the singing of the birds and the sounds of the various animals, could

not be intended to please man alone, but afforded pleasure to the animals themselves; and he expressed the hope that some of his hearers might be induced from what he had said to take a deeper interest in the different forms of life by which they were surrounded.

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### Ordinary Meeting, 16th January, 1883, at Watford.

George Rooper, Esq., F.Z.S., President, in the Chair.

Mr. John Callaway, Norris Lodge, Hoddesdon; the Honourable Colonel Capell, Lady's Close, Watford; Mr. Charles Edward Holford, Springfield, Ware; Mr. Frederick George Lloyd, Cranleigh Villas, Watford; Mr. Richard Lydekker, B.A., F.G.S., F.Z.S., The Lodge, Harpenden; Mr. John Macdonald, The Hall, Bushey, Watford; Mr. George Mowat, Holywell Hill, St. Albans; Mr. Henry S. Sherry, Dynmore, Watford; Mr. Arthur Stradling, C.M.Z.S., 20, Woodford Road, Watford; and Miss Woodley, Ware Road, Hertford, were elected Members of the Society.

Mr. A. F. Griffith, Bloomfield Road, Highgate, London, N.; the Rev. Francis H. Hodgson, M.A., The Vicarage, Abbot's Langley; and Sir Charles Nicholson, Bart., D.C.L., F.G.S., The Grange, Totteridge, were proposed as Members.

The following lecture was delivered:—

"Windsor Forest and its Famous Trees." By the Rev. Canon Gee, D.D., Vicar of Windsor. (*Transactions*, Vol. II, p. 189.)

Mr. Allan Barraud and Mr. John Weall were elected Auditors of the accounts for 1882.

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### Bye Meeting, 23rd January, 1883, at St. Albans.

This meeting was devoted to the exhibition of microscopic objects.

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### Ordinary Meeting, 15th February, 1883, at Hertford.

F. M. Campbell, Esq., F.L.S., F.Z.S., F.R.M.S., Vice-President, in the Chair.

Mr. Arthur Ernest Ekins, Market Cross, St. Albans, and Mr. Frederick Seebohm, The Hermitage, Hitchin, were proposed as Members of the Society.

The following paper was read:—

"On Methods of Illustrating Lectures on Microscopic Objects." By F. W. Phillips, F.L.S.

Mr. Phillips said that there might be many a member of the Society who could converse freely upon some branch of Natural History with those who knew something about it, and yet was extremely diffident of communicating it in public; and he believed this was almost always due to a fear of wearying the audience through inability to make the subject interesting to them. If the member had discovered a rare animal or plant, it was possible to exhibit it and point out its various distinguishing characteristics; but by far the greater number of subjects of study were those which could not well be exhibited. The department of the Infusoria might be especially instanced, owing to the uncertainty of the appearance, duration, and caprice of these creatures; and if one could not show the object, how would it be possible to *describe* a creature which had its eyes in its neck, its jaws in its stomach, which could tuck its head in its stomach, and turn

itself inside out like a stocking, having neither hands nor feet, yet making the most perfect and symmetrical bricks, then building its house with them, remaining always in the same place, and drawing its food from afar by sheer force of will; and it followed that a member who wished to talk on these subjects must either be content for his audience to leave with wonder-stricken but hazy ideas on the subject, or he must make a drawing of it. Now that was one of the great difficulties, the *pons asinorum* with many lecturers; many would say: "I cannot draw;" others could draw, and yet were unable to produce suitable drawings for want of knowledge of what should be done and what left undone, and he therefore thought that a few words on this subject might be acceptable to the members.

First of all there was the well-known black-board and chalk; this was a most excellent means of rough and ready illustration, and Mr. Phillips drew upon the board a group of insect-bitten rose-leaves, showing the action of the Micro-lepidoptera on the leaves as an instance of what could be done; but the utility of the black-board was, he said, essentially confined to diagrammatic outlines, and although it was possible to invest it with much artistic merit, yet it must be remembered that the principles of light and shade were reversed, white having to do duty for black as in a photographic negative.

Another method whereby greater finish might be obtained was by the substitution of a sheet of grocer's blue sugar-paper for the black-board, and the white which he had found best suited was a mixture of gum and whitening, to be applied in the same manner as paint; the shading could be "hatched" or stippled, but a very delicate effect could be obtained by a smudge of powdered chalk, the blue paper making a beautiful background, and he had seen this method used with great effect in the various learned societies, being especially suited for the delineation of delicate hyaline tissues.

Another method of illustrating was the water-colour drawing. Here was a field where art could revel, but there was one great rock which he must point out, whereon he and others had come to grief, and that was in painting a diagram as an ordinary painting. Mr. Phillips then showed a large diagram painted for his first lecture with scrupulous care and finish, the objects therein delineated being scarcely visible to those at the farther end of the room. It was, he said, always necessary to take into consideration the size of the room and the distance of the audience in making an illustration, and he thought as a rule no outline-strokes should be less than a quarter of an inch in thickness; but those who had worked with a microscope knew that every drawing, however finished, fell far short of the living reality, especially in one particular, viz. light—it was like trying to paint the sun. Now the nearest approach to light which one could get in painting was white—pure white. He remembered a passage in a celebrated lecture which said: "to do these creatures justice you would have to dip your brush in *light*."

Mr. Phillips then showed a method whereby this advice was closely followed, by the employment of light, pure and simple, for those parts which are refulgent. He raised a curtain and disclosed a screen whereon were portrayed in startling reality a number of animalcules. The chief charm of this new method was, he said, that like all other good things, it was extremely simple. The screen was an ordinary box, 3 feet square, open at one end, having a groove along the edge in which a light frame slid in and out like a lid. On this frame a sheet of brown paper was pasted of sufficient thickness to intercept the light; the objects were drawn on this paper roughly, and then with a penknife cut out like pictures for a scrap-book, a sheet of white paper was then laid at the back, giving white objects with a brown-paper background; upon this white paper all the details of colour—the cells, organs, muscles, or whatever there might be, were filled in, and then came the finishing touch (the high lights); these were simply holes pricked in the paper with a pin in continuous lines, and at a distance the individuality of the holes was not seen; in the box there should be placed one or two ordinary lamps, and the thing was complete.

Mr. George Turner exhibited a small micro-spectroscope, and explained its use in spectrum analysis.

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## Anniversary Meeting, 20th February, 1883.

(At Watford.)

George Rooper, Esq., F.Z.S., President, in the Chair.

Isaac Brown, Kendal; Thomas Henry Huxley, LL.D., Ph.D., F.R.S., F.L.S., F.G.S., F.Z.S., etc., Professor of Natural History at the Royal School of Mines, Museum, South Kensington, and 4, Marlborough Place, Abbey Road, London, N.W.; John Gwyn Jeffreys, LL.D., F.R.S., F.L.S., F.G.S., F.Z.S.; and Thomas Rupert Jones, F.R.S., F.G.S., late Professor of Geology at the Royal Military College, Sandhurst, 10, Uverdale Road, King's Road, Chelsea, London, S.W., were elected Honorary Members of the Society.

The Report of the Council for 1882, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address. (*Transactions*, Vol. II, p. 173.)

The Balloting-glass having been removed, and the lists examined by the Scrutineers, the following gentlemen were declared to have been duly elected as the Officers and Council for the ensuing year.

*President.*—The Right Honourable the Earl Cowper, K.G.

*Vice-Presidents.*—Professor John Attfield, Ph.D., F.R.S., F.C.S.; Alfred Fowell Buxton; Frank M. Campbell, F.L.S., F.Z.S., F.R.M.S.; John Evans, D.C.L., LL.D., F.R.S., F.S.A., F.L.S., F.G.S., etc.; William Ransom; and George Rooper, F.Z.S.

*Treasurer.*—Sydney Humbert.

*Honorary Secretaries.*—Richard B. Croft, R.N., F.L.S., F.R.M.S., and John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.M.S.

*Librarian.*—Allan Barraud.

*Curator.*—William Verini.

*Other Members.*—The Rev. Canon Bradby, M.A.; Alfred T. Brett, M.D.; E. M. Chater; Alfred J. Copeland; Arthur Cottam, F.R.A.S.; the Rev. C. W. Harvey, M.A., F.M.S.; John E. Littleboy; Frederick W. Phillips, F.L.S.; Frank W. Silvester, F.M.S.; W. Lepard Smith; the Rev. E. T. Vaughan, M.A.; and John Weall.

It was then resolved—

That the thanks of the Society be given to Mr. George Rooper, retiring from the office of President; to the Right Hon. the Earl Cowper, K.G., Dr. J. Gwyn Jeffreys, F.R.S., etc., and Mr. John E. Littleboy, retiring from the office of Vice-President; to Mr. E. M. Chater, retiring from the office of Librarian; to Mr. F. W. Silvester, retiring from the office of Curator; and to Mr. H. George Fordham, F.G.S., Mr. Charles F. Humbert, F.G.S., Mr. J. Logan Lobley, F.G.S., and Mr. Joseph Pollard, retiring from the Council.

The thanks of the Society were also accorded to the Honorary Secretaries, Mr. R. B. Croft and Mr. John Hopkinson.

## Report of the Council for 1882.

In presenting the eighth Annual Report, the Council of the Hertfordshire Natural History Society and Field Club has the pleasure of stating that the Society maintains its position as one of the most vigorous of the many provincial scientific societies in the kingdom, and continues to do valuable work in the investigation of the natural history of its legitimate area, the County of Hertford.

During the year nine ordinary members have been elected, and one honorary member; two members have compounded for their annual subscriptions; eight members have resigned; and the Council regrets to have to record the loss by death of one honorary member, Mr. Charles R. Darwin, M.A., LL.D., F.R.S., and four ordinary members, Mr. John Flower, M.A., the Rev. H. Wade Hodgson, M.A., Mr. Matthew Moggridge, F.G.S., and Mr. John Sedgwick.

By the death of Charles Darwin the Society has lost its most distinguished honorary member. While Linnæus left his mark on science by his comprehensive survey of living things, giving to every natural object known to him a name and place in the system he invented, Darwin will be chiefly known and honoured for his patient investigation of the reason of the harmonies and analogies existing in Nature and of the causes which have given rise to its diversity, and whether the philosophical theory of evolution to which his name has been given be eventually accepted or not, it cannot be denied that his writings have done more to advance the study of Natural History, and have had a far greater effect upon scientific thought and investigation, than those of any other naturalist.

The census of the Society at the end of the years 1881 and 1882 was as follows:—

| | 1881. | 1882. |
|---|---|---|
| Honorary Members ... ... ... ... ... | 15 | 15 |
| Life Members ... ... ... ... ... | 36 | 38 |
| Annual Subscribers ... ... ... ... ... | 220 | 215 |
| | 271 | 268 |

The Council has to announce the completion of the first volume of the 'Transactions of the Hertfordshire Natural History Society' and the commencement of the second volume, two parts of each having been published during the year. The contents of the first volume issued by the Society under its altered title are equal in value and interest to those of the 'Transactions of the Watford Natural History Society,' but while in the former series papers on Geology and Botany predominate, in the present volume Meteorology and Zoology have received the greatest amount of attention. For the valuable plate in this volume illustrating Mr. Henry Grove's paper on the occurrence of *Vertigo Moulinsiana* in Hertfordshire, the Society has to thank Dr. Gwyn Jeffreys, F.R.S., by whom the paper was communicated. For the other illustrations the Society is indebted to the liberality of authors, Mr. F. W. Phillips having supplied the plate illustrating Rotifera from the neighbourhood of

Hertford, Mr. John Hopkinson the map of Hertfordshire showing its River Basins and the position of its Rainfall Stations, and Mr. J. Vincent Elsden the geological sections illustrating his paper on the Post-tertiary deposits of Hertfordshire.

The following are the principal papers and lectures which have been read or delivered during the year 1882:—

Jan. 24, at Watford.—The Migration of Birds; by John E. Littleboy.
—— 26, at Hertford.—Notes on the Protozoa of Hertfordshire; Section Pantostomata; by F. W. Phillips, F.L.S.
Feb. 21, at Watford.—Anniversary Address; by the President, George Rooper, F.Z.S.
March 21, at Watford.—Meteorological Observations taken at Throcking, Herts, during the year 1881; by the Rev. C. W. Harvey, M.A., F.M.S.
—— Meteorological Observations taken at Wansford House, Watford, during the year 1881; by John Hopkinson, F.L.S., F.M.S.
—— Report on the Rainfall in Hertfordshire in 1881; by the Rev. C. W. Harvey, M.A., F.M.S.
—— Report on Phenological Phenomena observed in Hertfordshire during the year 1881; by John Hopkinson, F.L.S., F.M.S.
—— Notes on Insects observed in Hertfordshire during the year 1881; by Eleanor A. Ormerod, F.M.S.
—— Notes on Birds observed in Hertfordshire during the year 1881; by John E. Littleboy
—— 30, at Ware.—Notes on the Upper Portion of the River Rib and its Affluent the Quin; by R. P. Greg, F.G.S., F.R.A.S., and R. B. Croft, R.N., F.L.S.
—— Notes on the River Rib from Standon to its junction with the Lea; by Arthur Giles Puller, M.A., F.Z.S., F.R.G.S.
April 7, at Hertford.—Notes on the River Ash; by Hellier Gosselin.
—— Methods by which Members may assist the Recorder of the Arachnida; by F. M. Campbell, F.L.S., F.Z.S.
Nov. 7, at Watford.—The Importance of Minute Things of Life in Past and Present Times; by Prof. T. Rupert Jones, F.R.S., F.G.S.
—— 16, at Hertford.—Notes on the State of Vegetation in the neighbourhood of Hertford during the Winter and Spring of 1882; by R. T. Andrews.
Dec. 19, at St. Albans.—The Agricultural Geology of Hertfordshire; by J. Vincent Elsden, B.Sc., F.C.S.
—— 21, at Hoddesdon.—The Colour of Animals in relation to their Habits; by F. M. Campbell, F.L.S., F.Z.S.

Several short communications have also been read, and these have usually elicited a considerable amount of discussion, which has greatly added to the interest of the meetings.

The following Bye Meetings for microscopical study have been held:—February 27th at St. Albans; April 13th at Watford; May 25th at Ware; November 21st at Watford; December 15th at Watford. These meetings have not been so well attended as could be wished, but on each occasion several members have brought their microscopes and interesting objects have been exhibited.

A special meeting was held at Watford on the 18th of April, when a few alterations were made in the Rules, the principal changes being the addition of Pre-historic Archæology to the subjects of study, the limitation of the right of members to

receive the ordinary publications of the Society instead of *all* the publications, and the extension of their right to admit two visitors in place of one to any of the meetings.

On Saturday afternoon, the 20th of May, a visit was paid to the new British Museum of Natural History, at South Kensington, and, under the able guidance of Mr. Robert Etheridge, F.R.S., the members inspected the collections of fossils. The general plan of the Museum was also shown and explained by Mr. Etheridge, and the various workrooms, etc., in the crypt were visited, and the great facilities they afford for the special study of natural objects were made evident. About two hours were spent in the Museum, and at the conclusion of the visit the members present testified their appreciation of the valuable services of their guide, and the kind manner in which he had rendered them, by the hearty vote of thanks which they accorded him.

The following Field Meetings have been held during the year:—

May 27.—Harpenden and Wheathampstead.
June 15.—Hertford Heath and Hoddesdon.
June 17.—Rickmansworth and the Harefield Chalk Pits.
June 24.—Watford and the Leavesden Woods.
July 15.—Royston.
July 20.—Tewin and Welwyn.
Nov. 4.—Cassiobury Park, Watford.

The only meeting held in conjunction with any other Society was that at Rickmansworth, in which members of the Geologists' Association took part. The Royston meeting was the annual whole-day meeting, and was an eminently successful one.

For hospitality kindly afforded at the Field Meetings the Society is indebted to Mr. R. Luke Howard, Mackery End, Harpenden; Mr. F. M. Campbell, Rose Hill, Hoddesdon; Dr. Brett, Watford House (Rickmansworth meeting); the President, Nascott House, Watford; Mr. Henry Fordham, The Rookery, Royston; Mr. F. U. Fordham, The Bank House, Royston; and Colonel Smyth, The Grange, Welwyn.

A new departure in the proceedings of the Society has been attempted during the year. The Field Meeting on the 4th of November was announced as a "Fungus Foray," and resulted in the collection of 88 species of Fungi (74 species being Hymenomycetous), the list of which is the first which has been compiled for the County of Hertford. The species were identified by Dr. M. C. Cooke and Mr. H. T. Wharton, who accompanied the party, and to whom the thanks of the Society are due for an interesting and instructive afternoon. On this occasion also 22 species of Mosses were collected and identified by Mr. A. E. Gibbs.

In the report for 1881 the Council announced the bequest to the Society by the late Mr. R. A. Pryor, of the MS. of a new 'Flora of Hertfordshire,' and of his botanical library, herbarium, and the sum of £100. The whole of this bequest has now been received, less legacy-duty on the £100, by which this amount has been reduced to £91 16*s*. Of this the sum of £43 5*s*. was expended in 1881

in carrying out the terms of the bequest, etc., leaving £48 11*s.* towards the future preservation of the collection.

As this bequest was preceded in 1880 by the donation to the Society of the late Rev. R. H. Webb's botanical library and herbarium, so it has been followed in 1882 by another valuable and similar donation. Mr. Isaac Brown, who, when residing at Hitchin, was a frequent correspondent of Messrs. Coleman and Webb, and furnished them with notices of the occurrence in his neighbourhood of many species of plants, as recorded in their 'Flora Hertfordiensis,' has presented to the Society his herbarium and botanical library. The herbarium is an extensive one, and is especially rich in cryptogamic plants. The library consists of about 90 volumes, most of which are local floras and works on cryptogamic botany. The donation will probably be of great assistance in the compilation of a Cryptogamic Flora of the county, the publication of which may follow, at no long interval, that of the late Mr. Pryor's 'Flora of Hertfordshire' now being edited for the Society by Mr. James Britten, F.L.S.

Owing to these various donations the extent of the library has been so greatly increased since the publication of the catalogue in 1878, and supplementary catalogue in 1880, that these are now rendered almost useless, and it has been decided to prepare and publish a new catalogue. The great preponderance also of botanical works has induced the Council to authorise the expenditure during the year of £15 in the purchase of books chiefly treating of other branches of science, in addition to the usual subscriptions to periodical works, and it is hoped that the new catalogue will show that the amount has been judiciously expended. With the exception of Darwin's works, which are chiefly botanical, and a few books on geology, nearly all the books purchased are on zoology and microscopy, subjects in which the library has hitherto been very deficient.

The great difficulty at the present time is the want of sufficient accommodation both for the books and the botanical specimens in the possession of the Society. With the present extent of the Watford Public Library the Council cannot expect more accommodation to be provided, but it is hoped that before long the building may be considerably enlarged, and that one or two spacious and well-lighted rooms may be devoted to the exhibition of a collection of local natural objects and local antiquities—a collection which shall consist exclusively of objects found within the County of Hertford. When an extension of the building for this and other purposes is decided on by the Public Library Committee, the necessary funds will have to be provided by voluntary contributions, and in the carrying-out of a scheme which may greatly benefit the Society it is hoped that the members will largely contribute.

The finances of the Society are in a very satisfactory condition. The expenditure during the year almost exactly balances the ordinary receipts, £117 5*s.* 10*d.* having been expended and £117 12*s.* 7*d.*

received, in addition to the balance from 1881, the life compositions, and the Pryor bequest. The sum of £100, covering these last two items, has been transferred to a deposit account at the London and County Bank. With the amount invested in Consols, the reserve or invested funds of the Society are thus increased to about £300, more than covering the whole of the life compositions and the Pryor bequest.

The Council has now to announce the expiration of the term of office of your President, Mr. George Rooper, F.Z.S. During the term of his presidency Mr. Rooper has seldom been absent from the chair at the meetings which have been held at Watford, and his kind reception and entertainment of a large number of the members at his residence, Nascott House, in the summer, will always be remembered amongst the many pleasant events in the history of the Society.

The Council regrets to have to announce the resignation of your Librarian and your Curator, who have held their respective offices for the past two years. Your Librarian, Mr. E. M. Chater, is unable any longer to devote the necessary amount of time to the duties of his office; and your Curator, Mr. F. W. Silvester, resigns his office on account of the distance of his residence from Watford.

Your Secretary, Mr. Hopkinson, has also tendered his resignation, but, owing to the difficulty of finding a successor, has consented to retain the office for another year, and also to retain for the present the editorship of the 'Transactions.'

As in former years, the Council desires in conclusion to express the obligation the Society is under to the Committee of the Watford Public Library for the continued accommodation liberally afforded; and also to the Hertford Literary and Scientific Institution for the free use of their rooms for the Hertford meetings.

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## Donations to the Library in 1882.

| Title. | Donor. |
|---|---|
| Agricultural, Royal, Society. Journal. Ser. 2, vol. xviii, part 1. 8vo. London. . . . . | *Mr. R. B. Croft.* |
| Argyll, Duke of. Primeval Man. 8vo. London, 1869. | *Mr. J. Hopkinson.* |
| Baily, W. H. Descriptions of Fossil Invertebrata from the Crimea. (*Quart. Journ. Geol. Soc.* 1858). 8vo. . | ,, |
| Coleman, Rev. W. H. Outlines of the Geology of Leicestershire. 8vo. Sheffield, 1862 . . . | *Mrs. R. H. Webb.* |
| Darwin, Charles. Monograph of the Lepadidæ or Pedunculated Cirripedes. (*Ray Society*). 8vo. London, 1851 . . . . . | *Mr. J. Hopkinson.* |
| Crosskey, Rev. H. W. Ninth Report of the Committee [on] . . . Erratic Blocks. (*Rep. Brit. Assoc.* 1881) . | *Mr. H. G. Fordham.* |
| Greg, R. P. Neolithic Flint Implements of the Nile Valley and Egypt. (*Journ. Anthrop. Inst.* 1881). 8vo. . . . . | *The Author.* |
| Grevillea. Vol. x, Nos. 55–57. 8vo. London, 1882. | *Dr. M. C. Cooke.* |
| Hall, Prof. James. Fossils of the Niagara Group. (*Rep. New York State Cabinet*, 1865). . . . | *Mr. J. Hopkinson.* |
| ——— Contributions to Palæontology. 8vo. *Ib.* . | ,, |
| Henslow, Rev. J. S. A Catalogue of British Plants. 2nd ed. 8vo. Cambridge, 1835 . . . . . | *Mrs. R. H. Webb.* |

## *INCOME AND EXPENDITURE FOR THE YEAR ENDING 31st DECEMBER*, 1882.

| Dr. | £ | s. | d. |
|---|---|---|---|
| To Balance brought forward | 14 | 0 | 1 |
| ,, Subscriptions for 1880 | 0 | 10 | 0 |
| ,, ,, ,, 1881 | 1 | 10 | 0 |
| ,, ,, ,, 1882 | 96 | 10 | 0 |
| ,, ,, ,, 1883 | 4 | 0 | 0 |
| ,, Entrance Fees | 6 | 0 | 0 |
| ,, Life Compositions | 10 | 0 | 0 |
| ,, The late Mr. R. A. Pryor's bequest (less legacy duty) | 91 | 16 | 0 |
| ,, Dividend on £203 4*s.* 6*d.* Consols | 5 | 18 | 7 |
| ,, Interest on £100 on deposit from 6th October | 0 | 16 | 6 |
| ,, Sale of 'Transactions' per Secretary | 2 | 7 | 6 |
| | £233 | 8 | 8 |

| Cr. | £ | s. | d. |
|---|---|---|---|
| By Stationery | 1 | 14 | 9 |
| ,, Printing 'Transactions' | 54 | 0 | 0 |
| ,, Miscellaneous Printing | 6 | 11 | 10 |
| ,, Expenses of Watford Meetings | 2 | 18 | 0 |
| ,, ,, St. Albans ,, | 1 | 6 | 6 |
| ,, ,, Hertford ,, | 2 | 0 | 4 |
| ,, Library | 20 | 2 | 3 |
| ,, Subscription to 'Studies in Microscopical Science' | 4 | 4 | 0 |
| ,, Reporter | 2 | 0 | 0 |
| ,, Salary of Assistant | 5 | 0 | 0 |
| ,, Postages | 15 | 16 | 8 |
| ,, Sundry Small Expenses | 1 | 11 | 6 |
| ,, Amount placed to Deposit Account | 100 | 0 | 0 |
| ,, Balance at Bank | 16 | 2 | 10 |
| | £233 | 8 | 8 |

To amount invested in the purchase of £203 4*s.* 6*d.* Consols ..... £198 15*s.*
,, ,, on deposit at the London and County Bank ..... 100 0*s.*

Audited and found correct, this 9th day of February, 1883, { ALLAN BARRAUD. JOHN WEALL.

| Title. | Donor. |
|---|---|
| Hopkinson, John. On some Points in the Morphology of the Rhabdophora or true Graptolites. (*Annals Nat. Hist.* 1882). 8vo. . . . . | *The Author.* |
| Huxley, Prof. T. H. Address delivered at the Anniversary Meeting of the Geological Society of London, 1862. 8vo. London, 1862. . . . . | *Mr. J. Hopkinson.* |
| Johns, Rev. C. A. The Forest Trees of Britain. Vol. i. 8vo. London, 1849 . . . . . | ,, |
| Linnean Society. Journal. Botany. Vol. xix, Nos. 114–119. Zoology. Vol. xvi, Nos. 89–92. 8vo. London, 1881–82 . . . . . | *Mr. R. B. Croft.* |
| Ormerod, Eleanor A. Report of Observations of Injurious Insects during the year 1881. 8vo. London, 1882 . . . . . | *The Authoress.* |
| Preston, Rev. T. A. Wiltshire Rainfall, 1881. 8vo. Marlborough, 1882 . . . . . | *The Editor.* |
| Ramsay, Prof. A. C. Address delivered at the Anniversary Meeting of the Geological Society of London, 1864. 8vo. London, 1864 . . . . . | *Mr. J. Hopkinson.* |
| Roberts, George. Topography and Natural History of Lofthouse and its Neighbourhood. 8vo. London, 1882 . . . . . | ,, |
| Sedgwick, Prof. A. Lecture on the Strata near Cambridge and the Fens of the Bedfordshire Level. 8vo. (*Not published*) . . . . . | ,, |
| Smyth, W. W. Address delivered at the Anniversary Meeting of the Geological Society of London, 1868. 8vo. London, 1868 . . . . . | ,, |
| Symons, G. J. History of English Meteorological Societies, 1823-80. (*Quart. Journ. Met. Soc.* 1882). 8vo. . . . . | *The Author.* |
| ——— British Rainfall, 1881. 8vo. London, 1882 . | *The Editor.* |
| ——— Monthly Meteorological Magazine. Vol. xvii. 8vo. London, 1882 . . . . . | ,, |
| Tate, Ralph. Appendix to the Manual of the Mollusca of S. P. Woodward. 12mo. London, 1868 . . | *Mr. J. Hopkinson.* |
| Thurm, E. F. Im. The Birds of Marlborough . . | ,, |
| Webb, Rev. R. H., and Rev. W. H. Coleman. Report on the Flora of Hertfordshire. 12mo. Hertford, 1843 . . . . . | *Mrs. R. H. Webb.* |
| ——— Supplement to the Flora of Hertfordshire. 12mo. Hertford, 1851 . . . . . | ,, |
| Werner, Prof. A. G. A Treatise on the External Characters of Fossils. Translated by Thomas Weaver. 8vo. Dublin, 1805 . . . . . , . | *Mr. J. Hopkinson.* |
| Whitfield, R. P. Observations on the Internal Appendages of the Genus Atrypa. 8vo. . . . . | ,, |
| Wraxall, L. Life in the Sea. 8vo. London, 1860 . | ,, |

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## Presented by Mr. Isaac Brown.

Abbot, C. Flora Bedfordiensis. 8vo. Bedford, 1798.
Acharius, E. Methodus quo omnes detectos Lichenes. ...8vo. Stockholm, 1803.
Babington, C. C. Flora Bathoniensis. 2nd ed. 12mo. Bristol and London, 1839.
——— Primitiæ Floræ Sarnicæ . . . . . 12mo. London, 1839.
——— Manual of British Botany. 3rd ed. 12mo. London, 1851.
Backhouse, J. British Hieracia. 8vo. York, 1856.
Baines, H. Flora of Yorkshire. 8vo. London, 1840.

BAKER, J. G. Flowering Plants and Ferns of Great Britain. 8vo. London, 1855.
BAKER, J. G., and J. NOWELL. A Supplement to Baines' Flora of Yorkshire. 8vo. London, 1854.
BALFOUR, J. H. Manual of Botany. 8vo. London and Glasgow, 1849.
BENTHAM, G. Catalogue des Plantes indigènes des Pyrénées . . . . . 8vo. Paris, 1826.
BIGELOW, J. Florula Bostoniensis, 3rd ed. 12mo. Boston (U.S.A.), 1840.
CARPENTER, Dr. W. B. Vegetable Physiology and Botany. 8vo. London, 1844.
CHILDS, A. P. The British Botanists' Field Book. 16mo. London, 1857.
COOKE, M. C. Fungi: their Nature, Influence, and Uses. 2nd ed. 8vo. London, 1875.
COOPER, D. Flora Metropolitana. 12mo. London, 1837.
CORDA, A. C. J. Anleitung zum Studium der Mycologie. 8vo. Prague, 1842.
COWELL, M. H. A Floral Guide for East Kent. 8vo. Faversham, 1839.
DARLINGTON, W. Florula Cestrica. 2nd ed. 12mo. West-Chester, Penn., 1837.
DEAKIN, R., and R. MARNOCK. Florigraphia Britannica. Part 1. 8vo. London, 1837.
DILLENIUS, J. J. Historia Muscorum (reprint). 4to. Edinburgh, 1811.
EATON, A., and J. WRIGHT. North American Botany. 8vo. Troy, N.Y., 1840.
EDINBURGH, BOTANICAL SOCIETY OF. Annual Reports for 1836-44. 8vo. Edinburgh, 1837-44.
——— Proceedings for 1855-56. 8vo. Edinburgh. 1855-56.
——— Transactions. Vols. i-xiv, Parts 1 and 2. 8vo. Edinburgh, 1844-82.
FRIES, E. M. Systema Mycologicum. 3 vols. 8vo. Lundæ, 1830.
GOTTSCHE, C. M. Synopsis Hepaticarum. 8vo. Hamburg, 1844.
HALL, T. B. Flora of Liverpool. 12mo. London, 1839.
HARVEY, Hon. W. H. Manual of the British Algæ. 8vo. London, 1841.
HENSLOW, Rev. J. S. Principles of Descriptive and Physiological Botany. 12mo. London, 1835.
HOOKER, Sir W. J. Species Filicum. 5 vols. 8vo. London, 1846-64.
HUEBENER, Dr. J. W. P. Hepaticologia Germanica. 8vo. Mannheim, 1834.
HUDSON, W. Flora Anglica. Vol. i. 8vo. London, 1778.
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LEES, E. Botanical Looker-out among the Wild Flowers. 12mo. London, 1842.
LEIGHTON, W. A. Flora of Shropshire. 8vo. London, 1841.
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——— A Natural System of Botany. 2nd ed. 8vo. London, 1836.
LINNÆUS, C. Flora Suecica. 8vo. Stockholm, 1745.
——— Genera Plantarum. 2nd ed. 8vo. Vienna, 1767.
——— Systema Vegetabilium. Vols. i, ii. 16th ed. 8vo. Göttingen, 1827.
LUXFORD, G. Flora of the Neighbourhood of Reigate. 12mo. London, 1838.
MACKAY, J. T. Flora Hibernica. 8vo. Dublin, 1836.
MOORE, T. Index Filicum. Nos. 1-20 (all published). 8vo. London, 1857-63.
MUDD, W. A Manual of British Lichens. 8vo. Darlington, 1861.
PAGET, C. J. and J. A Sketch of the Natural History of Yarmouth. 8vo. Yarmouth, 1834.
PHYTOLOGIST. Vols. i-v (imperfect *). 8vo. London, 1844-54.
——— New Series. Vols. i-vi (imperfect †). 8vo. London, 1855-63.
PRESL, C. B. Tentamen Pteridographiæ. 8vo. Prague, 1836.
RALFS, J. The British Phanerogamous Plants and Ferns. 8vo. London, 1839.
——— British Desmidieæ. 8vo. London, 1848.
RAY, J. Synopsis Methodica Stirpium Britannicarum. 3rd ed. 8vo. London, 1724.
RELHAN, R. Flora Cantabrigiensis. 8vo. Cambridge, 1820.
SCHAERER, L. E. Lichenum Europaeorum. 8vo. Bernæ, 1850.

* Wanting the Nos. for June and Aug.-Dec., 1854.

† Wanting the Nos. for Jan.-Apl. and July, 1855; Jan. 1856; Oct. and Nov. 1860; July, 1861; May, Sept., and Dec. 1862; Feb., Mar., and May, 1863.

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——— Introduction to the Study of Botany. 7th ed. 8vo. London, 1833.
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Stroud, T. B. Elements of Botany. 8vo. Greenwich, 1821.
Sullivant, W. S. Musci Alleghaniensis. 8vo. Colombus, Ohio, 1846.
Thompson, J. V. Catalogue of Plants growing in the Vicinity of Berwick-on-Tweed. 8vo. London, 1807.
Trog, J. G. Verzeichniss Schweizer Schwæmme. 8vo. Bern, 1844.
Watson, H. C. Geographical Distribution of British Plants. 12mo. London, 1835.
——— The New Botanist's Guide. 2 vols. 12mo. London, 1835-37.
Williams, B. S. Ferns and Lycopodiums, British and Exotic. 8vo. London, 1852.

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## Received in Exchange, 1882.

American Museum of Natural History. Bulletin No. 1. 8vo. New York. 1881.
Bath Natural History and Antiquarian Field Club. Proceedings. Vol. v, No. 1. 8vo. Bath, 1882.
Bedfordshire Natural History Society and Field Club. Abstract of Proceedings for 1877-81. 8vo. Bedford, 1882.
Belfast Natural History and Philosophical Society. Proceedings for the Session 1880-81. 8vo. Belfast, 1882.
Belfast Naturalists' Field Club. Proceedings. Ser. II, Vol. ii, Part i. 8vo. Belfast, 1882.
Bristol Naturalists' Society. Proceedings. New Series, Vol. iii, Part 3. 8vo. Bristol, 1882.
Cardiff Naturalists' Society. Transactions. Vol. xiii. 8vo. Cardiff, 1882.
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Eastbourne Natural History Society. Transactions. Vol. i, Part 2. 8vo. Eastbourne, 1882.
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Entomological Society. Proceedings for 1879-81. 8vo. London, 1880-82.
Epping Forest and County of Essex Naturalists' Field Club. Transactions. Vol. ii, parts 5, 6. 8vo. Buckhurst Hill, 1881-82.
Field Naturalist and Scientific Student. Vol. i, Nos. 1-3. 4to. Manchester. 1882.
Geological Society. Abstracts of the Proceedings. Session 1881-82. 8vo. London, 1882.
Geologists' Association. Proceedings. Vol. vii, Nos. 4-6. 8vo. London, 1882.
Glasgow, Geological Society of. Transactions. Vol. vi, Part 2. 8vo. Glasgow, 1882.
Manchester Geological Society. Transactions. Vol. xvi, parts 11-17. Vol. xvii, parts 1, 2. 8vo. Manchester, 1882.
Marlborough College Natural History Society. Report for 1881. 8vo. Marlborough, 1881.
Meteorological Society. Quarterly Journal. New Series, Vol. viii. 8vo. London, 1882.
——— Index to the Publications of the English Meteorological Societies, 1839-81. 8vo. London, 1862.
——— The Meteorological Record. Nos. 3-5. 8vo. London, 1882.

Microscopical, Royal, Society. Journal. Series 2, Vol. ii. 8vo. London, 1882.
Midland Naturalist. Vol. v. 8vo. London and Birmingham, 1882.
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Norfolk and Norwich Naturalists' Society. Transactions. Vol. iii, Part 3. 8vo. Norwich, 1882.
Northern Microscopist. Vol. ii. 8vo. London, 1882.
Norwich Geological Society. Proceedings. Vol. i, part 6. 8vo. Norwich, 1882.
Quekett Microscopical Club. Journal. Series 2, Vol. i, No. 1. 8vo. London, 1882.
——— General Index to the Journal. Series 1, Vols. i-vi. 8vo. London, 1882.
Rugby School Natural History Society. Report for 1881. 8vo. Rugby, 1882.
Science Gossip. Vol. xviii. 8vo. London, 1882.
Scientific Roll and Magazine of Systematized Notes. Climate. Vol. i, part 1, Nos. 6-8; part 2, No. 9. 8vo. London, 1882.
Scottish Naturalist. Vol. vi, Nos. 45-48. 8vo. Edinburgh and London, 1882.
Smithsonian Institution. Annual Report for the year 1880. 8vo. Washington (U.S.A.), 1881.
Somersetshire Natural History and Archæological Society. Proceedings. New Series, Vols. vi, vii. 8vo. Taunton, 1881-82.
Wiltshire Archæological and Natural History Society. Magazine. Vol. xx, Nos. 58-60. 8vo. Devizes, 1881-82.
Yorkshire Geological and Polytechnic Society. Proceedings. New Series, Vol. vii, part 4. 8vo. Leeds, 1881.
Yorkshire Naturalists' Union. Transactions. Part 4. 8vo. London and Leeds, 1882.

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## Ordinary Meeting, 20th March, 1883, at Watford.

Alfred T. Brett, Esq., M.D., in the Chair.

Mr. Arthur Ernest Ekins, Market Cross, St. Albans; Mr. A. F. Griffith, Bloomfield Road, Highgate, London, N.; the Rev. Francis H. Hodgson, M.A., The Vicarage, Abbot's Langley; Sir Charles Nicholson, Bart., D.C.L., F.G.S., The Grange, Totteridge; and Mr. Frederick Seebohm, The Hermitage, Hitchin, were elected Members of the Society.

Mrs. Attenborough, Haydon Hill, Bushey, Watford, and Mr. Frederick H. Berry, M.B. (Lond.), High Street, Watford, were proposed as Members.

Letters were read from Mr. Isaac Brown, Professor Huxley, Dr. Gwyn Jeffreys, and Prof. Rupert Jones, thanking the Society for their election as Honorary Members.

The following papers were read:—

1. "Meteorological Observations taken at Wansford House, Watford, during the year 1882." By John Hopkinson, F.L.S., F.M.S., Hon. Sec. (*Transactions*, Vol. II, p. 201.)

2. "Report on Phenological Phenomena observed in Hertfordshire during the year 1882." By John Hopkinson, F.L.S. (*Transactions*, Vol. II, p. 181.)

3. "Notes on Insects observed in Hertfordshire during the year 1882." By Eleanor A. Ormerod, F.M.S. (*Transactions*, Vol. II, p. 187.)

4. "Notes on Birds observed in Hertfordshire during the year 1882." By John E. Littleboy. (*Transactions*, Vol. II, p. 209.)

5. "Notes on some Hertfordshire Mammalia." By Alfred T. Brett, M.D.

The following Mammalia, recently observed in Hertfordshire, were alluded to by Dr. Brett:—the mole (*Talpa europæa*), the badger (*Meles taxus*), the otter (*Lutra vulgaris*), the stoat (*Mustela erminea*), the squirrel (*Sciurus vulgaris*), and the brown rat (*Mus decumanes*). Thirty moles of a white or cream colour were reported to have been found in about half an acre of a field of oats. A badger was reported by Mr. Ernest O. Fordham to have been caught at Odsey, near Royston, on the 7th of March (1883), this being the only instance known of the occurrence of the badger in that neighbourhood. An otter had been seen at Cassiobury by a boatman, and another more recently by Mr. W. Lea, jun. A white stoat was reported to have been shot; the change to the winter coat, while almost universal in the north, being unusual in Hertfordshire, keepers believing that a white stoat was not seen more frequently than about once in three years. Squirrels had been very numerous about Watford, especially in Cassiobury Park. And lastly, the great abundance of the brown rat was remarked upon, the late Mr. Jonathan King having known of more than 1000 being killed at Watford in one day.

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## Ordinary Meeting, 29th March, 1883, at Hertford.

F. M. Campbell, Esq., F.L.S., F.Z.S., Vice-President, in the Chair.

Mrs. Charles Young, Fore Street, Hertford, was proposed as a Member of the Society.

The following paper was read:—

"Notes on the Re-introduction of the Beaver into Britain." By Augustus Hawks. (*Transactions*, Vol. II, p. 223.)

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## Ordinary Meeting, 17th April, 1883, at Watford.

Professor John Attfield, Ph.D., F.R.S., F.C.S., Vice-President, in the Chair.

Mrs. Attenborough, Haydon Hill, Bushey, Watford; Mr. Frederick H. Berry, M.B. (Lond.), High Street, Watford; and Mrs. Charles Young, Fore Street, Hertford, were elected Members of the Society.

Mr. Frederick Fisher, M.R.C.S., King's Langley, was proposed as a Member.

The following papers were read:—

1. "Some Experiments on the Physics and Chemistry of the Sap of Plants." By Professor Attfield, F.R.S., etc. (*Transactions*, Vol. II, p. 229.)

2. "Note on the River Bourne." By John E. Littleboy. (*Transactions*, Vol. II, p. 237.)

3. "Report on Flowering Plants and Ferns observed in Hertfordshire in 1882." By Ada Selby. (*Transactions*, Vol. II, p. 237.)

4. "Notes on Wild Flowers observed near Royston in 1882." By A. Kingston. Communicated by John Hopkinson, Hon. Sec. (*Transactions*, Vol. II, p. 240.)

5. "Notes on Injurious Insects observed near Harpenden in 1881 and 1882." By John J. Willis. Communicated by J. Hopkinson. (*Transactions*, Vol. II, p. 240.)

6. "Notes on some Fish recently caught in Hertfordshire." By John E. Littleboy.

Mr. Littleboy stated that a pike (*Esox lucius*) weighing 11¼lbs. was caught during the autumn of 1882 in a pond just within the grounds of Mr. W. Jones Loyd, Langleybury, and adjoining the Grand Junction Canal, and that another weighing 6½lbs. was taken from the same pond at about the same time; that Mr. A. F. Buxton had informed him that a bream (*Abramis brama*) was taken early in January, 1883, in a pond through which flows the River Ash; that Dr. Brett had informed him that on the 14th of April a trout (*Salmo fario*) weighing 5½lbs. and measuring 25 inches in length, was caught in the Colne near Hamper Mill; and that Mr. G. H. Thomas had secured with a fly on the 9th of April a trout weighing 9¾lbs. from the mill-stream at the back of Colne-brook, High Street, Watford.

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### Ordinary Meeting, 19th April, 1883, at Ware.

Richard B. Croft, R N., F.L.S., F.R.M.S., in the Chair.

1. "Notes on the River Lea below Hertford." By Richard B. Croft, R.N., F.L.S., Hon. Sec. (*Transactions*, Vol. II, p. 243.)

2. "Report on the Rainfall in Hertfordshire in 1882." By the Rev. C. W. Harvey. (*Transactions*, Vol. II, p. 249.)

3. "Meteorological Observations taken at Throcking, Herts, during the year 1882." By the Rev. C. W. Harvey, M.A., F.M.S. (*Transactions*, Vol. II, p. 255.)

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### Field Meeting, 21st April, 1883.

### BERKHAMPSTEAD AND THE VALLEY OF THE BOURNE.

Phenomena connected with the flow of water on the surface of the earth, or underground, either in past or present times, show how mutually related are the sciences of geology and meteorology. An intermittent river, dependent for its flow on an unusually large rainfall at a particular time in the year, and which may have ceased for some time before it commences to flow, seems at first sight to be a phenomenon of interest only to the meteorologist, but a little reflection will show that the existence of such a stream must also depend upon the nature of the strata upon which the rain falls, and upon the form of the ground or amount of its slope, and that it must therefore be of some interest to the geologist.

Such rivers are usually called "bournes," although this term merely signifies a "brook," or sometimes a "boundary." There

are "bournes" which flow in the winter and spring, usually ceasing in the summer and autumn; but the "Hertfordshire Bourne" is of a more erratic nature than this, running on the average only about once in from three to seven years. To see this River Bourne flowing, and to trace it from its source to its outflow into the River Bulbourne at the hamlet to which it gives the name of Bourne End, under the guidance of Mr. John Evans, D.C.L., F.R.S., was the object of this meeting, in which members of the Geologists' Association of London took part, meeting the members of the Hertfordshire Natural History Society at Berkhampstead station at three o'clock.

Before, however, proceeding to the valley of the Bourne, the members of the two societies first visited the ruins of Berkhampstead Castle, close to the station, and here Mr. John Evans gave an interesting outline of the history of the castle from Anglo Saxon times to the present day. He said that it was claimed for the Castle that it dated back to ancient British and Roman times, for there was a coin of Cunobeline which was reported to have been found here, and some Roman coins had also been found. It was certainly a low position for a castle, but the site accorded well with the ancient British "town" which was a place fortified by woods and marshes, for here there were in front extensive marshes and the town must have been surrounded by woods, and would therefore, owing to its natural defences, probably be a place of sufficient importance to become subsequently a castle. It was doubtful how far the great antiquity of the Castle was supported by facts, but it was certain that it was a place of considerable importance in Anglo-Saxon times, for it was here that, after the Battle of Hastings, William the Conqueror received the deputation of Saxon nobles which awaited him to offer him the crown and swear fealty to him. After tracing the further history of the Castle, Mr. Evans made some remarks upon its construction, pointing out that all the earthworks, and the double moat by which the keep is surrounded, were artificial, and that the walls were built of flints from the Chalk of the district.

The Rev. J. W. Cobb, Rector of Berkhampstead, and author of a work on its 'History and Antiquities,' who had joined the party in the Castle grounds, then gave some further historical information, referring to a paper by Mr. G. T. Clark, in the 'Proceedings of the Archæological Institute' * for 1873, in which a plan of the Castle was given, and stating that a new edition of his own work, in which this plan would be introduced, was now being printed.

The Church, dedicated to St. Peter, was next visited, its principal interest centering in its connection with the poet Cowper, whose father was rector of the parish. From the church Mr. Cobb conducted the party to the Rectory, Cowper's birthplace. In the Rectory grounds "Cowper's Well" was pointed out, and a large piece of the Hertfordshire conglomerate was inspected, affording Mr. Evans the text for a brief account of the physical characteristics

* Vol. xxx, p. 401.

and geological history of this peculiar rock, which is formed by the consolidation, by infiltration of silica, of a pebble-bed of the Woolwich and Reading Series.*

Continuing, from the Rectory grounds, to ascend the hill on the south-west of Berkhampstead, Haresfoot Park, the seat of Mr. F. A. Dorrien Smith, was soon reached; and after walking through the park, a descent was made into the valley of the Bourne, permission having been obtained from Mr. Dorrien Smith for the party to follow the course of the stream, which flows over his property. The Bourne was encountered where it is crossed by Harratt's End Lane, and where its source was found when it was visited by the Society two years ago (7th May, 1881). Now, however, it was flowing here in a considerable stream, the field above the lane was in great part submerged, and to find the present source of the river it was necessary to walk about half a mile up the valley by the side of the lake thus temporarily formed, and through some muddy fields. Here, in a field in Buckinghamshire,† on the right bank of the stream, in view of its present source, and of its course for some distance, Mr. Evans explained the geological and meteorological conditions to which the existence of this and other intermittent streams is due, his remarks being somewhat as follows:—

Such intermittent streams as this, to see the source of which we have come to these muddy fields, are governed by the same laws as are the other rivers of the district, and all streams which issue from and pass over a porous subsoil like the chalk. All streams are dependent upon the rainfall, if on hard or impervious soils directly, for the water in that case at once runs off on the surface; but if on absorbent soils or subsoils such as the chalk, the result is different, for much of the water percolates downwards, until it meets with some obstruction. It arrives at a "plane of permanent saturation," a natural subterranean reservoir, by which it must not be inferred that there is anything like a subterranean cavern full of water in the chalk, but merely that at a certain depth the chalk becomes thoroughly saturated with water. There is a vast amount of water continually in the chalk, and even in the driest weather there is always water in most chalk-streams, as they are not immediately dependent upon rain. The amount of water flowing from one of these areas represents merely a fraction of the amount of rain falling upon it. The average yearly rainfall over a period of 50 years in this neighbourhood is 25 or 26 inches. For the 12 years ending 1872, an average of 25½ ins. per annum fell, of which about half fell during the summer months (April to September), and the other half during the winter months (October to March).

In order to ascertain the amount of water which finds its way more than one or two feet below the surface, Messrs. Dickinson and Co. have had a series of gauges constructed, consisting of cast-iron cylinders, 18 inches in diameter and 3 to 6 feet in length, turned

* See 'Trans. Herts Nat. Hist. Soc.,' Vol. I, p. 33.

† The Bourne forms a boundary between the counties of Hertfordshire and Buckinghamshire for a considerable part of its course.

to a knife-edge at the top, and sunk to their full depth below the level of the ground in which they are placed, but so that the edge just projects above the ground. Some of these cylinders are filled with the ordinary surface-soil of the neighbourhood, and the others with chalk (from the Upper Chalk) in a fragmentary condition, and with sand; grass is growing on the upper surface of the contents of the cylinders, and also on the ground surrounding them; and there are means provided of collecting and measuring the amount of water which finds its way through the cylinders, that is, through three or six feet of soil, chalk, or sand. It is a remarkable thing that, although there may have been a rainfall of 15 or 16 inches in the summer months, not more than 1 inch finds its way through the ordinary soil, and $1\frac{3}{4}$ through the chalk; while, with an average rainfall for 23 years of 14·17 inches in the six winter months, 6·03 inches went through the 3 feet of soil, and 8·8 inches through the 3 feet of chalk. For the same (winter) period for the 12 years ending 1872, the average rainfall was 12·8 inches, of which 5·1 percolated through the soil, and 7·3 through the chalk. With an increase of about 2 inches in the rainfall in the winter period there was thus an increase of 1 inch in the quantity which went through 3 feet of soil, and $1\frac{1}{2}$ in that which went through 3 feet of chalk. In this way it was found out what is about the proportion of the water which percolates into the soil as compared with that which is carried off by evaporation and vegetation. Some idea of the vast amount of water absorbed from the ground by trees may be gathered from Professor Attfield's paper "On the Physics and Chemistry of the Sap of Plants," * which many of those now present heard him read at a meeting of the Society a few days ago.

These intermittent streams are thus fed from the natural subterranean reservoir, which varies in height as there are long periods of dry or wet weather. After a long period of drought, the surface of the underground reservoir falls, becoming very nearly level, in consequence of the water leaving it as springs not being replaced, but after heavy rains the inclination of the surface of the water is again raised. It is thus possible to tell the variation in the height of the water in the wells in the neighbourhood as well as elsewhere by knowing what the fall of rain has been. In a well at Studham, miles away from any stream, the level of the water in two successive years has varied as much as 70 feet. When the subterranean reservoirs receive a great accession of water by a long-continued rainfall, these "bournes," or intermittent streams, make their appearance; but it might happen that the rain which fell in the course of one winter would not be sufficient to raise the surface of the reservoir sufficiently high for a particular stream to flow, and on the other hand it might flow when there has not been any particularly heavy rainfall, for in some years the Bourne has been found flowing when there had been no excessive amount of rain, but this was in consequence of the accumulation of the rain of previous years.

* 'Trans.,' Vol. II, p. 229.

The Bourne is flowing strongly this year, it flowed last year, and also the year before, thus disproving the old idea that it only flows once in seven years. The water is now seen to be bubbling up from its fountain-head, which is caused by the subterranean reservoir being full. The plane of permanent saturation—the surface of this reservoir—is not level, but is inclined towards those places where the water finds its way to the surface of the earth in the form of springs. This plane varies at different times in the year, sometimes being inclined at an angle of 20 feet, and sometimes even of 25 feet to the mile, while sometimes the slope represented is not more than 12 feet to the mile. The rivers flowing past Watford and St. Albans will be found to have an inclination of about 12 feet 6 inches to the mile in the lower portion of their course, and 18 feet 6 inches in the upper portion. This shows what is the amount of impediment to water passing through the chalk in a lateral direction; for, assuming that water could find its way through the chalk at a less inclination than 12 feet 6 inches to the mile, these rivers would cease to flow, or, at all events, the streams would never be seen upon the surface. The whole of the chalk being porous or pervious, unless there were a sufficiently saturated bed beneath the river to hold the water up at an inclination at least equal to that of the river, it would sink into its bed and disappear. The inclination of the subterranean water passing through the chalk must therefore be at least 12 feet 6 inches to the mile in this district.

With regard now more particularly to this valley of the Bourne, in certain years the subterranean water is raised in the body of the hills, and the valley, cut at right angles or nearly so to the main stream, intersects the general surface of the plane of saturation, and the water appears on the surface of the ground at the bottom of the valley. This theory of intermittent streams being due to the intersection of the plane of saturation is well illustrated by the Bourne being sometimes found running in one place, then disappearing, and further on running again, and again disappearing. The plane of saturation being more even than the surface of the ground, where there is an elevation of the surface the water finds its way underground instead of running on the surface. Owing to the large amount of rain which has fallen in recent years, having been above the average of a long period every year since 1875 to the present time, the Bourne has during this period very frequently flowed. Since 1873 it has flowed in 1876, 1877, 1881, and 1882, and it is now flowing in 1883. On some occasions it commences flowing in summer; this year the flow of the stream will probably cease in June or July.

A hearty vote of thanks was accorded to Mr. Evans at the close of his address, on the proposition of the President of the Geologists' Association, Dr. Henry Hicks, seconded by Mr. Littleboy on behalf of the Hertfordshire Natural History Society.

The course of the Bourne was then followed to Bourne End, where the stream flows into the Bulbourne. In a portion of its

course it was found to have taken temporary possession of the road, a détour having to be made into the adjoining fields to avoid it, and at Bourne End it was observed to be flowing through the usually dry culvert under the high road in a powerful stream.

The party then dispersed, most of the members of both Societies walking to Boxmoor Station.

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## Field Meeting, 19th May, 1883.

### ALDENHAM, WATFORD.

The members assembled on Bushey Mill bridge and walked through Berry Grove to Aldenham, collecting on the way wild flowers and other natural objects with which this swampy wood abounds. Even after a long period of dry weather the foot-path through the wood is wet, in fact under water in places, owing to the very impervious bed of clay which forms the subsoil and frequently the actual surface, and to which, probably, this and the contiguous woods owe their survival, being remnants of a forest at one time of considerable extent. The blue-bell and the wood-anemone were noticed to be the plants in flower in the greatest abundance, but the latter was nearly over. *Athyrium Filix-fœmina*, *Lastrea spinulosa*, and other ferns were gathered.

At Aldenham the church was visited under the guidance of the vicar, the Rev. C. L. Royds; and in the Vicarage garden and adjoining meadow the rare *Anemone Apennina* was pointed out by him. The blue petals had fallen, but the plant was recognised by its leaves, and Mr. Royds showed some pressed specimens which he had gathered whilst the plant was in flower.

Mr. A. E. Gibbs then made a few remarks upon the Hertfordshire anemones. Only two species of *Anemone* were, he said, truly indigenous to Britain, *A. nemorosa*, the wood-anemone, which is common in Hertfordshire, and *A. Pulsatilla*, the pasque-flower, which occurs on our chalky pastures and hill-sides. Two introduced species had also become established here and there in England, *A. ranunculoides*, the yellow anemone, reported as being found near Abbot's Langley, and the plant now seen, *A. Apennina*, the mountain anemone, which in the 'Flora Hertfordiensis' was stated to occur in three localities in Hertfordshire—Stanstead, Berkhampstead, and "a wood at Aldenham." This he thought was most likely to have been Berry Grove wood, which was believed to have furnished the plants introduced by Lady Rendlesham, about 30 years ago, into the vicarage meadow. Thus Hertfordshire possessed all the four species of the genus *Anemone* known to be indigenous to or naturalised in Britain.

From the church the members proceeded to Aldenham Abbey, where they were most kindly received by Mr. and Mrs. McGregor. The fernery was first visited, and here Mr. Littleboy enumerated the following species of ferns which he had found in Hertfordshire,

adding some general remarks on their distinctive characters, habitats, and localities :—

*Polypodium vulgare*
*Lastrea Oreopteris*
,, *Filix-mas*
,, *spinulosa*
,, *dilatata*
*Polystichum aculeatum*
,, *angulare*
*Athyrium Filix-fœmina*
*Asplenium Adiantum-nigrum*
,, *Trichomanes*
,, *Ruta-muraria*
*Ceterach officinarum*
*Scolopendrium vulgare*
*Blechnum spicant*
*Pteris aquilina*
*Ophioglossum vulgare*

Tea was then served in the library, and interesting and valuable books, pictures, statues, and other works of art were inspected, after which, on the proposition of Mr. Littleboy, seconded by Dr. Morison, a vote of thanks was accorded to Mr. and Mrs. McGregor for their kind hospitality.

The grounds of Aldenham Abbey were next visited, the most picturesque part being a woodland glen, supposed to have once been a chalk-pit. From a summer-house at its upper end the view down the glen and through the trees extended over meadows beyond, through which was seen flowing the River Colne.

After taking leave of their host and hostess the members dispersed, the greater number walking or driving either to Watford, or to Radlett or Bricket Wood station for St. Albans.

The meeting was under the direction of Mr. F. W. Silvester.

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## Ordinary Meeting, 1st June, 1883, at Hertford.

Richard B. Croft, R.N., F.L.S., F.R.M.S., in the Chair.

The following papers were read :—

1. "The Spiders of the Neighbourhood of Hoddesdon: a Contribution to the Arachnidal Fauna of Hertfordshire." By F. M. Campbell, F.L.S., F.Z.S., F.R.M.S. (*Transactions*, Vol. II, p. 237.)

2. "Notes on the Construction and Application of the Spectroscope." By C. E. Shelly, B.A., M.B.

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## Field Meeting, 2nd June, 1883.

### BRICKET WOOD, WATFORD.

This was essentially a botanical and entomological recording and collecting expedition. The members from Watford were the first to arrive at Bricket Wood station, and, after noting the plants in flower on the Green near the station, they were joined by others from St. Albans, etc. The wood was then entered and strolled through as far as the point where it adjoins the main road from Watford to St. Albans, a different route being taken through it in returning.

In the wood, in the lane between it and the Scrubbs, and on the Green, the following plants were observed in flower, and were recorded by the writer of this report, who had the direction of the meeting :—

CYPERACEÆ
*Carex glauca*
,, *remota*
,, *sylvatica*
ARACEÆ
*Arum maculatum*
LILIACEÆ
*Scilla nutans*
ORCHIDACEÆ
*Habenaria bifoliata*
*Listera ovata*
*Neotia Nidus-avis*
*Orchis maculata*
,, *mascula*
EUPHORBIACEÆ
*Euphorbia officinalis*
POLYGONACEÆ
*Rumex acetosa*
,, *acetosella*
PRIMULACEÆ
*Anagallis arvensis*
*Primula veris*
SCROPHULARIACEÆ
*Melampyrum pratense*
*Pedicularis sylvatica*
*Scrophularia nodosa*
*Veronica Beccabunga*
,, *Chamædrys*
,, *officinalis*
PLANTAGINACEÆ
*Plantago lanceolata*
,, *major*
LAMIACEÆ
*Ajuga reptans*
*Lamium album*
,, *galeobdolon*
*Nepeta Glechoma*
BORAGINACEÆ
*Myosotis arvensis*
,, *palustris*
SOLANACEÆ
*Solanum Dulcamara*
ASTERACEÆ
*Bellis perennis*
*Carduus pratense*
*Chrysanthemum Leucanthemum*
RUBIACEÆ
*Asperula odorata*
*Galium aparine*
CAPRIFOLIACEÆ
*Viburnum lantana*
APIACEÆ
*Anthriscus sylvestris*
*Sanicula europæa*
ROSACEÆ
*Alchemilla vulgaris*
*Cratægus oxyacantha*
*Fragaria vesca*
*Geum urbanum*
*Potentilla anserina*
,, *fragariastrum*
,, *reptans*
*Rosa canina*
FABACEÆ
*Genista anglica*
*Lathyrus macrorrhizus*
*Lotus corniculatus*
*Trifolium agrarium*
,, *minus*
,, *pratense*
,, *procumbens*
,, *repens*
*Ulex europæus*
*Vicia sepium*
GERANIACEÆ
*Geranium Robertianum*
POLYGALACEÆ
*Polygala vulgaris*
CARYOPHYLLACEÆ
*Cerastium arvense*
*Lychnis diurna*
,, *Flos-cuculi*
*Stellaria graminea*
,, *holostea*
VIOLACEÆ
*Viola canina*
,, *tricolor*
BRASSICACEÆ
*Barbarea vulgaris*
*Capsella Bursa-pastoris*
*Cardamine pratensis*
RANUNCULACEÆ
*Ranunculus acris*
,, *aquatilis*
,, *auricomus*
,, *bulbosus*
,, *Flammula*
,, *repens*

The following butterflies and moths were collected, the list being furnished by Mr. A. E. Gibbs :—

BUTTERFLIES.

SPINIGERI
*Argynnis euphrosyne*
LIMACIFORMES
*Cœnonympha Pamphilus*
ONISCIFORMES
*Lycæna Alexis*
VERMIFORMES
*Rhodocera Rhamni*
VERMIFORMES (continued)
*Anthocharis Cardamines*
*Pieris Napi*
,, *Rapæ*
,, *Brassicæ*
CELANTES
*Hesperia Tages*
,, *Sylvanus*

MOTHS.

LIGNIVORÆ
*Hepialus lupulinus*
GEOMETRÆ
*Rumia cratægata*
*Venelia maculata*
*Iodis lactearia*
*Acidalia remutata*
*Cabera pusaria*
*Strenia clathrata*

GEOMETRÆ (continued)
*Numeria pulveraria*
*Fidonia automaria*
*Larentia didymata*
*Melanippe rivata*
,, *subtristata*
,, *montanata*
NOCTUÆ
*Euclidia Mi*

Before separating, the members had tea on the Green, when notes of the results of the afternoon's work were compared and a few species were examined and their names determined and added to the list of those recorded at the time of observation or collection.

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## FIELD MEETING, 16TH JUNE, 1883.

### BERKHAMPSTEAD.

Since Berkhampstead was last visited by the Society, about two months before the present occasion, death has removed from this sphere of his labours the author of the 'History and Antiquities of Berkhamsted,' the Rev. J. W. Cobb, vicar of the parish, who then accompanied the members, and a sense of loss in the absence of his genial welcome was felt by those who now so soon again visited this town.

From the station the canal was first crossed and then followed for some distance by the side of one of the most extensive of the many water-cress beds for which Hertfordshire is famous. At the foot of St. John's Lane this bed was crossed by a wooden bridge, and at a little distance up the road in the adjoining nursery-grounds (Messrs. Lane & Sons) a spring was seen rising in a well known as St. John's Well, the water from which flows down by the side of the lane. Now and then a number of bubbles rose with the water from the spring (or springs, for there are several) at the bottom of the well, sometimes in very rapid succession. These were thought to be of carbonic-acid gas, but how it was generated in the chalk through which the water percolates before rising here was discussed without any sufficient cause for the phenomenon being suggested.

The well is on the site of a former hospital for lepers which was known as the hospital of St. John the Evangelist, and Mr. Littleboy, who had the direction of this meeting, stated that in an inventory taken in the year 1545 this hospital was mentioned as "Ye over Spittle Howse," the meadow below being still called the "Spital Mead." At St. Julian's near St. Albans there was once a similar hospital, and in St. Stephen's church close by are small windows still called the "Lepers' windows" through which those afflicted with leprosy were allowed to gaze upon the altar.

The party then walked through Berkhampstead and up the hill-side to the "Cross of the Oak," examining on the way the remains

of an earthwork called Græme's or Gryme's Dyke. It was here stated that this dyke commenced on the west side of the common, first running for about 350 yards in an easterly direction without much elevation, and then becoming a high bank which maintained the same direction for about 700 yards; it had been traced as far as Wendover and Missenden, and was probably an ancient British entrenchment, erected after the taking of Verulam as a defence against the invading Belgæ.

A walk along a shady lane soon brought the party to Brick-hill Green, where a search was made for plants and insects peculiar to sandy heath-covered ground, and then Ashlyns Park was entered and strolled through to Long Green, *Epipactis grandiflora*, *Helleborus viridis*, and other interesting plants being found in a wood on the way. Long Green is a picturesque and secluded stretch of turf of irregular shape overshadowed by trees and commanding from various points fine views of the distant country. Here tea was kindly provided by Mr. and Mrs. Littleboy, under a clump of trees which afforded some protection from a heavy shower of rain which fell whilst it was being partaken of, and after this welcome refreshment the members took the nearest route back to Berkhampstead.

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## Field Meeting, 28th June, 1883.

### EASNEYE PARK, WARE.

This meeting was held in conjunction with the Essex Field Club. The members of the two societies, numbering about seventy, assembled at Ware Station under the leadership of Mr. A. F. Buxton, and first walked to Chadwell Hill, where they inspected the source of the New River and also the supposed earthworks. After spending a short time in botanising on the chalk, they wended their way to Garrison Field, where great interest was evinced by the archæological members in the trenches and earthworks, and several flint implements and "cores" were picked up. After a further walk the party entered Easneye, and soon arrived at the point at which the interest centred.

In the centre of a grove of trees is a tumulus or "barrow" which, at a rough guess, is about sixty feet in diameter. Mr. Buxton said that he had not brought the members here to tell them anything about the barrow—he came as a learner, and would be glad to hear the comments and suggestions of those who knew more about these things than he did. He hoped to have the barrow opened before long, but was desirous of receiving competent help before attempting it. Mr. Buxton then pointed out a pair of "dene holes," of which there are many in the park, and led the way to another, which had fallen in during the winter. This was apparently about 10 feet deep and 7 feet wide, but the depth could not be properly ascertained since the heavy rains had washed considerable débris into it. These curious holes appear to have no entrance except at the top; they are supposed either to have been used as granaries for the protection of corn and stores from the

Danes, who continually ravaged the district, or to be shafts which have been sunk in order to extract chalk for agricultural purposes. As the party were assembled around the brink, a beautiful kingfisher which had made its little habitation in the sides flew out, and seemed very much astonished to find so many people looking at him.

Several curious plants were noticed in the park, amongst them a peculiar gelatinous fungus of a bright chrome colour, which was not identified. Mr. Buxton pointed out two patches of the maiden-pink, one of which had been found there and the other brought from Germany; this and several other of the wild plants were carefully preserved from the rabbits by a ring of netting.

The party then entered the house, where they were most hospitably entertained by Mrs. T. F. Buxton, at the close of which Mr. R. B. Croft proposed a hearty vote of thanks to Mr. and Mrs. T. F. Buxton for the cordial way in which they had been welcomed. They had given them, he said, an opportunity of fraternising with another Society whose aims were the same as those of the Hertfordshire Society. Easneye Park was a place where botanical, zoological, and archæological members could all find objects of interest. Mr. Boulger, the president of the Essex Field Club, in seconding the vote, spoke of the great pleasure it had given the members of the Essex Club to meet the Hertfordshire Society. He looked upon this Society as one of the best of the County Societies in England; the 'Transactions' were full of thorough, earnest, and original work, and he was glad to see how thoroughly the county was being mapped out by various workers. They had all had a rich treat in the enjoyable scenery; perhaps he ought not to say it was *more* beautiful than the Essex scenery, but at all events it fully equalled it.

Several of the members then went to inspect a very good geological collection in the house, and the others walked about the grounds; some searching in the lake for living objects for the microscope, in which they were rewarded by finding large sponge-like masses of a polyzoon, *Alcyonella fungosa*, adhering to the bars of one of the outlets. The members of the two Societies then left for St. Margaret's Station.*

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## Field Meeting, 7th July, 1883.

### CASSIOBURY PARK, WATFORD.

Cassiobury Park has frequently been visited by the Society, but in each instance a different route has been taken, and, as the most beautiful and secluded portions of the park, and the private grounds of the Earl of Essex, have on each of these visits been most kindly thrown open to the members by him, a field meeting in Cassiobury Park is always attractive. On this occasion about forty members assembled at the principal entrance to the park, the number being increased to at least fifty before the park was left.

* I am indebted to Mr. F. W. Phillips for this report.—Ed.

The members at first crossed the park in the direction of the Swiss Cottage, the picturesque grounds of which were lingered in for some time. A deciduous cedar of fine growth here attracted attention, and, after crossing the River Gade by a rustic foot-bridge, in the woods which were then entered *Impatiens fulva* and *I. parviflora* were seen growing in abundance. Both these plants are introduced species, and their presence here, where a congenial habitat has allowed them to become completely naturalised, is probably due to the proximity of the Grand Junction Canal along which their seeds have been accidentally conveyed by barges.

Leaving the Swiss Cottage grounds at a private gate leading into Rouse Barn Lane, the canal was then crossed, and almost immediately the park was re-entered by another private gate. After a slight ascent, a fine double avenue was entered and was strolled through to a point from which is to be obtained one of the prettiest views in the park. There is here an opening in the trees through which the river and canal are seen in the valley below, and beyond a more distant part of the park, with Cassiobury House and its surroundings forming the background.

Whippendale Wood was then entered by a private gate at its lower end, and strolled through to near the lodge at the farther entrance to the park. From here the party returned towards Watford through the avenue of limes and beeches, over the river and canal, and, by the invitation of the Earl of Essex, through the beautiful and well-kept gardens of Cassiobury House, and then through the adjoining wood-walks. Amongst the many fine trees which adorn these grounds, a tulip tree, *Liriodendron tulipifera*, was specially noticed as of exceedingly handsome growth, and also a well-grown specimen of *Abies Douglassi*, the trunk of which measures 16 feet in circumference. In the wood-walks *Geranium nodosum* was met with, evidently being a stray from the cultivated grounds.

The meeting, which was under the direction of the writer, was brought to a close by a visit to Nascott House, the residence of Mr. George Rooper, late President of the Society, who, with Miss Rooper and other members of his family, very kindly received and hospitably entertained the numerous party.

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## Field Meeting, 28th October, 1883.

### WATFORD.

A few of the members of the Society assembled at a quarter to two on the bridge in the St. Albans road which crosses the London and North Western Railway, where they were met by Dr. Braithwaite, F.L.S., Dr. M. C. Cooke, A.L.S., Mr. E. M. Holmes, F.L.S., and Mr. Worthington G. Smith, F.L.S., who had come from London to investigate the cryptogamic flora of the Tunnel and Nascott Woods, this being the second Cryptogamic Meeting of the Society.

The fields were first crossed in the direction of Callow Land Farm, and in a copse close to the farm several cryptogamic plants

were found. Here also *Helleborus viridis* was seen. Turning then to the left the railway-cutting was soon reached and the Tunnel Woods were entered. First the banks of chalk which were formed when the new tunnel was made, and which have considerably altered the aspect of this part of the wood, were carefully examined, and were found to be particularly fruitful in mosses, one very rare species, *Seligeria paucifolia*, being found by Dr. Braithwaite growing on nodules of chalk. Some time was spent in collecting mosses, lichens, and fungi, and then the adjoining Nascott Wood was entered. It was now however getting dusk and it was difficult to see any cryptogamic plants but the more conspicuous fungi when this wood was reached, so that it could not be explored.

The fungi were noticed to be not nearly so abundant as usual, this not being a good season for them elsewhere as well as here, owing probably to the rainfall having lately been below the average for this time of the year, and therefore the wood not being sufficiently damp to favour their growth. However, although they were not seen in very large numbers, the number of species observed was considerable, the following being a list, communicated by Dr. Cooke, of species seen in addition to many of those recorded at the previous cryptogamic meeting.

HYMENOMYCETES.

*Agaricus* (*Amanita*) *excelsus*, Fr.
,, ,, *vaginatus*, Bull.
,, (*Armillaria*) *melleus*, Vahl.*
,, (*Tricholoma*) *resplendens*, Fr.
,, ,, *albus*, Fr.
,, (*Clitocybe*) *cerussatus*, Fr.*
,, ,, *infundibuliformis*, Sch.*
,, (*Collybia*) *fusipes*, Bull.
,, ,, *dryophilus*. Bull.
,, (*Mycena*) *alcalinus*, Fr.
,, ,, *galopus*, Schrad.
,, ,, *tintinnabulus*, Fr.
,, ,, *tenerrimus*, B.&Br.
,, ,, *filopes*, Bull.
,, ,, *striatus*, Fr.
,, (*Omphalia*) *griseus*, Fr.
,, (*Pleurotus*) *acerosus*, Fr.
,, (*Pluteus*) *cervinus*, Schæff.
,, (*Pholiota*) *squarrosus*, Müll.
,, (*Inocybe*) *geophyllus*, Sow.
*Agaricus* (*Galera*) *hypnorum*, Batsch.
,, (*Naucoria*) *semiorbicularis*, [Bull.
,, (*Psalliota*) *silvaticus*, Sch.*
,, (*Stropharia*) *æruginosus*, Cur.
,, (*Hypholoma*) *storea*, Fr.
,, (*Psathyra*) *conopileus*, Fr.
*Coprinus fuscescens*, Fr.
*Cortinarius caninus*, Fr.
*Paxillus involutus*, Fr.
*Hygrophorus olivacco-albus*, Fr.
*Lactarius vellereus*, Fr.
*Boletus chrysenteron*, Fr.
*Polyporus versicolor*, Fr.
,, *vaporarius*, Fr.
*Radulum orbiculare*, Fr.
*Stereum sanguinolentum*, Fr.
*Clavaria grisea*, Fr.
,, *rugosa*, Bull.*

ASCOMYCETES.

*Helvella crispa*, Fr.*

The following is a list of the lichens, recorded by Mr. Holmes, who says that "they seem by no means well developed on the trees, and are chiefly such as are usually found in a dry atmosphere not very free from smoke."

COLLEMACEI.

*Collema pulposum*, Bernh.

LICHENACEI.

*Cladonia pyxidata*, Fr.
,, *furcata*, Hffm.
*Evernia prunastri*, L.
*Ramalina farinacea*, L.
*Peltigera canina*, L.
*Parmelia caperata*, L.
,, *olivacea*, L.
,, *physodes*, L.
,, *saxatilis*, L.

* Edible species.

*Physcia tenella*, Scop.
*Lecanora Turneri*, Sm.
,, *varia*, Ehrh.
,, *atra*, Huds.
,, *subfusca*, L.
,, *albella*, Pers.
,, *phlogina*, Ach.
*Pertusaria fallax*, Pers.
,, *fagineа*, L.
*Pertusaria globulifera*, Turn.
,, *leioplaca*, Ach.
*Phlyctis argena*, Ach.
*Lecidea myriocarpa*, DC.
,, *parasema*, Ach.
,, *quernea*, Dicks.
,, *tricolor*, With.
*Arthonia Swartziana*, Ach.

Mr. Holmes also records the following scale-mosses.

*Lophocolea heterophylla*, Schr.
*Fossombronia pusilla*, Nees.
*Pellia calycina*, Tayl.
*Ancura pinguis*, L.
,, *multifida*, Dill.

Dr. Braithwaite reports that the woods visited are fairly productive in mosses, and gives the following list of species seen, especially referring to *Seligeria paucifolia* as a notable find.

ACROCARPI.

*Weissia viridula*, Brid.
*Dicranella rubra*, Huds.
,, *heteromalla*, Hedw.
*Dicranum scoparium*, L.
*Leucobryum glaucum*, L.
*Seligeria paucifolia*, Dicks.
*Pottia truncatula*, L.
,, *minutula*, Schwg.
*Tortula* (*Cuneifolia*) *muralis*, L.
,, (*Barbula*) *fallax*, Hedw.
,, ,, *revoluta*, Schwg.
,, ,, *convoluta*, Hedw.
,, (*Syntrichia*) *papillosa*, Wils.
*Ceratodon purpureus*, L.
*Orthotrichum affine*, Schrad.
,, *striatum*, L.
*Bryum cæspiticium*, L.
,, *argenteum*, L.
,, *capillare*, L.
*Mnium undulatum*, Hedw.
,, *hornum*, L.
*Catharinea undulata*, L.
*Polytrichum aloides*, Hedw.

PLEUROCARPI.

*Fissidens bryoides*, Hedw.
,, *taxifolius*, L.
*Anomodon viticulosus*, L.
*Hypnum* (*Pleuropus*) *sericeum*, L.
,, ,, *lutescens*, Huds.
,, (*Brachythecium*) *glareosum*, [B. and S.
,, ,, *velutinum*, L.
,, ,, *rutabulum*, L.
,, (*Rhynchostegium*) *piliferum*, [Schreb.
,, ,, *confertum*, Dicks.
,, (*Eurhynchium*) *Swartzii*, [Turn.
,, ,, *prælongum*, Dill.
,, ,, *pumilum*, Wils.
*Plagiothecium denticulatum*, L.
*Amblystegium serpens*, L.
*Stereodon cupressiforme*, L.
*Hypnum cuspidatum*, L.
,, *purum*, L.
*Hylocomium triquetrum*, L.

The following additional species are reported by Mr. Holmes and Mr. A. E. Gibbs.

ACROCARPI.

*Didymodon luridus*, Hornsch.
*Tortula unguiculata*, Dill.
*Mnium rostratum*, Schrad.

PLEUROCARPI.

*Neckera complanata*, L.
*Thamnium alopecurum*, L.
*Hypnum polymorphum*, Hedw.
*Hylocomium squarrosum*, L.

# TRANSACTIONS

OF THE

# HERTFORDSHIRE NATURAL HISTORY SOCIETY.





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## I.

## ON METHODS OF PREVENTION OF INSECT-INJURY.

By Eleanor A. Ormerod, F.M.S.

*Read at Watford, 22nd November*, 1881.

Amongst the various methods by which the attacks of injurious insects to our crops may be prevented or remedied, none are so sure as those that are based on natural principles, together with broad measures of cultivation, that is to say, on taking advantage of such peculiarities in the habits of the so-called pests as may afford points at which they are open to attack; and secondly, though in a lesser degree, we may utilize peculiarities in their nature which are affected by meteorological influence, or, in other words, by the weather. It is frequently remarked that "we cannot alter the weather,"—but this is not quite the case, for drainage and irrigation on a large scale have effect on atmospheric conditions, and may be brought also to bear as means of prevention of attack of serviceable practical use to the field crops, much more than they are at present. We also find that by observing the way in which continued sunshine and drought, or on the other hand long wet weather, or sudden and violent rainfall in a dry season, affect various kinds of insects most destructive to our crops, we may follow the lesson up practically by artificial means to our own great advantage.

Similarly amongst our forest or orchard trees, although we cannot have sunshine at command, we may often expose a much larger surface to its influence, and thus act at once on a broad scale on some of the injurious insects with much more effect and less cost than by any local applications, such as dressings, washings, or other remedies.

In considering the question of insect-attacks on our food-crops, and to a certain extent on our fruit, it is of some importance to remember that we are very often, if not for the most part, dealing with plants that are in some way or other in an abnormal state—in an unnatural condition as regards their own vegetable development; or the numbers in which they are grown together; or the soil they grow in. The object of cultivation is frequently to produce an increased development of some particular part, as for instance the enlarged succulent mass which forms the so-called bulb of the turnip, and the mass of close-pressed leafage of the "hearted" cabbage. A greater amount of fruit-cultivation also produces the aggregation of one kind of plant unnaturally over many acres, sometimes (as may be seen especially in the cultivation of cabbage in what is known as "garden-farming") without due rotation of crops.

With an increase of population it is necessary to increase our vegetable supplies, but the great increase of the insect-pests from the unavoidable massing together of food-plants which in their natural state would be thinly scattered amongst other kinds, either not infested by the same insects or deterrent to them, is one special point. Where there are only a few plants together of a kind, whether they are killed or not by the insect-attack, the attack itself either dies out for want of food, or is not propagated to any great extent, but where a space of many acres is covered by one crop, if any insect-pest that produces many generations in one season once gets hold, it has everything at hand for continuance.

Before entering on these points a little in detail, it may be of interest to quote the account given in Holinshed's 'Chronicles,' of the variation in the amount of vegetables cultivated in this country which was observable in a general view of a period of about three hundred years before the date of 1586. The extract is given from the Chapter entitled "Of Gardens and Orchards" in the 1st volume of the 'Chronicles.'

"Such herbs, fruits, and roots also as grow yearly out of the ground, of seed, have been very plentiful in this land, in the time of the first Edward and after his days: but in process of time they grew also to be neglected, so that from Henry the Fourth till the latter end of Henry the Seventh, and beginning of Henry the Eighth, there was little or no use of them in England, but they remained either unknown, or supposed as food more meet for hogs and savage beasts to feed upon than mankind. Whereas in my time their use is not only resumed among the poor commons, I mean of melons, pompions, gourds, cucumbers, skirrets, parsneps, carrots, cabbages, navews, turnips, and all kind of salad-herbs, but also fed on as dainty dishes," etc.

In our own days the quantity of food-crops is enormously increased; and as a matter of course there is an increase of the insect-feeders on these crops, but the amount of this increase depends on many circumstances or coincidences. Regarding some of these we have gained solid practical knowledge—long-continued

drought for instance, or sudden heavy rainfall after dry hot weather, —or long-continued rainfall affecting the state of plant-health, and the state of the ground, all have effects that we understand and can work on, but there is a great deal as to the reasons for insect-appearance in large or small quantities that as yet we have not got the clue to, and it is this variable amount of attack that makes the great difficulty in calling in the aid of what may be considered our first natural helpers, the insectivorous birds. There is no doubt that keeping up what is called the average amount is desirable, and in fact necessary; but when we come to inviting a large increase in numbers, or to the introduction of species which either for variety, or in emergency, are partially graminivorous in their diet, it is to be feared that we may be doing ourselves a mischief. So long as there is a great amount of insect-presence, so long do the extra number of these birds of mixed diet help us, but failing the insect-food they are very apt to prey on the crops instead, and may turn out a still greater evil.

It would be a great help for practical purposes, if we had a short account in plain form of the habits and the diet in ordinary circumstances and emergencies of our common insectivorous birds, together with the localities which they frequent. Many feed partially on insects, or, as the description often runs, "on insects, worms, and slugs," but it would be very useful to know which kinds in time of scarcity make up their scanty meals from our crops, and which turn to animal matter such as mice or the smaller Mammalia, carrion or offal, small fish, and the shell-fish of our ponds and streams, or the animal life of the sea-shore. Some of the gregarious birds that frequent both the sea-shore and the estuaries of our larger rivers are useful by coming occasionally, and when attracted by a great amount of insect-presence, far inland, but not burdening us with their keep when not serving us. Several kinds of sea-gulls are thus of use by following the plough on land infested with large grubs, especially those of the cockchafer; and I have notes sent in this year of the serviceableness of the black-headed gull, *Larus ridibundus* (sometimes known as the Scoulton gull), in destroying caterpillars and various kinds of moths during a bad attack on the oaks at Tullamore, King's County, Ireland.

The lapwing, which frequents marshy places as well as wild heaths and hill-sides, helps us by feeding on insects in their various stages, and was notably useful last year in the attacks of the larvæ of the daddy-long-legs, or *Tipulæ*.

Starlings also will most conveniently undertake, so to say, a temporary piece of work, such as clearing saw-fly larvæ, and though in default of insect-food they will eat berries or grain, and are sometimes injurious from the vast numbers in which they collect bearing down their roosting-places, yet near the sea-shore they will turn in times of scarcity to the supplies of animal food that they can gather on the beach.

The insectivorous night or twilight fliers, such as the tawny owl and the night-jar, are very serviceable; so also is the cuckoo,

by clearing off hairy larvæ; and many others would probably be utilized much more if we had some short account to show the many amongst us who are not practical Ornithologists the points where they help us, and also in cases of unusually large appearance of birds, as of titmice brought together by aphis-presence, rooks searching for grubs in the pastures, sea-gulls, starlings, or others, how to be able to distinguish between friends and foes, or species which are devoting themselves temporarily to good service.

Where there is a great amount of insect-attack, or where it may reasonably be supposed that insect-presence is doing harm although unseen, there the aggregation of birds should by all means be protected; but as a general thing the amount to which the insectivorous birds should be encouraged and increased beyond the natural balance, is a very difficult subject. It is often overlooked that these insectivora feed on the *insect-parasites* of our insect-pests as well as on the pests themselves, and consequently kill our allies as well as our enemies. This point is brought forward in the Report of the Agricultural Commission of Ontario, a work replete with useful information and suggestion, and deserves serious consideration. Various kinds of parasitic Hymenoptera are of such service in keeping down the caterpillars of various pests, as for instance the maggots of the ichneumon flies which hold the cabbage-butterfly in some sort of check, that their special protection and multiplication is advised; and not to go too much into detail, we may refer to ladybirds that keep down the aphides, dipterous flies that also serve us, and many other species. All these have their uses, and we should soon feel the want of them.

Other kinds of insect-feeders have their uses also, such as the mole, the bat, the shrew, and even the squirrel, in destroying the "cased" larvæ and pupæ of the pine saw-fly; but nevertheless it seems to me that any movement to decidedly increase the number of the insect-destroyers beyond the natural balance is not *certainly* desirable.

Of course when attack is present any means of getting rid of it is useful, and a great deal may often be done by working on *some one special habit,* which may frequently be found to exist in very different kinds of insects, and different stages of their lives. For instance various kinds of beetles, as cockchafers and weevils, also the caterpillars of various kinds of moths and sawflies, fall to the ground if their food-plant is shaken; and if we look at the large class of injury caused to leafage by these pests, we shall find that much good might be done by simply shaking or gently striking the infested boughs or small trees.

This is a regular part of German forestry or gardening; in America "jarring" the trees is equally looked to as a means of getting rid of the pests, and in the case of our vegetable crops also there are agricultural methods of carrying out the plan, and it may safely be advised whenever any plant (or tree of a size to which the plan is applicable) is infested, to try immediately what effect a good shaking, syringing, or *careful* beating will have in clearing

the vermin, of course taking measures to prevent those that drop down from returning again. Where the ground is bare, merely giving it a good trampling will destroy large numbers of fallen caterpillars, and if a ring of gas-lime is just thrown with a spade round the trunk of the tree, of course not touching it in case of the gas-lime being fresh, all regress is stopped.

Beating on to large cloths is a good plan with the wingless beetles, such as some weevils, which thus may be destroyed in large numbers at night; and in large attacks of beetles, such for instance as cockchafers, which lie for a short time on the ground and then take wing, some assistants, such as poultry, or better still, pigs, whose energy is unbounded in the service, are invaluable in completing the operation.

Again, looking at general methods of treatment, where the ground has been occupied by infested crops, thorough digging, trenching, or ploughing (of which the details would be too tedious to enter on here) which would turn some part of the soil so deeply down that the contained vermin, whether as perfect insects, chrysalids, larvæ, or eggs, could trouble us no further, and would throw part on the surface to the birds, or other agents of destruction, would all be useful; and besides the mitigation of evil we may get by reasonable general treatment, the more we examine into the life-histories of our commonly injurious crop-pests, the more we find that there is usually some point at which the injury they do lies open to special measures of prevention—literally a point where we may be before-hand with it.

Dressings and washings, and other applications, require much knowledge in the applicant to make them serviceable, and often only add to the expenses of the attack. For instance, in the case of turnip-fly, or flea-beetle, the dustings which are applied on a dry hot day, or even on a dewless late evening, or early morning, may probably be only a loss of so much money for labour and material per acre, whilst if applied when there was moisture and the leaping legs of the flea-beetle were so clogged therewith that it could not spring away, the dusting would take effect, first by falling on it before it had skipped out of reach, next by sticking to it, to its great injury.

Similarly with aphides—many of them have an exterior of a nature that repels all merely fluid washes, and often a mere watery wash runs off from them as from a duck's back, and unless it lodges amongst the crannies formed by their aggregated numbers, or poisons their food, they remain unharmed,—whilst if something adhesive, as soft soap, is added, the application remains and has due effect.

It is in points of this nature that the agriculturists of the United States of America, also of Ontario, and possibly of other Canadian States, have such a great advantage over ourselves. The great mass of practical information published by the Entomological Department of the United States Government gives a large amount that is intelligible to general readers as to the life-histories and

habits of the insects, and much that is valuable regarding practicable remedies, whilst the communications being from many correspondents in different circumstances of soil and climate, a variety of methods of attack on the pest, suitable for various conditions, is furnished.

In the course of last year the Congress of Vienna drew attention, under the name of Agricultural and Forest Meteorology, to the importance of attending to the connexion that might be worked out between conditions of weather and states of vegetation, and whatever *may* be worked out on this head regarding crops and trees, there *is* plainly shown, by a glance over the agricultural returns of this country extending over many years, to be such coincidence in certain states of the weather, and the appearance, either immediately or subsequently, of some of our crop-pests, that the subject well deserves our own careful attention.

We know how turnip-fly and drought appear in connexion, also how the attack of daddy-long-legs (which perhaps I should rather mention as that of larvæ of different kinds of Tipulæ) is increased by wet conditions, and was thus strongly brought to our notice after the long rainfall of 1879.

How these various meteorological states act on insect-life we know something about in many cases, though we ought to understand a great deal more; but as I fear to infringe too long on your time, I should like now to be permitted merely to draw attention, by one example somewhat in detail, to the great benefit we may receive by artificially copying in treatment the lesson that we may learn from special weather-effects.

Taking an example from the apple-orchard, observations on the apple-weevil, *Anthonomus pomorum*, show that the amount of attack is very much influenced by the nature of the weather in the spring, which affects the duration of the period during which the beetle can deposit its eggs, and also the suitableness of the blossom-buds as food for the larvæ when hatched.

This beetle is a small brownish weevil, about the eighth of an inch in length, with some transverse markings of whitish and pitchy colour on the wing-cases, and it begins its work early in the year. As soon as the blossom-buds are sufficiently advanced for its purpose, the female weevil pierces with her rostrum or snout through the still-closed bud into the parts of fructification, and lays her eggs slowly one by one in different buds, so that, if circumstances are favourable, she will occupy as much as three weeks in the task. She cannot commence the operation till the buds are well formed, and she discontinues it immediately the petals begin to unfold; consequently the duration of her laying-time depends very much on the state of the weather, and if the opening of the flower-buds is rapid, egg-laying is correspondingly cut short.

The same influences act on the young larvæ—they require protection from rain and sunshine, and therefore such an amount of sunshine as unfolds the petals of the bud is injurious to their development, and very beneficial to our crop of apples.

As examples of these effects of weather, it is stated by Schmidberger that in 1816 the apple-buds were attacked for nearly three weeks, "because the cold fog and rain checked the progress of the sap already in motion, and therefore the buds, which were already swollen out, were for several days prevented from unfolding, and scarcely a blossom was found that was not pierced." That year there was no apple-crop. In 1817 the sap did not begin to flow until nearly the end of April, and on the 16th of May the apple-trees were in full flower; laying time was thus cut short and the blossom was beautiful.

It is also mentioned by John Curtis that these little beetles sometimes occasion great loss to the grower, "especially in cider counties in backward seasons," and here it seems to me that we get to the point where the lesson learned from weather-influences may be applied. In our cider counties there are tracts beautifully managed, but also localities where, sometimes from neglect, sometimes from mis-applying the view that "trees bear best on their upper surface," the orchards are so thickly planted that the trees meet, or grow into each other so completely that the top is *nothing but* surface, as far as flowers are concerned. Perhaps some of the members present may have stood on the chief mound of the old Roman Station of Caerwent, the Venta Silurum of Antonine's 'Itinerary,' about six miles from Chepstow, and looked down during the month of May on the surrounding orchards in what has been well described as "a sea of blossom." It is a sight of no common beauty from above; but passing beneath this flood of bloom, I found, when I knew the locality, the precise state of things produced artificially which Curtis' and Schmidberger's observations show is congenial to the apple-weevil. Here, and in the many localities where trees are allowed to run up together so that direct sunshine, and also free play of air under the trees and amongst the boughs, is too much shut out, the buds on the lower branches in the shaded parts come on slowly, and thus lengthen out the blossoming-season during which they are available to the weevil for egg-laying. We imitate the state of things produced by wet cloudy weather, whilst if the trees were kept in healthy progress in the sun and air, we should be much less at the mercy of the weevils, and also the army of apple-tree vermin such as American-blight aphis, scale-insect, and many others, which thrive, or are hidden from observation, and so get a-head in such spots. The effect of heavy rainfall after heat and drought in destroying some kinds of caterpillars has long been known, and whether this occurs from the external effect of the moisture or from causing a sudden flow of dilute sap unwholesome to the creature, does not as yet seem clear; but the same effect might be brought about to a serviceable amount at least in garden-cultivation. Other meteorological influences may also be imitated.

Whatever good we may gain from the many different kinds of treatment which may be necessary for forestalling or keeping down insect-attack, *one point is incontrovertibly of immense importance,*

and that is by *every means*, whether by preparation of the ground, draining, manuring, proper thinning of the crops, pruning of the trees, or in whatever way we can manage it, to *promote healthy growth.* The crop that is run healthily through germination, and makes way rapidly in a kindly soil, is by no means *certainly* preserved in case of bad attacks, but in case of the moderate amount usually to be expected, the field of plants making (say) their *two* inches of growth per diem to counterbalance a loss of (say) one inch by insect-ravage, will hold on whilst the field of stunted growth that does not replace damage is lost; and whatever may happen in the occasional visitations of destroying legions, or with some pests whose attacks are especially difficult to meet, it may safely be laid down that whether in farm or garden, one most serviceable means of prevention of attack is *good cultivation.*

We must moreover all feel that prevention of loss which involves yearly what cannot be estimated at less than hundreds of thousands of pounds worth of the daily food of the nation, is a matter of vital importance both to growers and consumers.

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## II.

## IZAAK WALTON AND THE RIVER LEA.

By Richard B. Croft, R.N., F.L.S., F.R.M.S., Hon. Sec.

*Read at Hertford, 22nd December,* 1881.

Few books in our language have had a wider popularity than the 'Compleat Angler' of honest Izaak Walton, and as that work is the record of an excursion of five days in Hertfordshire, during a great part of which time the characters are seated by or fishing in the River Lea and discoursing on the habits of the inhabitants thereof, and on the beauty of the trees and flowers which grew near its banks, I cannot but think that a short paper calling attention to some of these "Natural History Notes" of two hundred years ago will be acceptable to this Society. The first chapter, which is one of the most charming in the book, is a conversation between an Angler, a Falconer, and a Hunter, each commending his recreation, and commences thus :*—

Piscator: "You are well overtaken, gentlemen, a good morning to you both; I have stretched my legs up Tottenham Hill to overtake you, hoping your business may occasion you towards Ware, this fine, fresh, May day in the morning."

To this inquiry Venator replies, "Sir, I for my part shall almost answer your hopes; for my purpose is to drink my morning's draught at the Thatched-house in Hodsden" — where he had business, and Auceps, who had only just joined Venator, says that he is going as far as Theobalds, where he has a friend "who mews a hawk" for him, which, he adds, "I now long to see."

Venator then remarks that "good company makes the way to seem the shorter;" and the three mutually agree to journey together, one of them remarking, "I will bee as free and openhearted as discretion will allow me to bee with strangers."

On Venator telling his companions that he proposes to go otter-hunting on the morrow, Piscator announces his purpose to bestow a day or two in helping to destroy some of those "villanous vermin," which he hates as a brother of the angle both for his own and for their sakes who are of his brotherhood.

The Hunter and Falconer profess no great admiration for the gentle science, and after further conversation the latter gives a description of his favourite pursuit, in which he introduces the following beautiful description of what he calls the "little nimble musicians of the air." "As first the *Lark*, when she means to rejoyce, to cheer her self and those that hear her, she then quits the earth, and sings as she ascends high into the aire, and having ended her heavenly Imployment, growes then mute and sad to think shee must descend to the dull earth, which shee would not touch but for necessity.

* Nearly all the quotations are from the second edition, which differs slightly from all others.

"How do the *Black-bird* and *Thrassel*, with their melodious voices, bid welcome to the cheerful Spring, and in their fixt Months warble forth such ditties as no Art or Instrument can reach to? Nay, the smaller birds also do the like in their particular seasons, as namely the *Leverock*, the *Tit-lark*, the little *Linet*, and the honest *Robin*, that loves mankind both alive and dead. But the *Nightingale* (another of my airy creatures) breathes such sweet lowd musick out of her little instrumental throat, that it might make mankind to think Miracles are not ceased. He that at midnight (when the very laborer sleeps securely) should hear (as I have very often) the clear aires, the sweet descants, the natural rising and falling, the doubling and redoubling of her voice, might well be lifted above earth and say, 'Lord, what Musick hast thou provided for the Saints in Heaven, when thou affordest men such musick on earth.'"

The Hunter, in praising his favourite pastime, mentions the "stately stag, the generous buck, the wild boar, the cunning otter, the crafty fox, and the fearful hare," and amongst other vermin the "mouldwarp." The reference to the wild boar is very interesting, as Mr. Harting tells us in his paper on "Animals which have become extinct within historic times," that shortly before the date of the publication of this book the wild boar had become very scarce; but it is evident from the text that hunting the wild boar was known as a pastime to Walton, who was born in 1593; therefore it seems probable that Mr. Harting is correct in his supposition that this animal was not extinct so early as 1620.*

Mouldwarp is the Anglo-Saxon name for the common mole (*Talpa europea*). An old mole-catcher who lives near me always sends in his bill for catching so many "moulds"—and I hope that if his grandson in the National School follows his example, Her Majesty's Inspector will not be too severe upon him for spelling the word correctly, instead of in the modern abbreviated style.

After commending his hounds, our Huntsman asks Piscator to describe the pleasures of angling, which he does with such eloquence that when Auceps leaves them at Theobalds Park wall, he does so full of good thoughts, not only of the fisherman, but of his recreation, and Venator refuses to tell any more about the chase, being very desirous to hear concerning the antiquity of angling.

Thus discoursing, our travellers reach the Thatched-house at Hoddesdon, where they part, mutually agreeing to meet the otter-hounds very early next morning. The position of the Thatched-house has been a matter of dispute since 1750, when the Rev. Moses Brown, at the instigation of Dr. Samuel Johnson, published a new edition of the 'Complete Angler,' in which he states that it is seventeen miles from London by the Ware road, and that it is supposed to be a thatched cottage once distinguished by the sign of the Buffalo's Head, standing at the farther side of Hoddesdon, on the left of the road going towards Ware. A member of this Society,

* See 'Trans. Herts Nat. Hist. Soc.,' Vol. I, p. 18.

Mr. Charles Whitley, of Hoddesdon, tells me that this is certainly incorrect, and that the Thatched-house to which Walton referred was situate in the centre of the town of Hoddesdon, near the old Chapel or Clock House, and not far from the site of the old Market Cross and Market House. Mr. Whitley gives as his authority an authentic copy of 'A Circuit of the Bounds of the Parish of Great Amwell, as they were recorded by Thomas Hassall, clerk, vicar there Anno 1634, and so observed in his day,' in which the following mention is made of the Thatched-house:—

"In the parish of Amwell, from Cunnisbye's or the Bell, we go up the town to Hoddesdon, taking in all those houses which stand together on the same side, as the Feathers, the Thatched House, and others, till we come to the White Hart, an inn fronting the new Town House over against Lord's Lane."

The Bell Inn spoken of above is still the Bell Inn, and Mr. Whitley is of opinion that the front of Hoddesdon Brewery is built on the site of the Feathers, and that the house on the south side of the brewery gateway, with inclosed square grass-plot in front, is built on the site of the old Thatched-house. His opinion is further confirmed by his knowledge of certain deeds relating to the Thatched-house, in which its site was represented as above; we may therefore consider the position of this famous hostelry now definitely settled. The Buffalo's Head (which was a thatched cottage) was some way off, and on the other side of the road.*

At sunrise next morning the two friends meet at Amwell and an otter-hunt is briefly described. A bitch otter is killed, and four cubs share her fate, one being reserved for Piscator to endeavour to tame. A curious conversation is introduced, in which the Huntsman is asked whether the otter is a beast or a fish; but the honest man cannot give a decided answer, and adds that the question hath been debated among many great clerks, and they seem to differ about it, thus throwing a curious sidelight on the knowledge of zoology at the time. It is satisfactory to think that the otter (*Lutra vulgaris*) is not quite extinct in these parts. Some years ago a pack of otter-hounds hunted but did not kill an otter in the Ash within sight of Amwell Hill; a few are left in the reaches of the Lea below Broxbourne, and are occasionally reported in the Rib and other tributaries.

In the name of those who strive to prevent the extinction of our rarer animals, I venture to plead on behalf of the few remaining otters. I hope that the sportsman may hold his hand when he gets a chance of a shot, and that the angler may forgive the occasional depredations of the "vilanous vermine."

The third, fourth, and fifth days were devoted by Piscator to the instruction of his companion in the art of fishing, such instruction being varied by pleasant discourses on nature, by songs, and by harmless merriment; while the whole is pervaded by the spirit of deep reverence which is so apparent in the one or two sentences from the opening chapter which I have quoted above.

* See 'Notes and Queries,' 23rd Sept. 1865.

I propose now making a few remarks on the natural history introduced into the conversation during these three days. As this is a book on angling, naturally fish are more fully described than anything else; therefore I shall commence with a comparison of those mentioned in 'The Compleat Angler' with those which now inhabit our waters; and as the habits of very nearly all of these have been fully described by one of our Vice-Presidents (Mr. Littleboy) in his paper on the Bulbourne and Gade,* I shall assume that my hearers have a general knowledge of their natural history, etc.

The Perch (*Perca fluviatilis*) is described by Walton, and is still very common; it is mentioned in the Conservancy byelaws, and may not be taken unless six inches in length (measured in this and all other cases from the eye to the end of the tail).

The Ruffe or Pope (*Acerina vulgaris*) is described by Walton, and is now somewhat scarce.

The Miller's Thumb, bullhead, or loggerhead (*Cottus Gobio*), is described by Walton. Some years ago this fish was more common than it is now in some parts of the river.

The Stickleback (called by Walton the sticklebag) is common. I think that at least three out of the five British species occur in the Lea—namely, *Gasterosteus trachurus*, *G. spinulosus*, and *G. pungilirus*.

The Carp (*Cyprinus Carpio*) is described by Walton as the water-fox for his cunning, and as "the queen of rivers: a stately, a good, and a very subtle fish." It is still common, and may not be taken under ten inches in length. A very large carp, weighing 14 lbs., was recently captured near Ware.

The Barbel (*Barbus vulgaris*) is still common, and may not be taken unless twelve inches long. Walton devotes a whole chapter to the description of this fish and the method of its capture. The barbel does not occur in the Bulbourne or Gade, and is, I believe, the only fish at present inhabiting the Lea which Mr. Littleboy does not describe in his paper on those rivers.

The Gudgeon (*Gobio fluviatilis*) is described, and is still very common.

The Tench (*Tinca vulgaris*) is called "the physician of fishes" by Walton, who describes at length the healing power ascribed to it, an opinion which is not quite exploded. The tench is still common, and may not be taken unless six inches in length.

The Bream or Carp-Bream (*Abramis Brama*) is not allowed to be taken unless eight inches long. Walton describes this fish at length, and mentions what he calls a bastard breed of breams, which is supposed to be the Bream-Flat (*A. blicca*) of the Norfolk waters. One of the most experienced of the Lea anglers recently told me that he had caught two fish near Sewardstone which he could not identify. From his description I have no hesitation in saying that they belonged to this species.

* 'Trans. Watford Nat. Hist. Soc.,' Vol. II, p. 113.

The Dace (*Leuciscus vulgaris*), the Roach (*L. Rutilis*), and the Rudd (*L. erythrophthalmus*) are all described by Walton. The latter he considers a cross between the two former, an opinion not concurred in by modern naturalists. Roach may not be taken under eight, dace and rudd under six inches in length.

The Bleak (*L. alburnus*), called by Walton the fresh-water-sprat, or the river-swallow, is still common, as is also the Minnow or pink (*L. Phoxinus*), which our author says is a sharp biter, "and in hot weather makes excellent sport for young anglers or boys or women that love the recreation."

The member of this family which is described at greatest length, and as to whose capture, cooking, etc., the fullest directions are given, is the Chub (*L. Cephalus*), called frequently the cheven, or the chavender. It was evidently a favourite of Walton's, and still abounds in the river he loved so well. No chub may be taken unless ten inches in length.

The Loach (*Cobitis barbatula*) is described as "a most dainty fish" and "by learned physicians commended for great nourishment, and to be very grateful both to the palate and stomach of sick persons." It still inhabits our waters, but I have not heard of its being prescribed by any learned physicians of late years. Locally it is sometimes called the stone-loach.

Of the mighty Luce or Pike (*Esox Lucius*) Walton has very much to say; he calls him "the tyrant of the rivers, or the fresh-water wolf," and believes that "some are bred by generation, and some otherwayes; as namely, of a weed called pickerel-weed, unless learned Gesner be much mistaken; for he says, this weed and other glutinous matter, with the help of the sun's heat in some particular months, and some ponds apted for it by nature, do become pikes." For this opinion Walton was severely taken to task even in his own day, and some of his editors have thought fit to comment sarcastically on his remarks. Yet it must be borne in mind that many of the leading naturalists of the time were firm believers in spontaneous generation, and amongst them several whom Walton (who professed to be an angler rather than a naturalist) had evidently deeply studied, such as Gesner, Francis Bacon, and others. The pike, I need scarcely say, is still numerous in our waters. In the fisheries under the control of the Board of Conservators it may not be taken unless ten inches in length. It is worthy of remark that Walton never calls this fish a jack, but always the luce or pike.

The Salmon (*Salmo Salar*) is described at some length in the 'Compleat Angler,' though much said therein as to its natural history is erroneous. In and after the days of Walton the Lea was a salmon-river. We read in Chauncy (1700) that in this river there were "some Salmons," "and if these Fish had free Passage by the Mills, and thro' the Sluces at Waltham up the Stream towards Ware and Hertford, where they might Spawn in fresh Water, and were carefully preserved from Pochers, they would greatly encrease in that River, and be of great benefit, as well to

the City of London as the Country; for some Water-men have observed, that they delight in this Stream and play much about those Sluces near Waltham." And thirty-five years later Farmer, in his 'History of Waltham Abbey,' * says that the river where it parteth itself into several small rivers affords "Plenty of Fish, some Salmon, Trouts, Eels, Carp, Tench, Pike, Perch, Crawfish, and many others." I have not been able to ascertain the date of the capture of the last salmon, probably they were very scarce, if not extinct here, before the end of the last century. In anticipation of a good time coming, the Lee Conservancy forbid the capture of any salmon of less than four pounds weight.

Walton mentions the Salmon-trout (*Salmo Trutta*), and in 1856 a remarkably fine salmon-trout, weighing between seven and eight pounds, was reported to have been caught in the Bleak Hall waters, near Edmonton. The report is mentioned by Mr. Henry G. Bohn, in his 'Notes on Fishing Waters,' but is not vouched for by him. To me it seems improbable, though there is no reason why a century earlier *Salmo Trutta* may not have been known in our waters.

We now come to the fish of which we have most reason to be proud—the Trout (*Salmo Fario*). The capture of several are described by Walton; the first we are told was twenty-two inches in length, and would have sufficed for a meal for six hungry persons. A trout of this size would weigh about 5lbs. This year (1881) the largest fish captured was one of 12lbs. 4ozs., by Mr. Brookwell, a celebrated Lea angler, at Dobb's Weir; another was caught over 9lbs., and several were caught between 6lbs. and 8lbs. in weight.† We learn from the 'Compleat Angler' that a trout of an ell long had had his picture taken, and that the picture was then "at mine hoste Rickabie's at the George in Ware"; we further learn that it was doubted at the time whether it was not a salmon, but Walton says that it had all the signs of being a trout, in shape, colour, and spots. I need scarcely say that any record of this picture would be most gratefully received by this Society. No trout is allowed to be taken unless one pound in weight.

After saying that "there is a fish that they in Lankie-shire boast very much of, called a char" (*Salmo Umbla*), Walton mentions as a Northumbrian fish the bull-trout (*Salmo Eriox*). The guiniad (*Coregonus Pennanti*), he says, is rare, and quotes Camden as to its inhabiting the Pemble-mere, near Chester. Probably neither of these have ever been known in the Lea.

Efforts have recently been made, I believe with success, to naturalize the Grayling (*Thymallus vulgaris*) in the Lea below Hatfield, and it is mentioned in the Conservancy bye-laws as not being allowed to be taken unless nine inches in length.

* 'History of the Ancient Town and once Famous Abbey of Waltham.' By J. Farmer, gent. London, printed for the Author, MDCCXXXV.

† For these and several other facts mentioned in this paper I have to thank Mr. George Corble, Clerk to the Lee Conservancy, who has been most kind in procuring me information.

Probably all three species of EEL, namely, the sharp-nosed (*Anguilla acutirostris*), broad-nosed (*A. labirostris*), and grig (*A. mediorostris*), are to be found. Walton says: "There be several sorts or kinds of eels, as the silver eel, and green or greenish eel, with which the river of Thames abounds, and those are called grig, and a blackish eel, whose head is more flat and bigger than ordinary eels; and also an eel whose fins are reddish, and but seldom taken in this nation." We are told that "Aldrovandus and divers physicians commend the eel very much for medicine, though not for meat."

Walton mentions the LAMPREY, lamperne, or pride (*Petromyzon fluviatilis*), which still frequents our waters, and the FLOUNDER (*Platessa Flesus*), which occurs in the tidal reaches of the Lea.

Counting the eels and sticklebacks as each one species, twenty-seven fresh-water fish are mentioned by Walton; of these three are assigned distinct habitats, viz. char, guiniad, and bull-trout, leaving twenty-four which we may infer might have been inhabitants of the Lea in his time. Twenty-two of these, if we include the grayling and the bream-flat, are still known to exist; one, the salmon, has become extinct within the last century, as has also probably the salmon-trout; and it is remarkable that, as far as I have been able to discover, no fish now exists in the Lea that was not known to the observant old naturalist whose work I have been endeavouring to analyse.

Our river is, I think, only once named in the 'Compleat Angler,' and then at the conclusion of a sonnet by Drayton.

"And the old Lea brags of the Danish blood."

Here Lea is spelt as above, but its name has since the days of Queen Elizabeth been spelt in two ways. Officially it is always the River Lee, and popularly nearly as constantly the Lea.

Camden says: "Lea, by our forefathers called Lizean," and Chauncy always writes "Luy or Lea." In a curious poem to be found in the introduction to Cussans' 'History of Hertfordshire,' date about 1590, it is spelt Lee. One spelling is probably as correct as the other, and as neither the Lee Conservancy nor the British public are likely to alter their orthography, it is probable that both methods will continue in use without doing any great mischief, or causing very much geographical confusion. The Roman name for the river was Logodonum, or Logrodonum.

The 'Compleat Angler' abounds in pleasant descriptions of trees, flowers, etc., but time will not allow me to dwell on them. Suffice it to say that the vexed question as to what flower is meant by the culverkey has not yet been definitely decided. Many authorities consider it to be the columbine (*Aquilegia vulgaris*), which in the 'Flora Hertfordiensis' is assigned a station near the Rye House. Although it is a wood-plant, it might be gathered at the edge of the wood, and need not have been a strictly meadow-flower to meet the description: "Looking downe the Meadows I could see here a boy gathering *Lillies* and *Lady-smocks*, and there a girle cropping *Culverkeyes* and *Cowslips*, all to make Garlands sutable to this

pleasant month of *May*." Fortunately, with this exception, the first words of the charming song,

> "Let me live harmlessly, and near the brink
> Of Trent or Avon have a dwelling-place,"

relieve us from the necessity of determining the present names of

> "Red Hyacinth, and yellow Daffodil,
> Purple Narcissus like the morning rayes,
> Pale Ganderglass, and azure Culverkayes."

I may be excused if in conclusion I say a few words about the history of the book of which I have been talking this evening. The first edition was published in 1653, and in 1655 it was followed by the second, much enlarged and with more woodcuts. In this edition the Falconer is first introduced in the introductory chapter. The third edition was published in 1664, the fourth in 1665, and the fifth (the last in the author's life) in 1676. With this edition was published a second part written by Walton's friend and adopted son, Charles Cotton, and the work is now commonly called Walton and Cotton's Complete Angler. In 1750 the Rev. Moses Brown revived the 'Complete Angler'; in 1760 Mr. John Hawkins (afterwards Sir John Hawkins) published an edition, with lives of Walton and Cotton, and copious notes of sufficient value to be retained in almost every subsequent edition. From that time till the present, edition after edition has appeared, some very good and others of less value. That of Major, 1823, is interesting to us as it contains several woodcuts of the Lea valley, as also does that of Jesse, 1856. In 1877 a facsimile of the first edition (a book which every true admirer of Walton ought to possess) was published by Elliot Stock. The last edition which has come under my notice is a marvel of cheapness, and, having been edited by a sympathetic naturalist, Mr. Christopher Davies, is a most satisfactory work, the woodcuts of Major's edition are reproduced, and a modern treatise on angling is included.

Those who may wish to further study the history of the various editions will find full particulars in a forthcoming work, 'Bibliotheca Piscatoria,' by T. Westwood and T. Satchell, in which I am told by the latter gentleman that no less than eighty reprints (dated, re-dated, and un-dated with dissimilar imprints) are chronicled.

The 'Compleat Angler' has been, since its first publication, one of the treasures of our literature. It has not inaptly been described as "England's one perfect Pastoral." As such I commend it to those members of this Society who have not read, or having read have forgotten it, and I cannot better conclude these somewhat discursive notes than in the words of the honest old angler whose masterpiece I have been endeavouring to describe: "And let the blessing of Saint Peter's Master be upon all that love *Vertue*, and to be *quiet* and go a-*fishing*."

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III.

# THE GALE OF THE 14TH OF OCTOBER, 1881, AND ITS EFFECTS IN HERTFORDSHIRE.

By the Rev. C. W. Harvey, M.A., F.M.S.

*Read at Hertford, 22nd December,* 1881.

From a meteorological point of view the year 1881 may most decidedly be regarded as an "*annus mirabilis.*" There are three days especially which I think will fix themselves upon our memory: (1) Tuesday, January 18th, when England, and more especially the south of England, was visited by an easterly gale and heavy snowstorm, which for two or three days impeded, and in many cases stopped, all traffic by road and rail; (2) Friday, July 15th, when a heat-wave passed over us, the temperature at Greenwich Observatory reaching 97°·1, while at Alton, Hants, and Alderbury, Salisbury, it was reported to have even reached 101° and 100° respectively; in our own county 91° at Watford and 89°·6 at Throcking were recorded by verified thermometers enclosed in Stevenson's stands; (3) Friday, October 14th, when the whole of the British Isles was visited by a terrific gale. It is the third of these visitations which forms the subject of the present paper. The facts which I have to lay before you with regard to this gale are drawn, partly from the daily weather report and weekly summary of weather issued by the Meteorological Office, partly from the London and local press, and partly—I may say largely—from the letters of correspondents, whom I would take this opportunity of thanking.

A serious depression of the barometer, which gave signs of its approach during the 13th, at 8 a.m. on the 14th lay over the north of England and south of Scotland, when readings were as low as 28·42 ins. The wind circulating round the centre of the system was N.W. in Ireland, W. to S.W. in the south of England, S. on the east coast, and E. to N.E. in the north and east of Scotland. At Oxford Observatory the velocity of the wind between 1 and 2 p.m. was 65 miles an hour, whilst at Holyhead between 2 and 3 p.m it at one time equalled 91 miles, at another 144 miles an hour.

At Greenwich the pressure on the square foot at one time was 56 lbs., the highest ever registered in that locality; while at Bidston Observatory, Birkenhead, it is said to have reached 77 lbs. When we reflect that this latter pressure represents a weight of air equal to 20 tons on a building 30 feet high by 20 broad, the only wonder seems to be that more damage was not done by the gale.

I think the following extract from 'The Times' for October 15th will show better than anything else how terribly telegraphic communication was interrupted. "Owing to the hurricane which raged over the country yesterday from very early morning, and which, though less fierce, had by no means abated when we went to press

this morning, we have been almost entirely deprived of telegraphic news, the communications being interrupted in all directions. With the exception of some telegrams which appeared in our second edition of yesterday, our Latest Intelligence is entirely wanting, no news having been received from France, Germany, Austria, or any other part of the Continent. Communications are also interrupted with Scotland and Ireland. The break-down all over England began at half-past five yesterday morning, after the publication of the morning papers; and down to an early hour this morning the wires were in most parts quite unusable, though the Post-office authorities had managed after strenuous efforts to establish a feeble and intermittent communication with Scotland and Ireland by one wire apiece, and in each case by a circuitous route. The telegraph poles have been blown down, and the wires broken in every direction; and, in fact, London is for all practical purposes cut off from all but the southern portions of the kingdom. So complete has been the break-down of communications that even the Meteorological Office presents but a maimed and imperfect record this morning of the weather which prevailed yesterday over these islands; and the observations it has received have not been sufficient to enable it to make its usual detailed predictions of what the weather in different districts will be to-day."

Great damage was done to public buildings, houses, trees, and corn-ricks in various parts of the country; many and many a giant of the forest succumbed to the force of the gale, so that it is estimated that the parks of England alone have lost as many as 100,000 of their finest trees. This wholesale slaughter among the trees may be partly accounted for by the fact that they were still full of foliage when the storm fell upon them. The trees which suffered most seem to have been the elms; comparatively few oaks have been actually uprooted, but in many cases huge limbs have been literally twisted off.

In our own county, to which I desire now to confine my remarks, after a fall of from half to three-quarters of an inch of rain during the night, the gale commenced to blow in earnest soon after 7 a.m., reaching its height about 2 to 3 p.m., after which time it gradually subsided; its general direction, to judge by the general lay of the trees, was as nearly as possible from west to east. Unfortunately as far as I am aware we had not a single anemometer at work in the county, and the instrument at Stotfold, which is just over the borders of the county, in Beds, was damaged, having lost an arm. Perhaps the following facts give a rough idea of the strength of the gale. At Hertford a slate weighing 6½ lbs. was blown from the roof of the Green Coat School into a garden on the opposite side, a distance of eighty feet. At Bishop's Stortford, in the grounds of Mr. Pritchett, a young willow-tree 55 feet high was snapped asunder 24 feet from the ground, and the upper portion (*i.e.* 31 feet) was carried 51 feet to the east before it touched the ground. At Rothamsted one large ash was seen to snap asunder in the middle of the trunk, like a carrot, the top and branches

were lifted up and twirled about in the air like a shuttlecock, and precipitated over the adjoining hedge with a tremendous crash. At Kensworth one barley stack was completely strewn over the field from whence it had been gathered; to use the words of the owner, "the corn was not only carried into the field again, but spread out and thrashed," nearly the whole of the grain being lost. At Woodhall Park a singular sight occurred at one of the tumbling-bays, where the spray was driven some 30 or 40 feet in height, and for a considerable distance.

Out of several sets of readings of the barometer and thermometer I have selected the following. For pressure I give the observations of Mr. Hopkinson at Watford and of Mr. Wortham at Royston, both being the readings of standard instruments. For temperature I give the observations of Mr. Hopkinson again, and my own at Throcking, because they are strictly comparable, verified instruments being in each case inclosed in a Stevenson's stand. Other observations with which I have been most kindly furnished agree very closely with these. I have also given the amount of rainfall at as many stations as possible, an M placed after a value indicating that it is the maximum fall of the month.

PRESSURE.

| | | | ins. | | | ins. |
|---|---|---|---|---|---|---|
| Watford, | 13th, | 9 a.m. | 29·854 | | 11 p.m. | 29·474 |
| ,, | 14th, | ,, | 29·052 | | ,, | 29·775 |
| ,, | 15th, | ,, | 29·943 | | | |
| Royston, | 13th, | 10 a.m. | 29·864 | | 7 p.m. | 29·706 |
| ,, | 14th, | ,, | 29·028 | | ,, | 29·525 |

TEMPERATURE.

| | | 9 a.m. | Max. | Min. | Mean. |
|---|---|---|---|---|---|
| | | ° | ° | ° | ° |
| Watford, | 13th, | 49·0 | 57·6 | 44·1 | 50·2 |
| ,, | 14th, | 55·3 | 55·0 | 47·4 | 52·6 |
| ,, | 15th, | 44·0 | 47·4 | 35·6 | 42·3 |
| Throcking, | 13th, | 45·6 | 56·2 | 41·9 | 47·9 |
| ,, | 14th, | 52·4 | 55·0 | 44·1 | 50·5 |
| ,, | 15th, | 41·5 | 46·0 | 36·1 | 41·3 |

RAINFALL.

| | inches. | | inches. |
|---|---|---|---|
| Kensworth | ·65 | Hoddesdon | ·57 |
| Rothamsted | ·76 | Welwyn | ·69 |
| Gorhambury | ·77 | Knebworth | ·75 |
| Berkhampstead | ·70 | Therfield | ·70 M |
| Nash Mills | ·76 | Throcking | ·76 M |
| Great Gaddesden | ·73 | Much Hadham | ·66 M |
| Watford, Watford House | ·63 | Southgate | ·54 |
| ,, Wansford House | ·71 | Hitchin | ·70 M |
| Bushey Heath | ·66 | High Down | ·61 M |
| Moor Park | ·70 | Odsey | ·53 M |
| Bayfordbury | ·66 | Royston | ·67 M |

From these values it appears that pressure, which had been steady during nearly the whole of Thursday, decreased very rapidly

during the night, and probably the barometer was about its lowest when read at 10 a.m. on the 14th at Royston; nor was the recovery less rapid, the rise being about half an inch in nine hours, *i.e.* between 10 a.m. and 7 p.m.; whilst at Watford at 9 a.m. on the 15th the mercury stood higher than it had been at 9 a.m. on the 13th, having meanwhile experienced a fall and a recovery of nearly an inch.

I will now proceed to the consideration of the amount of damage done by the storm in our own county, as far as it has come under my notice. Of course I do not pretend to exhaust an almost endless list of casualties; it would be impossible, even if desirable, to notice every tree laid low and every rick unthatched, to say nothing of the thousand and one tiles, and slates, and chimney-pots with which the thoroughfares of our towns and villages were strewn. In noticing then the *principal* damage done, I will follow the order already in use in our rainfall reports, where the county is divided into 17 river districts, of which a map will be found in Vol. I, Part 3, of the present series of our 'Transactions.'

*District* I. Tring.—Damage was principally confined to the uprooting of trees. In Tring Park alone 80 or 90 trees were torn up, in some instances several tons of earth adhering to the roots.

*District* II. Watford.—No serious damage was done in the town, but trees in the neighbourhood suffered immensely. I am indebted to Dr. Brett for the following statistics. Between High Wycombe and Watford 100 trees were uprooted along the roadside. At Langleybury 56 trees were blown down: 18 ash, 14 oak, 9 beech, 7 elm, 4 fir, and 4 cherry. At Munden Park between 30 and 40 trees, principally elms and abeles, fell. Some of the largest were measured, the length and girth being, among the elms, two 80 ft. by 12 ft., two 70 ft. by 11 ft., two 70 ft. by 9 ft.; an abele measured 90 ft. by 10 ft., and an oak 70 ft. by 13 ft. A *Quercus palustris* 52 ft. by 4 ft. 7 in. was successfully raised again. At The Grove 79 trees were uprooted, 28 different varieties, beech suffering most. At Durrant's Farm 6 trees were uprooted and many injured. At Cassiobridge Farm, on 100 acres, 20 trees were blown down, many being large. At Dalton House 14 fallen trees might be seen at one view; at the Silk Mills 7, one elm being 11 ft. 7½ in. in girth. At Cassiobury the prostrate trunks of beech and elm were to be met with in all directions; one monster elm at the entrance to the park, about 80 ft. high, which was blown down, is said to contain 5 loads of timber. At Red Heath 51 trees, of which 26 are beech, 12 ash, and 7 elm, were uprooted; 57 trees being greatly injured. At Aldenham Abbey about 30 trees were blown down, some being large. Two bridges, one at Munden, one at Watford, were broken by trees falling on them. In one instance the wind played a curious freak, snapping an immense forked branch from a tree, it bore it along some distance, fixing the prong firmly on to the trunk of a neighbouring tree. At the Rookery a woman and a child had a narrow escape while passing under a splendid elm which was suddenly and cleanly uprooted.

Rickmansworth.—The damage done in the town, though extensive, was confined to broken chimney-pots, tiles, etc.; it was, however, found impossible to light the street lamps for two nights succeeding the gale, some of the pipes having been damaged by the force of the wind. At Moor Park many trees of immense size were uprooted, chiefly elms, while oaks had huge branches twisted off. In the pleasure-grounds and park proper there were about 30 trees blown down, and on the rest of the estate about 50 more, besides many injured. The symmetry of the cedars was quite spoiled, especially of one in close proximity to the mansion. A like tale of destruction comes from Rickmansworth Park, Chorleywood, The Cedars, Croxley House, etc.

*District* III. Hatfield.—In the park immense damage was done, especially in the Home Park, the total number of trees blown down amounting to 118. In the principal avenue leading to Queen Elizabeth's oak, many fine elms and limes were uprooted or broken. One grand old beech was snapped off about 4 ft. from the ground, where it measured 6 ft. in diameter, the top weighing upwards of 20 tons. In the pinetum, two fine specimens of *Pinus pinaster*, and one of *Abies excelsa*, were uprooted. In the woods outside the park about 30 trees were blown down, one elm measuring 5 ft. in diameter 3 ft. from the ground, lifting with its roots earth 18 ft. in diameter.

*District* IV. Dunstable.—At Kensworth, the highest ground in the county, the storm raged with great fury. Fine trees were uprooted, many of them sound, others showing signs of decay. The Church had a portion of its roof stripped off.

Harpenden.—The spire of the church was blown out of the perpendicular, the vane being twisted nearly double. The stately elms in the village suffered severely. At Rothamsted, an elevated position, the gale proved very destructive, scarcely a tree with any pretension to size escaping mutilation. A large oak was split down the middle, one half being left standing; another oak was actually broken through the middle of the trunk, although it was perfectly sound. On the west side of the estate, where the soil is of a loose texture, over 100 trees were torn up, and for a considerable distance not more than half a dozen remain uninjured.

St. Albans.—The force of the gale was so great as to cause a partial stoppage of pedestrian traffic in the town. In a meadow adjoining St. Peter's Church a row of six elms was completely uprooted. A stack of chimneys was blown down, doing considerable damage to the back of the next two shops in Victoria-street. At Gorhambury great damage was done to the trees; the mansion also suffered. At Waterside the greatest force of the gale was felt about 2·25 p.m.; three large elms, an ash, and a very large Scotch fir were uprooted; the largest of the elms falling across the public road, and blocking it for nearly two days.

*District* V. Berkhampstead.—Less damage was perhaps done in the Bulborne valley than in some other parts of the county, owing to the shelter given by the hills rising from S. and W. The well-

known yew at the corner of the churchyard lost an arm. Near the "Crooked Billet" a large elm was blown down, whilst near Broadway the road was blocked, a man and a horse narrowly escaping. One elm tore up as much as 20 tons of earth in its fall.

Hemel Hempstead.—Between this place and Watford, a distance of some eight or nine miles, 36 uprooted trees were counted. In Gadesbridge Park a tree fell upon a cottage, breaking the roof and wedging it into the bedroom. At Nash Mills five large elms and a black poplar were blown down. Oaks suffered much, many having large branches twisted off, although but few were actually uprooted. Along the canal many alders and willows fell on the telegraph wires and broke them. The storm was observed to be at its height about 2 p.m. In the parish of Great Gaddesden at least 28 trees were torn up, and many of them thrown across the roads. The lime avenue at Golden Parsonage lost six of its trees; they are described as completely torn out of the ground, with a mass of earth 8 or 10 feet across adhering to their roots. In Ashridge Park over 60 trees were blown down, whilst many others were robbed of their branches; the killed and wounded being reckoned at close upon 200. One man was seriously hurt by the fall of a tree upon him at Flamstead.

*District* VIII. Southgate.—The gale was observed to blow strongest about 9 a.m., mid-day, and at sunset; about 3 p.m. there was a hailstorm. No particular damage is reported, though the elms, which in that neighbourhood are particularly fine, suffered much.

Cheshunt.—The fine old chestnut in front of the White Horse, Flamstead End, was blown down, and damaged the roof of the house; also a fine tree in Mr. Batter's grounds, as well as several in Theobalds Park, the College grounds, and at Great House.

Broxbourne.—A large elm which stood in the centre of Broxbourne fell on a corndealer's cart, narrowly escaping killing both man and horse. At Broxbournebury as many as 50 trees are said to be down, among them some remarkably fine specimens of forest trees. An ornamental terrace-wall in the garden, of five arches, each arch about 9 ft. span, was blown bodily out, totally spoiling a very large and splendid specimen of *Wistaria Sinensis*, one of the finest in the country.

Hoddesdon.—Trees were blown down in considerable numbers, including some fine poplars. Mr. S. Warner lost a very valuable fir-tree.

Hertford.—The trees in All Saints' Churchyard and Morgan's Walk suffered severely. Telegraphic communication was interrupted. The clock at the Shire Hall had a piece of glass blown out of each dial. Several narrow escapes are reported; in one instance four boys were passing under an elm, on their way to the Green Coat School, when a large branch suddenly fell, fortunately without doing them any injury.

Ware.—Great havoc was worked by the gale among the malting-cowls, as many as 16 being blown down, while others were damaged. The weathercock on St. Mary's was carried away,

several of the windows having panes of glass broken by the violence of the wind. Mr. Hanbury's lane was impassable from the trees and branches. In Crane Mead 13 trees were blown down. At Water-place a poplar 100 ft. high fell, and an elm fell across Mr. Hurford's house. Stansteadbury lost 9 fine elms, and at Stanstead itself two cowls were blown down.

*District* IX. Wheathampstead.—Great fears were at one time entertained for the church spire; its injuries, however, only amounted to the lead being torn off and hurled on to the roofs below to their considerable damage. The most serious calamity occurred about 3·30 p.m., when the bell-turret of the National Schools, a massive stone structure erected in 1862, was simply torn from its position and hurled bodily into the road below. Happily no injury was done to life or limb, the weather being such that the school was closed for the day.

*District* X. Welwyn.—The gale was observed to be at its height between 2 and 4 p.m., during which time a considerable number of trees were blown down; scarcely any park, field, or garden with large trees escaping without serious loss. A large chestnut-tree in the garden at Guessens was blown down, while at Tewin Water Park 14 beech and elm-trees succumbed to the gale. Around Datchworth it was observed that the greatest damage was done on the high ground; it was, however, comparatively inconsiderable.

*District* XI. Stevenage —Many trees were blown down, while huge branches were torn off and carried a considerable distance. One observer counted 13 trees in one row down, being a considerable portion of the whole. At Knebworth about 20 trees were blown down, and the turrets of the mansion suffered severely, some of them being blown off. At Ardeley Bury the loss was 1 fir-tree, 3 elms, and 2 oaks. In Woodhall Park (Hertford) the loss is estimated at about 50 trees, among them two fine cedars which were completely wrecked; the greatest force of the gale was felt here about 12·45 p.m.

*District* XII. Buntingford.—Little damage was done in the town, beyond a plentiful shower of tiles, etc. The gale seemed suddenly to gather strength soon after 7 a.m. At Throcking it was observed that the first downfall of trees occurred about 7·30. The lay of the trees was in all cases as nearly as possible W. to E. The gale was at its strongest between 1 p.m. and 3 p.m. At Wyddial Hall 20 trees were blown down, a fine old oak was shorn of all its limbs save one, and what had appeared a grand old tree is now only a lopsided pollard; a barn on the neighbouring farm of Beauchamps was blown down; at Aspenden Hall about 20 large trees fell, whilst the number of branches torn off was enormous; in Coles Park 7 or 8 were snapped off close to the ground, and many others, chiefly elms, were torn up or mutilated; and in Hamels Park about 100 trees suffered, some uprooted, some snapped off, some deprived of branches.

*District* XIII. Hadham.—At Moor Place 10 trees were blown down. Near the station a large tree fell across the road. At the north end of the village a number of trees were torn up by the

roots. Many oak-trees lost their tops. One large tree was snapped in two at about 20 ft. from the ground; its head falling upon another tree some 20 ft. away, it hung in a horizontal position, some 30 ft. from the ground.

Albury.—At and around The Hall about 30 trees were blown down, while 70 others were much injured.

*District* XIV. Bishop's Stortford.—A large bough broke through the roof of the school cottage, while a tree at South Mill fell across a barge; one of the large elms on the Causeway fell, and for a time blocked the thoroughfare.

*District* XV. Hitchin.—In this district the high ground suffered less than the valleys, so much so that a correspondent writes: "I do not know of a single tree uprooted on the high ground, on either side the effects were more severe." In Hitchin Park about 20 fine old elms were blown down, and in some cases trunks 2 ft. in diameter were snapped clean off.

*District* XVI. Baldock.—Many trees, chiefly elms of great size and age, were uprooted, those in Hitchin Road suffering most. An arm of a tree struck the School House roof. At Rushden a large tree standing near a public-house was blown down, taking the greater part of the house with it.

*District* XVII. Royston.—From 7 to 8 a.m., at 11 a.m., and 3 p.m. the gale blew with great force. In Melbourne Road the galvanized iron roof of a shed was blown off, and a large portion of it carried into the adjoining field; a rifle saloon in the market-place was blown over, one of two boys who were in the caravan being badly cut about the head. Some very large trees down the Drift on the Baldock Road were uprooted.

Odsey.—In a group of elms, standing in four rows, a gap was made, and the wind, passing through this gap, uprooted a number of trees standing in a fence beyond, and some few others in the same line. The first tree fell at about 11 a.m., the last between 3 and 4 p.m.

Thus it will be seen that the devastation wrought by this memorable gale was universally felt throughout the county; it is only surprising that considering the number of trees laid low, so little injury was done to life and limb. I believe an old man was killed by the fall of a tree, but I have been unable to fix the locality of the accident; there must, however, have been some very narrow escapes. It is to be regretted that there was no anemometer at work in the county to record the actual force of the gale; the fact however that at Greenwich no greater pressure than 56 lbs. on the square foot has ever been registered, makes the storm a memorable one, and this must be my apology for the length to which this paper has grown.

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IV.

# THE MIGRATION OF BIRDS.

By John E. Littleboy.

*Read at St. Albans, 24th January,* 1882.

It will perhaps be remembered that I read before the members of this Society, during our last session, a short paper on the Migration of Birds. The late period of the evening at which my paper was read precluded the possibility of discussion, and for reasons which I need not repeat, I was unable to offer it for publication in the pages of our 'Transactions.'

The subject of migration is one of general interest, and, in compliance with the expressed wish of several of our members, I have determined again to bring it before your notice. I am very conscious that I have little that is original to communicate. Those who, like ourselves, are resident in the Midland Counties of England, enjoy but few opportunities of observing the phenomena of migration. I hope that during the past few years we have, as a society, done what we could to record everything of interest that has come within our reach; but, even when this has been accomplished, we stand but on the threshold of a subject that extends and widens in every direction around us, and we find ourselves mainly dependent for information on the observations and investigations of a few enthusiastic naturalists who have unsparingly devoted both their time and talents to ornithological research, and to whom our best thanks are due.

It is stated by Mr. Harting * that 395 distinct species of birds have been recognised as occurring within the British Isles. Of these about 130 are residents, 100 periodical migrants, and 30 annual visitants, the period of whose arrival and departure it is impossible to predicate with certainty, the remainder, in number about 135, being rare and accidental visitants. Mr. Harting considers that "those species which rear their young annually in the British Islands, and are to be found in some part or other of the United Kingdom throughout the year," may fairly be defined as "resident"; and it follows, from the data just given, that only about 33 per cent. of our British avifauna can be classed under this head. When it is remembered that there are several species among those termed resident, which are, in reality, semi-migrant in their habits, and that almost all of those which are strictly resident with us, are migratory elsewhere, the marvellous prevalence of the wandering propensity that exists among birds becomes conspicuously evident. In confirmation of this fact I will quote a few lines from the report of a Committee appointed for the purpose of obtaining observations on the migration of birds at lighthouses and lightships, read at the recent York meeting of the British Associ-

* 'Handbook of British Birds,' p. v.

ation.* "The observations show, beyond doubt, that all birds are migratory (if we except our common game-birds and perhaps the green woodpecker). Even such comparatively weak-winged birds as the gold-crested wren, common wren, the titmice, the hedge-sparrow, common sparrow, and redbreast, change their locality, crossing the North Sea in large numbers."

What is true of our own is equally applicable to the birds of other countries and other continents. Of 110 species recorded by Mr. H. Seebohm, during his three months' tarriance in Northern Siberia, only four or five were found to be resident. Mr. Gurney informs us † that in Egypt, the winter home of several of our English migrants, only 138 species, out of a total of about 316, are resident.

With ascertained facts, such as these, brought before our notice, it seems almost impossible to avoid the inquiry, How does it happen that an infinite multitude of birds, after passing the winter months in the comfortable retreats of Africa or southern Europe, should rush, with common consent, to northern homes on the approach of spring; should remain there for only a few months, and then, with equal regularity, should wing their way southward to their winter haunts? This question was pertinently put by Alexander Pope, nearly two centuries ago, in the following lines:

> "Who bids the stork, Columbus-like, explore
> Heavens not his own and worlds unknown before?
> Who calls the council, states the certain day?
> Who forms the phalanx, and who points the way?"

Although I cannot agree with a writer in 'The Times,' ‡ who considers that "the migration of birds is simply a fact, as little accounted for to-day as it could be five thousand years ago," it must, I fear, be admitted that a completely satisfactory answer to Pope's inquiry has not yet been found.

When discussing the habits of animals, it is customary to account for everything not otherwise explicable, and it is a very easy method of overcoming difficulty, by a reference to instinct. It is impossible to dispose of the important questions connected with the migration of birds in quite so summary a manner. It is, indeed, extremely difficult to define the exact link in the chain of nature at which the promptings of instinct may be supposed to cease and the teachings of hereditary experience to commence. Experience, when handed down through many generations, appears to develope into what is known as instinct.

The migration of birds has been ably and elaborately discussed by Dr. Weissmann in the pages of the 'Contemporary Review.' § The subject naturally divides itself under two distinct heads; (*a*) Migration southward in Autumn; (*b*) Migration northward in

* 'Report Brit. Assoc. for 1881,' p. 193.
† 'Rambles of a Naturalist,' p. 114.
‡ Feb. 9th, 1881.
§ Vol. xxxiv, p. 531—February, 1879.

Spring. Respecting autumnal migration, taken as a whole, but little difference of opinion appears to exist. Birds migrate southward, writes Dr. Weissmann, because "they would perish, not from cold, but from want of food," should they remain in their summer quarters during the winter months. "They migrate because they are obliged to do so in order to maintain life, they migrate that they may not starve." It is a significant fact that "the stomachs of migratory birds, on their first landing, never contain any food." * Dr. Weissmann's conclusion is sufficiently confirmed by experience within the reach of any of my audience. In England our summer migrants are mostly insectivorous: swallows, martins, and swifts feed principally on gnats, flies, and small beetles; some of the warblers, especially the blackcap, indulge in ripe fruit as a dessert; the cuckoo delights in caterpillars, the night-jar in moths, and it would be easy to enlarge the list. As autumn advances, insect-life, and even fruit, becomes more and more scarce, and birds that have revelled in abundance during the summer, leave our comparatively inhospitable shores for more prolific hunting-grounds. It is true that a few of our migrants leave us, as in the case of the swift, when insect-life is still abundant and when the heat of summer has only partially diminished, but it cannot be doubted that habit is hereditary in the life of birds as well as in that of other animals, and if this be accepted as a fact, it is not difficult to suppose that the period of necessary migration may, in some cases, be anticipated in deference to the force of habit.

The spring, or northern migration, is a more difficult subject. Dr. Weissmann attempts to account for it by two leading propositions. I quote the following extracts. (*a*) "No possibility of life in nature remains unused. Wherever the outward conditions for the existence of a living being are favourable, there, for the most part, we find life. Every species tries to multiply itself indefinitely; hundreds of thousands are born every year, but far more than half perish early because there is not room for all. So long as any country remains unpeopled with bird-life, in which such life might be generally maintained, so surely will the unoccupied ground be quickly taken into possession." (*b*) "It is generally imagined that tropical countries have, all the year round, an abundant supply of food of all sorts, both for animal and vegetable life. This is true, however, only of certain regions; for the most part it is altogether a mistake. In the interior of Africa whole districts of country are completely dried up; all standing waters and most running streams disappear; frogs, newts, lizards, and snakes, as well as many fishes, bury themselves in the mud and there take their summer sleep; and even the insects disappear as a body when the green of the plants is parched by the burning heat, and all verdure withers. . . . . Hence, there is here again an obvious necessity for birds to seek other climes. . . . . We do not of course mean by this, that the individual bird, as we see him to-day, is driven away

* Cordeaux, 'Leeds Mercury,' Sept. 1867.

by the fear of hunger in the autumn. . . . . What we mean is, that there is an impulse within him which constrains him at the right time to migrate." The concluding sentence appears to be intended as a key to the preceding propositions. Dr. Weissmann not only attributes northern migration to an impulse that constrains "birds at the right time to migrate," but he pursues his subject a step further, and endeavours to define the method by which this "impulse," or, as he elsewhere terms it, this "wandering instinct," became engrafted into their nature.

The argument is ingenious and interesting, but it cannot be considered to furnish a sufficient answer to the much-debated query, Why do birds migrate northwards in the spring? The evidence adduced supplies, without doubt, an appreciable motive for the migration of birds from certain defined districts to others more or less contiguous, but it fails to account, in a satisfactory manner, for the enormous geographical area over which the migrations of certain species are known to extend, or for the admitted fact that the desire to migrate is as strong in young birds as in old ones, and even among those that are confined in cages and supplied with every requirement. That the supply of food in equatorial Africa becomes short during the heat of summer is extremely probable, and that a distinct motive for migration from that particular locality is thereby afforded, appears to be a reasonable conclusion. But there is food in abundance south of the tundra of Siberia, and why, under such conditions, should the willow-wren, a tiny bird that regularly frequents, as every one knows, the gardens and hedgerows of England, but which migrates southward during the winter, as far or even farther than the arid plains of Africa, leave behind it on the approach of spring—as multitudes of this species do—the aphide-haunted vines of France and Germany, the olive groves of Italy and Greece, or the many attractions of our English counties, to wing its way hundreds and hundreds of miles northward, and all for the sake of spending a very short summer in Siberia, or northern Russia?

There is an attractive theory, which was briefly alluded to after the reading of my former paper, and it is necessary that I should now discuss it. It was argued on that occasion that migration northwards is simply a physiological question, regulated and explained by physiological facts and inferences; in other words, that the necessities connected with incubation render migration, during the breeding season, to districts where a lower temperature prevails, absolutely imperative. This position was illustrated by reference to the well-known fact that successful incubation among our domestic poultry takes place, for the most part, before the heat of summer has commenced; but surely it is hardly allowable to build up an argument respecting the habits of birds in their naturally wild condition upon experience gained by observing them in a domesticated and highly artificial state. I will briefly notice a few facts which seem to range themselves in opposition to this hypothesis. (*a*) The range of migration that prevails among several

well-known species is so wide that every variety of climate is included within their breeding-area. Let us take a few illustrations. The sand-martin breeds occasionally within the arctic circle; * it is also abundant in Egypt, and breeds in colonies on the banks of the River Nile.† The hooded crow breeds profusely in Scandinavia and Western Siberia; in England and central Europe it is only a winter visitant, but it breeds also in Algeria, Egypt, Palestine, and Greece. The blue-throated warbler breeds in Europe only within the arctic circle or at high elevations above the limit of forest growth,‡ but it was recently found by Mr. Scully breeding as far south as Yarkand, in Turkestan.§ (*b*) Not only do many of the birds which breed in the north of Europe breed also in Egypt and Algeria, but there are immense numbers which breed exclusively or nearly exclusively in the tropics. Wallace ‖ asserts that there are about 140 species of parrots resident in tropical America, and 150 in tropical Australia and the tropical Australian islands; and that of 346 species of pigeons only 16 frequent temperate regions, the whole of the remainder being tropical. If it be correct that the necessities of incubation compel a certain number of birds belonging to a particular species always to migrate northwards in the spring, how comes it that others of the same species are not governed by a similar necessity, but breed regularly and successfully in tropical climates? This is a query, to which it will, I think, be difficult to find a satisfactory answer. Again, can it be shown that the eggs of the four or five pigeons which frequent the British Isles differ in any way from the eggs of their tropical congeners, or that the 339 parrots and 400 humming birds, which breed within the tropics, possess special powers enabling them to do so? Unless this can be done, it is difficult to understand how the physiological necessities of incubation can satisfactorily account for the phenomena connected with northern migration. That special facility for incubation is one among the chief desiderata that help to make up the ideal of a "Natural Home," I most willingly admit, but there are certain other conditions that appear equally essential.

The question as to what constitutes the "Natural Home" of a migrant is a very important one, and exercises, as I believe, no inconsiderable influence in determining the causes of migration. I shall detain you a few moments in discussing it.

There are three primary requirements which the term "Natural Home," when applied to the resort of birds, seems to imply:—(*a*) locality of birth; (*b*) abundant supply of food; (*c*) facility for incubation; and it will be necessary to consider whether the wide regions in the north of Europe, that are selected by migrants as their summer breeding-grounds, or their winter retreats in Africa and elsewhere, best fulfil these requirements. Dr. Weissmann's

* Seebohm, 'Siberia in Europe,' p. 156.
† Shelley, 'Birds of Egypt,' p. 122.
‡ Seebohm, 'Siberia,' p. 127.
§ 'Ibis,' 1881, p. 447.
‖ 'Tropical Nature,' p. 102.

authority appears to support the latter alternative. I have before referred to his opinion respecting the causes of northern migration; it is based on the assumption that the sunny south is the original home of migrants, and the same argument, couched in other words, is repeated at a more advanced stage of his essay. "We must not forget," writes Dr. Weissmann,* "that there was a time when the animal-life on our hemisphere was altogether different from what it is at present. In the Glacial period central Europe had a colder climate than now. . . . . We shall therefore not be wrong if we suppose that very many birds, which now inhabit the central and northern regions of Europe, were at that time wanting, because the climate was too severe for them. They must, therefore, have come subsequently from the south, and with the gradual rising of the temperature there must have been a corresponding steady, but of course very gradual, influx of birds to the north. Just in proportion as the ice retreated, would the birds push forward the bounds of their habitat, and in the course of centuries may even have advanced hundreds of miles in this way. Here then we have the first condition of the development of the migratory instinct; a gradual and steady progress of many species in a northerly direction."

The task of determining the conditions that prevailed during the Glacial period I leave to our geologists, nor shall I attempt to discuss the uncertain possibilities connected with a pre-glacial avifauna; but if it be true that the severity of an arctic climate spread, during that epoch, widely over Europe, and subsequently retreated slowly but continuously northward, it is probable that the physical aspect of southern Europe and northern Africa may not, at the period referred to, have differed, to any large extent, from that which now prevails in the northern districts that, on every recurring spring, afford breeding accommodation to millions of migrants. If viewed in this light, Dr. Weissmann's conclusion certainly supports the inference that climate and the consequences which naturally result from it, rather than arbitrary degrees of latitude and longitude, must always figure as important items among the causes which determine the natural home of migrants.

Let us now turn our attention to northern latitudes. Allow me, in the first place, to state an interesting fact, that cannot fail to exercise considerable influence on the decision to be arrived at. It is thus defined by Mr. Seebohm: †—"We may lay it down as a law, to which there is probably no exception, that every bird breeds in the coldest region of its migration." Secondly, the shores of the Arctic Ocean, together with its neighbouring lagoons, abound, during the summer months, with mullusks and small crustaceans, which supply in lavish profusion the requirements of the millions of water-fowl that annually resort to them. The abnormal supply of ripe fruit that follows the melting of the snow, a supply which is succeeded with marvellous rapidity by the

* 'Contemporary Review,' vol. xxxiv, p. 543.
† 'Siberia,' p. 244.

ordinary summer crop, and the extravagant abundance of insect-life with which the prairies of Northern Europe absolutely teem, has been described as follows: *—"Seed or fruit-eating birds find an immediate and abundant supply of cranberries and other fruit which have remained frozen during the long winter and are accessible the moment the snow has melted, while insect-eating birds have only to open their mouths to fill them with mosquitoes." Here, too, are to be found accommodation for nesting and facilities for incubation with which the most fastidious of migrants might well be satisfied. The undulating tundra, with its lakes, its sand-hills, its stunted bushes, and its thick herbage, offers an enticing home to the myriads of small waders that frequent it. Curlews, sandpipers, stints, phalaropes, and plovers here find an undisturbed breeding-ground. The peregrine falcon, with birds of kindred feather, builds its eyrie on the bleak promontories that frown over the Arctic Ocean. Woods, which the hand of man never thins, afford a welcome retreat to birds which frequent woodland districts, and the climate during summer is most congenial. It is true that a description such as this is not strictly applicable to our English counties or to many of the northern regions to which migrants resort for the purpose of incubation, but I believe that it will be found to be more or less representative of all, and as such, with your permission, I propose to accept it. Thirdly, there is another phase of the subject which is equally striking. The peculiar characteristics which distinguish birds at the period of their northern migration cannot be overlooked. They are then in the full vigour of health and life; what is called the instinct of procreation † is upon them. They are in full song and in brilliant plumage. They pair, they breed, they rear their offspring with a care and affection that might well teach a lesson to humanity, and they appear absolutely to revel in the joy and abundance which everywhere surrounds them.

I will re-state the argument in as few words as possible. I have attempted to define the essential conditions which the term "Natural Home" seems to imply. I have referred to Dr. Weissmann's argument in favour of southern climes. I have next pointed out the important fact that birds always breed at the northern limit of their migration. I have endeavoured to show that these northern latitudes supply with profuse abundance all the necessities of bird-life, and that the period of their residence in these quarters is the best and most important epoch in their existence. And what is the inference, I think it might well be said the only reasonable inference, which is deducible from these facts? I do not hesitate to answer the inquiry in the following words:—"That the summer or northern resort of a migrant is, and always has been, during the historic period, its 'Natural Home.'"

I shall assume that it is so, and shall next attempt to show that an intense love for the regions thus designated is engrafted into the nature of migrants. Those who are interested in country pursuits

* 'Siberia,' p. 296.

† 'Scribner's Magazine,' vol. xxii, p. 933.

can hardly fail to have observed the marvellous regularity with which migratory birds return to the localities in which they were reared. That universal favourite, the nightingale, not only frequents the same districts, but year after year pours forth from the same trees, and often from the very same boughs, the matchless music which we all love to listen to. I am informed by Mr. Geary that nightingales have frequented a particular tree in his garden at Westwood, without a single exception, for the last forty years. House-martins regularly build their comfortable nests against the same eaves and in precisely the same spot. Last summer I counted thirty-four nests on one small cottage in the village of Aldbury; the occupant told me that he was very fond of the birds, that he never allowed them to be disturbed, and that he always had as many nests as they could find room to build. Swallows frequent the same chimneys and warblers the same copses. It would be easy indefinitely to prolong the catalogue, but I prefer to quote a few lines from the pages of 'Scribner's Magazine' * in which incidents of kindred character are recorded as occurring on the American Continent. "Colonies of herons resort from time immemorial to the same swamps, and even the same trees, to rear their young. Terns, gulls, cormorants, and other water-fowl in like manner repair to the same stretch of sandy beach, or to the same cliffs, and only abandon them for more secure retreats after a long period of ceaseless persecution from human foes. Many, it is believed most, other birds return year after year to the same tree or to the same immediate locality to nest."

These facts become still more significant if contrasted with the habit of migrants when retiring into winter quarters. They appear to winter wherever shelter and food are found to be available, with but little reference to the particular localities visited in previous years. I have alluded to the wide geographical area that is frequently covered by the migration of a particular species; when viewed in the light of the foregoing interesting statements, the reason for such an occurrence is sufficiently obvious. Notwithstanding all that is so frequently written respecting the wonderful instinct of birds, it is certain that they lose their way very frequently, and in this manner stray colonies are continually forming; the young of the first year returning to the locality of their birth, as parent birds, the year following.

It is time that I attempted to arrive at some definite conclusion. I have endeavoured to demonstrate that neither the demands of appetite nor the exigencies of incubation, when taken separately and alone, can account, in a satisfactory manner, for the varied phenomena connected with migration; but they are without doubt important factors in the argument, and must always be comprised among the essential conditions that help to constitute the "Natural Home" of migrants. In order to formulate a theory, I propose to group both of these agencies, together with a third—

* October, 1881, p. 935.

the power of "Home Instinct"—under this distinctive title. They are each, as it seems to me, but part and parcel of a whole—absolutely inseparable the one from the other—and when considered as such, I believe that they will be found to shed a very important light on the difficult questions under discussion.

It appears to be impossible, with the limited amount of knowledge at present in our possession, to lay down a hard and fast line in reference to this subject. Contradictions, which it seems difficult to account for, are met with at almost every turn. I will enumerate just a few of them. Streams of birds of the same species are occasionally found crossing the Channel in opposite directions on the same day. To quote the words of the report before referred to: *—"In the autumn, there is what may be called a double stream of birds, crossing each other near the entrance to the English Channel, that is, from the Essex and Kent coast towards the S.E on the French and Belgium coast, and again, in an opposite direction, from Belgium to the coast of Kent." The same report states that "during the very severe weather in the early part of 1881, as well as in December, flocks of birds came to us direct from the French coast, or from south to north;" a course directly the reverse of what might have been anticipated. In a letter dated Ulceby, Lincolnshire, September 19th, 1881, Mr. Cordeaux writes as follows: "I have frequently, in the late autumn, observed at this place, large migrations of geese, plovers, and larks, to the north and north-west, and I generally find that it is a sign of mild open weather for some time to come." Here, again, is a fact which seems to contradict all preconceived anticipations. There is, also, good reason to believe that stonechats and a few other birds migrate † over central Europe, from east to west and from west to east, crossing the line of ordinary migration at right angles.

It must be admitted that these diversions of route, although governed, in all probability, by the same laws that regulate ordinary migration, appear to be more or less at variance with accepted theories. Herr Gätke, the veteran observer at Heligoland, a gentleman who has studied the subject with great zeal and intelligence, at what is probably the most favourable station in the world, thus writes respecting migration to his friend, Mr. J. Cordeaux:—"The 'how' we may in time determine, but the 'why' not before you and I migrate to the unknown world, or learn the language of birds and are told it in their own tongue." On looking at the subject as a whole, we must, I think, be content to assume that the many diversities and eccentricities of migration are the result of ever-varying local causes, such as inequality of temperature, storms, and the premature abundance or scarcity of food, but I think that these apparent contradictions should not prevent an attempt being made to generalise the conclusions to which known and admitted facts evidently tend.

* 'Rep. Brit. Assoc. for 1881,' p. 191.

† 'Transactions of the Norfolk and Norwich Naturalists' Society,' vol. iii, p. 264.

Without pretending to advance anything that is very novel or sensational, I venture to submit to you the following propositions, as embodying the views which I have already expressed and affording a proximate, or, at any rate, a possible solution of the problems at issue:—

(*a*) Birds migrate southward in the autumn because they are compelled to do so by the exigencies of life, and hereditary impulse or instinct teaches them, in some instances, to anticipate the inevitable.

(*b*) Birds migrate northward in the spring because the districts to which they resort are not only their breeding-haunts, but their "natural homes," and hereditary impulse or "home instinct" impels them to return to the localities of their birth.

It only remains for me to notice, as briefly as I can, the *modus operandi* by which migration is conducted. The manner in which birds migrate from north to south, and from south to north, together with the many variations which frequently occur, is a subject that has recently claimed the special attention of ornithologists. At their Swansea meeting the British Association appointed Mr. Harvie-Brown, Mr. John Cordeaux, and Professor Newton, a Committee "for the purpose of obtaining observations on the migration of birds at lighthouses and lightships, and of reporting on the same at York in 1881." The report of these gentlemen was read by Mr. Cordeaux at the York meeting in September last. Returns were obtained from 103 stations on the coasts of England and Scotland, the detailed particulars of the returns being embodied in a separate report published by Sonnenschein and Allen. To these reports; to the interesting work on the ornithology of Siberia by Mr. Henry Seebohm; to a paper on the spring migration of birds at St. Leonards by Mr. J. H. Gurney, jun.; and to other information most kindly supplied to me by Mr. Cordeaux and Mr. Seebohm, I am mainly indebted for the facts I am about to lay before our members.

It seems to be generally admitted that migration takes place, for the most part, at high elevations, not unfrequently beyond the range of human vision, and that birds migrate by sight, and not, as has been assumed, by blind instinct. "If," writes Dr. Weissmann,* "there were an unknown something within them which showed them that the land of their desire lay in this or that direction, then they would fly straight to the goal, over hill and vale, sea and river, to the place of their destination. But this they do not do. On the contrary, they follow all the sinuosities of coast or river; they go up a certain valley, cross a mountain-pass at one exact spot, and descend on the other side into another valley, bending their course to all its windings."

There are numerous facts which throw important light upon this subject. The lines of migration which are adopted by different species of birds have been mapped out in a very ingenious manner

* 'Contemporary Review,' vol. xxxiv, p. 548.

by Palmen, a continental ornithologist, in a work entitled 'Die Zugstrassen der Vögel.' Migrants which cross the Mediterranean in their northern flights are reported always to do so in certain defined routes. At Gibraltar the distance is short, and the passage easily accomplished; farther to the east the islands of Sardinia and Corsica present a ready highway towards France and northern Italy; while the islands of Sicily and Malta become handy stepping-stones between Tripoli on the north African coast and the mainland of the Italian Peninsula. The overland route afterwards pursued is not so readily determined, but it seems probable that the course of rivers, coast-lines, the position of lakes, mountain-ranges, and the general outlines of the district traversed, become beacons by which migration is directed. At Ust-ussa in Siberia the river Petchora describes a great curve; after running nearly due north it reverses its course and flows for about 150 miles in a south-westerly direction before again turning northward to discharge itself into the Arctic Ocean. An immense distance would be saved by crossing the prairie from Ust-ussa to Alexievka; but notwithstanding this inducement, the river-course is invariably followed by migrants. Mr. Seebohm watched their flight most carefully and he believes that the shorter course is never adopted. Migration from the south-eastern portion of Europe appears to proceed principally from the Black Sea, along the course of the Volga and other rivers, next across the short interval which intervenes between these rivers and the sources of the Dwina, the Petchora, and the Ob, and thence to the boundless breeding-grounds which border the White Sea and the Arctic Ocean.

Migration between our own shores and the northern homes of our winter visitants is, in all probability, mainly directed by coast-lines. The reports from lighthouses, to which I have alluded, establish the fact that the great stream of autumnal migration always strikes our shores from an easterly or south-easterly direction, and it is readily accounted for by this hypothesis. Migrants follow the coasts of the Baltic southward, until a westerly trend becomes necessary; Denmark is then crossed; the island of Heligoland lies directly in their onward course, and the coast-line of Holland, with its small outlying islands, conducts them within an easy distance of England. Only a detachment of the mighty stream of migrants which skims along the shores of Holland and Belgium finds its way to England, and it is believed that some of these, after reaching our eastern counties, pursue the coast-line southward and again cross to Belgium or France. The committee of the British Association reports as follows: *—"The great east to west stream of migration is mainly composed of some few well-known species which regularly come to us in the autumn, the great body undoubtedly remaining to winter. Placed in order of rotation, according to their numerical superiority or otherwise, we find the skylark, starling, hooded-crow, and rook, the song-thrush, blackbird,

* 'Report Brit. Assoc. for 1881,' p. 190.

fieldfare, and redwing; and then sparrows, linnets, and chaffinches compose the bulk of the immigrants. Others, as the redstart, wheatear, whinchat, stonechat, and other soft-billed insect-eaters, although coming from the eastward, after striking the coast, persistently follow the shore-line to the south."

There are other lines of migration to which I must allude. Flights of migrants come to us from the north-east. These follow the coast-line of Norway, southward, until they reach its most westerly point, and thence cross the sea, first to the Shetland Islands, and then to the mainland of Scotland. Others reach our shores from the north. It is believed that they pass the summer months in Iceland and Greenland, and that, leaving Iceland in the autumn, they wing their way southward, *viâ* the Faroe Islands, to the north of Scotland and north-east of Ireland. These are principally composed of swans, geese, ducks, and waders, but the white wagtail, redwings, blackbirds, redbreasts, meadow-pipits, snow-buntings, and other species are to be found among them.

It is difficult to account for the vast extent of ocean that is covered by the migration last mentioned. The explanation both of it and of the east to west flight said to be adopted by the stonechat, points, in all probability, to a period when, according to Professor Edward Forbes, Iceland was linked to Great Britain, and Great Britain to Germany, by extensive plains of dry land.* If this theory should be fully confirmed, it will follow that the habit of migration, once formed, must have been handed down through countless generations, and that the course pursued by migrants, under geological conditions very different from those which now exist, is continued to the present day.

Birds are provided with certain peculiar faculties which render such flights practicable. That their organ of locality is developed to an unusual extent, is shown by the extreme ease with which they thread the intricacies of the densest forests, and return with certainty to the secluded nook selected as their home. That their power of vision is something altogether extraordinary, there is also abundant evidence to prove. The hawk, as it hovers far aloft, distinguishes the little mouse which creeps along the hedge-side below, and darts upon its tiny prey with an unerring aim. The carrier pigeon, when released from confinement, rises at once high in air, takes the bearings of its position, and guided, as is generally believed, by sight alone, darts off with absolute certainty to its far-distant home.

The very existence of migratory birds must constantly depend on the possession of these powers, and it is highly probable that the influence of natural selection has played an important part in their attainment. The case is well put by Dr. Weissmann: †—"Individual birds of imperfect sight are more likely to lose their way and to fall victims to some of the dangers of the journey, than

* 'Memoirs of the Geological Survey of Great Britain,' vol. i, pp. 397-8.
† 'Contemporary Review,' vol. xxxiv, p. 550.

those of stronger organisation, so that these would for the most part become the progenitors of a keen-sighted and observant race." The immense height at which migration is generally accomplished renders the discernment of distant objects a comparatively easy task; the rocky island and the far-off coast, lie, like an extended map, within the ken of the little migrant, and it shapes its course accordingly. Important information respecting this phase of the subject has been obtained by telescopic observation. I quote a few lines from a letter by J. Tennant, R.E., which appeared some years ago in 'Nature': *—"Looking at the sun this morning, I saw birds very frequently pass the disc. Some were in focus with the sun itself, the wings being quite sharp against the disc, and must have been several miles high, but some were much nearer, and I estimate their distance from me at about two miles." "The theory that migration ordinarily takes place at high elevations," and that it is guided by sight, is said to be "supported by the fact that it is only in dark and cloudy weather that migration on a large scale is observed." On such occasions the power of sight is useless; all landmarks are obscured by clouds, and birds are compelled to descend in order to find their way. It is a remarkable fact that "in dark nights the stream of migration stops suddenly when the moon rises."

The great rush of autumnal migration takes place, almost always, in the month of October. A few "*avant-courriers*,† supposed to consist of barren birds or birds that have been unable to find mates, appear at uncertain intervals for weeks before the regular period of migration is due." Strange to tell, it is young birds which have never before attempted to migrate that are the first to start. It would seem that a restless hereditary impulse impels them to migrate, and the result is very frequently fatal. It is believed that myriads of young birds perish; some are taken out to sea, while others, and "their name is legion," lose their way and wander far away, in directions where bird-life is impossible during the winter months. Stray birds are almost invariably young birds; a rare migrant, whether in England or elsewhere, is nearly certain to be a bird of the year. Certain it is, that the number of birds which return northward in the spring is infinitely smaller than the autumn flight. The autumnal migration of a particular species continues day by day or week by week, till it attains its maximum in a "great rush." Old birds, which know the way, are fond of loitering about wherever an inviting resting-place is found; by-and-bye frost or a severe storm renders flight a necessity, and hence the final rush.

The direction of the wind is found to exercise considerable influence on migration. I quote a few lines from a paper by Mr. J. A. Harvie-Brown and Mr. John Cordeaux in the 'Zoologist.' ‡ "In the great majority of cases birds migrate flying within two

* Vol. xiii, p. 447—April, 1876.

† 'Siberia,' p. 255.

‡ Third series, vol. iv, p. 187.

to four points of the wind. . . . If the wind changes during the actual passage, birds will change the direction of their flight to suit the wind. . . . If subsequent observations should prove the correctness of this rule, it will go far to account for all the irregularities of migration—the 'why' birds are seen in great numbers in one year in any locality, and perhaps absent altogether in following seasons." An absolutely favourable wind "ruffles their feathers and chills them, while an absolutely contrary wind, if too strong, impedes their progress."

A large proportion of the migrants which visit England in the spring reach our coast by crossing the sea, in a direct line, from France and Belgium; others follow a more northerly track and strike our eastern counties, after crossing from the shores of Holland. Spring migration appears to be conducted in a leisurely and deliberate fashion; there are none of the impetuous rushes that distinguish autumnal flights. Migrants frequently remain for many days in succession at favourite halting-places. Those which nest in England return to their accustomed haunts, and become our summer migrants, while others pursue their way onwards to more northern homes. These facts are strictly in accord with the theory of migration which I have attempted to advocate. We flee from impending danger with all the energy of our natures. We pursue the path of pleasure with a light and easy step, and linger lovingly over the many attractions of the way. In the spring, male birds generally migrate in advance of their mates—this is notoriously the case with the nightingale—and migration takes place, with rare exceptions, at night. Mr. John H. Gurney, jun., has selected the wheatear as offering a representative example of the manner in which insessorial birds arrive on the coast of Sussex. I extract the following from 'The Transactions of the Norfolk and Norwich Naturalists' Society:'*—"About the middle of March the first wheatear makes its appearance, and is sure to be a male; a week or two later, there are quantities of them, another week and not a bird is to be seen. At the end of April you may see a few pairs settling themselves down at long intervals to nest. These are the resident birds, which do not number a hundredth part of what are seen on passage. Waders and ducks arrive much later than the Insessores." A little marsh about 300 yards from the sea, in the neighbourhood of St. Leonards, is described by Mr. Gurney as "a paradise for tired waders." Here, redshanks, sandpipers, godwits, stints, turnstones, and many other species find a temporary resting-place; the length of their visit depending, apparently, on atmospheric conditions. Respecting spring migration in Lincolnshire, Mr. Cordeaux writes to me as follows:—"The lines of migration followed by the insessorial birds are undoubtedly both from south to north and from S.E. to N.W. The cuckoo invariably comes, year by year, from the south-east, and gradually spreads westward and northward. On this coast, willow-wrens, white-

* Vol. iii, p. 171.

throats, and other small summer visitants come in from the sea, and we first hear of them at some lighthouse that they have visited in their night wanderings."

There is an infinite variety of incident connected with the method of migration which might well claim our attention, but the necessary limits of a paper forbid me further to amplify. I do not know that I can better conclude my remarks than by quoting the graphic sketch given by Mr. H. Seebohm * of his visit to the lighthouse on the island of Heligoland, during a period of autumnal migration. "The whole zone of light within range of the mirrors was alive with birds coming and going—nothing else was visible in the darkness of the night but the lantern of the lighthouse, vignetted in a drifting sea of birds. From the darkness in the east, clouds of birds were continually emerging in an uninterrupted stream; a few swerved from their course, fluttered for a moment, as if dazzled by the light, and then gradually vanished with the rest in the western gloom. The scene from the balcony of the lighthouse was equally interesting; in every direction birds were flying like a swarm of bees, and every few seconds one flew against the glass. All the birds seemed to be flying up-wind, and it was only on the lee-side of the light that any birds were caught. They were nearly all skylarks. In the heap captured was one redstart and one reed-bunting. The air was filled with the warbling cry of larks; now and then a thrush was heard, and once a heron screamed as it passed by. I should be afraid to hazard a guess as to the hundreds of thousands that must have passed in a couple of hours."

* 'Siberia,' pp. 257-8.

V.

## ANNIVERSARY ADDRESS.

By the President, George Rooper, F.Z.S.

*Delivered at the Annual Meeting, 21st February, 1882, at Watford.*

Ladies and Gentlemen,—

I feel, I assure you, very great diffidence in addressing you on this occasion, for I am well aware that there are many amongst you far more capable of imparting instruction to me on any matters connected with Natural History than I can be to them. But without wasting your time on apologetic suggestions of my own incompetency which are too likely to prove themselves, I will merely say that the title of my address—"Facts and Fallacies in Natural History"—must not be considered as indicating an intention of making dogmatic assertions and insisting on their infallibility. Some of my facts may appear to you fallacies, some of my fallacies facts—possibly they may be so. They will at any rate give occasion for consideration, perhaps discussion.

It was suggested to me that I should on this occasion detail the results of my own experience and observations in Ornithology, but not only are my opportunities limited, but that department of science is already most admirably filled by other members of the Society. I do not believe that any noteworthy occurrence in the neighbourhood ever happens unnoted, and I would not advise an old crow to fly over Cassiobury if he desired to remain *incog.* Besides, the faculty of observation does not always keep pace with the opportunities for exercising it, and the generality of persons, I fear, go through the world with their eyes partially closed.

I dare say that many of you have read Hood's works. I hope so, for he is a most humorous and entertaining writer. I remember in one of his sketchy articles he repeats a dialogue between himself and an old coachman, "Mat" by name, at whose side he finds himself seated on the box of his coach. "Forty years, man and boy," says Mat, "I have driven up and down this road." "You must have observed a great deal in that time, and remarked many things worthy of note." "Yes, I have not been asleep all the time; I have had my eyes pretty well open." "Favour me with the result of your observations." "Well, I have observed three things: I never see a sailor in top-boots! I never see a Jew pedlar with a Newfoundland dog! I never see a black man driving a long stage!" These are not important results from forty years'

observation, but they are unanswerable, and their merit is that though they are things which readily might have happened, so far as my experience goes, I agree with Mat that they never did happen.

I might cap these truisms by some such as these—their interest also resting on the fact that the contrary might, very easily, have happened, but has not. I never saw a thrush eat a slug, a swallow catch a butterfly, or a weasel suck a rabbit. Yet general belief would tend to the contrary. Thrushes, feeding as they do on snails, are generally assumed to eat slugs, but they do not; indeed, with the exception of ducks, and perhaps pheasants, I know of no birds that do. Darwin tells us that the early ancestors of the slug race, finding themselves exposed to dangers they could not run away from, developed for themselves the acrid, slimy juice which coats them, and which renders them so generally disagreeable that birds and beasts alike avoid them. Swallows, having perhaps tried in vain, have, so far as my observation goes, given up trying to catch butterflies. The weasel, although his doing so is almost proverbial, does not suck a rabbit—he kills him and drinks his blood.

With reference to animated nature in general, there is an old formula which reads somewhat in this manner. Stones grow; vegetables grow, and live; animals grow, and live, and feel! In the last category insects are included, although, in fact, insect-life seems to me to be far nearer akin to vegetable life. There is not much that insects do that vegetables do not. They seek their sustenance in the same way, through the multitudinous mouths of their fibrous roots; they are similarly affected by light, air, warmth, and cold; they turn their leaves and flowers towards the light; they bend their heads away from the prevailing blast; they anchor their stems, as it were, against it; they seek and find the most appropriate soil for their sustenance; and they will wander great distances in pursuit of light. A potato in a dark cellar has been known to send forth a shoot thirty feet and upwards from its root, and eventually find its way to a crevice where light was admitted, and there put forth its leaves. But there is a stronger point of resemblance not generally noticed or perhaps admitted; that is, their mutual insensibility to pain. I am convinced in my own mind that no insects feel pain, in our sense of the word. Why should they do so? Pain is absolutely necessary to the preservation and continuance of the life of the higher animals. Were it not for pain, a hungry dog would eat his own leg; a child, instead of sucking his thumb, would bite it off; but to insects pain would be superfluous and unnecessary. To my mind it would be to doubt the beneficence of the Creator to assume that they were endowed

with it. Insects were made for the sustenance of the higher grades of creation, and, in fulfilling their mission, they perish in such countless millions that only the absence of feeling can reconcile the mind to such wholesale destruction. What would be the aggregate suffering caused by the casual destruction of the numberless insects we daily tread upon or otherwise destroy, in some cases, devour? How many ants does a partridge eat at a meal?—how many flies a swallow? Think of the horrible cruelties perpetrated on one another by different tribes of insects, if for a moment you can assume them capable of feeling pain. Do you know how the mason-wasp provides for the maintenance of its family? Having bored a hole, some few inches deep, into a sandy bank or rotten paling, the creature flies forth, and, seizing on a green caterpillar, which instinctively curls itself into a ball, conveys it to the hole, which is exactly proportioned to the size of the victim. Having deposited the caterpillar at the bottom, the wasp lays a single egg in its body, and flies off for another. This is repeated until the hole is full, when, sealing up the entrance, she leaves the living mass to be gradually devoured whilst still alive, each one by its separate maggot. This proceeds until the worms arrive at the stage of changing into chrysalises, when the vital cord is severed and such life as the caterpillar possessed is extinguished. The treatment of a fly by the spider is not humane, to say the least of it. Having induced the fly to "walk into his parlour," the spider, if not hungry at the moment, seizes and envelopes it in a silken bag, from which, without the power of moving wing or leg, the victim can watch, for days, the same process pursued with relations and friends, until the time arrives to be relieved from what, in an animal, would be intolerable misery, by the simple process of being devoured alive. The hornet is not less hard upon the fly. Having caught a blue-bottle, for instance, he simply bites off the legs and wings, and then, packing up the trunk, still instinct with life, carries it away to be eaten at leisure by the workers in the nest. The ichneumon, again, lays her eggs in the living body of a caterpillar, apparently without any objection, expressed or implied, by the latter, who goes on eating the cabbage, while the little worms, which are forthwith hatched from the eggs, go on eating her own living body, which they do until there is literally nothing left of the caterpillar excepting its skin, which forms a receptacle for the cocoons of the devouring grubs. These are only a few instances which might be adduced, but, in fact, and I might have referred to it sooner, insects have not the necessary organs for feeling. These I take to be "nerves" and

"brain." You know that if either are affected feeling ceases, but insects are, practically, devoid of brain. If, therefore, they possess feeling, it must have been given to them in a totally different mode, and apparently without adequate motive.

Are not insects, therefore, capable of feeling pleasure? No doubt, to a limited extent, they are. I can hardly conceive a created being that is not.

We have lately read and heard many wonderful things in connexion with worms, some of which I am bound to say I can only accept "*cum grano*"—with a good many grains of doubt in fact. Worms, we are told, eat the stalks of, and line their holes with, dead leaves. It may be so, but I have never found their holes coated with anything but slime, which seems to me to be more suitable to their comfort, and though I cannot contradict the fact of their eating stalks and leaves, I have been unable to verify it by observation. I have always considered that the drawing of these substances to the mouths of their holes was a provision of nature for the fertilization of the earth, and that their food was the earth itself, pure and simple. The worm, in fact, eats its way into the soil, as the law-student eats his to or towards the Woolsack. Credit also is given to worms for levelling the land, yet the flattest lands are those which are constantly flooded, and consequently devoid of worms. As to their raising the level of the soil, I fail to see how that can be. The result of their food, the "worm-casts," represents only the earth they have eaten, from which the nutriment has been extracted by digestion. The result cannot be greater in bulk than that of the earth originally swallowed. The species which live in the moist sea-sand make castings precisely similar to those of the earth-worm—they are pure sand, and nothing else—no extraneous matter is dragged by them into the holes. There may be, and no doubt is, earth without worms, but assuredly there are no earth-worms without earth.

Did you ever see a mole eat a worm? Having first squeezed out the lately-digested earth, he just skins him alive, and then devours the writhing carcase, bit by bit. You may say that this "writhing" is an indication of pain. No doubt, pain, in the higher orders of animals, induces similar contortions, but we must not judge from appearances. The sensitive plant shrinks from the slightest touch, and curls up its leaves as though in acute pain; but no one supposes that it feels any. Cut an india-rubber ring or a piece of catgut into small pieces, and put them on a hot plate. They will turn, and twist, and wriggle, as though they were in mortal agony, but they feel nothing.

Having referred to Charles Darwin, I may say that I have lately read his "Descent of Man" and "Origin of Species." Darwin is a man of wonderful intellect and great powers of mind; to criticise him would be highly presumptuous on my part; still, I may very briefly refer to some of his theories, which do not commend themselves to my limited intellect. I refer particularly to his theory of the Creation, to which I still prefer the Mosaic narrative. Man, we are told, had his origin in some lower form of animated nature —a mollusc, or a jellyfish, which has gone on rising in the scale of creation through successive generations, through apes and monkeys, at last culminating in man. I do not believe this. If I believed that I originated in a tadpole, I should believe that I might return to one. Plants, as well as animals, are represented as forming themselves, and assuming attributes, either necessary for their existence, or constituting safeguards against their enemies at their own sweet will. Here is an instance, one of many similar ones. Darwin, talking of the arum, the common "lord and lady," says: "The acrid juice of the arum has been acquired by the herb as a defence against its enemies. Some early ancestors of the arum were molested by goats, rabbits, or other animals, and it has adopted this means of repelling their advances." Referring to insects which seek their sustenance from flowers, and whose visits are essential to their fecundation, he says that most plants "lay themselves out to secure the attention of only two or three varieties of insects," and "*make* their ovaries either too deep or too shallow for the convenience of other kinds." The cameleopard acquired its long neck through some remote ancestors in a time of dearth finding the necessity of reaching beyond their fellows, so as to browse on the higher trees, and then, mating with each other, gradually increasing to the present disproportionate length. It may well be asked why they stopped where they did, for there are still trees out of their reach. And besides, why should goats or deer have contented themselves with their own short necks, and the necessary consequence of feeding on the lower branches? The instinct of the cuckoo, which teaches him to turn out of the nest his foster-brethren, he ascribes to the fact that in remote ages some unquiet youngster accidentally performed that operation, and that subsequently (having paired, I presume, with an equally restless mate) the habit became fixed, and all cuckoos have since acted in accordance with it. I must say that these, and numberless other instances, strike me as sheer nonsense. When the greyhound increased his running powers by lengthening his legs, the hare would, I think, have done so in a like degree. Animals of the lower grades would

hardly have been contented to remain in their humble position, and some of them at least would have remedied their natural defects. The sloth cannot walk on the surface of the earth; some birds are incapable of flight; the crocodile is devoid of a tongue, and is beholden to a little bird of the Trochilus order for picking its teeth, its mouth swarms with leeches, and the little bird runs in and out and picks them off.

I may now refer to the assumption, which Darwin takes as absolutely unassailable, and on which many of his arguments rest, that all tame animals originated from their wild congeners. This too I look upon as a fallacy. No doubt all tame animals have their wild types, but that those wild animals were the progenitors of the domesticated breeds I greatly doubt. Take any one you please—the sheep for instance. The earliest records speak of sheep as subservient to, and the property of man. Not to mention allusions in the New Testament, the Psalms of David are full of references to the flocks and their keepers. It is 3600 years since Jacob arrived in "the land of the people of the East" in search of a wife, and saw a well with three flocks of sheep lying by it. Moses 300 years later kept the flock of Jethro. The very number of Job's sheep is recorded, he had 7000. Abel was a keeper of sheep. Who tamed those sheep? The "moufflon" and the "aouda," the wild sheep still existing, are, like the goats, active beyond expression, utterly untameable, their dwelling is on inaccessible rocks, they laugh at all attempts to bring them under the "care and protection and regular government of man." How then, in the earliest days, were they tamed, brought to know and to follow their shepherd, and submit themselves to be shorn and slaughtered? Then there is the cat, the harmless, necessary cat. The wild cat, amongst savage beasts, is pre-eminently savage. The few specimens in the Zoological Gardens have been, of necessity, relegated to the most retired and unvisited portions of the Gardens. They will not endure even the presence of the keeper who daily ministers to their wants, but after months and years of kindness and attention, would meet his advances with savage snarls and signs of unmitigated ferocity. Their very anatomy, too, is different, not only externally but internally, the simple straight and short intestine being that of the Carnivora, totally different from the complicated intestines of the tame animal. Who, I ask, tamed the wild cat? You must not mistake the cat which has left its home, and run wild in the woods, for a "wild cat." The difference is manifest, and, in fact, proves the position I take. Find the lair of such a cat as this, take the young, and, though

they may have the hereditary instinct of the mother, and be prone to wander from home, they will become, to all intents and purposes, tame cats. Take the young of the wild cat, and from its earliest infancy it will display the savage and ferocious instincts of its wild race. The wild duck, again. You may rear the young from the egg; up to a certain point they are tame, but let them arrive at maturity, and they at once assume all the habits of the wild bird; they pair, which tame ducks do not; they take their regular flights at even; and, when the breeding season approaches, the migratory instinct seizes them, and they are away to distant climes to bring up a progeny as regardless as themselves of any ties that can bind them to man. This will occur through any number of generations; you cannot tame a wild duck. Even the pigeon, which in its wild state approximates more nearly than any other bird to the domestic type, is simply untameable. There are records of dovecotes and flocks of tame pigeons from the days of Herodotus. But who ever stocked a dovecote with ring-doves? I could give you any number of instances, but will mention only one more—the patient ass—that "foal of an oppressed race." What he is you see; the willing, enduring, ofttimes ill-used slave of man. What is his wild type? The quagga, zebra, or oneida, swiftest and most untameable of brutes. Rarey himself—I was one of his earliest pupils, and witnessed many of his experiments—though he subdued Cruiser and many another horse assumed to be incorrigible, could do nothing with the zebra, whose spirit, after years of confinement in the Zoological Gardens, after being stared out of countenance by thousands, poked with parasols, and tempted with buns, might fairly have been supposed to be broken. After many attempts, Rarey gave him up in despair. Who then, I ask, and when, and by what means were these creatures subdued and domesticated, and made subservient to man? If now, with all means and appliances, with bars and bolts, and cages and wire-netting, and, far more potent, a thorough knowledge of the habits and idiosyncracies of the creatures, and the result of patience and kindness, we can do nothing towards taming a single animal, how could they who lived in the olden time effect it? They could not! How then was it done? My answer would be laughed at by the advanced reasoners of the Darwinian school, and would be despised by the majority of the certificated teachers of the present day—it would be something in the spirit, if not in the words, of Dr. Watts:—

"God has made them so"!

With reference to fallacies—It is impossible to read books, and

especially popular books on natural history, without being struck with the number contained in them. This arises from the fact that writers have to a great extent been content to copy from one another, instead of consulting the Book of Nature for themselves, and making their own observations, which, if made with the view of arriving at truth, not of supporting a foregone conclusion, must always be valuable. Indeed, the most pleasing as well as the most instructive books are those which, without aiming at any great scientific result, record in simple language the daily occurrences brought under the authors' notice. Such authors—I do not refer to living authors—are Waterton, St. John, White of Selborne, Buckland, Knox. The nonsense promulgated by many writers occasions infinite mischief, especially amongst the young, who are apt to give implicit credence to anything and everything they see in print. Only yesterday I happened on an anecdote I remember in more than one book, years since; it is of a venerable rat, blind through age, which, on the occasion of a migration of its tribe, was led by two other rats by means of a stick held in its mouth. I venture to say that if a blind rat was unfortunate enough to fall in with any number, even of his nearest relations, they would incontinently kill and eat him, body and bones. In Bishop Stanley's 'Book of Birds' I read a story of a finch, which, having made her nest at the end of a bough, and finding when the young were hatched that their weight bowed it down, to the manifest danger of toppling them out, got a bit of string and tied the branch to the one above it. In the first place, there never was a finch, since the world began, that built its nest at the end of a bough, and if one were eccentric enough to do so, it would hardly have the wit to repair the error in so scientific a manner. Yarrell is a most painstaking author, and, as a book of reference, his work enjoys a deservedly high reputation, but he had little opportunity of observing for himself the haunts and habits of birds, and in consequence fell into many errors. Take, for instance, his description of the feeding of its young by the pigeon—a bird, by the way, most improperly classed among the Rasores, the scratchers—it might as well have been classed with the crows. After stating that the old birds first swallow and partially digest the food intended for their nestlings, he says: "Inserting their bills betwixt the soft mandibles of their young, they feed them with the half-digested mass." Amongst other peculiarities of the pigeon, a very striking one is that, contrary to the established custom of birds, the young pigeon thrusts its soft mandibles into the mouth—ay! and half down the throat—of the parent bird—it sucks its

food, in fact. Hence, no doubt, the mythical "pigeon's milk" for which soft schoolboys are sent on the 1st of April.

Even the best and most conscientious observers occasionally fall into error, especially when they start with preconceived notions. The mistakes of Pliny, the father of Natural History, of whom you have probably heard more than you have read, are extremely amusing, and if time allowed I might give more instances, but here is one. Talking of the cuckoo, he says: "The cuckoo is another form of hawke. At a certain season it changes its shape and plumage. It is the only hawke that hath not hooked talons. Neither is it like a hawke in its head, nor, indeed, in *any other* respect, while in the beake it resembles the pigeon. In addition it is devoured by other hawkes. It changes its voice alsoe." (Holland's translation.) It is certainly strange that, observing all these points of difference, it never occurred to Pliny that the bird was not a hawk at all. He adds further that it "lays its egg in the nest of the pigeon," which I need not say it never does, nor ever did; and that it is "hated of other birds because it finishes by devouring its foster-mother." You will remember that Shakespeare refers to this myth—

> "The hedge-sparrow fed the cuckoo so long,
> She had her head bitten off by her young."

The strangest peculiarity of the bird, however, as narrated by Pliny, is that it, in common with the crow, "lays its egg *from its mouth.*" This assertion arose from no spirit of untruth, but simply from hasty observation. The cuckoo, as you know, deposits her egg—a disproportionately small one—in the nest of some insectivorous bird, the wagtail, hedge-sparrow, or such like. As it would, in many cases, be impossible for the bird to sit on the nest for the purpose, she lays her egg on the ground, and then, taking it in her capacious mouth, deposits it in the chosen nest. The habit of the crow, a professed egg-stealer, is to strike its lower mandible into the egg, and so carry it away. No doubt Pliny observed the cuckoo in the act of placing the egg in the nest, and the crow carrying the egg protruding from its bill, and jumped at the extraordinary conclusion referred to.

VI.

# METEOROLOGICAL OBSERVATIONS TAKEN AT THROCKING, HERTS, DURING THE YEAR 1881.

By the Rev. C. W. Harvey, M.A., F.M.S.

*Read at Watford, 21st March,* 1882.

No change having taken place since my last communication, I need only here state the *Position of Station*, Lat. 51° 57′ N., Long. 0° 3′ W., Rib District; *Height of Station* above sea-level, 484 feet; and *Times of Observing*, 9 a.m. and 9 p.m.

Unlike the preceding year, there are several points in which 1881 may be regarded as a notable year in meteorology. The heavy snow-storm of January 18th; the extreme heat of July 15th; and the terrific gale of October 14th, are happily not every-day occurrences. It is rarely we experience such a range of temperature, a range close upon 79°, *i.e.* from 10°·7 on Jan. 22nd, to 89°·6 on July 15th; it is rarely traffic is so completely blocked as it was on Jan. 18th by drifted snow; and it is rarely that a gale works such havoc among our sturdy forest trees as did that of Oct. 14th.

I have again adopted Mr. Hopkinson's form of table, thus rendering comparison between the two stations easy (pp. 50, 51).

In the following table I give a set of adopted means, at the same time comparing my own observations for 1880-81 with them.

| Months. | Pressure. | | | Temperature. | | | Rainfall. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean * | Difference. | | Mean * | Difference. | | Mean † | Difference. | |
| | 1866–75 | 1880. | 1881. | 1857–69. | 1880. | 1881. | 1870–79. | 1880. | 1881. |
| | ins. | in. | in. | ° | ° | ° | ° | ° | ° |
| January | 29·86 | +·48 | +·02 | 38·0 | + 6·0 | —9·4 | 2·40 | —2·14 | — ·88 |
| February | 29·96 | —·19 | —·15 | 40·5 | —0·3 | —5·1 | 1·74 | + ·71 | +1·19 |
| March | 29·93 | +·17 | —·07 | 42·5 | —0·6 | —1·9 | 1·62 | — ·75 | — ·06 |
| April | 29·96 | —·13 | —·04 | 48·5 | —3·5 | —5·0 | 1·92 | — ·18 | —1·11 |
| May | 29·98 | +·11 | +·11 | 54·0 | —4·2 | —1·8 | 2·03 | —1·35 | —1·00 |
| June | 30·03 | —·13 | —·06 | 60·0 | —4·9 | —3·3 | 2·35 | — ·12 | — ·69 |
| July | 29·98 | —·12 | +·02 | 63·5 | —5·5 | —1·2 | 2·49 | +2·74 | — ·43 |
| August | 29·98 | = | —·12 | 62·5 | —2·6 | —6·1 | 2·41 | —1·32 | +2·44 |
| September | 29·93 | +·03 | +·03 | 59·0 | —1·0 | —5·0 | 2·60 | + ·49 | — ·49 |
| October | 29·90 | —·03 | +·11 | 52·0 | —7·5 | —10·1 | 2·25 | +2·56 | + ·17 |
| November | 29·92 | +·02 | +·01 | 43·5 | —3·4 | +2·8 | 2·65 | — ·35 | — ·29 |
| December | 29·90 | —·01 | +·07 | 40·5 | —0·9 | —3·6 | 2·08 | + ·58 | +1·93 |
| Year | 29·94 | +·02 | —·01 | 50·5 | —3·4 | —4·3 | 26·57 | + ·84 | + ·75 |

* London and Yarmouth. † Lea District.

## Results of Meteorological Observations taken at Throcking Rectory, Herts, in 1881.

| Months. | Pressure of the Atmosphere. | Temperature of the Air. | | | | | | | | | | Humidity of the Air. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 9 a.m. | Means of | | Adopted Mean. | Mean Daily Range. | Absolute Min. and Max. | | | | Absolute Range. | Dryness. | Tension of Vapour. | Relative Humidity. |
| | | | Min. | Max. | | | Min. | Date. | Max. | Date. | | | | |
| | ins. | ° | ° | ° | ° | ° | ° | | ° | | ° | ° | in. | % |
| January | 29·88 | 27·2 | 23·4 | 33·5 | 28·6 | 10·1 | 10·7 | 22nd | 48·1 | 31st | 37·4 | 2·1 | ·136 | 92 |
| February | 29·81 | 35·1 | 31·9 | 39·9 | 35·4 | 8·0 | 25·4 | 7th | 48·9 | 3rd | 23·5 | 1·8 | ·191 | 94 |
| March | 29·86 | 40·1 | 34·4 | 48·9 | 40·6 | 14·5 | 24·3 | 1 & 20 | 61·2 | 16th | 36·9 | 4·8 | ·206 | 84 |
| April | 29·92 | 44·8 | 35·4 | 53·9 | 43·5 | 18·5 | 23·1 | 4th | 62·6 | 17th | 38·5 | 6·5 | ·232 | 78 |
| May | 30·09 | 54·3 | 42·6 | 62·4 | 52·2 | 19·8 | 31·7 | 4th | 76·3 | 31st | 44·6 | 7·0 | ·324 | 77 |
| June | 29·97 | 58·0 | 48·3 | 65·5 | 56·7 | 17·2 | 34·6 | 9th | 78·3 | 4th | 43·7 | 7·6 | ·367 | 76 |
| July | 30·00 | 63·2 | 53·6 | 73·1 | 62·3 | 19·5 | 44·5 | 28th | 89·6 | 15th | 45·7 | 9·3 | ·432 | 75 |
| August | 29·86 | 57·2 | 49·7 | 65·0 | 56·4 | 15·3 | 41·4 | 28th | 82·4 | 5th | 41·0 | 4·7 | ·394 | 84 |
| September | 29·96 | 53·4 | 48·5 | 61·7 | 54·0 | 13·2 | 43·1 | 29th | 74·1 | 18th | 31·0 | 1·6 | ·387 | 95 |
| October | 30·01 | 43·8 | 37·9 | 49·9 | 41·9 | 12·0 | 27·3 | 31st | 58·4 | 1st | 31·1 | 3·5 | ·251 | 87 |
| November | 29·93 | 46·3 | 41·3 | 52·1 | 46·3 | 10·8 | 29·6 | 1st | 61·2 | 5th | 31·6 | 1·8 | ·192 | 93 |
| December | 29·97 | 36·3 | 33·0 | 41·2 | 36·9 | 8·0 | 26·3 | 11 & 24 | 50·4 | 2nd | 24·1 | 0·7 | ·209 | 98 |
| Year | 29·93 | 46·6 | 40·0 | 54·0 | 46·2 | 14·0 | 10·7 | Jan. 22 | 89·6 | July 15 | 78·9 | 4·2 | ·271 | 86 |

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THROCKING RECTORY, HERTS, IN 1881—(*continued*).

| Months. | Rainfall. | | | | | Cloud. | | | Wind. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Fall. | Max. fall in 24 hours. | | No. of days of | | Mean Amount 0–10. | No. of days of | | Mean Force 0–12. | Number of days of | | | | | | | | | |
| | Ins. | Ins. | Date. | Rain or Snow. | Snow only. | | Clear Sky. | Over-cast. | | N. | N.E. | E. | S.E. | S. | S.W. | W. | N.W. | Calm. |
| January | 1·52 | ·70 | 29th | 12 | 5 | 6·8 | 6 | 16 | 3 | 6 | 7 | 2 | 1 | 1 | 3 | 3 | 8 | 0 |
| February | 2·93 | ·56 | 7th | 20 | 5 | 8·6 | 1 | 21 | 3 | 5 | 4 | 2 | 4 | 4 | 1 | 4 | 4 | 0 |
| March | 1·56 | ·48 | 5th | 11 | 3 | 5·5 | 6 | 9 | 4 | 2 | 2 | 2 | 5 | 1 | 2 | 6 | 11 | 0 |
| April | ·81 | ·14 | 11th | 13 | 1 | 5·6 | 1 | 10 | 4 | 3 | 5 | 9 | 2 | 3 | 3 | 3 | 2 | 0 |
| May | 1·03 | ·20 | 18th | 12 | 0 | 5·3 | 5 | 5 | 3 | 7 | 3 | 3 | 2 | 2 | 7 | 2 | 5 | 0 |
| June | 1·66 | ·64 | 5th | 13 | 0 | 6·7 | 1 | 6 | 2 | 3 | 2 | 1 | 3 | 1 | 10 | 5 | 5 | 0 |
| July | 2·06 | ·38 | 6th | 14 | 0 | 6·0 | 2 | 5 | 2 | 3 | 1 | 0 | 0 | 3 | 12 | 6 | 6 | 0 |
| August | 4·85 | ·82 | 29th | 23 | 0 | 6·6 | 1 | 7 | 3 | 2 | 0 | 0 | 2 | 2 | 6 | 12 | 7 | 0 |
| September | 2·11 | ·70 | 24th | 18 | 0 | 7·9 | 2 | 20 | 2 | 2 | 4 | 0 | 6 | 1 | 4 | 5 | 8 | 0 |
| October | 2·42 | ·76 | 13th | 17 | 0 | 5·5 | 6 | 12 | 3 | 6 | 6 | 5 | 4 | 1 | 4 | 4 | 1 | 0 |
| November | 2·36 | ·52 | 24th | 18 | 1 | 7·0 | 2 | 12 | 3 | 0 | 0 | 0 | 4 | 5 | 17 | 3 | 1 | 0 |
| December | 4·01 | 1·36 | 17th | 18 | 1 | 6·6 | 4 | 16 | 2 | 1 | 1 | 0 | 3 | 11 | 8 | 3 | 4 | 0 |
| Year | 27·32 | 1·36 | Dec. 17 | 186 | 16 | 6·5 | 37 | 139 | 3 | 40 | 35 | 24 | 36 | 35 | 77 | 56 | 62 | 0 |

Without a set of mean values, with which to compare one's observations, it is difficult to demonstrate the peculiar features in the meteorology of each year. Having, as yet, no set of my own, I have temporarily supplied the want by comparing my observations with the *mean* of the pressure and temperature values given in the daily weather charts for London and Yarmouth. The means of pressure given above are for the 10 years 1866-75; the means of temperature, for the 13 years 1857-69; whilst in the matter of rainfall, I have already a set of means for the 10 years 1870-79 for this particular district.

Looking at the two years, we find that pressure was most in excess of the mean in a month of naturally *low* pressure, January; temperature showed the max. deficiency in each year in October; while in the matter of rainfall, the excess in 1880 occurred in July, in 1881 in August, affecting the harvest materially in both years, but not to the same extent in the latter as in the former year.

Pressure.—During the year the chief depressions occurred in January, February, October, November, and December, in all of which months the mercury fell below 29 ins. High pressures were, on the other hand, attained in January, March, May, and December, exceeding 30·6 ins. between the 7th and 11th of May. Regarding it in its relation to the mean, the month of highest pressure was October, and of lowest, February.

Temperature.—The extremes of cold and heat (if more polar and tropical, respectively, in their nature than is usually the case) occurred at a time when we should look for any excesses of the kind. The following are the four highest maxima and lowest minima registered during the year:—

| Highest Maxima. | | Lowest Minima. | |
|---|---|---|---|
| (*a*) July 15th | 89°·6 | (*a*) January 22nd | 10°·7 |
| (*b*) ,, 5th | 86 ·4 | (*b*) ,, 24th | 11 ·2 |
| (*c*) ,, 18th | 85 ·8 | (*c*) ,, 26th | 11 ·5 |
| (*d*) ,, 14th | 84 ·8 | (*d*) ,, 25th | 11 ·7 |

The warmest and coldest periods of 14 days occurred between July 4th—17th, and Jan. 13th—26th respectively, of which the following are the mean daily temperatures:—

| Warmest Period. | | | | Coldest Period. | | | |
|---|---|---|---|---|---|---|---|
| July 4th | 71°·3 | July 11th | 64°·6 | Jan. 13th | 25°·1 | Jan. 20th | 19°·1 |
| ,, 5th | 73 ·1 | ,, 12th | 66 ·7 | ,, 14th | 18 ·7 | ,, 21st | 18 ·5 |
| ,, 6th | 63 ·5 | ,, 13th | 63 ·5 | ,, 15th | 19 ·9 | ,, 22nd | 23 ·1 |
| ,, 7th | 54 ·6 | ,, 14th | 69 ·6 | ,, 16th | 19 ·3 | ,, 23rd | 26 ·9 |
| ,, 8th | 54 ·6 | ,, 15th | 75 ·5 | ,, 17th | 21 ·1 | ,, 24th | 17 ·9 |
| ,, 9th | 57 ·7 | ,, 16th | 66 ·2 | ,, 18th | 23 ·7 | ,, 25th | 18 ·5 |
| ,, 10th | 60 ·6 | ,, 17th | 66 ·0 | ,, 19th | 24 ·2 | ,, 26th | 21 ·8 |
| Mean | 64°·8 | | | Mean | 21°·4 | | |

The warmest period last year, which occurred between Aug. 28th and Sept. 10th, was about 2° above the mean for Aug.—Sept., while the excess this year was only about 1°·5 above the mean for July. The most noticeable point is the difference between the

mean temp. of 4th, 5th, and 15th on the one hand, and that of 7th, 8th, and 9th on the other. Roughly speaking it was a difference of 20°, namely 10° on either side of the mean. The cold period was far more remarkable, because more persistently cold, so that while in 1880 the deficiency for almost the same days was 10°, this year it was as much as 18°·5.

RAINFALL.—The driest months were April and May, the wettest, February, August, and December. The only period of anything like lengthened dry weather was March 9th to April 10th, during which period the only falls were ·04 in. on 20th; ·01 (**S**) on 21st; ·01 (**S**) on 22nd, ·10 on 23rd. On the other hand, the only short period in which the fall was excessive was during the week ending Dec. 20th, when the fall, 2·52 ins., was ·44 in. in excess of the mean for the whole month.

Under the general headings of Pressure, Temperature, Rainfall, and Weather, I will now add a few notes on the months, using the same abreviations as last year, *i.e.* **F** for fog; **H** hail; **L** lightning; **R** rain; **S** snow; **T** thunder; **T S** thunderstorm; adding to these **B** for bright, and **C** for cloudy or dull weather.

JANUARY.—*Pressure*—highest 30·57 ins. on 7th; lowest 28·82 ins. on 29th; *Temperature*—warmest day 40°·6 on 30th, coldest 17°·9 on 24th; highest in sun 88°·5 on 12th; lowest on grass 3°·0 on 22nd. Max. above 42° on 4 days; min. below 32° on 23 nights, below 22° on 14, and below 12° on 5. The temperature between 13th and 26th was exceedingly low, the max. never rising above 32°, and the min. being below 22° with only one exception. For readings of the thermometer during this period see 'Transactions,' Vol. I, Part 6, p. 232. I need here only record the minima on grass:—

MINIMA (ON GRASS).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13th | 14°·1 | 17th | 6°·1 | 21st | 5°·5 | 25th | 7°·8 |
| 14th | 11 ·1 | 18th | 12 ·6 | 22nd | 3 ·0 | 26th | 9 ·1 |
| 15th | 7 ·8 | 19th | 21 ·7 | 23rd | 18 ·1 | Mean | 9°·9 |
| 16th | 9 ·3 | 20th | 7 ·8 | 24th | 4 ·2 | | |

*Rainfall.*—This would have been small but for the snowstorm of the 18th, which it was impossible to gauge and difficult to estimate. **S** 10th, 11th, 18th, 19th, 22nd. *Weather*—generally **B**; **F** 9th—14th, and 27th—30th; solar halo, 17th, 3 p.m.; aurora, 31st, very bright.

FEBRUARY.—*Pressure*—highest 30·28 ins. on 21st; lowest 28·89 ins. on 10th. *Temperature*—warmest day 44°·2 on 10th; coldest 27°·8 on 28th; highest in sun 100°·5 on 28th (the instrument on grass out of order). Max. above 42° on 11 days; min. below 32° on 16 nights. *Rainfall*—**S** fell on 5th, 20th, 23rd, 27th, and 28th; the fall of 20th was 6 inches in depth and ganged ·49 in.; **H** (slight) on 11th. *Weather*—**C** and wet; **F** prevalent 16th—22nd; strong wind 10th and 11th.

MARCH.—*Pressure*—highest 30·53 ins. on 17th; lowest 29·09 ins. on 5th. *Temperature*—warmest day 50°·4 on 15th; coldest 29°·6 on 1st; highest in sun 109°·4 on 6th; lowest on grass 17°·3

on 1st. Max. above 52° on 11 days; min. below 32° on 12 nights; the last week was cold.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| March | 26th | mean | 33°·1 | min. in stand | 26°·9 | min. on grass | 21°·7 |
| ,, | 27th | ,, | 34 ·7 | ,, | 26 ·2 | ,, | 19 ·4 |
| ,, | 28th | ,, | 36 ·2 | ,, | 27 ·6 | ,, | 21 ·7 |
| ,, | 29th | ,, | 37 ·6 | ,, | 28 ·5 | ,, | 21 ·7 |
| ,, | 30th | ,, | 34 ·6 | ,, | 24 ·3 | ,, | 19 ·1 |
| ,, | 31st | ,, | 37 ·2 | ,, | 27 ·1 | ,, | 22 ·5 |
| April | 1st | ,, | 39 ·0 | ,, | 26 ·8 | ,, | 22 ·7 |
| | | Mean | 37 ·2 | | 28 ·7 | | 25 ·7 |

*Rainfall*—**H** 8th and 25th; ·35 on 4th, only important fall except max. *Weather*—unsettled until 10th, **B** 11th—19th; **C** 20th—25th; **B** 26th to end of month; **T** 15th and 21st; strong wind 8th and 9th.

April.—*Pressure*—steady, the smallest range in the year; highest 30·26 ins. on 28th; lowest 29·72 ins. on 1st; range ·54 in. *Temperature*—warmest day 52°·8 on 30th; coldest 31°·1 on 21st (a very low mean temperature for the month); highest in sun 120°·5 on 16th; lowest on grass 20°·0 on 4th. Max. above 52° on 18 days, and above 62° on 2; min. below 32° on 11 nights. On the grass 12° and 11°·1 of frost were registered on 4th and 21st. *Rainfall*—**S** on 20th and 21st; **H** 21st. *Weather*—**B** until 10th; **C** and showery 11th—15th; **B** 17th and 18th; **C** with showers 19th to end of month, except **B** on 28th; **T** 14th and 16th; **T S** 26th, only ·05 in. of **R** with it however.

May.—*Pressure*—highest 30·67 ins. on 10th; lowest 29·43 ins. on 16th; above 30·6 ins. 7th—11th. *Temperature*—warmest day 61°·0 on 31st; coldest 41°·5 on 3rd; highest in sun 126°·9 on 25th; lowest on grass 24°·2 on 4th. Max. above 72° on 2 days; min. below 32° on 2 nights. Sharp frosts on 4th, 11th, and 17th when 7°·8, 6°·4, and 7°·1 of frost were registered on grass. *Rainfall*—just about half the average; **H** on 4th. *Weather*—**C** until 6th; **B** 7th—13th; **C** and showery 14th—20th; **B** 21st to end of month, with occasional showers; **T S** on 4th; fresh wind 9th and 10th; **F** morning of 27th.

June.—*Pressure*—highest 30·28 ins. on 30th; lowest 29·45 ins. on 6th. *Temperature*—warmest day 64°·3 on 3rd; coldest 43°·8 on 9th; highest in sun 139° on 4th (max. of the year); lowest on grass 31°·0 on 9th. Max. above 72° on 4 days, the first four of the month; min. below 42° on 3 nights. The temperature of 1st to 4th was high.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st | Mean | 62°·9 | Max. | 76°·1 | Min. | 52°·2 |
| 2nd | ,, | 62 ·4 | ,, | 75 ·3 | ,, | 50 ·2 |
| 3rd | ,, | 64 ·3 | ,, | 76 ·9 | ,, | 53 ·0 |
| 4th | ,, | 64 ·1 | ,, | 78 ·3 | ,, | 52 ·5 |

*Rainfall*—but for fall of 5th would have been small. *Weather*—**B** and hot until 5th, 5th a wet day, the rest of the month **C**, and at times inclined to be unsettled. A late frost occurred on 9th and 10th, on the latter day the therm. on grass just registered 32°.

JULY.—*Pressure*—highest 30·25 ins. on 28th; lowest 29·57 ins. on 26th. *Temperature*—warmest day 75°·5 on 15th; coldest 53°·4 on 27th; highest in sun 137°·8 on 19th; lowest on grass 38°·1 on 7th. Max. above 82° on 6 days,

| | | | | | |
|---|---|---|---|---|---|
| 4th | 84°·2 | 14th | 84°·8 | 18th | 85°·8 |
| 5th | 86 ·4 | 15th | 89 ·6 | 19th | 84 ·4 |

min. below 52° on 11 nights; on the night of 6th it did not sink below 64°·5, night temp. also high on 5th (61°·5), 15th (60°·7), and 19th (61°·9). At 3 p.m. on 18th the dry-bulb registered 84°·6, wet-bulb 64°·4, the degree of dryness was therefore 33°·5, and of humidity only 31 °/₀ (100 representing complete saturation). *Rainfall*—chief falls besides max., ·34 in. on 5th, ·21 on 8th, and ·31 on 28th. *Weather*—**B** until 5th, **C** 6th—11th, **B** 12th—19th, **C** 20th—27th, except 21st, then **B**, last two days being showery; **T** 6th and 8th, **T** and **L** 5th.

AUGUST.—*Pressure*—highest 30·32 ins. on 4th; lowest 29·37 ins. on 26th. *Temperature*—warmest day 66°·8 on 5th; coldest 50°·1 on 31st; highest in sun 128°·4 on 4th; lowest on grass 36°·5 on 28th. Max. above 72° on 1 day, above 82° on 1 day; min. below 42° on 1 night. *Rainfall*—excessive, more than double the average fall; **R** fell every day after 8th, except 14th and 20th; chief falls besides max., ·73 in. on 8th, ·56 on 12th, ·46 on 25th. *Weather*—**C** and wet throughout month, except **B** 4th—6th; **T** 23rd, 24th, 30th.

SEPTEMBER.—*Pressure*—highest 30·37 ins. on 29th and 30th; lowest 29·46 ins. on 21st. *Temperature*—warmest day 61°·2 on 18th; coldest 49°·2 on 27th; highest in sun 120°·4 on 25th; lowest on grass 38°·1 on 30th. Max. above 62° on 15 days, above 72° on 1 day; min. below 42° on no occasion. *Rainfall*—chief falls besides max. ·32 in. on 5th, ·42 on 22nd. *Weather*—**C** until 13th, except 8th and 9th; **B** 14th—19th; **C** rest of the month, except 26th, 29th, 31st; **L** on 18th.

OCTOBER.—*Pressure*—highest 30·47 ins. on 7th; lowest 28·96 ins. on 14th; fall and recovery on 13th and 14th very rapid, fall ·83 in., recovery ·94, range 1·51. *Temperature*—warmest day 50°·0 on 11th, coldest 33°·5 on 31st; highest in sun 109°·9 on 1st, lowest on grass 22°·6 on 31st. Max. above 52° on 9 days; min. below 32° on 4 nights; first trace of frost on 5th, sharp on 17th (23°·6) and 31st. *Rainfall*—**S** slight shower on 29th; **H** on the same day; chief fall besides max., ·56 in. on 22nd. *Weather*—**B** until 5th; **C** 6th—14th, on which day the very heavy gale previously mentioned occurred, doing much damage; **B** 15th—18th; then **C** to end of month, except on 25th and 31st.

NOVEMBER.—*Pressure*—highest 30·36 ins. on 14th; lowest 28·90 ins. on 26th, remaining very low on 27th. *Temperature*—warmest day 55°·1 on 5th; coldest 32°·8 on 1st; highest in sun 101°·4 on 6th and 13th; lowest on grass 25°·9 on 1st. Max. above 52° on 15 days, reaching 61°·2 on 5th, and 60°·0 on 13th; min. below 32° on 3 nights. The 1st was a very cold day, max. 36°·5, min. 29°·6, mean 32°·8. *Rainfall*—chief falls besides max., 25th, ·26 in.,

and 26th, ·51 ; **S** on 1st. *Weather*—**C** throughout the month, except 12th, 28th, and 29th ; **F** 8th, also in mornings 3rd—9th, 14th, 18th, 20th ; gale 25th and 26th.

DECEMBER.—*Pressure*—highest 30·61 ins. on 27th ; lowest 28·90 ins. on 20th. *Temperature*—warmest day 43°·5 on 2nd ; coldest 29°·7 on 23rd ; highest in sun 82°·2 on 3rd ; lowest on grass 21°·2 on 24th. Max. above 42° on 15 days ; min. below 32° on 13 nights. *Rainfall*—excessive. Chief falls besides max., ·44 in. on 6th, and ·34 on 19th ; **S** on 10th. *Weather*—unsettled ; **B** 2nd and 3rd, otherwise **C** with frequent **F** in mornings ; fresh wind 20th ; **L** 20th.

I append a table similar to Mr. Hopkinson's showing the chief features of the *seasons*.

THROCKING.

| Seasons, 1880-81. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | in. | % | ins. |
| Winter | 29·89 | 34·4 | 9·2 | ·184 | 95 | 6·60 |
| Spring | 29·96 | 45·4 | 17·6 | ·223 | 72 | 3·40 |
| Summer | 29·94 | 58·5 | 17·4 | ·396 | 78 | 8·57 |
| Autumn | 29·97 | 47·4 | 12·0 | ·305 | 94 | 6·89 |

The following figures will show wherein and to what extent the seasons of 1880-81 differed from the seasons of 1879-80, the figures representing the excess or deficiency of 1880-81.

WINTER.—No observations for Dec. 1879, therefore comparison impossible.

SPRING.—Pres. —·06 in. ; Temp. —0·2 deg. ; Range of temp. + 0·5 deg. ; Tension of vapour —·040 in. ; Humidity —13% ; Rainfall +·11 in.

SUMMER.—Pres. —·01 in. ; Temp. + 0·5 deg. ; Range of temp. +2·9 deg. ; Tension of vapour —·026 in. ; Humidity —7% ; Rainfall +·02 in.

AUTUMN.—Pres. +·13 in. ; Temp. +0·5 deg. ; Range of temp. —0·6 deg. ; Tension of vapour +·012 in. ; Humidity +3% ; Rainfall —3·31 ins.

VII.

# METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE, WATFORD, DURING THE YEAR 1881.

By John Hopkinson, F.L.S., F.M.S., etc., Hon. Sec.

*Read at Watford, 21st March*, 1882.

Longitude of station, 0° 23′ 40″ W.; Latitude, 51° 39′ 45″ N. Ground-level at thermometer-stand and rain-gauge 223 feet, and cistern of barometer 233½ feet above Ordnance Datum.*

The monthly means, etc., of the daily observations, which have been taken in the same manner as in previous years, are given in the accompanying tables (pp. 58, 59), from which (for Dec. 1880 from the previous report) the following summary for the different seasons is deduced, results for Greenwich Observatory being added for comparison as before.

Watford.

| Seasons, 1880–81. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | in. | % | ins. |
| Winter | 29·898 | 35·5 | 9·9 | ·189 | 89 | 8·01 |
| Spring | 29·989 | 48·1 | 17·7 | ·246 | 73 | 4·35 |
| Summer | 29·951 | 60·9 | 17·4 | ·379 | 71 | 7·89 |
| Autumn | 29·980 | 49·4 | 13·5 | ·311 | 87 | 7·59 |

Greenwich.

| Seasons, 1880–1. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | ins. | % | ins. |
| Winter | 29·888 | 37·5 | 9·2 | ·199 | 88 | 6·59 |
| Spring | 29·986 | 47·5 | 18·7 | ·248 | 75 | 4·08 |
| Summer | 29·941 | 61·1 | 20·4 | ·407 | 74 | 7·87 |
| Autumn | 29·979 | 49·8 | 13·5 | ·318 | 88 | 7·15 |

The most striking feature of the weather of the year 1881, as shown in these tables, is the great range of temperature. I have not before registered at Watford a temperature either so low as 6°·4 nor so high as 91°·7, and the range of 85°·3 thus shown is certainly exceptional. The year will not, however, be chiefly memorable either for the extreme cold in January or the extreme heat in July. The snowstorm of the 18th of January, which put a stop to all

* For fuller particulars see 'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 217, and Vol. II, p. 209; and 'Trans. Herts Nat. Hist. Soc.,' Vol. I, p. 121.

## Results of Meteorological Observations taken at Wansford House, Watford, in 1881.

| Months. | Pressure of the Atmosphere. | Temperature of the Air. | | | | | | | | | | Humidity of the Air. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 9 a.m. | Means of | | Adopted Mean. | Mean Daily Range. | Absolute Min. and Max. | | | | Absolute Range. | Dryness. | Tension of Vapour. | Relative Humidity. |
| | | | Min. | Max. | | | Min. | Date. | Max. | Date. | | | | |
| | ins. | ° | ° | ° | ° | ° | ° | | ° | | ° | ° | in. | % |
| January | 29·915 | 28·4 | 24·1 | 35·1 | 29·2 | 11·0 | 6·4 | 21st | 45·8 | 30th | 39·4 | 3·0 | ·137 | 88 |
| February | 29·843 | 37·0 | 33·1 | 41·8 | 37·3 | 8·7 | 24·5 | 13th | 50·7 | 3rd | 26·2 | 2·9 | ·196 | 89 |
| March | 29·913 | 41·6 | 34·6 | 49·7 | 42·0 | 15·1 | 22·8 | 1st | 59·0 | 18th | 36·2 | 5·5 | ·213 | 81 |
| April | 29·965 | 46·6 | 37·4 | 54·5 | 46·2 | 17·1 | 27·8 | 21st | 64·0 | 13th | 36·2 | 8·9 | ·226 | 71 |
| May | 30·089 | 56·1 | 42·9 | 63·8 | 54·3 | 20·9 | 28·2 | 11th | 78·4 | 31st | 50·2 | 11·2 | ·298 | 66 |
| June | 29·979 | 59·4 | 49·4 | 66·7 | 58·5 | 17·3 | 37·4 | 9th | 80·0 | 1st | 42·6 | 10·3 | ·350 | 69 |
| July | 30·010 | 64·7 | 54·2 | 74·2 | 64·4 | 20·0 | 39·2 | 28th | 91·7 | 5th | 52·5 | 12·1 | ·397 | 65 |
| August | 29·865 | 58·6 | 51·0 | 66·0 | 58·5 | 15·0 | 40·5 | 28th | 81·8 | 5th | 41·3 | 6·5 | ·389 | 79 |
| September | 29·985 | 55·3 | 48·5 | 63·4 | 55·7 | 14·9 | 37·6 | 16th | 73·9 | 18th | 36·3 | 3·9 | ·380 | 87 |
| October | 29·991 | 45·3 | 38·1 | 51·3 | 44·9 | 13·3 | 24·2 | 31st | 62·5 | 1st | 38·3 | 4·5 | ·255 | 84 |
| November | 29·965 | 47·5 | 41·5 | 53·8 | 47·6 | 12·3 | 29·3 | 1st | 62·1 | 5th | 32·8 | 2·8 | ·296 | 90 |
| December | 29·983 | 37·6 | 33·4 | 43·2 | 38·1 | 9·8 | 22·2 | 24th | 52·7 | 18th | 30·5 | 1·7 | ·211 | 94 |
| Year | 29·959 | 48·2 | 40·7 | 55·3 | 48·1 | 14·6 | 6·4 | Jan. 21 | 91·7 | July 5 | 85·3 | 6·1 | ·279 | 80 |

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE, WATFORD, IN 1881—(*continued*).

| Months. | Rainfall. | | | | | Cloud. | | | Wind. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Fall. | Max. fall in 24 hours. | | No. of days of | | Mean Amount 0-10 | No. of days of | | Mean Force 0–12. | No. of days of | | | | | | | | |
| | Ins. | Ins. | Date | Rain or Snow. | Snow. | | Clear Sky. | Over-cast. | | N. | N.E. | E. | S.E. | S. | S.W. | W. | N.W. | Calm. |
| January | 1·56 | ·63 | 18th | 14 | 8 | 7·2 | 3 | 13 | 1·4 | 5 | 13 | 3 | 1 | 2 | 1 | 2 | 3 | 1 |
| February | 3·76 | ·73 | 9th | 20 | 8 | 8·4 | 2 | 22 | 1·9 | 4 | 10 | 0 | 5 | 2 | 3 | 1 | 3 | 0 |
| March | 2·14 | ·69 | 5th | 12 | 4 | 5·7 | 6 | 9 | 2·3 | 3 | 4 | 5 | 3 | 1 | 3 | 4 | 8 | 0 |
| April | ·82 | ·25 | 11th | 11 | 1 | 4·7 | 7 | 9 | 3·0 | 4 | 10 | 5 | 3 | 2 | 2 | 3 | 1 | 0 |
| May | 1·39 | ·39 | 18th | 12 | 0 | 4·3 | 9 | 6 | 2·1 | 4 | 6 | 3 | 3 | 2 | 7 | 3 | 3 | 0 |
| June | 2·12 | ·68 | 5th | 15 | 0 | 6·0 | 4 | 8 | 1·2 | 2 | 3 | 2 | 4 | 5 | 5 | 2 | 4 | 3 |
| July | 1·83 | ·50 | 30th | 14 | 0 | 5·0 | 10 | 9 | 1·8 | 3 | 2 | 1 | 0 | 4 | 9 | 4 | 5 | 3 |
| August | 4·94 | ·80 | 29th | 21 | 0 | 6·7 | 2 | 12 | 2·3 | 2 | 0 | 1 | 1 | 3 | 12 | 4 | 7 | 1 |
| September | 2·09 | ·77 | 24th | 16 | 0 | 8·0 | 3 | 17 | 1·2 | 5 | 6 | 3 | 3 | 1 | 4 | 2 | 4 | 2 |
| October | 2·77 | ·96 | 22nd | 16 | 1 | 4·8 | 8 | 11 | 2·1 | 3 | 5 | 9 | 2 | 2 | 3 | 4 | 3 | 0 |
| November | 2·73 | ·56 | 26th | 17 | 1 | 6·2 | 5 | 15 | 2·8 | 0 | 3 | 0 | 2 | 9 | 11 | 4 | 1 | 0 |
| December | 4·00 | 1·09 | 17th | 17 | 1 | 6·5 | 6 | 15 | 1·7 | 1 | 2 | 0 | 6 | 7 | 6 | 4 | 3 | 2 |
| Year | 30·15 | 1·09 | Dec. 17 | 185 | 24 | 6·1 | 65 | 146 | 2·0 | 36 | 64 | 32 | 33 | 40 | 66 | 37 | 45 | 12 |

traffic both by road and rail in many parts of the country, besides doing considerable damage by its violence, will be remembered longer than the extremes of heat and cold; but longer still by far will the gale of the 14th of October, by its destruction of many of our finest trees, leave its impress on the surface of the country, especially in our own county so renowned for its many finely-timbered parks.*

With these exceptions the weather of the year, taken as a whole, was not very different from that of 1880. The barometric pressure was rather less, the mean temperature about half a degree lower, and the mean daily range of temperature about the same. The absolute range of temperature was more than 10° greater, and the mean thermometric dryness about 1° greater (relative humidity 3 per cent. less), in 1881 than in 1880; and, while the total rainfall was more than 4 inches less, but still considerably above the mean, rain fell more frequently and snow on twice the number of days. There was less cloud generally, and the sky was more frequently quite clear of clouds and less often completely overcast. The mean force of the wind was considerably greater in 1881 than in 1880. In both years the most frequent direction was N.E. and S.W.†

In the following notes the general character of the weather in each month, and its principal changes, are briefly referred to.

January.—Nearly 10° colder than any other month in the year, as in 1880, and the coldest January I have yet registered at Watford; with very little rain falling as rain (about half an inch), but with at least an inch falling in the form of snow, and, except during snowstorms, with but little wind. The first eleven days were comparatively warm, the minimum temperature never even once falling so low as the mean of the month, but on the 12th a very cold period set in and lasted to the 26th inclusive, the max. temperature during this period only twice exceeding 32° and the min. only twice exceeding 22°.

| | Max. | Min. | | Max. | Min. | | Max. | Min. |
|---|---|---|---|---|---|---|---|---|
| 12th | 31°·5 | 26°·9 | 17th | 31°·5 | 7°·3 | 22nd | 31°·9 | 10°·7 |
| 13th | 31 ·7 | 20 ·9 | 18th | 30 ·6 | 9 ·5 | 23rd | 34 ·0 | 11 ·8 |
| 14th | 24 ·0 | 15 ·0 | 19th | 26 ·6 | 24 ·5 | 24th | 25 ·8 | 20 ·4 |
| 15th | 27 ·6 | 8 ·6 | 20th | 29 ·7 | 17 ·3 | 25th | 26 ·9 | 20 ·2 |
| 16th | 29 ·5 | 8 ·7 | 21st | 27 ·9 | 6 ·4 | 26th | 35 ·4 | 11 ·6 |

The mean 9 a.m. temperature during this cold period was 20°·2, giving with the above the very low mean temperature of 21°·5, the mean max. being 29°·6 and the mean min. 14°·6.‡ During these fifteen days on every one at least 5° of frost were registered, on thirteen at least 11°, on eight at least 20°, and on four at least 23°.

* The January frost and the October gale, as experienced in Hertfordshire, have been fully treated of in our 'Transactions' by the Rev. C. W. Harvey. See Vol. I, p. 228; and Vol. II, p. 17.

† Not south-easterly as stated in error in the previous report, Vol. I, p. 254.

‡ In all cases the mean temperature given is the mean of the 9 a.m., max., and min. readings.

The last five days in the month were warm, the minimum, as during the first eleven, not once falling as low as the mean of the month. Max. above 42° on 5 days; min. below 32° on 23, below 22° on 15, and below 12° on 8. Wind N. or N.E. with few exceptions from 3rd to 28th. The extreme and long-continued cold, and the heavy snow-storm on the 18th before alluded to, are the remarkable features of the month.

February.—Cold, with a humid atmosphere and much rain, and the most gloomy month in the year. The earlier part of the month, with a prevalence of rain, and wind varying in direction, was much warmer than the latter part. North-easterly winds set in on 16th and continued to the end of the month, with a dense mist from 16th to 18th and snow on 6 days after 19th. Max. temperature above 42° on 15 days; min. below 32° on 11.

March.—Mild, with a rather dry atmosphere, very bright, and windy. All the rain in the month fell between the 3rd and 9th, daily, and the 20th and 24th, also daily, including two days with slight snow and one with hail (24th). A little snow, too slight to be measured, fell on two other days. The warmest weather occurred towards the middle of the month, between the 5th and 24th. Max. above 52° on 12 days; min. below 32° on 12.

April.—Rather cold, very dry, bright, and extremely windy. The first week was especially characterised by violent E. and N.E. winds amounting almost to a gale every day, and the wind continued easterly until the 20th, from which day it varied in direction. Max. temperature above 52° on 20 days, above 62° on 3; min. below 32° on 7. From the 25th of March to the 10th of April the weather was cold, dry, and bright, and for these seventeen days no rain fell. A few days from the 11th were warm and wet, after which it became colder and drier, and then warm and wet again the last three days. Snow and hail fell on the 20th.

May.—Warm, very bright, with a very dry atmosphere, and a great range of temperature. Max. above 62° on 19 days, above 72° on 3; min. below 32° on 2. Wind S.W. every day from 14th to 20th, variable at other times. For ten days, 5th to 14th, and again for six days, 19th to 24th, no rain fell. Pressure very high for several days in succession, 7th to 12th, increasing gradually from 2nd and decreasing again to 16th.

| | ins. | | ins. | | ins. |
|---|---|---|---|---|---|
| 2nd | 29·631 | 7th | 30·587 | 12th | 30·444 |
| 3rd | 29·967 | 8th | 30·658 | 13th | 30·225 |
| 4th | 30·065 | 9th | 30·621 | 14th | 30·016 |
| 5th | 30·207 | 10th | 30·652 | 15th | 29·776 |
| 6th | 30·237 | 11th | 30·649 | 16th | 29·513 |

June.—Rather bright, with a dry and calm atmosphere, and of average temperature. Max. above 72° on 5 days; min. below 42° on 3. The first four days were bright, warm, and without rain; the next two colder, gloomy, and with 1·26 in. of rain, more than half the total of the month, accompanied on the 6th by a thunderstorm between 5 and 6 p.m. followed by hail and heavy rain

between 6 and 7·30; the next four were again colder, with a little rain and persistent N.E. wind.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st to 4th | Mean | 64°·9 | Max. | 80°·0 | Min. | 46°·4 |
| 5th and 6th | ,, | 54·1 | ,, | 60·6 | ,, | 46·7 |
| 7th to 10th | ,, | 47·7 | ,, | 47·7 | ,, | 37·3 |

On the morning of the 9th a ground frost was observed, disappearing before 9 a.m. For the remainder of the month the weather was more normal in character.

JULY.—Bright and hot, with a very dry atmosphere and a great range of temperature, a month of very similar character to May. Max. temperature above 72° on 15 days (all before 21st), above 82° on 5; min. below 52° on 10 days, below 42° on 1. The hottest periods were 1st to 5th, and 14th to 19th, thus dividing the month into two hot and two comparatively cool periods.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1st to 5th | Mean | 68°·4 | Max. | 91°·7 | Min. | 50°·5 |
| 6th to 13th | ,, | 61·7 | ,, | 78·6 | ,, | 44·7 |
| 14th to 19th | ,, | 71·7 | ,, | 91·0 | ,, | 56·2 |
| 20th to 31st | ,, | 60·2 | ,, | 72·2 | ,, | 39·2 |

AUGUST.—Very cold and wet, dull, humid, and windy, and marked by a great prevalence of south-westerly winds. Max. temperature above 72° on 4 days; min. below 52° on 16, below 42° on 1. The first eight days were warmer than the rest, and, except the 8th, finer.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1st to 8th | Mean | 62°·4 | Max. | 81°·8 | Min. | 46°·1 |
| 9th to 20th | ,, | 57·5 | ,, | 68·0 | ,, | 45·2 |
| 21st to 31st* | ,, | 58·4 | ,, | 68·5 | ,, | 40·5 |

No rain fell from 2nd to 7th, but the only other days without rain were the 9th, 13th, 20th, and 27th. The principal falls of rain were ·73 in. on 8th, ·64 in. on 12th, ·72 in. on 23rd, and ·80 in. on 29th. After the first few days south-westerly winds generally prevailed, and the wind was direct S.W. without intermission from 20th to 29th.

SEPTEMBER.—Rather cold, very dull, calm, extremely humid, and with frequent fogs and much dew, though with but little rain. There was no decided change of temperature, but a gradual diminution for the last six days, and with the increase of cold an increasingly humid atmosphere, becoming at last completely saturated.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 25th | Mean | 61°·5 | Humidity | 92°/₀ | 28th | Mean | 51°·1 | Humidity | 97°/₀ |
| 26th | ,, | 54·3 | ,, | 96 | 29th | ,, | 50·4 | ,, | 99 |
| 27th | ,, | 52·9 | ,, | 97 | 30th | ,, | 48·5 | ,, | 100 |

Max. above 62° on 21 days, above 72° on 1; min. below 42° on 3 (28th to 30th). Wind mostly N. or N.E. the first half of the month, variable afterwards.

* The 9th to the 31st forms *one* cold period, but I have here divided this period into two because the results for the last eleven days, during which time I was away from home, are not from my own observations, being deduced from returns kindly supplied to me by Miss Ormerod, Isleworth, and the Rev. C. W. Harvey, Throcking. The *rainfall* was taken regularly during my absence.

OCTOBER.—Exceedingly cold, very bright, with a dry and windy atmosphere, more than average rainfall, and a great prevalence of easterly winds, greatly contrasting with September, but like that month in one feature, the last six days became gradually colder, though not with increasing humidity. There was also one very cold day near the middle of the month and a few days before that there were two very much warmer than the rest.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11th..... | Mean | 53°·2 | Min. 43°·9 | 17th..... | Mean | 37°·1 | Min. 24°·9 |
| 14th..... | ,, | 52 ·6 | ,, 47 ·4 | 31st..... | ,, | 33 ·8 | ,, 24 ·2 |

Max. above 52° on 12 days (all before 21st), above 62° on 1; min. below 42° on 21, below 32° on 5 (after 15th). The month is chiefly remarkable for the great storm on the 14th before alluded to. There was also a second storm with heavy rain but much less wind on the 22nd. Hail fell on 15th, 16th, and 29th, and the first fall of snow of the winter occurred on the 28th.

NOVEMBER.—Very mild, rather dull, and with a humid atmosphere, greatly contrasting in these respects with October, but, like it, windy and with a considerable rainfall. The first three days (mean 37°·8, max. 56°·4, min. 29°·3) and the last two (mean 39°·5, max. 49°·4, min. 30°·3) were decidedly colder than the rest. Max. above 52° on 23 days, above 62° on 1; min. below 32° on 4 (first two and last two). This month, as October, is notable for a severe gale which commenced on the 26th and lasted through the night and with less severity for some time on the 27th. Although the wind appeared at one time to be about as strong as in the October gale, not much damage was done. This may be accounted for with respect to the trees by the difference in the time of the year; the leaves having fallen in the interval between the two gales, the surface exposed to the wind was therefore greatly reduced. The more unstable trees and weaker branches, also, had succumbed to the earlier gale, and in November the wind did not blow in such gusts as in October. The prevailing direction of the wind throughout the month was S. and S.W.; in fact on only six days did it blow from any other quarter than S., S.W., or W. There was a slight fall of snow on the 1st and of hail on the 27th.

DECEMBER.—With much rain and a humid atmosphere, but of average character in other respects, as amount of cloud, force of wind, etc. The month may be divided into five periods alternately warm and cold.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st to 7th..... | Mean | ..... | 42°·6 | Max. | ..... | 51°·9 | Min. ..... 33°·7 |
| 8th to 15th..... | ,, | ..... | 34 ·1 | ,, | ..... | 43 ·6 | ,, ..... 25 ·8 |
| 16th to 21st..... | ,, | ..... | 40 ·8 | ,, | ..... | 52 ·7 | ,, ..... 33 ·9 |
| 22nd to 25th..... | ,, | ..... | 31 ·8 | ,, | ..... | 44 ·8 | ,, ..... 22 ·2 |
| 26th to 31st..... | ,, | ..... | 36 ·3 | ,, | ..... | 46 ·0 | ,, ..... 32 ·2 |

Max. above 42° on 20 days, above 52° on 1; min. below 32° on 11. There was a rather heavy fall of snow on the 10th (equal to ·25 in. of rain), and a storm of rain and wind on the 17th. From the 16th to the 20th two inches of rain fell, exactly half the total fall in the month.

## VIII.

## REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1881.

By the Rev. C. W. Harvey, M.A., F.M.S.

*Read at Watford, 21st March,* 1882.

Our list of observers this year contains two fresh names, *i.e.* Mr. A. C. McKenzie, of Hoddesdon, where it may be remembered observations were formerly made (1861-77); and Mr. E. O. Fordham, of Odsey. Both these are important additions. Hoddesdon covers the upper part of the Lower Lea district, which district was previously only represented by Southgate in the extreme S.; while at Odsey we have now a gauge which stands within the actual boundary of the county. Bushey Heath also is again in its old position at the head of our list, its absence last year having been caused by the unfortunate loss of the record; to guard against any such possibility in future would it not be well if all observers entered their observations in duplicate?

The mean rainfall for 1881 at 30 stations (28·85 ins.), although slightly above the mean for 1870-79 (28 ins.) is less than it has been in any year since 1874; in that year the mean rainfall at 13 stations was only 22·33; in 1875 at the same 13 stations it was 30·83; in 1876 at 22 stations it was 30·77; in 1877 at 26 stations it was 31·15; in 1878 at 26 stations it was 29·80; in 1879 at 27 stations it was 32·21; and in 1880 at 27 stations it was 31·00. I have given the number of stations recording just to show how steady has been the increase of observers. Through the kindness of the Revs. T. A. Preston and J. M. Du Port, who send me monthly the table of rainfall which they compile for their respective counties, *i.e.* Wilts and Norfolk, I am able to compare our own rainfall with the fall in each of these counties, showing how the amount fines off as we proceed from W. to E. The three counties lie upon that band of chalk which intersects England in a north-easterly direction from Dorset to Norfolk. If we take Devizes, Welwyn, and East Dereham as roughly speaking the centre of Wilts, Herts, and Norfolk, respectively, we shall find that as the crow flies the three places are nearly equidistant. In Wilts the mean fall at 29 stations last year was 31·97, or rather more than 3 inches *above* our mean fall. In Norfolk the mean fall at 27 stations was 26·90, or rather less than 2 inches *below* ours. The mean rainfall for the three counties being 29·24, the fall in Wilts is 9°/₀ above, in Herts 2°/₀ below, and in Norfolk 8°/₀ below this mean; it will be seen then that, lying midway between these two counties, our rainfall is as nearly as possible the mean of the three.

*Distribution of Rainfall throughout the Year.*—This was far more equal than in the preceding year; although unfortunately August was the wet month, as in 1878 and 79; while April we may call the dry month. On the one hand, January appears considerably below the mean, but the fall of snow on the 18th must in some cases

have been underrated. Mr. Symons, in the 'Meteorological Magazine' for February, gives the average depth of snow in Herts at about 7 or 8 inches; in this particular instance it is estimated that this would represent ·70 to ·80 of snow-water, almost the whole monthly return of some observers; the amount found in the gauge has possibly misled them, for that amount was probably but a little of the whole, the rest having been blown out by the gale, before which the snow drifted. The snow in my own Snowdon gauge only yielded ·18, manifestly too little. Others again may have been misled by following the ordinary rule, and taking the depth of 1 foot of snow to equal 1 inch of water, whereas owing to the peculiar fineness of the snow, which caused it to lie more compact, experiment showed that only 10 inches of snow yielded 1 inch of water. On the other hand, the December fall was much in excess, principally in consequence of the very heavy fall of the 17th (in my own case the heaviest since Aug. 1879); a fall which was general throughout the county, and which caused considerable floods.

The mean monthly fall for 1881 differed from the mean monthly fall for 1870-79 by the following amounts:—

| | | | |
|---|---|---|---|
| January | —1·19 | July | — ·64 |
| February | +1·38 | August | +2·47 |
| March | + ·29 | September | — ·38 |
| April | —1·40 | October | + ·09 |
| May | — ·87 | November | + ·05 |
| June | — ·49 | December | +1·72 |

*Distribution of the Rainfall throughout the County.*—While the rainfall in the Thames basin, *i.e.* that part of the county drained by the Colne and the Lea, was *above* the mean for the district; the fall in the basin of the Ouse, *i.e.* the extreme N.W. part of the county drained by the Ivel and Cam, was *below* the mean. On the one hand the fall at Moor Park, Gorhambury, and Great Gaddesden was large, while on the other hand the fall at Odsey was remarkably small, which may in some measure account for the difference. The amounts gauged at Great Gaddesden during August and September will no doubt attract attention. Mr. Drake, however, assures me that to the best of his belief these figures are correct (between 10th of Aug. and 9th of Sept. the gauge was emptied by a deputy). I have therefore taken these values into the account. It may be mentioned as a piece of corroborative evidence that at this station during August and September, morning after morning the water had to be baled out of a tub outside the greenhouse to prevent it from overflowing.

In the eleven minor river-districts, which, of the seventeen into which the county is divided, are the only ones at present with observers, the mean fall was as follows:—

| | | | | | |
|---|---|---|---|---|---|
| Lea | Lower Lea | 29·46 | Colne | Lower Colne | 30·90 |
| | Upper Lea | 26·72 | | Ver | 31·26 |
| | Mimram | 27·57 | | Gade | 32·47 |
| | Beane | 29·26 | Ivel | Hiz | 25·27 |
| | Rib | 27·15 | Cam | Rhee | 22·38 |
| | Ash | 29·15 | | | |

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS.

| River District. | | | Station. | Observer. | Latitude. | Longitude. | Diameter of Gauge. | Height of Gauge above Ground. | Height of Gauge above Sea-level. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ins. | ft. ins. | ft. |
| THAMES. | COLNE. | Lower Colne | Bushey Heath | Forrester Scott | 51 38 0 N | 0 20 0 W | 5 | 1 0 | 480 |
| | | | Watford—Bushey Station | Robert Savill | 51 38 50 N | 0 22 50 W | 5 | 0 6 | 220 |
| | | | ,, Watford House | Alfred T. Brett, M.D. | 51 39 25 N | 0 23 35 W | 8 | 1 3 | 240 T |
| | | | ,, Wansford House | John Hopkinson | 51 39 45 N | 0 23 40 W | 5 | 1 0 | 224 ↑ |
| | | | ,, Oaklands | Edward Harrison | 51 40 5 N | 0 24 20 W | 5 | 5 6 | 273 T |
| | | | Rickmansworth—Moor Park | Lord Ebury | 51 37 30 N | 0 26 20 W | 5 | 2 0 | 340 |
| | | Ver | St. Albans—Gorhambury | The Earl of Verulam | 51 45 20 N | 0 23 0 W | 6 | 2 6 | 425 |
| | | | Harpenden—Rothamsted | Drs. Lawes and Gilbert | 51 48 10 N | 0 21 30 W | 5 | 0 9 | 420 T |
| | | | ,, ,, (2nd gauge) | ,, ,, | 51 48 10 N | 0 21 30 W | 72 × 87 | 0 9 | 420 T |
| | | | Dunstable—Kensworth | Miss Grace Jones | 51 51 30 N | 0 30 0 W | 5 | 1 0 | 600 ? |
| | | Gade and Bulborne. | Hemel Hempsted—Nash Mills | J. Dickinson & Co. | 51 44 0 N | 0 26 40 W | 12 | 2 9 | 237 T |
| | | | ,, Great Gaddesden | Rev. W. T. Drake | 51 47 20 N | 0 30 30 W | 8 | 1 0 | 426 |
| | | | Berkhampstead | William Squire | 51 45 40 N | 0 33 30 W | 8 | 1 6 | 370 B |
| | | | Tring—Cowroast | Hubert Thomas, C.E. | 51 47 0 N | 0 36 30 W | 10 | 4 2 | 345 L |
| | LEA. | Lower Lea | East Barnet—Southgate | George A. Church | 51 37 40 N | 0 8 0 W | 6 | 0 6 | 240 T |
| | | | Hoddesdon | A. C. McKenzie | 51 45 40 N | 0 0 30 W | 8 | 1 6 | 147 |
| | | Upper Lea | Ware | James Muir, C.E. | 51 48 20 N | 0 2 0 W | 12 | 3 0 | 114 T |
| | | | Hertford—Bayfordbury | W. Clinton Baker | 51 46 30 N | 0 5 30 W | 8 | 0 4 | 250 |
| | | | Hatfield—Brocket Hall | Hon. H. F. Cowper, M.P. | 51 48 0 N | 0 14 0 W | 8 | 1 0 | ..... |
| | | Mimram | Welwyn | Rev. C. L. Wingfield | 51 49 50 N | 0 12 30 W | 5 | 0 4 | 230 |
| | | | ,, Datchworth | Rev. J. Wardale | 51 51 20 N | 0 9 50 W | 6 | 1 0 | 385 |
| | | Beane | Stevenage | Rev. J. O. Seager | 51 55 5 N | 0 11 40 W | 8 | 2 0 | 319 L |
| | | | ,, Knebworth | Rev. F. G. Jenyns | 51 52 30 N | 0 12 30 W | 5 | 1 0 | 390 T |
| | | Rib | Buntingford—Throcking | Rev. C. W. Harvey | 51 57 5 N | 0 3 0 W | 5 | 1 0 | 484 T |
| | | | Royston—Therfield | Rev. J. G. Hale | 52 1 0 N | 0 3 0 W | 5 | 4 3 | 500 |
| | | Ash | Ware—Much Hadham | Rev. T. W. Mott | 51 51 20 N | 0 4 40 E | 5 | 1 0 | 222 B |
| OUSE. | CAM. IVEL. | Hiz | Hitchin | William Lucas | 51 57 0 N | 0 16 20 W | 5 | 2 1 | 238 ↑ |
| | | | ,, High Down | Joseph Pollard | 51 57 40 N | 0 20 0 W | 5 | 1 1 | 422 T |
| | | Rhee | Royston | Hale Wortham | 52 2 30 N | 0 1 0 W | 8 | 0 6 | 269 ↑ |
| | | | ,, Odsey | Ernest O. Fordham | 52 1 25 N | 0 6 40 W | 5 | 0 10 | 257 |
| | | | ,, Odsey Grange | H. George Fordham | 52 1 25 N | 0 6 40 W | 5 | 1 0 | 263 ↑ |

TABLE II.—SHOWING THE RAINFALL AT VARIOUS STATIONS IN HERTFORDSHIRE IN 1881.

| | | Stations. | Jan. | Feb. | Mar. | Apl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. | Days. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colne. | Lower Colne. | Bushey Heath | 1·54 | 3·65 | 2·38 | ·96 | 1·33 | 2·36 | 1·83 | 4·80 | 2·14 | 2·56 | 3·09 | 4·86 | 31·40 | 184 |
| | | Watford—Bushey Station | 1·80 | 3·59 | 2·24 | ·82 | 1·31 | 2·21 | 1·49 | 4·88 | 1·92 | 2·64 | 2·73 | 4·33 | 29·96 | ..... |
| | | ,, Watford House | 1·94 | 3·54 | 2·04 | ·95 | ·93 | 1·99 | 1·80 | 4·85 | 2·30 | 2·39 | 3·21 | 4·01 | 29·95 | 171 |
| | | ,, Wansford House | 1·56 | 3·76 | 2·14 | ·82 | 1·39 | 2·12 | 1·83 | 4·94 | 2·09 | 2·77 | 2·73 | 4·00 | 30·15 | 185 |
| | | ,, Oaklands | 1·18 | 3·61 | 2·03 | ·79 | 1·29 | 2·01 | 1·71 | 5·34 | 2·03 | 2·70 | 2·78 | 3·85 | 29·32 | 162 |
| | | Rickmansworth—Moor Park | 1·19 | 4·94 | 2·70 | ·94 | 2·06 | 2·12 | 2·06 | 5·25 | 2·28 | 2·73 | 2·98 | 4·38 | 33·63 | 169 |
| | Ver. | St. Albans—Gorhambury | 1·81 | 4·06 | 2·52 | ·94 | 2·38 | 1·46 | 1·36 | 5·87 | 2·13 | 2·82 | 3·64 | 4·13 | 33·12 | 151 |
| | | Harpenden—Rothamsted | 1·12 | 3·33 | 2·11 | ·97 | 1·39 | 1·62 | 1·73 | 5·70 | 2·09 | 2·93 | 3·45 | 4·33 | 30·76 | 186 |
| | | ,, ,, (2nd gauge) | 1·14 | 3·70 | 2·15 | 1·00 | 1·38 | 1·63 | 1·76 | 5·82 | 2·17 | 3·05 | 3·48 | 4·38 | 31·66 | 190 |
| | | Dunstable—Kensworth | ·97 | 2·52 | 1·96 | 1·02 | ·93 | 2·04 | 2·26 | 5·45 | 2·76 | 2·77 | 2·76 | 4·05 | 29·49 | 170 |
| | Bulborne and Gade. | Hemel Hempsted—Nash Mills | 1·50 | 3·20 | 1·98 | ·91 | 2·17 | 1·65 | 1·90 | 5·69 | 2·53 | 2·94 | 3·50 | 3·75 | 31·72 | 174 |
| | | ,, ,, Great Gaddesden | 1·12 | 2·72 | 1·97 | 1·06 | 1·38 | 1·59 | 2·27 | 7·23 | 5·29 | 2·61 | 2·76 | 3·54 | 33·59 | ..... |
| | | Berkhampstead | 1·75 | 3·52 | 2·35 | ·92 | 1·77 | 2·13 | 2·19 | 5·57 | 2·53 | 2·75 | 3·26 | 3·90 | 32·64 | 157 |
| | | Tring—Cowroast | 1·22 | 2·98 | 2·21 | ·94 | 1·64 | 2·15 | 2·48 | 5·55 | 2·53 | 2·72 | 3·30 | 4·20 | 31·92 | 137 |
| Lea. | L. Lea. | East Barnet—Southgate | 1·64 | 4·01 | 2·28 | ·78 | 1·35 | 1·89 | 2·15 | 4·72 | 1·89 | 3·22 | 2·56 | 3·53 | 30·02 | 184 |
| | | Hoddesdon | 1·51 | 3·57 | 2·09 | 1·10 | 1·19 | 1·80 | 2·02 | 4·50 | 2·13 | 2·18 | 3·93 | 3·89 | 28·91 | 160 |
| | Upper Lea. | Ware | 1·30 | 2·79 | 1·85 | ·94 | 1·12 | 1·95 | 2·20 | 4·21 | 1·84 | 2·44 | 2·06 | 3·59 | 26·29 | 133 |
| | | Hertford—Bayfordbury | 1·36 | 3·06 | 2·02 | ·98 | 1·04 | 1·79 | 1·96 | 4·00 | 1·66 | 3·00 | 2·85 | 3·58 | 27·30 | 148 |
| | | Hatfield—Brocket Hall | 1·08 | 2·17 | 2·05 | ·80 | 1·32 | 1·41 | 1·01 | 4·73 | 1·63 | 2·82 | 3·53 | 4·03 | 26·58 | 135 |
| | Mimram. | Welwyn Rectory | 1·55 | 2·99 | 2·02 | ·88 | 1·41 | 2·13 | 1·55 | 4·92 | 1·84 | 2·58 | 2·90 | 3·96 | 28·73 | 186 |
| | | Datchworth | ·84 | 2·93 | 1·60 | ·80 | 1·07 | 1·86 | 1·61 | 4·76 | 1·87 | 2·78 | 2·62 | 3·68 | 26·42 | 161 |
| | Beane. | Stevenage | 1·29 | 3·00 | 1·60 | ·90 | ·95 | 1·72 | 2·00 | 5·09 | 2·60 | 2·71 | 2·54 | 3·97 | 28·43 | 170 |
| | | ,, Knebworth | 1·09 | 3·21 | 1·72 | ·86 | 1·03 | 2·01 | 1·86 | 5·80 | 2·18 | 2·91 | 3·32 | 4·10 | 30·09 | 167 |
| | Rib. | Buntingford—Throcking | 1·52 | 2·93 | 1·56 | ·81 | 1·03 | 1·66 | 2·06 | 4·85 | 2·11 | 2·42 | 2·36 | 4·01 | 27·32 | 186 |
| | | Royston—Therfield | 1·21 | 2·47 | 1·55 | 1·11 | ·75 | 1·94 | 2·17 | 5·32 | 2·15 | 2·51 | 2·16 | 3·64 | 26·98 | 151 |
| | Ash | Ware—Much Hadham | 1·22 | 3·55 | 1·71 | ·86 | 1·28 | 1·93 | 1·77 | 4·98 | 2·08 | 2·48 | 3·01 | 4·28 | 29·15 | 194 |
| Cam. Ivel. | Hiz. | Hitchin | 1·05 | 2·91 | 1·39 | ·73 | ·65 | 1·55 | 2·29 | 4·70 | 1·91 | 2·26 | 2·14 | 3·58 | 25·16 | 183 |
| | | ,, High Down | ·94 | 2·39 | 1·36 | ·77 | ·82 | 1·72 | 2·25 | 4·70 | 2·28 | 2·27 | 2·48 | 3·40 | 25·38 | 144 |
| | Rhee. | Royston | 1·35 | 2·74 | 1·18 | 1·02 | ·66 | 1·69 | 1·76 | 4·61 | 1·50 | 1·98 | 2·06 | 3·47 | 24·03 | 148 |
| | | ,, Odsey | ·89 | 2·37 | 1·16 | ·88 | ·74 | 1·42 | 1·57 | 4·09 | 1·75 | 2·02 | 1·35 | 3·05 | 21·29 | 174 |
| | | ,, Odsey Grange | 1·02 | 2·57 | 1·09 | ·91 | ·75 | 1·46 | 1·52 | 4·27 | 1·78 | 2·00 | 1·44 | 3·00 | 21·81 | 171 |
| Mean fall | | | 1·35 | 3·20 | 1·95 | ·65 | 1·25 | 1·85 | 1·90 | 5·05 | 2·25 | 2·65 | 2·80 | 3·90 | 28·80 | 168 |

TABLE III.—MEAN MONTHLY FALL IN THE RIVER DISTRICTS.

| River District. | January. | Difference from mean 1870-79. | February. | Difference from Mean 1870-79. | March. | Difference from Mean 1870-79. | April. | Difference from Mean 1870-79. | May. | Difference from Mean 1870-79. | June. | Difference from Mean 1870-79. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colne | 1·37 | —1·43 | 3·51 | +1·44 | 2·20 | +·45 | ·93 | —1·25 | 1·52 | — ·70 | 1·92 | —·48 |
| Lea | 1·23 | —1·17 | 3·06 | +1·32 | 1·84 | +·22 | ·90 | —1·02 | 1·13 | — ·90 | 1·84 | —·51 |
| Ivel | 99 | —1·23 | 2·65 | +1·06 | 1·37 | +·11 | ·75 | —1·20 | ·73 | —1·25 | 1·63 | —·50 |
| Cam | 1·09 | — ·87 | 2·56 | + ·97 | 1·14 | —·28 | ·94 | — ·74 | ·72 | —1·18 | 1·52 | —·61 |

| River District. | July. | Difference from Mean 1870-79. | August. | Difference from Mean 1870-79. | September. | Difference from Mean 1870-79. | October. | Difference from Mean 1870-79. | November. | Difference from Mean 1870-79. | December. | Difference from Mean 1870-79. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colne | 1·90 | —·88 | 5·50 | +2·73 | 2·48 | —·23 | 2·74 | —·10 | 3·12 | +·23 | 4·19 | +1·90 |
| Lea | 1·86 | —·53 | 4·82 | +2·11 | 2·00 | —·60 | 2·67 | +·42 | 2·74 | +·09 | 3·85 | +1·77 |
| Ivel | 2·27 | —·43 | 4·70 | +2·43 | 2·09 | —·38 | 2·26 | +·09 | 2·31 | —·29 | 3·49 | +1·44 |
| Cam | 1·62 | —·49 | 4·32 | +2·00 | 1·68 | —·68 | 2·00 | +·10 | 1·62 | —·66 | 3·17 | +1·27 |

Mean annual fall in 1881 in Colne District 31·39 ins. being 1·80 *above* mean 1870-79.
,, ,, ,, Lea ,, 27·95 ,, ,, 1·38 *above* ,, ,,
,, ,, ,, Ivel ,, 25·27 ,, ,, 1·39 *below* ,, ,,
,, ,, ,, Cam ,, 22·38 ,, ,, 1·21 *below* ,, ,,

Again the Lower Colne shows the greatest and the Rhee district the least rainfall. Indeed, since 1876 at all events, when our systematic reports commenced, the rule has been invariable. The mean difference between the two districts during the five previous years, 1876-80, appears to be about 7 inches; the difference was greatest in 1878 (11·05) and least in 1876 (2·83). With regard to the absolute maximum fall in each month and the station recording it, we find—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| January | 18th | Berkhampstead | ·80 | July | 7th | Kensworth | ·86 |
| February | 20th | Southgate | 1·07 | August | 29th | Brocket Hall | 1·09 |
| March | 4th | Hoddesdon | ·87 | September | 24th | Nash Mills | ·99 |
| April | 14th | Royston | ·38 | October | 22nd | Bayfordbury | 1·17 |
| May | 28th | Moor Park | ·67 | November | 9th | Brocket Hall | 1·02 |
| June | 5th | Welwyn | ·89 | December | 17th | Brocket Hall | 1·74 |

The maxima for January and February were the result of snow. As in previous reports, I add an analysis of the wettest day in each month.

January 11th at 1 station; 18th at 15; 26th at 1; 27th at 2; 29th at 9.

February 7th at 15; 9th at 5; 20th at 5. At Odsey one gauge records 9th, the other 20th; at Hoddesdon fall of 7th and 22nd equal.

March 4th at 4; 5th at 19; 7th at 4. At Berkhampstead fall of 5th and 7th equal.

April 8th at 1; 11th at 13; 12th at 1; 13th at 6; 14th at 3; 23rd at 2; 25th at 1; 29th at 1.

May 1st at 2; 4th at 2; 17th at 3; 18th at 14; 26th at 1; 28th at 2. At Bushey Heath and Southgate on 18th and 26th, and at Stevenage on 18th and 28th, falls were respectively equal.

June 5th at all stations.

July 5th at 7; 6th at 4; 7th at 1; 8th at 1; 10th at 1; 28th at 1; 30th at 10; 31st at 1. At Berkhampstead fall of 5th and 30th equal.

August 8th at 8; 23rd at 2; 29th at 18.

September 18th at 1; 20th at 1; 24th at 22; 29th at 1. At Berkhampstead fall of 5th and 6th equal; also on 6th, 7th, and 23rd at High Down.

October 13th at 9; 22nd at 19.

November 9th at 1; 20th at 1; 24th at 8; 26th at 18.

December 6th at 1; 10th at 1; 17th at 36.

From this we may conclude in a general way that the wettest day in each month was

| | | | | | |
|---|---|---|---|---|---|
| January | 18th | May | 18th | September | 24th |
| February | 7th | June | 5th | October | 22nd |
| March | 5th | July | 30th | November | 26th |
| April | 11th | August | 29th | December | 17th |

On the days of max. fall in each month the following falls of 1 inch or more are recorded:—

February 20th, Southgate, 1·07.

August 29th, Bushey Heath, 1·02; Oaklands, Watford, 1·07; Moor Park, 1·05; Rothamsted, 1·00; Brocket Hall, 1·09.

October 22nd, Moor Park, 1·12; Great Berkhampstead, 1·00; Cowroast, 1·00; Southgate, 1·10; Bayfordbury, 1·17.

November 9th, Brocket Hall, 1·02.

December 17th, Watford House, 1·19; Wansford House, 1·09; Oaklands, 1·05; Moor Park, 1·19; Gorhambury, 1·07; Rothamsted, 1·25; Kensworth, 1·12; Nash Mills, 1·00; Berkhampstead, 1·12; Great Gaddesden, 1·15; Cow-

roast, 1·15; Bayfordbury, 1·12; Ware, 1·24; Brocket Hall, 1·74; Welwyn, 1·18; Datchworth, 1·14; Stevenage, 1·53; Knebworth, 1·27; Throckiug, 1·36; Therfield, 1·27; Much Hadham, 1·22; Hitchin, 1·26; High Down, 1·20; Royston, 1·15; Odsey, 1·12.

Other falls of one inch or more not on the day of max. fall are recorded on

August 8th. Gorhambury, 1·05; Nash Mills, 1·08; Knebworth, 1·06.
December 10th, Bushey Heath, 1·20 (S).

The mean number of wet days in each month, with the relation that number bears to the mean for 1870-79, appears to be

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. | wet days | 10 | being | 6 below | mean. | July | wet days | 12 | being | 1 below | mean. |
| Feb. | ,, | 18 | ,, | 3 above | ,, | Aug. | ,, | 19 | ,, | 5 above | ,, |
| Mar. | ,, | 10 | ,, | 4 below | ,, | Sept. | ,, | 13 | ,, | equal | ,, |
| Apr. | ,, | 10 | ,, | 3 above | ,, | Oct. | ,, | 14 | ,, | 1 below | ,, |
| May | ,, | 11 | ,, | 2 below | ,, | Nov. | ,, | 16 | ,, | equal | ,, |
| June | ,, | 9 | ,, | 5 below | ,, | Dec. | ,, | 17 | ,, | 2 above | ,, |

Fortunately this year July proved a fairly fine month, and there was every prospect of an early harvest; the rain which fell after August 7th for exactly a month, however, disappointed these hopes, although the actual damage done to the corn was not I fancy as great as was at first feared, and not nearly as great as in previous years. Ever since 1877 either July or August, or both these months, have proved wet; thus in 1877 July and August were both wet; in 1878, while July was remarkably dry, August was as remarkably wet, the wettest August in fact of the series; in 1879 both July and August were very wet; while in 1880 a remarkably fine August was preceded and followed by a very wet July and September.

Again for the second year in succession we have had snow in October, a slight fall occurring on the morning of the 29th.

Of the heavy falls, the only one which was anything like general was that of Dec. 17th. Falls of 1 inch or more occurred in 5 months—February, August, October, November, and December; only one station in each case, however, records such a fall in February and November.

I am glad to be able to add that during the past year observations have been commenced by Miss Joyce Croft of Fanhams Hall, Ware, who has two gauges at work, one in the district of the Upper Lea, the other in that of the Ash, Fanhams Hall being just on the watershed.

## IX.

## REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1881.

By John Hopkinson, F.L.S., F.M.S., Hon. Sec.

*Read at Watford, 21st March, 1882.*

Nearly all the observers who recorded Phenological Phenomena in 1880 have continued to observe in 1881, and the localities at which regular observations have been made are almost the same as in that year. In the principal table giving the dates of flowering of plants, instead of Hoddesdon, at which 12 species were observed this year as last, is inserted Berkhampstead, at which were observed 21 this year and only 3 the previous year, and for South End near St. Albans we have had to substitute St. Albans. The supplementary table is considerably extended, comprising seven stations instead of five, and twenty species in place of fourteen.

The latitudes and longitudes of the phenological stations, from which returns are entered in the tables, are as follow:—

| | N. Lat. | Long. | | N. Lat. | Long. |
|---|---|---|---|---|---|
| Watford | 51 39 | 0 24 w | Hertford | 51 48 | 0 5 w |
| Hunton Bridge | 51 41 | 0 26 w | Harpenden | 51 48½ | 0 21 w |
| St Albans | 51 45 | 0 20 w | High Wych | 51 48½ | 0 8 e |
| Berkhampstead | 51 45½ | 0 34 w | Fanhams Hall | 51 49 | 0 1 w |
| Hoddesdon | 51 46 | 0 1 w | Throcking | 51 57 | 0 3 w |
| Hailey Hall | 51 46½ | 0 1 w | Great Hormead | 51 57 | 0 2 e |
| Redbourn Bury | 51 47 | 0 23 w | Odsey | 52 1½ | 0 7 w |

For their position in the county, reference should be made to the outline-map given in the previous report.*

Of the 71 species of plants in the Meteorological Society's list the date of flowering of 70 species has been observed in the county, the same number as in 1880. Of these we observed 51 in the neighbourhood of Watford; 21 were observed at Berkhampstead by Mr. A. S. Eve; 23 at St. Albans by (1) Mr. A. E. Gibbs; 18 at Redbourn Bury near St. Albans by (2) Mrs. Arnold; 57 at Harpenden by Mr. J. J. Willis; 64 at Hertford by Mr. R. T. Andrews; 34 at Fanhams Hall near Ware by Mr. R. B. Croft; 33 at High Wych near Sawbridgeworth by Miss Simpson; 45 at Great Hormead near Buntingford by the Rev. J. S. ffoster Chamberlain; and 18 at Odsey by Mr. H. George Fordham. These observations are recorded in the table on pp. 72, 73.

In the following supplementary table are recorded 7 observations at Watford by Dr. A. T. Brett; 3 at Hunton Bridge by Mrs. Vaughan; 4 at St. Albans by (1) Mr. F. W. Silvester (Hedges); 4 at St. Albans by (2) Miss Rose C. White; 12 at Hoddesdon by Miss Alice Warner; 8 at Hailey Hall near Hertford by Mr. H. C. Heard; and 14 at Throcking near Buntingford by the Rev. C. W. Harvey.

* 'Trans. Herts Nat. Hist. Soc.,' Vol. I, p. 257.

## Dates of Flowering of Plants observed in 1881.

| No. | Species. | Watford. | Berkhampstead. | St. Albans, 1. | St. Albans, 2. | Harpenden. | Hertford. | Ware. | High Wych. | Hormead. | Odsey. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | *Anemone nemorosa* | Mar. 20 | ..... | Apl. 11 | Mar. 21 | Mar. 21 | Mar. 23 | Mar. 20 | ..... | Mar. 19 | ..... |
| 2. | *Ranunculus Ficaria* | Mar. 9 | Mar. 10 | ..... | Mar. 9 | Mar 16 | ..... | Mar. 16 | ..... | Mar. 11 | ..... |
| 3. | *Ranunculus acris* | May 3 | May 3 | Apl. 30 | ..... | May 10 | May 1 | May 8 | ..... | May 12 | ..... |
| 4. | *Caltha palustris* | Mar. 20 | Mar. 20 | ..... | Apl. 1 | Mar 20 | Apl. 14 | Apl. 30 | ..... | Apl. 20 | ..... |
| 5. | *Papaver Rhœas* | June 1 | ..... | June 6 | ..... | June 2 | June 2 | June 11 | June 8 | ..... | May 29 |
| 6. | *Cardamine hirsuta* | ..... | ..... | Apl. 17 | ..... | Mar. 26 | Mar. 18 | ..... | ..... | Mar. 9 | ..... |
| 7. | *Cardamine pratensis* | Apl. 19 | ..... | Apl. 24 | Apl. 24 | Apl. 30 | Apl. 21 | Apl. 27 | Apl. 26 | Apl. 23 | ..... |
| 8. | *Draba verna* | ..... | ..... | ..... | ..... | Apl. 6 | Apl. 12 | ..... | ..... | ..... | ..... |
| 9. | *Viola odorata* | Mar. 6 | Mar. 17 | ..... | ..... | Mar. 6 | ..... | ..... | ..... | Mar. 5 | Mar. 17 |
| 10. | *Polygala vulgaris* | ..... | May 20 | ..... | ..... | June 9 | May 20 | ..... | ..... | June 2 | ..... |
| 11. | *Lychnis Flos-cuculi* | June 3 | ..... | ..... | ..... | May 30 | May 28 | ..... | June 6 | June 1 | ..... |
| 12. | *Stellaria Holostea* | Apl. 12 | Apl. 23 | Apl. 15 | ..... | Apl. 15 | Apl. 12 | Apl. 18 | .... | Apl. 19 | ..... |
| 13. | *Malva sylvestris* | June 9 | ..... | ..... | May 31 | June 8 | June 4 | June 4 | May 21 | June 14 | June 6 |
| 14. | *Hypericum tetrapterum* | ..... | ..... | ..... | ..... | ..... | July 1 | ..... | ..... | ..... | ..... |
| 15. | *Hypericum pulchrum* | June 25 | ..... | ..... | ..... | July 14 | July 1 | ..... | ..... | ..... | ..... |
| 16. | *Geranium Robertianum* | May 8 | May 13 | May 8 | May 3 | May 2 | May 12 | May 14 | May 13 | May 20 | ..... |
| 17. | *Trifolium repens* | May 22 | ..... | May 10 | May 17 | May 25 | May 18 | May 29 | May 23 | May 24 | ..... |
| 18. | *Lotus corniculatus* | May 29 | ..... | May 11 | May 24 | May 31 | May 18 | May 29 | May 24 | May 17 | ..... |
| 19. | *Vicia Cracca* | ..... | ..... | ..... | ..... | June 30 | ..... | ..... | June 23 | June 20 | ..... |
| 20. | *Vicia sepium* | May 5 | ..... | May 8 | ..... | May 4 | Apl. 26 | May 3 | Apl. 30 | May 6 | ..... |
| 21. | *Lathyrus pratensis* | June 2 | ..... | ..... | ..... | June 7 | May 27 | June 11 | June 4 | June 3 | ..... |
| 22. | *Prunus spinosa* | Apl. 18 | May 3 | Apl. 15 | ..... | Apl. 15 | Apl. 14 | Apl. 17 | ..... | Apl. 19 | Apl. 21 |
| 23. | *Spiræa Ulmaria* | ..... | ..... | ..... | ..... | June 27 | June 20 | June 30 | June 23 | ..... | July 3 |
| 24. | *Potentilla anserina* | May 24 | May 24 | May 28 | May 16 | May 15 | May 16 | May 17 | May 22 | May 24 | May 10 |
| 25. | *Potentilla Fragariastrum* | Mar. 15 | Mar. 17 | ..... | ..... | Mar. 14 | ..... | ..... | ..... | Mar. 12 | ..... |
| 26. | *Rosa canina* | June 5 | ..... | June 6 | ..... | June 2 | June 8 | June 11 | June 10 | June 8 | June 6 |
| 27. | *Epilobium hirsutum* | ..... | ..... | ..... | ..... | ..... | July 4 | ..... | July 3 | ..... | ..... |
| 28. | *Epilobium montanum* | June 10 | ..... | ..... | ..... | June 10 | June 7 | ..... | June 12 | June 15 | ..... |
| 29. | *Angelica sylvestris* | .... | ..... | ..... | ..... | ..... | Aug. 2 | ..... | ..... | ..... | ..... |
| 30. | *Anthriscus sylvestris* | Apl. 23 | ..... | ..... | Apl. 25 | Apl. 28 | Apl. 18 | Apl. 21 | Apl. 15 | Apl. 19 | Apl. 24 |
| 31. | *Hedera Helix* | Sept. 8 | ..... | ..... | ..... | ..... | Sept. 13 | ..... | ..... | ..... | ..... |
| 32. | *Galium Aparine* | May 15 | May 15 | May 10 | May 15 | May 31 | May 20 | May 14 | May 14 | May 17 | ..... |
| 33. | *Galium verum* | July 1 | ..... | ..... | ..... | June 30 | ..... | ..... | July 2 | ..... | July 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 34. | *Dipsacus sylvestris* | ..... | ..... | ..... | ..... | ..... | Aug. 1 | ..... | July 17 | ..... | ..... |
| 35. | *Scabiosa succisa* | June 29 | ..... | ..... | ..... | June 29 | Aug. 1 | ..... | ..... | ..... | ..... |
| 36. | *Petasites vulgaris* | Mar. 27 | ..... | ..... | ..... | ..... | Mar. 28 | ..... | ..... | ..... | ..... |
| 37. | *Tussilago Farfara* | Mar. 12 | Mar. 23 | ..... | Mar. 10 | Mar. 17 | Mar. 16 | Mar. 12 | ..... | Mar. 9 | Mar. 6 |
| 38. | *Achillea Millefolium* | June 20 | ..... | ..... | ..... | June 22 | ..... | ..... | June 24 | ..... | ..... |
| 39. | *Chrysanthemum Leucan.* | May 22 | May 17 | May 15 | May 21 | May 28 | May 16 | May 30 | May 25 | May 24 | ..... |
| 40. | *Artemisia vulgaris* | July 31 | ..... | ..... | ..... | ..... | Aug. 10 | ..... | Aug. 3 | ..... | ..... |
| 41. | *Senecio Jacobæa* | July 3 | ..... | ..... | ..... | July 6 | June 20 | ..... | July 9 | ..... | June 23 |
| 42. | *Centaurea nigra* | June 24 | ..... | ..... | ..... | June 21 | June 10 | June 24 | June 21 | June 25 | ..... |
| 43. | *Carduus lanceolatus* | June 18 | ..... | ..... | ..... | June 13 | June 18 | ..... | July 10 | ..... | ..... |
| 44. | *Carduus arvensis* | June 10 | ..... | ..... | ..... | June 6 | June 6 | ..... | ..... | ..... | ..... |
| 45. | *Sonchus arvensis* | ..... | ..... | ..... | ..... | July 7 | July 6 | ..... | ..... | ..... | ..... |
| 46. | *Hieracium Pilosella* | May 15 | May 17 | ..... | ..... | May 25 | May 10 | ..... | ..... | May 27 | ..... |
| 47. | *Campanula rotundifolia* | July 10 | ..... | ..... | ..... | July 9 | July 4 | ..... | ..... | ..... | ..... |
| 48. | *Gentiana Amarella* | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 49. | *Convolvulus sepium* | ..... | ..... | ..... | ..... | July 19 | July 10 | .... | July 4 | ..... | ..... |
| 50. | *Symphytum officinale* | ..... | May 14 | ..... | ..... | ..... | May 12 | May 10 | May 23 | May 30 | ..... |
| 51. | *Pedicularis sylvatica* | ..... | May 1 | ..... | May 27 | ..... | May 14 | ..... | ..... | ..... | ..... |
| 52. | *Veronica Chamædrys* | May 3 | .... | May 6 | ..... | May 14 | Apl. 25 | May 2 | May 2 | May 5 | ..... |
| 53. | *Veronica hederifolia* | ..... | Mar. 16 | ..... | ..... | Mar. 11 | Feb. 17 | ..... | ..... | Mar. 15 | ..... |
| 54. | *Mentha aquatica* | ..... | ..... | ..... | ..... | ..... | Aug. 1 | ..... | ..... | ..... | ..... |
| 55. | *Thymus Serpyllum* | ..... | ..... | ..... | May 28 | July 3 | June 14 | ..... | ..... | ..... | June 9 |
| 56. | *Prunella vulgaris* | June 20 | ..... | ..... | ..... | June 16 | June 12 | ..... | June 17 | June 23 | ..... |
| 57. | *Nepeta Glechoma* | Apl. 3 | ..... | Apl. 10 | ..... | Apl. 4 | Mar. 24 | Apl. 7 | ..... | Mar. 28 | Apl. 3 |
| 58. | *Galeopsis Tetrahit* | ..... | ..... | ..... | ..... | ..... | July 1 | ..... | ..... | ..... | ..... |
| 59. | *Stachys sylvatica* | June 10 | ..... | June 6 | ..... | June 7 | June 4 | ..... | June 4 | June 10 | ..... |
| 60 | *Ajuga reptans* | May 7 | May 7 | May 8 | ..... | May 12 | May 6 | ..... | May 10 | May 10 | ..... |
| 61. | *Primula veris* | Mar. 25 | ..... | .... | Apl. 9 | ..... | Apl. 7 | Mar. 19 | ..... | Mar. 24 | Apl. 5 |
| 62. | *Plantago lanceolata* | Apl. 24 | ..... | Apl. 15 | ..... | Apl. 28 | Apl. 18 | May 4 | Apl. 26 | Apl. 20 | ..... |
| 63. | *Mercurialis perennis* | Feb. 9 | Mar. 7 | ..... | ..... | Feb. 11 | Mar. 15 | Mar. 12 | ..... | Feb. 26 | ..... |
| 64. | *Ulmus montana* | ..... | ..... | ..... | ..... | Mar. 23 | Mar. 20 | ..... | ..... | Mar. 31 | Mar. 18 |
| 65. | *Salix caprea* | Mar. 17 | ..... | ..... | Mar. 9 | Mar. 23 | Mar. 16 | ..... | ..... | Mar. 19 | Mar. 18 |
| 66. | *Corylus Avellana* | Feb. 6 | ..... | ..... | ..... | Feb. 15 | Feb. 12 | Feb. 13 | ..... | Feb. 11 | ..... |
| 67. | *Orchis maculata* | June 8 | ..... | May 31 | ..... | ..... | June 4 | June 14 | ..... | June 22 | ..... |
| 68. | *Iris Pseudacorus* | June 3 | ..... | June 6 | ..... | June 2 | June 1 | June 4 | June 8 | ..... | ..... |
| 69. | *Narcissus Pseudo-narcis.* | Mar. 15 | Mar. 16 | ..... | ..... | Mar. 20 | Mar. 16 | Mar. 17 | ..... | Mar. 21 | Mar. 17 |
| 70. | *Galanthus nivalis* | ..... | ..... | ..... | ..... | Jan. 31 | Jan. 30 | Feb. 6 | ..... | Feb. 9 | Jan. 31 |
| 71. | *Endymion nutans* | Apl. 19 | Apl. 30 | Apl. 24 | Apl. 11 | Apl. 15 | Apl. 23 | Apl. 30 | ..... | Apl. 19 | ..... |

## Dates of Flowering of Plants observed in 1881.
(*Supplementary Table.*)

| No. | Watford. | Hunton Bridge. | St. Albans, 1. | St. Albans, 2. | Hoddesdon. | Haile Hall | Throcking. |
|---|---|---|---|---|---|---|---|
| 1. | Apl. 15 | ..... | ..... | Mar. 30 | Mar. 14 | Apl. 2 | Mar. 17 |
| 2. | Mar. 11 | Mar. 8 | ..... | ..... | Mar. 9 | Mar. 15 | Mar. 15 |
| 4. | ..... | ..... | ..... | ..... | Apl. 7 | ..... | Apl. 17 |
| 7. | ..... | ..... | ..... | ..... | Apl. 20 | Apl. 20 | Apl. 24 |
| 9. | ..... | Mar. 8 | ..... | ..... | Mar. 17 | ..... | Mar. 16 |
| 12. | Apl. 15 | ..... | ..... | Apl. 24 | Apl. 15 | ..... | Apl. 12 |
| 18. | ..... | ..... | May 8 | ..... | ..... | ..... | ..... |
| 22. | Apl. 15 | ..... | ..... | ..... | Apl. 15 | Apl. 17 | Apl. 17 |
| 25. | Mar. 16 | Mar. 16 | ..... | ..... | ..... | Mar. 26 | ..... |
| 37. | ..... | ..... | ..... | ..... | ..... | ..... | Mar. 15 |
| 39. | ..... | ..... | May 11 | ..... | ..... | ..... | ..... |
| 46. | ..... | ..... | May 8 | ..... | ..... | ..... | ..... |
| 50. | ..... | ..... | May 25 | ..... | ..... | ..... | ..... |
| 57. | ..... | ..... | ..... | Apl. 22 | Apl. 2 | ..... | Apl. 7 |
| 61. | Mar. 18 | ..... | ..... | ..... | Apl. 7 | Apl. 16 | Apl. 10 |
| 63. | ..... | ..... | ..... | Mar. 15 | ..... | ..... | Mar. 16 |
| 65. | ..... | ..... | ..... | ..... | Mar. 15 | ..... | ..... |
| 69. | Mar. 12 | ..... | ..... | ..... | Mar. 17 | Mar. 25 | Mar. 21 |
| 70. | ..... | ..... | ..... | ..... | ..... | Feb. 1 | Feb. 7 |
| 71. | ..... | ..... | ..... | ..... | Apl. 20 | ..... | Apl. 13 |

The following notes on the flowering of some of the plants are added by the observers:—

1. *Anemone nemorosa.* Hertford.—Has been exceedingly shy in flowering, but is very plentiful.—R. T. A.

4. *Caltha palustris.* Fanhams Hall, Ware.—Very late, having been in flower in profusion in the valleys since April 11.—R. B. C.

9. *Viola odorata.* Hertford.—Has been plentiful in sheltered situations throughout the winter to Jan. 5, when a sharp hard frost came and cut it off.—R. T. A.

22. *Prunus spinosa.* Berkhampstead.—Flowering finer than (I believe) it has done for three or four years.—A. S. E.

31. *Hedera Helix.* Watford.—Sept. 8, a very early date, but well out.—J. H.

57. *Nepeta Glechoma.* Great Hormead.—A solitary flower seen March 22, I imagine a premature one.—J. S. C.

63. *Mercurialis perennis.* Harpenden. — Observed in flower towards the end of December, 1880, in a somewhat warm situation between Luton and Harpenden. [So mild was the month of December that in many of the woods around this district the primrose (*Primula vulgaris*) was quite conspicuous by its numerous flowers.]—J. J. W. Great Hormead.—One male flower opening Feb. 26; did not see more for some days.—J. S. C.

69. *Narcissus Pseudo-Narcissus.* Hertford.—Very plentiful this season.—R. T. A. Ware.—Double variety.—R. B. C.

70. *Galanthus nivalis.* Hertford. — The garden variety may be

said to be in flower about one week before the wild one.—R. T. A. Ware.—Double variety.—R. B. C. Odsey.—Nearly out before the snowstorm of Jan. 9.—H. G. F.

To the birds in the Meteorological Society's list three species have been added since our last report was drawn up, in fact in the present year (1882), so that the number of insects and birds, etc., to be observed is now 29. Of the 26 species in the former list adopted by our Society, 23 have been observed during the year, a larger number than in any previous year. In the following table the earliest of these dates is in each case alone given. For details of observations of the insects reference must be made to the report by Miss Ormerod,* and of the birds to that by Mr. Littleboy.†

Observations of frog-spawn only remain to be recorded. This was seen at Redbourn Bury, St. Albans, and at Hertford, on the 12th of March, at Hoddesdon on the 18th, and at Fanhams Hall, Ware, on the 19th.

EARLIEST DATES OF OBSERVATIONS OF INSECTS, BIRDS, ETC., IN 1881.

| No. | SPECIES. | DATE. | No. | SPECIES. | DATE. |
|---|---|---|---|---|---|
| 72. | *Melolontha vulgaris* ap. | May 23 | 86. | *Phylloscopus Trochilus* sg. | Apl. 8 |
| 73. | *Rhizotrogus solstitialis* ap. | ..... | 87. | *Phylloscopus collybita* sg. | Mar. 16 |
| 74. | *Apis mellifica* ap. | Feb. 28 | 88. | *Alauda arvensis* sg. | Jan. 30 |
| 75. | *Pieris Brassicæ* ap. | Apl. 6 | 89. | *Fringilla cœlebs* sg. | Feb. 3 |
| 76. | *Pieris Rapæ* ap. | Apl. 4 | 90. | *Corvus frugilegus* builds | Feb. 22 |
| 77. | *Epinephile Janira* ap. | May 24 | 91. | *Cuculus canorus* heard | Apl. 10 |
| 78. | *Bibio Marci* ap. | Apl. 30 | | —— changes its note | June 4 |
| 79. | *Trichocera hiemalis* ap. | Jan. 1 | 92. | *Hirundo rustica* seen | Apl. 8 |
| 80. | *Strix Aluco* hoots | Mar. 4 | | —— begins to flock | Aug. 3 |
| 81. | *Muscicapa grisola* seen | May 8 | 93. | *Cypselus Apus* seen | May 2 |
| 82. | *Turdus musicus* sg. | Jan. 9 | 94. | *Columba Turtur* seen | May 2 |
| 83. | *Turdus pilaris* arrives | Nov. 19 | 95. | *Perdix cinerea* hatches | ..... |
| 84. | *Daulias Luscinia* sg. | Apl. 9 | 96. | *Scolopax Rusticola* seen | ..... |
| 85. | *Saxicola Œnanthe* returns | Apl. 21 | 97. | *Rana temporaria* spawns | Mar. 12 |

Phenological observations have now been carried on in Hertfordshire for six years, and nearly half the species in the Meteorological Society's list have been observed every year of the six. A table showing the mean date of the earliest observations in each year for the first three years was given with the report for 1878,‡ and a table for the six years, 1876-81, accompanies the present report (pp. 76, 77). As in the previous table the phenomena are entered in the order of the mean date of their occurrence, the number of years from which this mean date is derived being entered in a column preceding that of the dates. It will be seen that 44 of the phenomena selected for observation have been observed six years, 17 five years, 18 four years, 4 three years, 11 two years, and 3 one year, and that only 3 have not been observed at all.

* At p. 80. † At p. 83.
‡ 'Trans. Watford Nat. Hist. Soc.,' Vol. II, pp. 234, 235.

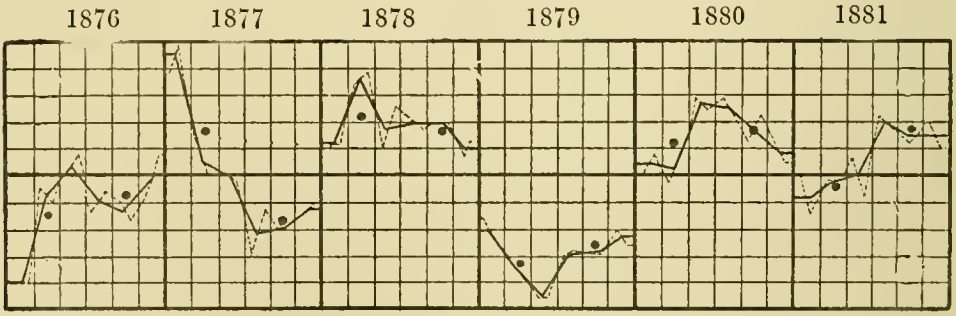
| | | | | |
|---|---|---|---|---|
| 79. | Winter Gnat (*Trichocera hiemalis*) ap. .. .. | 4 | Jan. | 3 |
| 81. | Song-thrush (*Turdus musicus*) sg. .. .. .. | 5 | ,, | 15 |
| 88. | Skylark (*Alauda arvensis*) sg. .. .. .. .. | 6 | ,, | 21 |
| 70. | Snowdrop (*Galanthus nivalis*) fl. .. .. .. | 5 | ,, | 27 |
| 74. | Honey-bee (*Apis mellifica*) ap. .. .. .. .. | 5 | ,, | 30 |
| 89. | Chaffinch (*Fringilla cœlebs*) sg... .. .. .. | 2 | Feb. | 1 |
| 66. | Hazel (*Corylus Avellana*) fl. .. .. .. .. | 4 | ,, | 7 |
| 53. | Ivy-leaved Speedwell (*Veronica hederifolia*) fl. | 4 | ,, | 15 |
| 90. | Rook (*Corvus frugilegus*) builds .. .. .. | 6 | ,, | 20 |
| 9. | Sweet Violet (*Viola odorata*) fl. .. .. .. | 6 | ,, | 24 |
| 37. | Coltsfoot (*Tussilago Farfara*) fl. .. .. .. | 6 | ,, | 28 |
| 63. | Dog's Mercury (*Mercurialis perennis*) fl. .. .. | 6 | ,, | 28 |
| 2. | Pilewort (*Ranunculus Ficaria*) fl. .. .. .. | 6 | March | 1 |
| 64. | Wych-elm (*Ulmus montana*) fl. .. .. .. | 5 | ,, | 4 |
| 69. | Daffodil (*Narcissus Pseudo-narcissus*) fl. .. .. | 5 | ,, | 8 |
| 65. | Great Sallow (*Salix caprea*) fl... .. .. .. | 4 | ,, | 9 |
| 25. | Barren Strawberry (*Potentilla Fragariastrum*) fl. | 5 | ,, | 13 |
| 6. | Hairy Bittercress (*Cardamine hirsuta*) fl.. .. | 3 | ,, | 14 |
| 80. | Tawny Owl (*Strix Aluco*) hoots .. .. .. | 3 | ,, | 14 |
| 8. | Whitlow-grass (*Draba verna*) fl. .. .. .. | 4 | ,, | 15 |
| 97. | Common Frog (*Rana temporaria*) spawns .. | 6 | ,, | 16 |
| 1. | Wood-anemone (*Anemone nemorosa*) fl. .. .. | 6 | ,, | 17 |
| 36. | Butter-burr (*Petasites vulgaris*) fl. .. .. .. | 4 | ,, | 18 |
| 61. | Cowslip (*Primula veris*) fl. .. .. .. .. | 6 | ,, | 18 |
| 86. | Willow-wren (*Phylloscopus Trochilus*) sg. .. | 2 | ,, | 20 |
| 87. | Chiff-chaff (*Phylloscopus collybita*) sg. .. .. | 4 | ,, | 22 |
| 4. | Marsh-marigold (*Caltha palustris*) fl. .. .. | 6 | ,, | 23 |
| 22. | Blackthorn (*Prunus spinosa*) fl.. .. .. .. | 6 | ,, | 27 |
| 76. | Small White Butterfly (*Pieris Rapæ*) ap. .. | 5 | ,, | 27 |
| 57. | Ground-ivy (*Nepeta Glechoma*) fl. .. .. .. | 6 | ,, | 28 |
| 12. | Greater Stitchwort (*Stellaria Holostea*) fl. .. | 6 | April | 10 |
| 30. | Wild Chervil (*Anthriscus sylvestris*) fl. .. .. | 6 | ,, | 12 |
| 84. | Nightingale (*Daulias Luscinia*) sg. .. .. .. | 6 | ,, | 14 |
| 92. | Swallow (*Hirundo rustica*) first seen .. .. | 6 | ,, | 14 |
| 7. | Cuckoo-flower (*Cardamine pratensis*) fl. .. .. | 6 | ,, | 15 |
| 91. | Cuckoo (*Cuculus canorus*) first heard .. .. | 6 | ,, | 17 |
| 71. | Blue-bell (*Endymion nutans*) fl. .. .. .. | 6 | ,, | 19 |
| 75. | Large White Butterfly (*Pieris Brassicæ*) ap. .. | 5 | ,, | 20 |
| 62. | Ribwort-plantain (*Plantago lanceolata*) fl. .. | 6 | ,, | 24 |
| 78. | St. Mark's Fly (*Bibio Marci*) ap. .. .. .. | 2 | ,, | 27 |
| 3. | Upright Crowfoot (*Ranunculus acris*) fl. .. .. | 6 | ,, | 28 |
| 52. | Germander-speedwell (*Veronica Chamædrys*) fl. | 6 | ,, | 29 |
| 16. | Herb-Robert (*Geranium Robertianum*) fl.. .. | 6 | ,, | 30 |
| 20. | Bush-vetch (*Vicia sepium*) fl. .. .. .. .. | 6 | May | 3 |
| 60. | Creeping Bugle (*Ajuga reptans*) fl. .. .. .. | 6 | ,, | 4 |
| 94. | Turtle-dove (*Columba Turtur*) first seen .. .. | 2 | ,, | 6 |
| 10. | Milkwort (*Polygala vulgaris*) fl. .. .. .. | 6 | ,, | 8 |
| 51. | Red Rattle (*Pedicularis sylvatica*) fl. .. .. | 4 | ,, | 9 |
| 50. | Comfrey (*Symphytum officinale*) fl. .. .. .. | 4 | ,, | 10 |
| 93. | Swift (*Cypselus Apus*) first seen .. .. .. | 5 | ,, | 10 |

| | | | | |
|---|---|---|---|---|
| 32. | Cleavers (*Galium aparine*) fl. .. .. .. .. | 6 | May | 17 |
| 24. | Silver-weed (*Potentilla anserina*) fl... .. .. | 6 | ,, | 18 |
| 17. | Dutch Clover (*Trifolium repens*) fl. .. .. .. | 6 | ,, | 20 |
| 81. | Flycatcher (*Muscicapa grisola*) first seen.. .. | 5 | ,, | 20 |
| 46. | Mouse-ear (*Hieracium Pilosella*) fl. .. .. .. | 6 | ,, | 21 |
| 39. | Ox-eye (*Chrysanthemum Leucanthemum*) fl. .. | 6 | ,, | 23 |
| 18. | Bird's-foot Trefoil (*Lotus corniculatus*) fl. .. | 6 | ,, | 24 |
| 77. | Meadow-brown Butterfly (*Epinephele Janira*) ap. | 4 | ,, | 24 |
| 72. | Cock-chafer (*Melolontha vulgaris*) ap. .. .. | 2 | ,, | 31 |
| 5. | Red Poppy (*Papaver Rhœas*) fl. .. .. .. | 6 | June | 1 |
| 11. | Ragged Robin (*Lychnis Flos-cuculi*) fl. .. .. | 6 | ,, | 1 |
| 68. | Yellow Iris (*Iris Pseudacorus*) fl. .. .. .. | 6 | ,, | 4 |
| 21. | Meadow-vetchling (*Lathyrus pratensis*) fl. .. | 6 | ,, | 5 |
| 67. | Spotted Orchis (*Orchis maculata*) fl.. .. .. | 6 | ,, | 5 |
| 26. | Dog-rose (*Rosa canina*) fl... .. .. .. .. | 6 | ,, | 6 |
| 73. | Fern-chafer (*Rhizotrogus solstitialis*) ap... .. | 1 | ,, | 6 |
| 13. | Common Mallow (*Malva sylvestris*) fl. .. .. | 6 | ,, | 7 |
| 59. | Hedge-woundwort (*Stachys sylvatica*) fl.. .. | 6 | ,, | 7 |
| 55. | Wild Thyme (*Thymus Serpyllum*) fl. .. .. | 5 | ,, | 9 |
| 91. | Cuckoo (*Cuculus canorus*) changes its note .. | 2 | ,, | 9 |
| 28. | Broad Willow-herb (*Epilobium montanum*) fl... | 5 | ,, | 11 |
| 56. | Self-heal (*Prunella vulgaris*) fl.. .. .. .. | 4 | ,, | 17 |
| 43. | Spear-thistle (*Carduus lanceolatus*) fl. .. .. | 4 | ,, | 18 |
| 95. | Partridge (*Perdix cinerea*) hatches .. .. .. | 2 | ,, | 19 |
| 44. | Field-thistle (*Carduus arvensis*) fl. .. .. .. | 5 | ,, | 20 |
| 23. | Meadow-sweet (*Spiræa Ulmaria*) fl. .. .. | 5 | ,, | 21 |
| 42. | Black Knapweed (*Centaurea nigra*) fl. .. .. | 5 | ,, | 22 |
| 38. | Milfoil (*Achillea Millefolium*) fl. .. .. .. | 6 | ,, | 28 |
| 15. | Upright St. John's-wort (*Hypericum pulchrum*) fl. | 4 | ,, | 30 |
| 58. | Hemp-nettle (*Galeopsis tetrahit*) fl. .. .. .. | 4 | ,, | 30 |
| 19. | Tufted Vetch (*Vicia Cracca*) fl. .. .. .. | 5 | July | 1 |
| 33. | Yellow Bedstraw (*Galium verum*) fl. .. .. | 6 | ,, | 2 |
| 41. | Ragwort (*Senecio Jacobœa*) fl. .. .. .. .. | 6 | ,, | 2 |
| 85. | Wheatear (*Saxicola Œnanthe*) returns .. .. | 0 | | |
| 14. | Square St. John's-wort (*Hypericum tetrapterum*) fl | 3 | ,, | 5 |
| 27. | Great Hairy Willow-herb (*Epilobium hirsutum*) fl | 4 | ,, | 10 |
| 45. | Corn Sow-thistle (*Sonchus arvensis*) fl. .. .. | 4 | ,, | 11 |
| 47. | Hair-bell (*Campanula rotundifolia*) fl. .. .. | 6 | ,, | 11 |
| 49. | Greater Bindweed (*Convolvulus sepium*) .. .. | 4 | ,, | 15 |
| 34. | Common Teasel (*Dipsacus sylvestris*) fl. .. .. | 2 | ,, | 22 |
| 35. | Devil's-bit (*Scabiosa succisa*) fl. .. .. .. | 4 | ,, | 26 |
| 29. | Wild Angelica (*Angelica sylvestris*) fl. .. .. | 2 | ,, | 30 |
| 54. | Water-mint (*Mentha aquatica*) fl. .. .. .. | 2 | ,, | 30 |
| 92. | Swallow (*Hirundo rustica*) begins to flock .. | 1 | Aug. | 3 |
| 40. | Mugwort (*Artemisia vulgaris*) fl. .. .. .. | 3 | ,, | 5 |
| 48. | Autumn Gentian (*Gentiana Amarella*) fl.. .. | 0 | | |
| 31. | Ivy (*Hedera Helix*) fl. .. .. .. .. .. | 5 | Sept. | 29 |
| 87. | Chiff-chaff (*Phylloscopus collybita*) last heard .. | 0 | | |
| 83. | Fieldfare (*Turdus pilaris*) arrives .. .. .. | 2 | Nov. | 8 |
| 96. | Woodcock (*Scolopax Rusticola*) first seen.. .. | 1 | ,, | 8 |

Confining our remarks to the plants, and excluding the ivy, flowering in September, it will be found that out of 38 species of which the time of flowering has been observed in all the six years, to which may be added 10 with only one year out of the six without a record, all of which 48 species come into flower as a rule during the six months February to July, 22 came out in 1881 earlier than the previous mean date (1876-80), 8 later, and 18 within three days of the previous mean, showing that in 1881 vegetation was generally in a rather more forward state than the average of the previous five years.

It has before been shown that in 1880 vegetation was more than eight days more forward than the average of the four previous years. A similar analysis of all the dates in 1881 of the 48 species mentioned shows an extent of forwardness over the mean of the previous five years of only 3 days, or more exactly 3·1.

The relation of each of these six years to the mean of the whole is shown in the accompanying diagram. The 48 selected species which come into flower from February to July, as a rule, being grouped into twelve sets of four each, each set will represent a duration of time of about a fortnight. The mean for the six years of each of these groups being calculated, and also the mean for each year of the six, the difference in each year from the mean of the whole period is laid down on the diagram, if earlier above the centre line and if later below it, each horizontal line representing four days' variation from the mean. The points thus found are then connected by a dotted line, which therefore shows approximately the state of vegetation for about every two weeks during six months each year in reference to the mean of the six years.




The number of species from the observation of which these means are derived being very small, the line thus shown is necessarily irregular, and a nearer approach to the actual state of vegetation may be arrived at by taking the mean date of flowering of every eight species instead of that of every four. In the same diagram the result of this is shown in the unbroken line, which therefore represents the extent of backwardness or forwardness of each month from February to July. It will be seen that in February 1876 and April 1879 plants were very late in flowering, that in February 1877 and March 1878 they were very early, and that in April and July 1876, March and April 1877, February and March 1880, and March and April 1881 they were in flower at about the average date for the whole period.

By grouping these 48 species into two sets of 24 each, the character of the spring and summer seasons may be indicated. This is shown in the diagram by the single round dot. Vegetation is thus shown to have been in 1876 backward in both spring and summer; in 1877 forward in spring and backward in summer; in 1878 forward in both spring and summer; in 1879 backward in both spring and summer, especially so in spring; in 1880 forward in both spring and summer; and in 1881 about the mean in spring and forward in summer.

The following are the species from the observation of which these results have been derived:—

For February (Jan. 27 to Mar. 13).

| | |
|---|---|
| 70. *Galanthus nivalis.* | 2. *Ranunculus Ficaria.* |
| 9. *Viola odorata.* | 64. *Ulmus montana.* |
| 37. *Tussilago Farfara.* | 69. *Narcissus Pseudo-narcissus.* |
| 63. *Mercurialis perennis.* | 25. *Potentilla Fragariastrum.* |

For March (Mar. 14 to Apl. 15).

| | |
|---|---|
| 1. *Anemone nemorosa.* | 57. *Nepeta Glechoma.* |
| 61. *Primula veris.* | 12. *Stellaria Holostea.* |
| 4. *Caltha palustris.* | 30. *Anthriscus sylvestris.* |
| 22. *Prunus spinosa.* | 7. *Cardamine pratensis.* |

For April (Apl. 16 to May 8).

| | |
|---|---|
| 71. *Endymion nutans.* | 16. *Geranium Robertianum.* |
| 62. *Plantago lanceolata.* | 20. *Vicia sepium.* |
| 3. *Ranunculus acris.* | 60. *Ajuga reptans.* |
| 52. *Veronica Chamædrys.* | 10. *Polygala vulgaris.* |

For May (May 9 to June 1).

| | |
|---|---|
| 32. *Galium Aparine.* | 39. *Chrysanthemum Leucanthemum.* |
| 24. *Potentilla anserina.* | 18. *Lotus corniculatus.* |
| 17. *Trifolium repens.* | 5. *Papaver Rhœas.* |
| 46. *Hieracium Pilosella.* | 11. *Lychnis Flos-cuculi.* |

For June (June 2 to 19).

| | |
|---|---|
| 68. *Iris Pseudacorus.* | 13. *Malva sylvestris.* |
| 21. *Lathyrus pratensis.* | 59. *Stachys sylvatica.* |
| 67. *Orchis maculata.* | 55. *Thymus Serpyllum.* |
| 26. *Rosa canina.* | 28. *Epilobium montanum.* |

For July (June 20 to July 13).

| | |
|---|---|
| 44. *Carduus arvensis.* | 19. *Vicia Cracca.* |
| 23. *Spiræa Ulmaria.* | 33. *Galium verum.* |
| 42. *Centaurea nigra.* | 41. *Senecio Jacobæa.* |
| 38. *Achillea Millefolium.* | 47. *Campanula rotundifolia.* |

During the period of our register these species, as is indicated above, have not all opened their flowers, on the average, within the month for which they are selected, for, in order to derive the several means from equal numbers of observations, by which alone truly comparable results can be attained, it has been necessary to utilise observations the mean dates of which extend over somewhat irregular periods.

X.

# NOTES ON INSECTS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1881.

By Eleanor A. Ormerod, F.M.S.

*Read at Watford, 21st March, 1882.*

In compliance with the request of our Secretary that I would arrange for the Society the Entomological Observations of 1881, I endeavour to offer a Report, but at the same time I much regret that the notes of our observers are so few in number, and record so little beyond dates of first appearance, that they are scarcely of the interest we could wish.

The first appearance of insects has been recorded by the following observers :—

At Bushey, Watford, by Dr. A. T. Brett; at Watford by Mr. J. Hopkinson; at Harpenden by Mr. J. J. Willis; at St. Albans by Mr. A. E. Gibbs; at Redbourn Bury, St. Albans, by Mrs. Arnold; at Hertford by Mr. R. T. Andrews; at Fanhams Hall, Ware, by Mr. R. B. Croft; at Great Hormead, Buntingford, by the Rev. J. C. ff. Chamberlain; at Throcking, Buntingford, by the Rev. C. W. Harvey; and at Ashwell by Mr. H. George Fordham.

The observations are as follow :—

*Melolontha vulgaris* (cockchafer)—seen at Harpenden, May 23; Great Hormead, Buntingford, June 3.

*Apis mellifica* (honey-bee)—at Ashwell, Jan. 31; Ware, Feb. 28; Great Hormead (Buntingford), Harpenden, and Hertford, March 5; Throcking, March 6.

*Pieris Brassicæ* (large white cabbage-butterfly)—at Harpenden, April 6; Hertford, April 7; Watford, April 15; Bushey, April 16; Great Hormead, Buntingford, April 17; Redbourn Bury, April 25; St. Albans, May 11.

*Pieris Rapæ* (small white cabbage-butterfly)—at Hertford, April 8; Ware and St. Albans, April 10; Watford, April 10; Bushey, April 16; Great Hormead and Throcking, near Buntingford, April 17; Harpenden, May 28.

*Epinephile Janira* (meadow-brown butterfly)—at Hertford, May 24.

*Bibio Marei* (St. Mark's fly)—at Watford, April 30.

*Trichoeera hiemalis* (winter gnat)—at Watford, Jan. 1; not having been noticed in the previous December.

*Gonepteryx Rhamni* (the brimstone butterfly) and *Vanessa Urticæ* (the common tortoise-shell) were seen on the wing on the 11th of March (which is recorded as a warm sunny day) at Throcking, Buntingford; and *Vanessa Io* (the peacock butterfly) was seen at Hertford on the preceding day, March 10.

From the above notes it appears that honey-bees were noticed at four of the six localities of observation respectively on the 5th or 6th of March, and that of seven observations of the appearance of

the large white butterfly, six occurred from April 6th to 25th; and of eight observations of the small white butterfly, seven took place from April 8th to 17th.

Observations have also been forwarded regarding an appearance of white butterflies in enormous numbers for a few hours at a locality in the parish of Great Gaddesden near Hemel Hempstead. It is much to be regretted that no specimens were secured, but such being the case it is perhaps better not to enter here on further details of this unusual circumstance.

The year 1881 was a season of severe insect-injury to many crops, and if we turn now to records bearing on this point, we shall find that Hertfordshire did not escape. A note of much interest contributed by Mr. Silvester, Hedges, St. Albans, mentions that the damage done by turnip-fly in that neighbourhood was almost incalculable. Some few localities seem to have escaped, but generally after repeated sowings either the swedes had to be ploughed up and the ground sown with rape or white turnip, or the few swedes which escaped the ravages of the turnip-fly were patched with white or yellow turnip to form a crop. Mr. Silvester mentions that on his own farm, out of 60 acres of swedes, only 20 withstood the attack of fly, and the remaining 40 had to be resown; he also draws attention to the circumstance of the "fly" having cleared whole fields of charlock in the neighbourhood before the turnips came up for it to feed on. This point (of the food afforded to the "insect-pest" by this troublesome weed) is one which deserves much attention; for by diminishing the weeds that feed and shelter it until the crop is ready we should diminish its numbers.

The following notes were forwarded to me relatively to insect-pests of the crops, from Knebworth, for my Report on Injurious Insects, by an excellent observer, Mr. Benjamin Brown, and though already published, I venture to offer them in order to give some idea of the serious extent to which attack has been going on around us, and the important service that would be rendered by obtaining the contributions of others similarly qualified to note the presence of important attacks, especially if accompanied by suggestions on methods of prevention.

Mr. Brown says of the *Plusia Gamma* (the silver Y moth which was so prevalent in 1879) that he never saw it in such small numbers as in the summer and winter of 1881, and no damage was caused by it.

*Sitones lineatus* (the pea-weevil) was unusually abundant in April and May, the dry weather favouring the weevils and being bad for the peas; 20 acres of white peas were so much damaged by these destructive beetles where the land was rough, and therefore less moist than usual, that the loss was estimated at (at least) £40.

The larvæ of *Tipula oleracea*, commonly known as daddy-long-legs grubs, which were amongst the worst insect troubles of 1880, were still committing great ravages at Baldock, and the consequent loss on 40 acres of wheat was estimated at quite £100.

Going a little over the Hertfordshire border to the rich gardening district of Sandy near Biggleswade, serious damage (and to a much greater extent than is usual) was caused by the larvæ of *Anthomyia* (*ceparum ?*), the onion-maggot, to the onion crops which are grown largely in that neighbourhood.

*Cecidomyia Tritici*, or the wheat-midge, was seen swarming in chaff near Knebworth at the end of June, and its larvæ known as "red maggots" did an appreciable amount of mischief.

Turnip-fly—scientifically *Phyllotreta*, and where identified, of the species *undulata*—is recorded by the observer as having done greater damage than he had ever known in previous years, owing greatly to the dry weather which did not allow the plants to grow away from the attack; that is, they could not grow quickly enough to counterbalance the injury caused by the ravenous feeding of the "fly" or flea-beetle.

*Agrotis segetum*, or the turnip-moth, was also present and did considerable injury by means of its caterpillars to the turnip crops.

Other insects are mentioned, but the information being already published, I have only given some points to show the amount of injury going on around us and the great benefit that would ensue by any information being contributed that would bear directly on the subject, in addition to the notes of general entomological interest already requested from observers.

## XI.

## NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1881.

By John E. Littleboy.

*Read at Watford, 21st March, 1882.*

On referring to our register, I find that I have recorded, since my last report, thirteen additional species of birds. Of these thirteen species, only one belongs to the large class known as Passeres; two are Accipitres; four Grallatores; and the remainder Natatores. Twelve of them have been observed within the year; one, although only recently reported, belongs to a former year, but is comprised within the period of our register. I will proceed, as on previous occasions, briefly to notice them.

1. The Golden Oriole (*Oriolus Galbula*).—The nest of a golden oriole with three eggs was found at Charlie Farm, in the parish of Amwell, near Ware, by Mr. H. Beningfield and his son, in the month of June. It was built in a thick hawthorn hedge about ten feet from the ground. When first discovered it was believed to be a thrush's nest, but an inspection of the eggs quickly dispelled the illusion. I have carefully compared one of them with a number of authenticated specimens at the British Ornithologists' Union, and I think that there can be no doubt whatever as to the accuracy of this important announcement. The golden oriole is among the rarest of our summer visitors. The brilliant plumage of the male bird, said to be attained only in its second or third year, renders it peculiarly conspicuous, and whenever it occurs in our English counties, it is hunted down and shot with an eagerness worthy of a better cause. Yarrell * states that "its flat and saucer-shaped nest is very different in the style of its architecture from those of nearly all other birds, being placed in and suspended under the horizontal fork of a bough, to both branches of which it is firmly attached." It winters south of the Mediterranean, and when recorded in England has been generally met with in the month of May.

2. The Little Owl (*Carine noctua*).—I am informed by Mr. W. Norman, of Royston, that a "little owl" was taken at Ashwell on the borders of our county in the month of May, 1877. It is a rare bird, and having occurred within the period comprised by our register, I am pleased to be able to record it. The little owl is described by Macgillivray † as about the size of a jay, and is the smallest of its class. It is nocturnal in its habits, and this fact may probably account for its apparent scarcity.

3. The Honey-Buzzard (*Pernis apivorus*).—Two honey-buzzards were shot within the limits of our county on the 23rd of September.

* 'British Birds,' ed. iv. vol. i, p. 234.

† 'Rapacious Birds,' p. 359.

The first at Westmill Rectory, near Buntingford, where it was observed, by the Rev. J. A. Ewing, to alight on some palings about twenty yards from the house. It is described by Mr. Ewing as "a noble bird about two feet in length and four or thereabouts in expanse of wing." The second was taken at Little Hadham, near Bishop's Stortford. Its capture is thus described by Mr. Herbert Langton, in the 'Zoologist' for November, 1881:—"On September the 23rd, while shooting at Little Hadham, a honey-buzzard, mobbed by some half a dozen rooks, flew over me, and I was fortunate enough to secure it. It was a female in very dark plumage, and measured 53½ inches from tip to tip of wings." Honey-buzzards have been fairly numerous in Norfolk during the past autumn, and it is probable that our two visitors may have reached us from that county. It is believed that both were birds of the year.

The genus *Pernis*, represented in Europe by the honey-buzzard, was instituted by Baron Cuvier to distinguish it from true buzzards.* It is stated by Macgillivray † to be intermediate between kites and buzzards. It is said to differ from the latter in having a more elongated and less powerful beak, the wings and tail being also much longer. It may be distinguished from other raptorial birds by the plumage of its head. "There are no bristles about the bill or on the eyelids, but the loral spaces and eyelids are covered with small compact imbricated feathers." The honey-buzzard is rare in England; it is a summer visitant, and is most frequently met with in the Eastern counties. It is said to derive its name from its reputed fondness for honey and the honey-comb. "Instances are given," writes Yarrell,‡ "where honey-buzzards have excavated and devoured a wasp's nest," and I find that similar facts are recorded by other writers. It is probable that it attacks a wasp's nest for the sake of the larvæ or grubs that it contains rather than for its honey. Like other hawks it preys more or less upon reptiles, mice, and small birds, but it is, for the most part, insectivorous, and greedily devours coleopterous insects, caterpillars, butterflies, and moths.§ It is said to be the most gentle and docile of all birds of prey.

4. The Glossy Ibis (*Falcinellus igneus*). — On the 10th of September a glossy ibis was shot by Mr. Pantia Ralli on a lake in the grounds of Balls Park. The glossy ibis is an important addition to the birds of Hertfordshire. It has occasionally been met with in Kent and Sussex, but very rarely, of late, in any of the midland counties. It must not be confounded with its congener, the sacred bird of the Egyptians, which is more generally known, but which has only once been taken in this country. Mr. John H. Gurney, jun., has been good enough to supply me with the following notice:—"The glossy ibis is an inhabitant of Africa, and is rare to the north of the Mediterranean: it cannot be very common in Egypt, as in seven months' collecting there, I only saw *one*, and

* Yarrell, 'British Birds,' vol. i, p. 86.
† 'Rapacious Birds,' p. 257.
‡ 'British Birds,' vol. i, p. 86.
§ *Ib.*, p. 87.

that was near the famous Sitting Colossi, in the height of the migratory season, but I had a fine old bird sent me from Damietta, in the Delta. I have never believed that this species was ever sufficiently common in England to warrant the application of the old couplet which appears to refer to its market value—

> 'A Curlew, be she white or black,
> She carries ten-pence on her back.'

The grey-lag goose, the crane, and the spoonbill were common in the days of our forefathers, but not so the stork, the ibis, or the egret."

5. The Whimbrel (*Numenius Phæopus.*)—The Rev. C. W. Harvey reports that a whimbrel was shot by Mr. John Coleman, in the parish of Throcking, during the month of July. Our Society is indebted to Mr. John H. Gurney, jun., for the following particulars:—"The whimbrel is a bird well known to shore-shooters. It bears a general resemblance to a curlew, but differs from it in the size and colour of the crown of its head. It is of migratory habit; its distribution extending from Greenland to India and from Russia to the Cape of Good Hope. Captain Shelley met with it in Egypt, but it cannot be very common, as I did not see it during my seven months' collecting in that country. Probably it is nowhere commoner than in Iceland and the Faroe Isles, where it breeds abundantly. It also breeds sparingly in Scotland. In England it is known as a bird of spring passage, and, at various places, has obtained the name of 'May-bird.' In Ireland it is said to be common in that month, but very rare in the autumn, and several observers conjecture that whimbrels return southward in the autumn by a different route. On the coast of Norfolk—at such harbours as Breydon, Blakeney, and Lynn—their apparent scarcity is, I am sure, explained by their resemblance to the young of the curlew. I have frequently shot them and have found them easier to get near to than curlews. I often find single birds feeding at low-tide in salt-water ditches, a place the curlew hardly ever affects. I have one in my collection which was killed at Stratford-on-Avon, which is nearly in the centre of England."

6. The Dunlin (*Tringa alpina*).—Mr. W. Hill, jun., informs me that three dunlins were picked up, either dead or dying, after the great gale of January 18th, in the neighbourhood of Hitchin. The following account of the dunlin is from the pen of Mr. Henry Seebohm:*—"The dunlin is a circumpolar bird, visiting the British Isles in winter and breeding in considerable numbers in Scotland. Its principal breeding-ground is on the tundras beyond the limit of forest growth, but it is also found nesting south of the arctic circle. It winters in the basin of the Mediterranean, and in Africa as far south as Abyssinia."

7. The Ringed Plover (*Ægialitis Hiaticula*).—Mr. W. Norman reports that a ringed plover was killed by flying against telegraph-wires near Royston. The ringed plover or dotterel is common on

* 'Siberia,' p. 180.

almost all our coasts and may generally be observed wherever a wide stretch of beach is to be found. It remains with us throughout the year, "but is nevertheless migratory in spring and autumn." *

8. The Black-headed Gull (*Chroïcocephalus ridibundus*).—A black-headed gull was shot at Bennett's End, near Hemel Hempstead, about the middle of December. It is common on our English coasts, and is said to breed in Norfolk. In Scotland it is very abundant, and may be seen in large numbers on Loch Lomond and other lakes.

9. The Common Gull (*Larus canus*).—A common gull was shot near Hemel Hempstead about the close of the year. It has been reported on former occasions, but I have omitted to register it.

10. Richardson's Skua (*Stercorarius crepidatus*).—We are indebted to Mr. W. Hill, jun., of Hitchin, for the mention of a gull not previoutly recorded on our register. A specimen of Richardson's Skua, or, as it is sometimes styled, "The Arctic Gull," was shot near Stevenage on the 5th of November. "It is a circumpolar bird breeding upon most of the islands of the Arctic Ocean." † It is also said to breed in the Hebrides and Orkneys, and is met with occasionally in England during the winter months, but is by no means common. Like most of the gulls, it changes the colour of its plumage as it advances in age.

11. The Stormy Petrel (*Procellaria pelagica*).—A male and female petrel were picked up dead on the morning of the 15th of December in a field near East Lodge, Hemel Hempstead. The stormy petrel, better known among sailors as "Mother Carey's chickens," is the smallest of our web-footed birds. Popular superstition points to this bird as one of evil omen, but too frequently the precursor of wild and stormy weather. The fact appears to be that it prefers the twilight and the night, and, unless disturbed by tempest, remains, for the most part, secluded and hidden during the day. Its exceptional appearance is the result, in all probability, of existing, rather than impending, storm. The name "Petrel" is said to be derived from that of the Apostle Peter, and to be suggested by the bird's habit of lightly skimming or walking over the surface of the waves. I find that numerous instances are recorded of dead petrels having been picked up in the midland counties; the impossibility of obtaining suitable food satisfactorily accounts for their being taken in this condition. It seems certain that the two birds in question were unwilling visitors to Hertfordshire, and that they were blown across-land by the extreme violence of the December gales. It has been said of the petrel that she finds a home upon the waves—

> "A home, if such a place may be,
> For her who lives on the wild, wild sea."

12. The Bean-Goose (*Anser Segetum*).—A bean-goose was shot near Royston about the end of January. It is a winter visitant to

* Harting, 'Hand-book of British Birds,' p. 44. † 'Siberia,' p. 188.

the British Isles. It breeds in Iceland, Siberia, and Northern Europe, frequenting principally the open wastes within the arctic circle. Flocks of bean-geese occasionally fly over our county during the winter months, but generally at a height that secures them perfect immunity from the efforts of the sportsman. It is believed that they reach our shores from Iceland, and that they follow the coast-line that is supposed, in pre-historic times, to have stretched from that island, *viâ* the Faroes, to Scotland.

13. The Black Scoter (*Œdemia nigra*).—During February Mr. P. Clutterbuck observed a pair of black scoters on Bushey Heath. The male bird was the first to disappear, but it was followed by the female after the interval of a day or two. The black or common scoter is said to breed freely in some parts of Scotland, but is a winter visitant in both England and Ireland. It is the only duck that is completely black, and is readily distinguished from all others. It is an expert diver, and lives principally on small mollusks and crustaceans obtained by diving. It occurs but very rarely in our inland counties.

The birds now mentioned increase the number of species at present on our register to 137.

The dates at which the arrival and departure of our summer migrants and winter visitants have been reported, together with the names of the observers, will be found in the following tables:—

Summer Migrants.

| Species. | Locality. | Date. | | Observer. |
|---|---|---|---|---|
| Nightingale | Hailey Hall, Hertford | Apl. | 9 | H. C. Heard. |
| (*Daulias Luscinia*) | Throcking Rectory | ,, | 11 | Rev. C. Harvey. |
| | Odsey Grange | ,, | 12 | H. G. Fordham. |
| | Royston | ,, | 12 | P. F. Fordham. |
| | Royston | ,, | 13 | W. Norman. |
| | Watford | ,, | 13 | W. M. Fawcett. |
| | Fanhams Hall | ,, | 13 | R. B. Croft. |
| | Kimpton Rectory | ,, | 14 | Rev. T. D. Croft. |
| | Shenley | ,, | 15 | J. E. L. |
| | Watford | ,, | 15 | J. Hopkinson. |
| | Hoddesdon | ,, | 15 | Miss Warner. |
| | Moor Park | ,, | 16 | C. K. Smith. |
| | Hertford | ,, | 16 | R. T. Andrews. |
| | Redbourn Bury | ,, | 17 | Mrs. Arnold. |
| (Last heard) | Hunton Bridge | June | 11 | J. E. L. |
| Redstart | Hertford | Apl. | 25 | R. W. Brett. |
| (*Ruticilla phœnicurus*) | | | | |
| Whinchat | Odsey Grange | May | 13 | H. G. Fordham. |
| (*Pratincola rubetra*) | Elstree | ,, | 17 | J. E. L. |
| Wheatear | Royston | Apl. | 21 | P. F. Fordham. |
| (*Saxicola Œnanthe*) | Odsey Grange | ,, | 25 | H. G. Fordham. |
| Chiff-Chaff | Fanhams Hall | Mar. | 16 | R. B. Croft. |
| (*Phylloscopus collybita*) | Hunton Bridge | ,, | 24 | J. E. L. |
| | Royston | Apl. | 4 | P. F. Fordham. |
| | Watford | ,, | 8 | A. Barraud. |
| | Throcking Rectory | ,, | 14 | Rev. C. Harvey. |
| | Watford | ,, | 15 | B. C. Smith. |
| Willow-Wren | Odsey Grange | Apl. | 8 | H. G. Fordham. |
| (*Phylloscopus trochilus*) | Watford | ,, | 13 | A. Barraud. |

| Species. | Locality. | Date. | Observer. |
|---|---|---|---|
| Willow-Wren | Throcking Rectory | Apl. 14 | Rev. C. Harvey. |
| (*Phylloscopus trochilus*) | Shenley | ,, 15 | J. E. L. |
| | Royston | ,, 17 | P. F. Fordham. |
| Wood-Wren | Shendish | May | E. J. Lake. |
| (*Phylloscopus sibilatrix*) | Cassiobury | ,, | E. J. Lake. |
| Whitethroat | Royston | Apl. 22 | P. F. Fordham. |
| (*Sylvia rufa*) | Hunton Bridge | May 1 | J. E. L. |
| | Odsey Grange | ,, 3 | H. G. Fordham. |
| | Bricket Wood | ,, 5 | F. Littleboy. |
| Lesser Whitethroat | Hertford | Apl. 15 | R. W. Brett. |
| (*Sylvia curruca*) | Royston | May 3 | P. F. Fordham. |
| Blackcap | Watford | Apl. 13 | A. Barraud. |
| (*Sylvia Atricapilla*) | Grove Park | ,, 13 | F. Littleboy. |
| | Odsey Grange | ,, 14 | H. G. Fordham. |
| | Royston | ,, 15 | P. F. Fordham. |
| | Hertford | ,, 20 | R. W. Brett. |
| Sedge-Warbler | Hunton Bridge | ,, 11 | F. Littleboy. |
| (*Calamodus schœnobœnus*) | ,, ,, (common) | May 3 | F. Littleboy. |
| Red-backed Shrike | Redbourn | ,, 13 | E. Brown. |
| (*Lanius Collurio*) | Caldicott Hill | ,, 17 | J. E. L. |
| | Royston | ,, 24 | P. F. Fordham. |
| Spotted Flycatcher | Odsey Grange | ,, 8 | H. G. Fordham. |
| (*Muscicapa grisola*) | Royston | ,, 12 | P. F. Fordham. |
| | Hunton Bridge | ,, 15 | J. E. L. |
| (Last seen) | Odsey Grange | Sept. 4 | H. G. Fordham. |
| Swallow | Hailey Hall, Hertford | Apl. 8 | H. C. Heard. |
| (*Hirundo rustica*) | Royston | ,, 8 | P. F. Fordham. |
| | Watford | ,, 10 | J. Hopkinson. |
| | Redbourn Bury | ,, 11 | Mrs. Arnold. |
| | Hertford | ,, 11 | R. W. Brett. |
| | Watford | ,, 12 | A. Barraud. |
| | Kimpton Rectory | ,, 14 | Rev. T. D. Croft. |
| | Throcking Rectory | ,, 14 | Rev. C. Harvey. |
| | Hemel Hempstead | ,, 14 | F. Littleboy. |
| | Rickmansworth | ,, 15 | B. C. Smith. |
| | Hoddesdon | ,, 15 | Miss Warner. |
| | Fanhams Hall | ,, 15 | R. B. Croft. |
| | Hertford | ,, 17 | R. T. Andrews. |
| | Great Hormead | ,, 17 | Rev. J. S. Chamberlain. |
| | Harpenden | ,, 17 | J. J. Willis. |
| | Hunton Bridge | ,, 18 | J. E. L. |
| (Last seen) | Royston | Oct. 16 | P. F. Fordham. |
| ,, | Ashwell | ,, 26 | H. G. Fordham. |
| Martin | Hertford | Apl. 15 | R. W. Brett. |
| (*Chelidon urbica*) | Royston | May 4 | P. F. Fordham. |
| | Ashwell | ,, 5 | H. G. Fordham. |
| (Last seen) | Odsey Grange | Oct. 15 | H. G. Fordham. |
| | Hunton Bridge | ,, 15 | F. Littleboy. |
| Sand-Martin | Denham, Herts | Mar. 20 | S. Humbert. |
| (*Cotyle riparia*) | Hertford | Apl. 15 | R. W. Brett. |
| | Near Rickmansworth | Mar. 21 | H. Procter. |
| Wryneck | Hertford | Apl. 17 | R. W. Brett. |
| (*Yunx torquilla*) | Near Watford | July 23 | A. J. Copeland. |
| Cuckoo | Hailey Hall | Apl. 10 | H. C. Heard. |
| (*Cuculus canorus*) | King's Langley | ,, 11 | H. Betts. |
| | Throcking Rectory | ,, 14 | Rev. C. Harvey. |
| | Kimpton Rectory | ,, 14 | Rev. T. D. Croft. |
| | Great Hormead | ,, 14 | Rev. J. S. Chamberlain. |

| Species. | Locality. | Date. | Observer. |
|---|---|---|---|
| Cuckoo (*Cuculus canorus*) | Fanhams Hall | Apl. 14 | R. B. Croft. |
| | St. Albans | ,, 15 | A. E. Gibbs. |
| | Redbourn Bury | ,, 15 | Mrs. Arnold. |
| | Watford | ,, 15 | Mrs. Hopkinson. |
| | Harpenden | ,, 15 | J. J. Willis. |
| | Hertford | ,, 17 | R. T. Andrews. |
| | Odsey Grange | ,, 20 | H. G. Fordham. |
| | Hoddesdon | ,, 21 | Miss Warner. |
| | Royston | ,, 22 | W. Norman. |
| | Royston | ,, 25 | P. F. Fordham. |
| Swift (*Cypselus Apus*) | Town Hall, St. Albans | Apl. 10 | Henry Lewis. |
| | Watford | May 2 | A. Barraud. |
| | Hunton Bridge | ,, 3 | J. E. L. |
| | Redbourn Bury | ,, 5 | Mrs. Arnold. |
| | Bovingdon | ,, 7 | Members of H.N.H.S. |
| | Harpenden | ,, 10 | J. J. Willis. |
| | Great Hormead | ,, 11 | Rev. J. S. Chamberlain. |
| | Royston | ,, 16 | P. F. Fordham. |
| | Odsey Grange | ,, 16 | H. G. Fordham. |
| (Last seen) | Hunton Bridge | Sept. 1 | J. E. L. |
| | Odsey Grange | ,, 2 | H. G. Fordham. |
| Turtle Dove (*Turtur auritus*) | Odsey Grange | May 2 | H. G. Fordham. |
| | Great Hormead | ,, 11 | Rev. J. S. Chamberlain. |
| | Throcking Rectory | ,, 27 | Rev. C. Harvey. |
| (Last seen) | Odsey Grange | Sept. 24 | H. G. Fordham. |

## Spring, Autumn, and Winter Visitants.

| | | | |
|---|---|---|---|
| Fieldfare (*Turdus pilaris*) | Royston | Feb. 22 | P. F. Fordham. |
| | Windridge Farm | Nov. 19 | O. R. Ilott. |
| | Odsey Grange | ,, 25 | H. G. Fordham. |
| Ring-Ousel (*Turdus torquatus*) | Near Royston | May 20 | W. Norman. |
| | Stanmore | Oct. 29 | P. Clutterbuck. |
| Great Grey Shrike (*Lanius excubitor*) | Boxstead Farm, near Hemel Hempstead (a pair shot) | Jan. | W. W. Bowers. |
| Siskin (*Carduelis spinus*) | Near Hemel Hempstead. | Dec. | J. E. L. |
| | Hunton Bridge | Dec. | J. E. L. |
| Lesser Redpole (*Linota rufescens*) | Near Hemel Hempstead (two caught in nets) | Jan. | J. E. L. |
| Brambling (*Fringilla montifringilla*) | Little Gaddesden | Jan. | G Underwood. |
| | Near Hemel Hempstead. | Jan. 27 | W. Wyman. |
| | Aldenham | Feb. 2 | Miss Selby. |
| Snow Bunting (*Plectrophanes nivalis*) | Near Royston (several) | Jan. | W. Norman. |
| | Near Hitchin | Feb. | W. Hill, jun. |
| Hooded Crow (*Corvus Cornix*) | Odsey Grange (last seen) | Apl. 6 | H. G. Fordham. |
| | ,, ,, (first seen) | Oct. 11 | H. G. Fordham. |
| | Near Royston | ,, 27 | P. F. Fordham. |
| Short-eared Owl (*Asio accipitrinus*) | Hatfield Park (several shot) | Jan. | W. Platten. |

Sundry interesting notes have been received during the past year from various localities throughout our county. I select the following for publication.

The Great Grey Shrike (*Lanius excubitor*).—Two of these rare

birds were shot during the month of January on Mr. Ginger's farm, at Boxstead, near Hemel Hempstead. They are at present in the possession of Mr. Bowers of that town.

The Hedge-Sparrow (*Accentor modularis*).—Mr. W. Hill, jun., of Hitchin, reports the taking of a hedge-sparrow's nest with two eggs on the first day of January. The birds were watched during the building of the nest, and Mr. Hill carefully examined the yolk of one of the eggs and found it to be perfectly fresh.

The Siskin (*Carduelis Spinus*).—Flights of siskins are reported to have been observed in several localities during the months of January and December. In December they were repeatedly noticed about the alder trees near Hunton Bridge.

The Cirl Bunting (*Emberiza Cirlus*).—One of these birds was shot near Royston on the 14th of February, in company with a flock of yellow-hammers.

The Snow-Bunting (*Plectrophanes nivalis*).—Mr. W. Norman informs me that several of these birds were seen, about the beginning of the year, in the neighbourhood of Royston, and that two were caught alive in nets, together with a number of larks. Mr. W. Hill, jun., reports a specimen being shot near Hitchin in February, and it is now in his collection. The snow-bunting is a circumpolar bird, breeding principally within the Arctic circle. It has only once before been reported, and we are probably indebted to the extreme severity of the winter of 1880-81 for its appearance in our county.

The Wryneck (*Yunx Torquilla*).—Mr. A. J. Copeland has kindly forwarded the following note:—"Yesterday afternoon (July 22) my gardener brought me a very fine specimen of the wryneck; he had caught it in the greenhouse. The bird was the most self-possessed I ever saw, almost tame; he stroked its head, and it showed, to perfection, the peculiar habit it has of twisting its neck with a slow, undulatory movement, like that of a snake.* When released it flew away, as lively as possible, into the Cassiobury woods."

The Cuckoo (*Cuculus canorus*).—On the 9th of July a young cuckoo was taken from the nest of a pied-wagtail which had built for the second time during the season in some ivy growing against the mill-house, Hunton Bridge, only about ten yards from the mill.

The Kingfisher (*Alcedo Ispida*).—Dr. Brett reports the finding of a kingfisher's nest, with eight eggs, in a bank near Hamper Mills. A workman at the mills informed him that, on two previous occasions, he had seen eight young kingfishers in the nest.

The Hobby (*Falco Subbuteo*).—Lord Ebury informs me that a nest of the hobby with four eggs was taken by his gamekeeper from a fir tree in Moor Park. This is the first time that the nesting of the hobby has been reported within the limits of our county.

The Partridge (*Perdix cinerea*).—A nest with twelve eggs was found early in June, 16 feet from the ground, on a haystack, at Little Munden. I have once before recorded a similar occurrence,

* See Harting's 'Summer Migrants,' p. 245.

but it is very unusual. The Rev. T. D. Croft reports that a "snow-white" partridge was frequently observed from the railway on the Hatfield side of Cole Green. It was seen by himself, Mr. Richard Hoare, and other gentlemen.

The Heron (*Ardea cinerea*).—Mr. P. F. Fordham reports having seen two herons near Royston on the 14th of January. A specimen was shot at Bennett's End, near Hemel Hempstead, in December.

The Green Sandpiper (*Helodromas ochropus*).—A green sandpiper is again reported, by Mr. W. Hill, jun., as observed, during the autumn, near Hitchin.

The Spotted Crake (*Porzana maruetta*).—A spotted crake was killed in the month of October, by flying against the telegraph-wires, near the railway-arch at the bottom of Watford. It is now in the possession of Mr. Walter Downer.

The Dusky Grebe (*Podiceps cornutus*).—A dusky grebe was caught by some boys in Gadebridge Park, near Hemel Hempstead. It has been mounted by Mr. Bowers, and is now in his possession.

General Remarks.—The influx of numerous sea-birds during the months of October, November, and December, appears to be the distinguishing feature of the present year. It is not difficult to account for the occurrence. On the 14th of October a violent storm of wind, the effects of which have been already noted by the Rev. C. W. Harvey, passed over our district. Storms of less severity occurred during the succeeding months, and it is reasonable to suppose that the birds in question were driven inland by atmospheric forces which they were unable to resist.

I am informed by sportsmen that partridges have been unusually abundant throughout the county during the past season.

The extreme scarcity of fieldfares and redwings during the two consecutive winters, 1880-1 and 1881-2, the first remarkable for its severity and the latter for its mildness, is a fact worthy of notice. Precisely opposite causes appear, in this instance, to have produced similar results. In 1880-1 fieldfares and redwings found the English winter too severe for them and left us for the south. In 1881-2 the mildness of the European winter has allowed them to remain in southern Russia or Scandinavia. Mr. J. Cordeaux informs me that but very few fieldfares and redwings passed the light-ships on our east coast during the autumn, and that he has seen none in Lincolnshire during the winter.

Several of our members have remarked on the comparative scarcity of "summer migrants"; among these the red-backed shrike has been especially alluded to by the Rev. C. W. Harvey. On the other hand, I think it must be admitted that nightingales, flycatchers, and some of the warblers, have been tolerably abundant.

Allow me once more heartily to thank my correspondents for their interesting communications. I am glad to report several additions to their number from the eastern side of the county.

XII.

# ON *CHLORODESMOS HISPIDA*, A NEW FLAGELLATE ANIMALCULE.

By F. W. Phillips, F.L.S.

*Read at Hertford, 24th November*, 1881.

PLATE I.

The animalcule which I am about to introduce to your notice differs so strikingly from all other known forms that it is necessary to institute a new genus for its reception.

It was found three weeks ago in water taken from Mangrove Lane, Hertford, by Mr. Robinson, who drew my attention to an animalcule having a strange motion. Being familiar with most of the flagellate types of the Infusoria, I perceived that, although possessing certain characteristics resembling those of *Synura Uvella*, it differed from anything I had ever seen or read about.

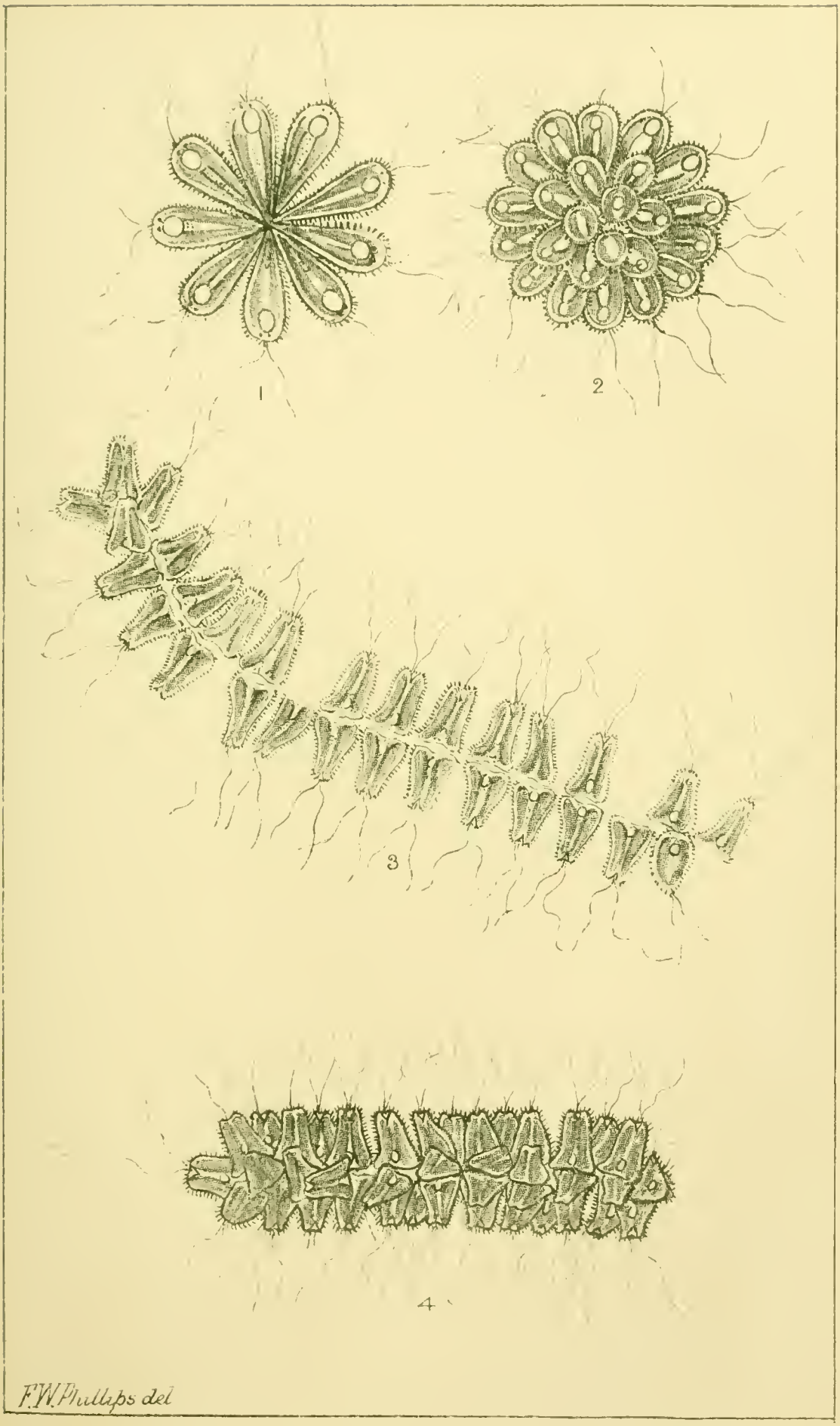
We met with three examples entangled in vegetable débris which interfered somewhat with the view. I investigated them carefully, making a drawing of them, as far as I could make them out, and sent it to Mr. Saville Kent, the authority on the Infusoria. He replied: "It is a new and highly interesting form, allied to *Uvella*, but differing substantially in the chain-like grouping of the constituent zooids, and referable to my newly-proposed family group, Chrysomonadinæ, in which all the various types are characterised by the possession of two distinct lateral pigment-bands."

Before I describe the animalcule, it would perhaps be well to give an outline-sketch of the section and family to which it belongs.

The present system of classification is based on the manner in which food-particles are incepted, or taken in.

The first order of the Infusoria is called Pantostomata, and includes all those animalcules which incept food indifferently at any part of the body, like the typical *Amœba*. The second order is called Discostomata: here the animalcules incept food within a circumscribed space, within a collar-like expansion; this manner of inception is confined to one section, Choano-flagellata, or the collared monads. In the third order, Eustomata, there is a distinct oral aperture, or mouth, as in *Euglena;* and in the fourth order, Polystomata, there are many such apertures, *Acineta* being an example of this.

The order Eustomata, to which our animalcule belongs, is subdivided into three sections. The first, called Flagellata-eustomata, includes those species which possess one or more flagellate, or whip-like appendages, serving as the sole organs of locomotion. In the second section, Cilio-flagellata, we find the flagella supplemented by rows of cilia; and in the third section the flagellum




SYNURA UVELLA

AND

CHLORODESMIS HISPID

disappears, cilia only being present. The section Flagellata-eustomata is divided into nine families; we have to deal with the fifth, called Chrysomonadinæ (χρυσὸς, gold; μόνος, single). Of this family I will give you the diagnosis contained in Mr. Saville Kent's Manual.

"Animalcules bi-flagellate, rarely mono-flagellate, social or solitary, free swimming or adherent, naked, loricate or immersed within a common matrix or zoocytium; endoplasm always containing two lateral differentiated pigment-bands, occasionally green but more usually olive-brown or yellow; one or more supplementary eye-like pigment-spots frequently present."

The animalcules included in this family group were for a long time held to be approximate to *Volvox*, *Protococcus*, and other unmistakable protophytes, and it is only recently that their undoubted animal organization has been substantiated.

The family Chrysomonadinæ is divided into fifteen genera:—*Chloromonas*, *Chrysomonas*, *Microglena*, *Cryptomonas*, *Nephroselmis*, *Stylochrysalis*, *Uvella*, *Chloranginum*, *Hymenomonas*, *Chrysopyxsis*, *Epipyxsis*, *Dinobryon*, *Synura*, *Syncrypta*, and *Uroglena*.

The single species, *Synura Uvella*, which constitutes the genus *Synura*, most nearly resembles our new animalcule. In the genus *Synura* the animalcules are united in spheroidal clusters which swim freely through the water. Each zooid inhabits a closely-fitting lorica of a pear-shaped contour, which is beset with short spinous processes. There are two flagella of equal length. The endoplasm contains two lateral pigment-bands in which are developed two minute, coloured, pigment eye-like spots. A large vascular space exists at the anterior extremity, which is supposed to fulfil a pharyngeal office. There are three contractile vesicles situated at the anterior extremity. The spherical clusters consist of as many as eighty zooids.

The animalcules which are now for the first time recorded, exist in colonies of about thirty zooids, grouped together in a chain-like manner, and possibly united by a contractile, hyaline ligament of extreme delicacy. The constituent zooids each inhabit a closely-fitting lorica of a somewhat triangular aspect, pointed anteriorly, and twice the width posteriorly at the point of attachment. The lorica is covered with very minute spinous processes of even length. At the anterior extremity there is a slight indentation, in the centre of which is the oral aperture, which is continued into a short, distinct, triangular, pharyngeal cleft or cavity. Seen from a side view, the lorica has an oval aspect. The flagella are two in number and of equal length, issuing from the pharyngeal cleft. The endoplasm contains the two characteristic lateral pigment-bands; there are no eye-spots; one contractile vesicle is developed posteriorly.

The most remarkable characteristic in connection with these colonies is the peculiar movements, which are of a twofold nature. The first consists of an elongation and corresponding retraction of the whole chain of zooids to about five times the retracted length.

During these movements one end of the chain is anchored to some substance, the other floating freely with a worm-like motion; these movements take place at the rate of about three per minute. The second movement is a clapper-like motion, each zooid closing upon the other, like the two shells of a bivalve mollusk; this motion is much quicker than the former and is irregular, while the former is rhythmical.

Owing to the awkward position of those groups I saw, I have never been able to make out clearly the nature of the supposed elastic integument which unites the zooids, but from a careful examination of the movements, I have but little doubt as to its existence.

The genus and species may be thus briefly described:—

Genus *Chlorodesmos* (χλωρὸς, green; δεσμὸς, chain).

Animalcules free-swimming and adherent, united in chain-like, social clusters, each zooid contained in a separate membranous sheath or lorica; flagella two in number, subequal; endoplasm containing two lateral pigment-bands.

*C. hispida.* Loricæ triangular, widest posteriorly, their external surfaces beset with evenly-developed spinous processes; contained animalcules entirely filling the cavities of the loricæ; flagella produced from within a pharyngeal cavity or cleft, at anterior extremity; one contractile vesicle. Chain-like colonies consisting of as many as thirty zooids.

*Habitat.* Pond water.

## DESCRIPTION OF PLATE I.

Figs. 1–2. *Synura Uvella* (after Stein). 1. Small colony, showing manner of attachment. 2. Adult spheroidal colony-stock.

Figs. 3–4. *Chlorodesmos hispida.* 3. Colony attached and extended. 4. Colony free-swimming and contracted.

## XIII.

## MISCELLANEOUS NOTES AND OBSERVATIONS.

*Read at Watford, 22nd November,* 1881.

### Meteorology.

*Whirlwind between Watford and St. Albans.*—At a few minutes after 1 a.m on Tuesday the 9th of September, a destructive whirlwind just touched the edge of Bricket Wood where it adjoins the high-road close to the toll-gate about half-way between Watford and St. Albans.

Passing along the road a few days after it occurred I was able to trace its path for half a mile or more in a south-westerly and north-easterly direction. In its course large trees have been uprooted and portions of others broken off and scattered in all directions. One elm, about 11 feet in circumference three feet from the ground and scarcely any less twelve feet from the ground, and at least 60 or 70 feet in height—I could not tell exactly, for it had been sawn in pieces when I measured it—fell across the high-road, and must have completely blocked it at the time; and another, which I did not measure, fell at right angles to the former, across the bye-road leading to Waterdell Farm. Between these two trees a few branches have been carried away from some fir-trees at the extreme edge of Bricket Wood; and farther on, towards St. Albans, a small garden has been laid waste, some trees have had their lower and larger branches cut clean away while the upper branches remain intact, some have been split down as if by lightning, and one has had the upper portion cut off and carried away without injury to the lower branches. Other trees, in the direct path of the wind if it had travelled in a straight line, are quite uninjured.

That the storm took place at the time mentioned, and that it was a whirlwind, of which its effects are almost sufficient evidence, I was told by the toll-gate keeper, who had been up at 5 minutes to 1 to open the gate, and was aroused shortly afterwards by the noise of the wind and the crashing of the trees, all being quiet again before half-past 1.

It appears that this whirlwind was not, as might have been inferred from the absence of any further trace of it in the neighbourhood, quite local; for a similar phenomenon, though not so violent, occurred at Spring Grove, Isleworth, and is thus recorded in the 'Meteorological Magazine' (vol. xvi, p. 136) by Miss Ormerod:—"At 1·15 a.m. on the morning of the 9th inst. [Sept.], we were visited for a few minutes by a most tremendous gust of wind, which I estimated to be about '8' Beaufort notation, but the movement was very peculiar in the air, for though there was a force that rocked the large old elms close to my window nearly down to the ground, yet the large arms tossed wildly *to and fro*, but did *not* bend, as in a common gale, mainly in one direction, and then regain position. The highest rate of movement appeared to

be at 1·15 a.m., but I had been roused, as well as two others in the house, by the noise about four minutes before, and about the same number of minutes after, the great disturbance ceased." The coincidence in the time of occurrence of the whirlwind, at two places so distant from each other, is remarkable.—*John Hopkinson, Watford.*

## Entomology.

*A Cloud of Butterflies.*—On the 18th of July, as Mr. P. Procter was driving from Leighton Buzzard to The Hoo, Great Gaddesden, he was stopped by an agricultural labourer, who told him that he had better go round in another direction as "the road was blocked by butterflies." Mr. Procter treated the story as a hoax, and drove on. On reaching the lane between the "Cross-Hands" public-house and Hudnal Common, he was quickly undeceived; a cloud of common white butterflies, supposed to have been the larger white cabbage-butterfly (*Pieris Brassicæ*), presented a dense fluttering mass, extending twenty or thirty yards along the lane. Mr. Procter describes them as appearing "as thick as a swarm of bees," and states that it was with difficulty that he forced his horse through them.—*John E. Littleboy, Hunton Bridge.*

## Ornithology.

*A Cuckoo laying in a Swallow's Nest.*—My son, Mr. F. Rooper, some years since took the egg of a cuckoo out of a swallow's nest built under the bridge in Cassiobury Park. I do not remember any record of this egg being found in a swallow's nest,* but there is nothing extraordinary in it, the swallow being insectivorous. The fact, however, is interesting, as from its position the egg *must* have been placed in the nest by means of the cuckoo's beak. From the situation and form of the nest, it could not possibly have been laid in the ordinary way.—*George Rooper, Watford.*

* There appears to be only one other instance known, recorded in our 'Transactions' by Dr. Brett ('Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 136).—Ed.

XIV.

# HERTFORDSHIRE DEER-PARKS.

By James Edmund Harting, F.L.S., F.Z.S.

*Read at Watford, 20th December*, 1881.

Although the researches and inquiries carried on by any Natural History Society need not necessarily be restricted to objects within the county or district in which the Society has been formed, it is only natural to suppose that these should occupy the chief share of attention, since they possess a greater interest for members of the Society than topics having no special relation to the county. From this point of view it occurred to me that some account of Hertfordshire Deer-Parks—past and present—might be an acceptable contribution to our 'Transactions.'

In selecting this subject, however, I unfortunately under-estimated the length of the task I thus set myself, and, notwithstanding the diligent inquiries I have been making for some time past, I am forced to the unsatisfactory conclusion that considerably more time and labour must be expended than I have been able to bestow upon the subject before the Society can be in possession of anything like a complete account of Hertfordshire Deer-Parks. So intimately are these parks associated with all that goes to form a county history, that as well might I have undertaken a revision of the folios of Chauncy, Clutterbuck, or Cussans, as attempt, at so short a notice, a full exposition of the subject in question.

The remarks, then, which I have to offer, so far from being exhaustive, can only be regarded as forming the skeleton, as it were, of a more comprehensive essay, which the energy of some active member of this Society with more leisure and greater resources at his disposal than I can hope to possess, may some day bring to light.

With this apology for the incompleteness of my task, I will proceed to state such information as I have been able to collect.

In its literal sense the word "Park," from the French *parquer* (to pen cattle), signifies an inclosure.

Manwood, in his treatise on 'Forest Laws,' states that a *Park* only differs from a *Chace* in being inclosed. A *chace* he defines as "a franchise next in degree unto a *forest*, being an open place for the keeping of game, and in that respect something resembling it, yet with this difference that a *chace* hath neither the same kinds of game on it, nor any particular laws belonging to the same, proper to a *chace* only." The beasts of *forest* are, or were, the hart, hind, hare, boar, and wolf; while the beasts of *chace* are the buck, doe, fox, marten, and roe. In like manner all offenders in a *park*, as in a *chace*, are punishable by the common law of the realm and not by the forest-laws.

A park, then, is an inclosed chace, and may vary in extent from a few acres to a couple of thousand or more. It has three essentials,

*vert*, *venison*, and *inclosure*, and if any one of these be wanting, it is (strictly speaking) no longer a park. By the removal of any one of these essentials it becomes "disparked." From this it follows that on the death of the owner of a park the deer belong to the heir-at-law, because without them the park, which is his inheritance, would be no park. Formerly no one could make a park without a royal licence under the Great Seal; for by so doing he would be inclosing animals which are *feræ naturæ* and consequently *nullius in bonis*, and thus appropriating them by restraining them of their natural liberty, which no one could do without prescription or a grant from the Crown. It is true there are parks in use and reputation which have been formed without such licence, and, having been so used for a considerable period, the law allows the owner a right of action for killing or stealing deer therein; but whether these are parks, or not, they are "grounds inclosed where deer are usually kept" and are protected by statute.

To inquire into the various laws which have been made from time to time relating to deer, and to show how they have been modified, altered, or repealed, would not only require more space than can be here accorded to the subject, but would be in fact beside my present purpose, which is merely an attempt to determine the situation and extent of the deer-parks which formerly existed in Hertfordshire, and to ascertain the number and position of those still maintained in the county.

The extent to which parks increased throughout England as successive sovereigns granted licences to inclose, and subsequently decreased in number, as many, from various causes, became "disparked," is very curious. In the first distribution of property after the Conquest, licences to inclose portions of the ancient forests, with liberty to chase and kill the wild animals of the district, were almost daily bestowed, enormous tracts being here and there reserved to the Crown for the pleasure of the sovereign, whose chief delight was in hunting. As the forest-laws became mitigated and in a great measure repealed, such grants became still more frequent, until the forests became mere remnants of their former greatness, so split up were they and so parcelled out amongst the English nobility. Not unfrequently these privileges were purchased from the Crown, and in some reigns this proved a very convenient mode of recruiting an impoverished exchequer, until at length there was scarcely a nobleman or gentleman of position in the country who was not the possessor of a park.

But at length this state of things reached a climax, and the number of existing parks began to decrease. The civil wars caused the destruction of many a noble park and the extermination of the deer within its pales, while the forfeiture of others to the Crown was brought about by the attainder of the owners for treason. Many noblemen, impoverished by the enormous expenses or losses incurred during the civil wars, were no longer able to hold so many unproductive acres as lay within their parks, and were forced to sell. As timber became more and more valuable, and the value of

land for agricultural purposes increased, many a park was obliterated. The deer were killed, the pales removed, the timber felled, and the ground ploughed up, until all traces of the former inclosure were destroyed. In this way many an ancient park has been swept away whose former existence is now only known to us from the ancient records of its original formation and temporary maintenance. Indeed we may look in vain on a modern map of the County of Hertford for an indication of many parks which appear upon maps prepared from surveys made no longer ago than the reign of Elizabeth.

It would seem that the number of deer-parks in England has for some time been gradually decreasing. If we may rely upon the statistics published by the Rev. W. B. Daniel in 1807, and Mr. Evelyn Philip Shirley in 1867, the number of parks now existing is less than half what it was at the commencement of the present century. Mr. Daniel, at p. 252 of the first volume of his 'Rural Sports,' observes: "There are in England 69 forests, 13 chases, and upwards of 750 parks." Mr. Shirley remarks: "It appears as the result of the inquiries which I have made that there are at present (1867) 334 parks still stocked with deer in the different counties of England; among that number red-deer are kept in about 31 parks." * He adds: "With regard to the antiquity and size of these aristocratic inclosures in the present day, I have collected many particulars, by which it appears that there are parks whose origin is lost in the obscurity of early Norman times down to the date of the inclosure of yesterday, and that their extent varies from the stately area of more than 2000 acres to the little paddock of a few roods." †

It has often been stated in print, and is perhaps generally believed, that the first park made in England was that of Woodstock in Oxfordshire, which was formed by Henry the First, and was surrounded by a stone wall seven miles in circumference. This impression, however, is erroneous, for thirty-one parks are mentioned in Domesday.

"It is perhaps impossible," says Mr. Shirley, "to ascertain with accuracy the oldest existing deer-park in England; but if Lord Abergavenny's park at Eridge, in Sussex, may be identified with the *Reredfelle* of Domesday, there can be no doubt that it may lay claim to this unique distinction, there being no other park which appears in the category of existing inclosures stocked with deer."

Of the thirty-one deer-parks mentioned in Domesday, *three* were in Hertfordshire: St. Albans, which was appurtenant to the Abbey, and is described as *parcus bestiarum sylvaticarum;* Ware, which is described as containing wood to feed 400 hogs, and a park of deer,

* Preface to his 'Account of English Deer Parks,' p. ix.

† About the beginning of the eighteenth century a fashion was introduced of making small paddocks for deer, generally near the house, where the land was mostly rich and good, whereas in former times the parks were almost always at a distance from the residences of the proprietors, and often of great extent over the worst and wildest lands of the manor.

together with a vineyard lately planted, belonging to Hugh de Grentemaisnil; and BENINGTON (anciently Belintone), which contained "wood to feed a hundred hogs, and a park of deer," the property of Peter de Valongies.

The mention of St. Albans in connexion with deer recalls the fact that it was here, in 1486, that the celebrated Book of St. Albans was printed, treating of Hunting, Hawking, and Coat-armour. It contains a good deal about deer from the sportsman's point of view, and is generally believed to have been written by Dame Juliana Barnes, or Berners, the prioress of a Benedictine Convent at Sopwell,* near St. Albans, deriving its name from the place where it was printed by a schoolmaster whose name has not come down to us.

From a careful examination of this curious work, and a perusal of all that has been published concerning the reputed author of it, I am convinced that it is not an original composition, but a translation and compilation from Latin and French manuscripts of an older date, and that most of the statements put forth in biographical notices of the lady have no foundation in fact. To enter here upon all the "pros" and "cons" would cause too great a digression. On some future occasion, perhaps, I may be able to offer some remarks on a subject which I venture to think possesses a special interest for members of a Society carrying on researches in the very county in which the book was produced and the reputed authoress lived.

To return to the parks mentioned in Domesday. Besides St. Albans and Ware there was Benington, already named, or, as it was formerly called, Belintone. This park, which appears on Saxton's map of 1577 (N.C.),† after very many changes of ownership, became the property, in James the First's time, of Robert Devereux, third Earl of Essex, who sold it in 1614 to Sir Charles Cæsar, in whose family it remained until 1744, when it was sold to the trustees of the will of Sir John Chesshyre, Knt.‡

The parks which have been formed in Hertfordshire since the preparation of the great Domesday Book may be divided into two classes: those which have been long since "disparked," and those

* The Priory of Sopwell, which, upon the Dissolution, Henry the Eighth granted to Sir Richard Lee, came to his eldest daughter (he had no sons) Anne Lee, who married Edward Sadleir, the second son of Sir Ralph Sadleir of Standon. It remained in possession of the family of Sadleir until 1662, when, on the marriage of Ellen Sadleir (daughter of Robert Sadleir) with Thomas Saunders, of Beechwood, it passed to the Saunders family, by whom it was subsequently sold to Sir Harbottle Grimston, Master of the Rolls in the reign of Charles the Second, from whom it has descended to James Walter, Viscount Grimston.

† That is, "north central." The position of parks shown on Saxton's map is indicated throughout this paper by letters, to facilitate reference; and it has been thought desirable also to quote volume and page in every case where some account of the park is furnished in the works of our County historians. The dates of these respective works are Chauncy 1700, Salmon 1728, Clutterbuck 1815-1827, and Cussans 1870-81.

‡ Clutterbuck, 'Hist. Herts,' vol. ii, p. 285.

which are still maintained at the present day. Many more belong to the former than to the latter class, and in the majority of cases it is very difficult to ascertain their history. We know that they formerly existed, from the fact of their being mentioned in ancient records and surveys, and marked on maps three centuries ago; but we know little else concerning many of them. Not that there is nothing more to be ascertained; for if one had access to the family records of the various owners to whom they successively belonged, it would no doubt be possible in time to trace the history of each. This, however, would involve a considerable expenditure of time and trouble, and for the present, therefore, we must be content with little more than an enumeration of the localities in Hertfordshire in which it has been possible to ascertain the present or past existence of a park. The existing parks are:—

1. Hatfield,* the seat of the Marquis of Salisbury. The manor was given by James the First in the fifth year of his reign to Sir Robert Cecil, afterwards 1st Earl of Salisbury, in exchange for Theobalds in the parish of Cheshunt. This Earl, who died in 1612, erected a stately building on this manor which is described by Chauncy as "a fair palace that exceeds all the houses in this county, and two large parks, one for fallow- the other for red-deer, with a vineyard at the bottom of the park."

These two parks, says Mr. Evelyn Shirley, were united by the late Marquis of Salisbury, and now comprise 314 acres, beautifully undulating and well wooded, with 360 head of fallow-deer.† In this park, one of the largest in the county, is still standing and now fenced round, the oak tree under which Elizabeth sat while awaiting the arrival of her troops to escort her to London to be proclaimed Queen, having resided here for some years before she ascended the throne.‡ It was here too that Charles the First was detained for some time in custody.

2. Cassiobury Park,§ near Watford, the property of the Earl

* Saxton, S.C.; Chauncy, p. 308; Salmon, p. 210; Clutterbuck, vol. ii, p. 334; Cussans, 'Broadwater,' p. 265.

† It was formerly the practice to keep the red-deer and fallow-deer apart in parks where both species were maintained, owing to an impression that the stags of the former species would kill the latter. Gervase Markham, in his edition of the 'Maison Rustique; or, The Countrey Farme,' printed in 1616, says (chap. xix.): "You shall not by any meanes in one parke mixe the Red-deere and the Fallow-deere together, for the Red-deere is a masterfull beast, and when the time of bellowing cometh, he grows fierce and outragious, so that hee will be entire lord of the field, and will kill the Fallow-deere if they but crosse him in his walke; and therefore each must be kept severally in severall parkes."

That such was the practice in the sixteenth and seventeenth centuries is proved by the "Red-deer Parks," distinct from parks for fallow-deer, which are found in many of the great places of England, such as Badminton in Gloucestershire, and Grimsthorpe in Lincolnshire, where separate parks for the different kinds of deer were formerly kept up. The present practice appears to be generally to allow both red- and fallow-deer to be together, the danger alluded to by Markham having been proved to be exaggerated, if not without foundation.

‡ See 'Trans. Watford Nat. Hist. Soc.' Vol. II, p. 11.

§ Saxton, S.W.; Chauncy, p. 482; Salmon, p. 105; Clutterbuck, vol. i, p. 236; Cussans, 'Cassio,' p. 167.

of Essex, covers about 670 acres, watered by the river Gade, and adorned with fine fir-trees and immense beeches. It belonged in Henry the Eighth's reign to Richard Moryson, Esq. (a descendant of a Yorkshire family), afterwards knighted, to whom it was conveyed by royal letters patent, and who was in much favour with the King by reason of his learning and great administrative powers as ambassador. He began "a fair and large house in this place, situated upon a dry hill, not far from a pleasant river, in a fair park," but died before it was completed in 1556.* By his marriage with Elizabeth, daughter and heiress of Sir Charles Morrison, Cassiobury became the property of Lord Capell, whose eldest son Arthur, upon the restoration of King Charles the Second, was advanced to the titles of Viscount Maldon and Earl of Essex by patent dated 20th April, 1661. The herd of fallow-deer still maintained in this park was formerly much larger than at present, numbering perhaps 700 or 800 head. It now consists of between 300 and 400 only. This great decrease is in some measure due to an epidemic which broke out on more than one occasion, and in the present year has carried off no less than about 300 deer.

3. Grove Park,† adjoining Cassiobury, the property of the Earl of Clarendon, contains between 200 and 300 acres, and about 100 head of fallow-deer. The bucks average 10½ stones, the does 8½ stones (8lbs. to the stone). The horns of the bucks are broadly palmated, although the park has never been re-stocked. Saxton does not indicate the existence of any park here in 1577. It was the ancient seat of the Heydons, from whose family it was alienated to the ancestors of Sir Denis Hampton, who sold it to Sir Robert Ashton, for many years the eldest bencher of Lincoln's Inn, and from whose family it passed by marriage to the family of Sir John Buck, and subsequently by sale first to Lord Donneraile, and afterwards, in 1753, to the Hon. Thomas Villiers, who was created Earl of Clarendon in 1776. There are some fine trees in this park, and a great variety, walnut, ash, elm, beech, chestnut, and lime, being all well represented.

4. Knebworth,‡ the property of the Earl of Lytton, is described by Chauncy as "a large pile of brick with a fair quadrangle in the middle of it, upon a dry hill in a fair park § stocked with the best deer in the county." This building was partly pulled down in the year 1811, and a handsome Gothic mansion erected nearly upon the site of the buildings removed, and finished in 1816. The park, of 280 acres, has some splendid avenues of lime and chestnut, and one remarkable hornbeam. The herd of fallow-deer at present numbers 140 head, the bucks, with broadly palmated antlers,

* No park is shown on Saxton's map of 1577.

† Chauncy, p. 484; Salmon, p. 106; Clutterbuck, vol. i, p. 250; Cussans, 'Cassio,' p. 169.

‡ Chauncy, p. 356; Salmon, p. 199; Clutterbuck, vol. ii, p. 373; Cussans, 'Broadwater,' p. 111.

§ No park is shown on Saxton's map of 1577.

averaging 100 lbs. in weight, the does 60 lbs. Occasionally fresh blood has been introduced, some new deer being turned in. There has been no such re-stocking, however, for the last ten years.

5. Gorhambury,* near St. Albans, the seat of the Earl of Verulam. This manor was parcel of the ancient revenue of the Church of St. Alban, and was probably so named from Robert de Gorham, Abbot of this Monastery in 1151. The Abbot held it until the dissolution of that church, when it came to the Crown. Being granted by Henry the Eighth to Sir Ralph Rowlet, it was enjoyed for some time by Sir Nicholas Bacon, and subsequently by his son, the celebrated but unfortunate Francis Bacon, Lord Verulam, who, upon his downfall, conveyed it to his secretary, Sir Thomas Meautys, who had married his niece, Anne. She, on the death of her first husband, became the wife of Sir Hartbottle Grimston, afterwards Lord Grimston, who purchased the reversion of the Meautys family—she having only a life interest.

This park of 500 acres is not shown upon Saxton's map of the county published in 1577, nor on a map of the manor dated 1634.

6. Moor Park,† Rickmansworth, the seat of Lord Ebury, covers 500 acres. The manor was formerly part of the possessions of the Abbey of St. Albans, and the history of the park dates back to the time of King Henry the Sixth, who granted to George Nevil, brother to the Earl of Warwick, and successively Bishop of Exeter and Archbishop of York, licence to inclose 600 acres of pasture and land in Rickmansworth and Watford "for a park," and to embattle the site of the manor of Moor in Rickmansworth. The house and park were formerly appurtenant to the Manor of the Moor, and descended along with it until alienated therefrom (temp. Charles the First) by the Earl of Pembroke, who sold it to the Earl of Monmouth. The acreage of the park at that date was stated to be 400 acres or thereabouts. It is now, as above stated, somewhat larger. It contains about 250 fallow-deer, the bucks averaging 16 stones, and the does 7 stones in weight.

7. Ashridge Park,‡ lying to the north-east of Tring, the seat of Earl Brownlow, formerly belonged to the Duke of Bridgewater, and occupies the site of the ancient monastery of "Bonhommes" founded in Henry the Third's time. Although not marked as a park on Saxton's map of 1577, it appears on the map prepared by Moll in 1700, and is engraved in Chauncy's 'History of Hertfordshire.' The house, however, with most of the park, stands in Buckinghamshire. The park is about five miles in length by more than two in breadth, and well timbered. Besides a herd of fallow-deer, there are also some red-deer here, which, as I learn from Mr. A. J.

* Chauncy, p. 464; Salmon, p. 83; Clutterbuck, vol. i, p. 88; Cussans, 'Cassio,' p. 244.

† Chauncy, p. 160; Salmon, p. 110; Clutterbuck, vol. i, p. 191; Cussans, 'Cassio,' p. 123.

‡ Moll, 1700; Chauncy, p. 552; Salmon, p. 134; Clutterbuck, vol. i, p. 386; Cussans, 'Dacorum,' pp. 31, 136.

Copeland, are usually allowed to grow to the age of twelve or fourteen years before they are killed.

8. Woodhall Park,* Hertford, the seat of Abel Smith, Esq., M.P., is believed to have been so called from the great abundance of wood and timber that grew there. It is referred to by Chauncy (pp. 3*b*, 330*a*) as Watton Woodhall Park, the ancient seat of the Botelers, and is thus described by Salmon † :—"The Mansion House of the Family is most nobly situated upon a rising Ground, watered with small Streams, which fall into the *Bean* on the South of it. It stands in a Park beautifully consisting of Hills and Flats, and renowned for as good Timber as the Island, or perhaps the Earth, produceth. Near 30 Years since [i.e. about 1700] one Tree was sold for £43. There were 18 Horses to draw one Part of it when it was slit, and out of it was made the Cutwater of the Royal Sovereign. Another in the same Park called *the Walking Stick*, might some Years ago have been sold for 50 Guineas, but is at present upon the Decay by the Burrowing of Rabbets under it." Amongst notable trees here at the present time are a number of hornbeams, planted originally as food for the deer, which have to be constantly pollarded, the heads being too heavy for the stems. The present park consists of 400 acres supporting about 300 deer. The bucks in this park are killed at seven years old, a certain number of fawns being marked every year and the rest killed. The bucks average from 100 lbs. to 125 lbs. in weight, the does from 60 lbs. to 65 lbs.

9. Rickmansworth Park,‡ the seat of John William Birch, Esq., extending over two hundred acres, ornamented with chestnut, lime, and beech trees, contains about 50 head of fallow-deer. The bucks in this park average 16 stones, and the does 7 stones in weight.

10. Puttridge Park, near Lilley, on the borders of Bedfordshire, the seat of Lieut.-Col. G. Sowerby, who is lord of the manor, contains about 450 acres, and is well stocked with deer.

Of the parks which once existed in Hertfordshire but do so no longer, the most important perhaps is

Theobalds,§ lying to the N.E. of Enfield Chace. It was the favourite hunting-seat of James the First, who stayed here on his way from Scotland to London, and was nobly entertained by Sir Robert Cecil (afterwards Earl of Salisbury). So pleased was the King with this place that he gave Sir Robert Cecil Hatfield in exchange for it. He then enlarged the park ‖ and inclosed it with a brick wall ten miles in circumference. Here he kept not only red-deer and fallow-deer, but also elk, which were presented to him in 1612 by the Marquis of Brandenburgh.¶ They were still there in 1624.

* Saxton, S.C.; Chauncy, p. 308; Salmon, p. 211; Clutterbuck, vol. ii. p. 472; Cussans, 'Broadwater,' p. 168.

† 'Hist. Hertfordshire,' 1728, p. 218.

‡ Chauncy, p. 478; Salmon, p. 109; Cussans, 'Cassio,' p. 145.

§ Saxton, S.E. "Thehall"; Chauncy, p. 297; Salmon, p. 10; Clutterbuck, vol. ii, p. 87; Cussans, 'Hertford,' p. 209.

‖ For the purposes of this enlargement land was acquired in 1607 and again in 1615.

¶ 'Pell Records,' pp. 63, 149, 176, 294.

The red-deer were imported from Denmark in 1612.* There were still wild red-deer however outside the park walls. Salmon says: "Besides the park he walled in, he could hunt in Epping Forest, Enfield Chase, and Hoddesdon Woods both red- and fallow-deer." It is probable that he also turned out in this park some of the wild boars which he caused to be imported from France and Germany,† although, perhaps, these went to Windsor Forest, where we know on good authority he hunted the wild boar in 1617.‡ Here he had a heronry, and a large pigeon-house, wherein he kept pigeons for his hawks; and he also kept silkworms. On a large pond with an island in it he kept wild-fowl which he had netted in Lincolnshire. We do not learn that he cared much for fishing, except fishing with trained cormorants, with which he sometimes amused himself. His chief delight was in hunting and hawking, and to these sports nearly all his time was devoted while staying at Theobalds.§ It was here that the King died on the 27th of March, 1625. It was also during a hunt in this park that Henry Cary, Lord Falkland, lost his life, by falling from a "stand" which had been erected in one of the glades for the purpose of shooting deer as they were driven past. By this accident he broke his leg, and gangrene setting in, it had to be amputated, and he died the next day.‖

From a survey made in 1650, before the palace here was destroyed, it appears that the park contained 2508 acres, valued together with six lodges at £1545 15*s.* 4*d.* per annum; the deer were valued at £1000; the rabbits at £15; the timber at £7259, exclusive of 15,608 trees marked for the use of the navy, and others already cut down for that purpose. The park contained an avenue a mile long between a double row of trees. Lysons, quoting from an old work, tells us that in the gallery of the palace, 120 feet by 21, were "divers large stagges heads sett round the same, and fastened to the sayd room, which were an excellent ornament to the same."¶ Although there have been deer in this park since its occupation by the present Sir Henry Meux, the last was killed there some years ago, and the park has not been re-stocked.

Close to Theobalds was CHESHUNT,** or CHESTON, so called perhaps from the chestnut-trees which formerly abounded there (for most of the old houses in the neighbourhood are built of chestnut). A park is indicated by Saxton (S.E.), and it appears that the grant of this manor by James the First to Sir Henry Cock, in 1606, included all those four-and-twenty acres in the Frith, and all those woods,

* 'Pell Records,' p. 150.

† 'Pell Records,' pp. 86, 143, 144.

‡ Harting, 'Extinct British Animals,' p. 102.

§ A hunting-seat was built at Royston by James the First, and was for many years the occasional rendezvous of that monarch and Charles the First. A portion of the building is still standing. King James's stables too, now used as cottages, are on the outskirts of Royston Heath.

‖ State Paper Office, Domestic, Sept. 27, 1633.

¶ Lysons, 'Environs,' vol. ii, p. 770.

** Saxton, S.E.; Chauncy, p. 296; Salmon, p. 6; Clutterbuck, vol. ii, p. 77; Cussans, 'Hertford,' p. 17.

called Old Parke, Rowgh Cattel, and the common-wood in Cheshunt. Under date 1st May, 1609, the following entry appears in the account of payments made of the royal exchequer:*—"To Humphrey Flint the sum of £4. 17. 9. for the ploughing and sowing of oats in Theobalds and Cheshunt Parks for his Majesty's deer there. By general writ current . . . . . £4. 17. 9."

Cheshunt Park was formerly the property of Oliver Cromwell, a lineal descendant of the Protector, and author of Memoirs of the family. It passed by marriage to the late Mr. T. A. Russell, and is now in the hands of his devisees.

Panshanger,† near Hertford, the seat of Earl Cowper, with Cole Green Park adjoining, well wooded, and containing about 500 acres, formerly inclosed a herd of deer, but none have existed there for many years. On the lawn stands an oak, which at 10 feet from the ground measures nearly 20 feet in circumference.

At Sawbridgeworth ‡ there seems to have been formerly a park. Licence to impark there and in Thorley was granted by Henry the Sixth to John Leventhorpe in 1449. The park was licensed to inclose 400 acres of land, 40 of meadow, and 40 of wood.

Subsequently, in Charles the First's time, the manor with the inclosed park called Sayesbury Park was granted by royal charter dated 2nd August, 1633, to Arthur Brett, of London, Esq., and Nicholas Horman, as trustees for Lord Cranfield, created Earl of Middlesex, who subsequently, in 1636, sold it to Thomas Hewit, of the parish of St. Martin, Esq.

Close to Sawbridgeworth was Pishobury Park,§ now the residence of Andrew Caldecott, Esq., formerly held on lease under the Crown (temp. Elizabeth) by Henry Chauncy, but sold to Walter Mildmay [see Gilston], who was afterwards knighted as Sheriff of the County and died in 1606. "He built the Manor-house upon a rising ground in the vale near the river *Stort*, which courses about 20 acres of ground on the east side of the house, *lately converted into a paddock for deer*." This was written in 1700, but the present owner informs me that there have been no deer kept here for a great number of years.

Three miles S.W. of Sawbridgeworth lay New Place,‖ Goldeston, otherwise Geldeston, or Gilston. It was built in the reign of Queen Elizabeth by Henry Chauncy, who had previously leased the manor of Pishobury from the Crown; but, having incurred the displeasure of Henry Cary, Lord Hunsdon (the chief favourite of Elizabeth, by whom he was created Baron on her accession), because he would not sell part of his Manor of Gilston to enlarge the park at Hunsdon, Lord Hunsdon prevailed with the Queen to sell the

* 'Pell Records,' p. 91.

† Cussans, 'Hertford,' p. 70.

‡ Saxton, E.; Chauncy, p. 172; Salmon, p. 259; Clutterbuck, vol. iii, p. 89; Cussans, 'Braughing,' p. 74.

§ Chauncy, p. 177; Salmon, p. 261; Clutterbuck, vol. iii, p. 196; Cussans, 'Braughing,' p. 78.

‖ Chauncy, p. 187; Salmon, p. 262; Clutterbuck, vol. iii, p. 169; Cussans, 'Braughing,' p. 67.

manor over the head of her tenant to Walter Mildmay, Esq. This caused him, on the expiration of his lease, to remove to New Place, Gilston. His eldest son John sold it to one William Parker, who again sold it to Sir John Gore, in whose family it was when Chauncy wrote. It is now the property of William Hodgson, Esq., J.P., who informs me that there have been no deer in this park for the last thirty-five years.

Hunsdon Park,* just mentioned, the seat of James Wyllie, Esq., was of considerable antiquity. The records show that in 1124, Richard, Earl of Hertford, granted to the monks of St. Augustine of Stoke an annual gift of a doe out of the park at *Honesdon*. Henry the Eighth built a palace here and erected it into an "Honour" in connexion with the adjoining manors of Hansted and Joyden in Essex; and, as above mentioned, it was at one time the property of Henry Cary, Lord Hunsdon, cousin to Queen Elizabeth, who, as well as Queen Mary and Edward the Sixth, occasionally visited it. Hunsdon Lodge was the old hunting-lodge of Queen Elizabeth.

In the parish church here there is a curious brass to the memory of a former deer-keeper, who died in 1591. He is represented with his bugle-horn and broadsword, having just discharged his cross-bow at a stag, while death, delineated as a skeleton, with one hand plucks the arrow from the deer, while he plunges a second in the keeper's breast.† His motto, *sic pergo*.

The inscription runs:—

BELOVED OF ALL WHILST HE HAD LYFE,
VNMOENED OF NONE WHEN HE DID DIE,
JAMES GRAY, INTERRED OF HIS WIFE,
NEER TO THIS DEATHS-SIGNE BRASSE DOTH LYE.
YEARES THIRTY-FYVE, IN GOOD RENOWNNE,
PARKE AND HOVSE-KEEPER IN THIS TOWNE.
OBIIT 12 DIE DECEMBRIS A° DNI. 1591.
AETATIS SVE: 69:

In the neighbourhood of Hunsdon there were formerly other parks, of which only brief particulars have been obtained, but which appear on Saxton's map of 1577.

There was Widford,‡ N. of Hunsdon, which was apparently disparked before Chauncy's time, for he makes no mention of any park there.

Eastwick,§ or, as Norden gives it, *Eastwike*, adjoining Hunsdon and a mile from Gilston, and belonging to Sir Humphrey Gore, who also owned Gilston.

* Saxton, E.; Chauncy, p. 190; Salmon, p. 251; Clutterbuck, vol. iii, p. 177; Cussans, 'Braughing,' p. 42.

† A facsimile of this brass will be found in Shirley's 'English Deer Parks,' p. 54, and also in Cussans, 'Braughing Hundred,' p. 52.

‡ Saxton, E.; Chauncy, p. 200; Salmon, p. 258; Cussans, 'Braughing,' p. 55.

§ Saxton, E.; Chauncy, p. 183; Salmon, p. 254; Cussans, 'Braughing,' p. 61.

Hondon, Thorley,* and Hadham Parva,† where there was an old park referred to by Chauncy as having formerly belonged to the Bishop of London.

A little to the south of Hunsdon was the Manor of the Rye, ‡ where Henry the Sixth granted a licence to Andrew Agard and others to impark fifty acres of land, eleven acres of meadow, eight acres of pasture, and sixteen acres of wood.

This park is marked on both Saxton's and Speed's maps, but has long been disparked.

To the N.E. lay Furneux Pelham § (or Pelham Furneux as Norden has it), disparked in Elizabeth's reign, as appears from the record that in 1600 Lord Mounteagle conveyed the manor-house, with the two disparked parks called the old and new parks, and other lands, to Richard Mead, of Berden, and his heirs.

Also to the N.E. lay Withiall, or Wyddial,‖ made by Richard Gulston, Esq., who died in 1686. Chauncy, in his view of this seat, depicts deer in the park, but gives no information on the subject. The present owner is Mrs. Heaton Ellis, who is lady of the manor.

Close by was Throcking,¶ formerly the seat of Robert Elwes, Esq. This park is not marked on Saxton's map, but Chauncy gives a view with deer. No trace of it now remains, although the site is known. The manor-house was pulled down, but some of the extensive massive foundations may still be seen adjoining the Hall Farm, the property of Mr. George Coleman.

Hamels or Hamills,** covers about 200 acres, and contains some very ancient oaks, hornbeams, and thorns, as well as some fine ash and beech trees. When Chauncy wrote, in 1700, the owner of this manor was Sir Thomas Brograve, whose father had enlarged the park, and greatly improved the property. The view which he gives of the manor-house depicts deer in the park. They existed there up to within the last half century, a fact known to people now living. An old man named John Drage remembers the last deer being killed, by order of the late owner, Miss Mellish, and states (as I am informed through the courtesy of Mr. Gladwin and the Rev. J. A. Ewing) that in the days of the Yorke family the hounds were kept at Hamels, near the park, at the cottages in Westmill Lane, on the way to the park-wall. In the view of this park given by Chauncy, as before stated, deer are depicted, and in an old map of the park dated 1722, in the possession of Mr. Gladwin, deer are also prominently figured.

Further to the north of the county lay Walkerne Park,†† near

* Salmon, p. 268; Cussans, 'Braughing,' p. 100.

† Chauncy, p. 152; Salmon, p. 279; Cussans, 'Edwinstree,' p. 188.

‡ Saxton, E.; Chauncy, p. 195; Salmon, p. 250.

§ Saxton, N.E.; Chauncy, p. 144; Salmon, p. 285; Cussans, 'Edwinstree,' p. 146.

‖ Saxton, N.E.; Norden; Chauncy, p. 111; Salmon, p. 305; Cussans, 'Edwinstree,' p. 116.

¶ Chauncy, p. 115; Salmon, p. 317; Cussans, 'Edwinstree,' p. 108.

** Chauncy, p. 225; Salmon, p. 230; Cussans, 'Braughing,' p. 173.

†† Saxton, N.C.; Salmon, p. 192; Cussans, 'Broadwater,' p. 72.

Benington, already noticed, and marked as a park by Saxton. No mention, however, of any park here is made by Chauncy, so that it was doubtless disparked before his day. The Earl of Essex is lord of the manor. Walkern Park farm-house to this day is moated, and, some years ago, when it was found necessary to dredge the moat, a vast number of antlers were brought up, thus testifying to the former proximity of the old deer-park. There is a remarkable hollow oak here thirty-four feet in circumference, and capable of holding a good number of people.

If we may rely upon the figures of deer as indicating the former existence of a deer-park, there was one, according to Chauncy, at Offley Place,* the seat of Sir John Spencer, Bart., and another at

Stagenhoe,† the property of Sir John Austen. Chauncy figures the manor-house, with a stag-hunt in the park.

A third was at Aspenden Hall,‡ two miles east of Wakeley, the seat of Ralph Freeman, Esq., D.L. and J.P. for the county.

Proceeding westward we come to Berkhampstead,§ where there was an ancient royal park attached to the castle in the time of Edward the First, but long since disparked.

A little to the north-west lay Penley or Pendley Park,‖ inclosed in the reign of Henry the Sixth, but disparked before Chauncy's time.

At King's Langley,¶ a little to the north of Watford, a royal seat was founded by Henry the Third. The Home Park here was granted by Edward the Sixth to the Prior of Langley. After the Dissolution it reverted to the Crown, and in 1626 "King's Langley Park and all the deer, marsh, grass, wood, and all trees whatsoever," were leased to Sir Charles Morrison for ninety-nine years, and soon afterwards passed entirely from the Crown.

In the south-central district on Saxton's map we find—

Brocket Hall,** to the west of Woodhall, now the seat of the Hon. Henry F. Cowper, M.P.

Tittenhanger,†† south of Hatfield, formerly an ancient deer-park of the Abbots of St. Albans. It was disparked at the Dissolution of the Monasteries by Henry the Eighth, who granted the manor and estate of Tittenhanger to Sir Thomas Pope, from whom it has descended in a direct line to the present owner, Jane, Countess of Caledon, who is lady of the manor.

And Shenley,‡‡ south of Tittenhanger, not marked as a park by Norden in 1596.

* Chauncy, p. 403; Salmon, p. 157; Cussans, 'Hitchin,' p. 96
† Chauncy, p. 413; Salmon, p. 152; Cussans, 'Hitchin,' p. 127.
‡ Cussans, 'Edwinstree,' p. 96.
§ Saxton, W.; Chauncy, p. 575; Salmon, p. 119; Cussans, 'Dacorum,' p. 48.
‖ Saxton, W.; Chauncy, p. 593; Salmon, p. 130; Cussans, 'Dacorum,' p. 17.
¶ Saxton, S.W.; Chauncy, p. 543; Salmon, p. 113; Cussans, 'Dacorum,' p. 192.
** Cussans, 'Broadwater,' p. 273.
†† Chauncy, p. 506; Cussans, 'Cassio,' p. 23.
‡‡ Cussans, 'Dacorum,' p. 307.

Proceeding to the south-east of the county, we come to BEDWELL,* near Berkhampstead Parva, where Saxton indicates the former site of a park, and to the south-east of this

PUNSBURNE,† also marked as a park by Saxton, but not mentioned by Chauncy.

HERTINGFORDBURY is referred to by Cussans ('Hertford Hundred,' p. 104) as having been well stocked with deer, and capable of maintaining one hundred and fifty, but I believe there are none in this park at the present time.

The last of which I have been able to find any record was at ROXFORD.‡ Here there was formerly a small park well stored with timber, about a mile in compass, formerly parcel of the revenue of the Castle of Hertford, until conveyed by Charles the First to William Earl of Salisbury.

These statistics may appear somewhat dry; but if they contribute towards a better knowledge of the county in which under the auspices of this Society we are all so happily working, the labour bestowed in collecting them will not have been in vain. As a matter of fact, they lead us to infer that out of about forty deer-parks once existing in Hertfordshire, not more than ten are now maintained. It shows what changes must have taken place in the aspect of the county even in so comparatively short a period as that which has elapsed since Queen Elizabeth visited Hunsdon, and King James hunted the deer at Theobalds.

In the case of many disparked manors it is extremely difficult at the present day to obtain information; the brief notices given by topographers and county historians not being directed as a rule to the subject of the present inquiry.

It should be stated that, with a view to ensure accuracy in the above-given statistics of acreage, number of deer, remarkable trees, etc., I addressed a circular to every owner of a park in the county, begging the favour of replies to a short series of questions on these points, and I take this opportunity of tendering my thanks to those who have courteously responded to my enquiries. Should any inaccuracies be discovered or omissions noted in the particulars given, it is to be understood that in such cases the owners have not enabled me to attain that precision which I desired.

I offer, then, these fragmentary remarks in the hope that other members of this Society will be able to add to them, and so eventually to place us in possession of more thorough information concerning a county in which we all take such special interest.

* Saxton, S.E.; Cussans, 'Hertford,' p. 157.

† Saxton, S.E.

‡ Chauncy, p. 272; Cussans, 'Hertford,' p. 103.

## Summary of Hertfordshire Deer-Parks.

*Existing.*

Hatfield.
Cassiobury.
Grove Park.
Knebworth.
Gorhambury.
Moor Park.
Ashridge.
Woodhall.
Rickmansworth.
Putteridge.

*Disparked.*

St. Albans.
Ware.
Benington.
Theobalds.
Cheshunt.
Panshanger.
Sawbridgeworth.
Pishobury.
New Place, Gilston.
Hunsdon.
Widford.
Eastwick.
Hondon.
Thorley.
Hadham Parva.
Manor of the Rye.
Furneux Pelham.
Wyddial.
Throcking.
Hamills.
Walkern.
Offley Place.
Stagenhoe.
Aspenden Hall.
Berkhampstead.
Penley Park.
King's Langley.
Brocket Hall.
Tittenhanger.
Shenley.
Bedwell.
Punsburne.
Hertingfordbury.
Roxford.

XV.

# NOTES ON A MICROSCOPICAL AQUARIUM.

By Isaac Robinson.

*Read at Hertford, 24th November*, 1881.

A few months ago I set up a small aquarium for the purpose of having living specimens for the microscope readily available. As the plan adopted has accomplished the object in view very satisfactorily, and as the various inhabitants discovered in the aquarium by the aid of the microscope have all been collected in the neighbourhood of Hertford, a brief description of them may be of interest.

The aquarium itself consists simply of an inverted bell-glass about ten inches in diameter and about the same in depth, supported upon an ebonized wooden stand, and having a flat glass cover resting upon its upper edge, for the purpose of preventing dust from settling on the surface of the water. The slightly uneven rim of the bell-glass seems to afford sufficient space between itself and the glass cover for the necessary supply of air. It is placed upon a hall-table, where it receives only a moderate supply of light, and direct sunshine only on very rare occasions, when the sun is near to the horizon.

It was originally filled from the River Lea, and it has not since been found necessary to change the water, but small quantities have from time to time been added to compensate for evaporation. Various kinds of water-weeds collected in the neighbourhood were afterwards placed in it. Amongst these the hornwort (*Ceratophyllum demersum*) appears to be much in favour with large numbers of the Infusoria, which very freely attach themselves to it. A small piece of this weed which appeared to have floated down the Lea was found to abound with great numbers of the delicate forms of the "collared monads" (Choano-flagellata). Another favourite weed, *Riccia fluitans*, which in small branched fragment-like portions floats upon the surface of the water, was found in a pond near Broxbournebury Woods, but it does not appear to be very common in the neighbourhood. Another very useful weed for the aquarium, the water-milfoil (*Myriophyllum spicatum*), is comparatively common.

The American water-weed (*Anacharis Alsinastrum*) is a desirable acquisition, both on account of the foothold which it offers to numerous animalcules, and for the beautiful illustration its leaves so readily afford of the circulation in their cells. The common duckweed (*Lemna minor*), to the slender rootlets of which many of the Infusoria may be found attached, and the curiously-formed ivy-leaved duckweed (*Lemna trisulca*), which has also been found near Hertford, but is by no means common, may be added.

Amongst the various forms of microscopic animals which I have from time to time found in this aquarium the following may be mentioned.

Attached to a fragment of *Riccia fluitans*, I was so fortunate as to find representatives of five species of the collared monads. One of these, the beautiful and delicate *Monosiga globosa*, is in form very similar to *Monosiga gracilis*, a representation of which, under the extraordinary magnification of 8000 diameters, forms the frontispiece to Mr. Saville Kent's 'Manual of the Infusoria.' Another, *Monosiga Steinii*, which is of smaller size, has the singular habit of attaching itself to the stalks of *Vorticella* (on one such stalk I counted eighteen of these zooids, and they did not appear to be at all discomposed by its frequent contractions and extensions). Of two others, *Salpingœca gracilis* possesses a lorica or sheath on a long pedicle, within which it resides ; and *Salpingœca fusiformis* has a most gracefully-formed lorica, but no pedicle. And lastly there was a form individually similar to *Monosiga globosa*, but instead of appearing singly, grouped in clusters of from two to six upon each pedicle, and resembling *Codosiga grossularia*, as described by Mr. Kent.

The transparent collar-like extension of these organisms is of so extremely delicate a character that it is a matter of some difficulty to succeed in clearly defining it. To do so requires good optical appliances, and very careful illumination. Its shape may be described as resembling that of a wine glass, and is said by Mr. Kent to be "infundibuliform." In consequence of its perfect transparency it is generally observable as a line on either side, while the flagellum may be seen waving about between. Its presence throughout may, however, often be known by the small particles of matter which adhere to it, and which may be seen to travel slowly upward on its outer surface and downward within, in order that they may be conveyed to the food-receiving portion of the body, which is situated within the base of the collar.

I have also found many specimens of *Floscularia ornata*, which, with its long slender cilia, is a very interesting object for the microscope. It is frequently found in this neighbourhood, and is usually attached to one of the slender-leaved water-plants. It possesses a case or sheath around its body, which, however, in consequence of its perfect transparency, is not easily seen. When retracted, the long cilia—which probably number several hundreds—project in the form of a single pencil, but when fully expanded they radiate in all directions from five lobes, and are of the most extreme tenuity. It is a very pretty sight to watch their gradual expansion.

Another interesting animalcule of somewhat larger size which I have met with is the crown-animalcule, *Stephanoceros Eichhornii*. It possesses five long arms covered with cilia, which, when expanded, form a sort of net for the capture of its food. It has also a gelatinous sheath, which, although very transparent, is more easily seen than that of *Floscularia*.

A specimen of *Chætospira* was easily recognizable by its peculiarly twisted form when extended. From its position on the weed to which it was attached, its lorica was not visible, and I am therefore unable to say to which species it belonged.

I have also met with specimens of *Anthophysa vegetans*, which is found in globular clusters on coarsely-granulate stems. Each monad of the cluster possesses a long flagellum, which waves about in all directions. Their minute size may be imagined when it is stated that as many as ten clusters, each composed of from 30 to 50 monads, were visible within the field of a $\frac{1}{10}$in. objective.

Some time since a curious mass of animalcules plainly visible to the naked eye was observed upon a branch of *Anacharis*. In size the group measured fully a quarter of an inch in length, and nearly as much in width and thickness. On being placed under the microscope it proved to be an enormous growth of *Epistylis flavicans*.

Of the Rotifera which have been found may be mentioned *Rotifer vulgaris* and *Stephanops lamellaris*. The latter possesses a transparent hood which appears to cover the whole of the anterior portion of its body.

One of the peculiar swan-necked animalcules, *Trachelocerca Olor*, which has been observed, has the power of extending its neck or proboscis to an immense length, in proportion to the size of its body. The surface of the body is throughout covered with fine cilia, obliquely striated, and the extremity of the neck is furnished with a wreath of much longer cilia, for the purpose of obtaining its food.

I have also found a curious worm-like creature (*Spirostomum ambiguum*) having a number of rather long cilia at its anterior extremity, and the body distinctly striated; a very minute animalcule, oval in form, and ciliated at each extremity, which exactly accords with *Stylonchia lanceolata*, as described by Pritchard; the curious leaf-like form of *Loxophyllum meleagris*; and the equally curious though very different *Platycola decumbens*, in its transparent case.

Two young newts were also found a few weeks ago in the aquarium, the eggs from which they were hatched having doubtless been attached to some of the weeds placed in it. These in their young state are very interesting objects under the microscope, as in consequence of the transparency of their bodies the circulation of the blood may be very distinctly seen.

Had time permitted I have no doubt but that the foregoing list might have been greatly extended, but I trust sufficient has been said to show that much interest may be derived by the microscopist from the possession of an aquarium similar to the one described. Such interest is also greatly increased by the varying character of the organisms found in the aquarium at different times, many varieties appearing to develope in great abundance at one time, and subsequently giving place to others of perhaps a totally different type.

XVI.

# NOTES ON THE PROTOZOA OF HERTFORDSHIRE: SECTION PANTOSTOMATA.

By F. W. Phillips, F.L.S.

*Read at Hertford, 26th January,* 1882.

The present paper forms the first of a series on the Protozoa which I hope to read at various times.

So many additions to our knowledge of this class have been made during the last ten years that a few prefatory remarks may not be out of place. Great improvements have been made in our microscopes; in the increase of the magnifying power, in the definition of the objectives, in the illumination, and in many other points. Chemistry has come to our aid with new re-agents and tests. The science of Microscopy has become more popular, and has brought many fresh observers into the field who by continuous observation have thrown new light upon subjects hitherto obscure, and have succeeded in dispelling many previously-existing errors.

The consequence of all this is that our knowledge of the Protozoa has in many respects undergone a complete change; the delimitating lines of the group have been more closely drawn, and many motile plants and protophytes have been excluded, as well as many other animals whose higher organization demands an advancement in the scale. On the other hand, a distinct animal organization has been discovered in many organisms previously considered too lowly to be included. During the past year many of us who do not lay claim to any severely scientific knowledge have had to go to school again. Mr. W. Saville Kent has collected into a most compendious and complete 'Manual of the Infusoria,' the writings of all who have treated of the subject, to which he has added his own observations. He has been fortunate to be an early worker in a new field, and being a diligent student and an acute observer has much to show in the way of original work. He has adopted the newest and most approved systems of classification, and we who had educated ourselves according to Pritchard, have had to unlearn much that we had learned, and learn again. So far as my time has permitted, I have followed up these systems, and have devoted some labour to observation. I therefore wish, in the first place, to make it clear to you what the Protozoa are, using this term as synonymous with Infusoria, as afterwards explained.

There are two or three primary points to be noticed.

Firstly, the animalcules which compose the sub-kingdom Protozoa are referable to the lowest grade of animal life.

Secondly, the essential body-substance of all its members consists of a clear or granular, very transparent, slime-like matter, called sarcode or protoplasm. We will call this the "flesh" of the animalcule.

Thirdly, the organization of each animal is so extremely simple,

that it has only the histological value of a single, simple, living cell. There is no special organ of circulation or respiration, no digestive apparatus, there is nothing approaching to sexual elements, conjugation, or ova.

Their reproduction, which I shall shortly touch upon, is confined to the sub-division of the animal, or to its breaking up into spores. I wish these unicellular characteristics to be remembered, as they are necessary to a proper understanding of the group. You will of course see that the Rotifera, which were formerly included in the Infusoria, are now excluded by reason of their higher organization, being promoted to the sub-kingdom Vermes, or the worm-tribe.

The protoplasm or body-substance of an Infusorian may be divided into two primary parts, the outer or cuticular layer which is called *ectoplasm*, and the inner contained substance called *endoplasm*.

The cuticle may be again divided into two elements. Firstly, an outer, structureless, hyaline layer.* This layer is well shown in the beautiful Vorticellidæ or bell-animalcules, where, in addition to forming the envelope of the body, it is continued downwards, as the hyaline sheath of the characteristic retractile stalk. Secondly, there is what is called the *ciliary* layer, of a hyaline appearance, and of a highly elastic and contractile nature. All such appendages as cilia, flagella, setæ, styles, and uncini, are merely modified extensions or prolongations of this element. Perhaps it would be as well to here explain the nature of these appendages.

*Cilia* are the short, slender, vibratile appendages, which clothe the entire body of some animalcules, and form the locomotive organs in others.

*Flagella* are elongated, isolated cilia.

*Setæ* are slender, hair-like, but non-vibratile appendages.

*Styles* differ from the last-named organs only in their greater bulk and thickness.

*Uncini* coincide with styles, only they have a curved or claw-like shape, and act most efficiently as ambulatory organs.

Beneath the previously-mentioned *ciliary* layer there is sometimes found a peculiar muscular layer called by Prof. Ernst Haeckel the *myophan* layer, but as this is found only in the higher ciliate types, we shall not touch upon it, as we have now to deal with the lowest section only. Whilst speaking of the ectoplasm and its appendages, I ought not to omit to mention the excreted elements, by which I mean all those products which are excreted to form an external protective envelope for the defence of the animalcules inclosed therein, and also the variously-modified pedicles, or fulcra of attachment of the attached or sedentary species. Amongst the former are included those exceedingly beautiful, variable, vase-like, and tubular structures which are called *loricæ*. These structures are the product of exudation or separation from

* The word *hyaline* will frequently occur; it means a transparent structureless appearance, like glass.

the ectoplasm. In its simplest form this exuded structure has a purely gelatinous consistence, sometimes it is a simple mucus.

The transition of the structures from a simple gelatinous sheath to a hardened test is well shown in the members of the genus *Salpingœca*.

The composition of the lorica is of a very uniform character in all classes, having an apparently chitinous consistence. In the majority of instances it is perfectly transparent, but in some genera it assumes with age a deep chestnut hue, and becomes more or less opaque. There is the greatest diversity of form in these protective cases. In the class Flagellata many of the loricæ closely resemble the amphoræ and classic vases of ancient Greece in their exquisite contour and outline.

Another remarkable form which these excreted structures take is the wonderful tree-like growth of the supporting stalk, or zoodendria, common amongst the Flagellata and Ciliata. A complex type is shown in *Anthophysa vegetans*, where the pedicle is built up of the residual particles of substances first incepted for nutrient purposes, which are excreted from the posterior region and then cemented together by some cohesive mucus.

One of the most important features to be noticed is the manner in which food is incepted or taken into the body, because the present system of classification is based upon these features. Perhaps it would be as well to here introduce the outline of this system; but before doing so I should like to say a few words about the term Infusoria, which is occasionally used in this paper.

Originally it was used to denote almost all minute aquatic organisms, whether animal or vegetable. In its modern application it includes all those animals belonging to the sub-kingdom Protozoa, which in the adult stage are furnished with the locomotive or prehensile appendages previously described, and those possessing simple pseudopodia only are separated into a distinct class called Rhizopoda. The presence or absence of these organs, however, is very variable, sometimes appearing or disappearing at certain stages of development, as in *Actinophrys*,* and sometimes entirely dependent upon the will of the animal. The close relationship which exists is clearly shown upon comparing such types as *Dinamœba* with *Mastigamœba*, *Amœba* with *Reptomonas*, or *Actinophrys* with *Actinomonas;* again, the closest affinity exists between the typical Polycystinæ and such types as *Euchitonia* and *Spongocyclia*. A close examination will show that all are parts of one harmonious whole, that no lines of demarcation really exist, and that any attempt to separate them must necessarily be arbitrary; and it should be borne in mind that these divisions are of value only so far as they assist in classification. The separation of the Infusoria from the Rhizopoda appears to me to especially lack a status of any intrinsic value, and were it not for its long association with the study, it would seem advisable to drop the term Infusoria altogether.

* See Saville Kent's 'Manual of the Infusoria,' p. 225.

There are four great sections of the Protozoa. The first is called Pantostomata, and includes all those animalcules which have no true mouth, or inceptive area, but are able to incept food indifferently at any part of the body, after the manner of the typical *Amœba*.

In the second section, Discostomata, the inceptive area is limited to a discoidal or circular region, but it does not constitute a true mouth or aperture.

In the third section, Eustomata, we find a single but distinct mouth or oral aperture, as in *Stentor* and *Vorticella*.

The fourth section is called Polystomata, and here we find a great number of such apertures or mouths; an example of this is afforded by *Acineta* and its allies.

These four sections are subdivided into classes, according to the nature of the appendages they possess. The first section, Pantostomata, with which we have now to deal, is divided into two classes, Rhizopoda and Flagellata.

The Rhizopoda are those animalcules whose appendages are pseudopodic, lobate, or radiate. This class, of which the well-known *Amœba* is a representative, is further divided into six orders, which I shall enumerate further on. The Flagellata are distinguished by the possession of one or more whip-like appendages called flagella; they are divided into five orders.

In these remarks which I have made concerning the classification I have digressed somewhat, but it has been with the view of curtailing the remarks relating to the physiology of the Protozoa, because, as far as it is possible, I wish to speak only of the pantostomatous section. We have considered the ectoplasm or cuticle of an Infusorian, and now, for a short time, I wish to draw your attention to the endoplasm, or contained matter. The most prominent feature we notice is a clear, spheroidal space, expanding and contracting with a regular rhythmical motion, which is distinguished by the title of *contractile vesicle*. This organ early attracted the attention of observers. Opinion has been, and is still, much divided as to its exact structure and function. Ehrenberg first described it as a spermatic gland; Spallanzani and Dujardin considered it a respiratory organ; Lieberkuhn, Claparède, and Lachman recognised it as a rudimentary heart or organ of circulation; while, according to Oscar Schmidt and Stein, its functions are excretory. Prof. Haeckel, however, most reasonably maintains that its functions are twofold, being both respiratory and excretory. A long-disputed but most important point is whether or not a communication is maintained with the outer, inhabited water.

By nearly all the earliest writers it was maintained that no such communication took place; a contrary decision, however, was first arrived at by Oscar Schmidt and Mr. H. J. Carter, and strong additional evidence given by Prof. Ray Lankester has called forth testimony from various sources establishing this intercommunication beyond a doubt. Mr. Saville Kent argues well that the leading

function of the contractile vesicle is excretory, in getting rid of the large amount of water taken in with the incepted food-material. He says: "It is conspicuously evident, when watching the feeding-process of a *Vorticella*, or other highly-organised Infusorian, that each spheroidal pellet, or isolated fragment of incepted pabulum, is inclosed within an equal, or even more extensive mass of water, and which liquid, without some special outlet for its discharge, would soon accumulate to an extent incompatible with the well-being of the animal." It is very easy to understand that the immense quantity of water thus brought into the endoplasm, and circulating by means of the tributary canaliculi through every part, re-oxygenises the plasma, and thus fulfils the rôle of a rudimentary respiration; the contractile vesicle being the reservoir into which the fluid debouches after thus circulating through the body, and from which it is discharged after accumulating.

Brief mention must be made of another structure to be discerned in the endoplasm, which is assumed to be the elemental factor of all infusorial life. It is called the *nucleus* or *endoplast*. In its initial phase it has a simple spherical form, but in the more highly-organised forms it is more elongated; it looks like a string of beads in the Stentor family.

In the section Pantostomata, which we are now studying, an oral aperture or mouth does not exist. Recent investigation has demonstrated that an anal aperture, or *cytopyge*, exists in the majority of the species, although this organ is rarely to be seen except during the passage of rejectamenta; in the present section it is situated posteriorly.

Perhaps there is nothing more wonderful or interesting in the study of the Infusoria than their reproductive phenomena, which may be divided into three processes: *Binary Division*, or splitting into two parts; *Gemmation*, or budding; and *Sporular Multiplication*, or breaking into infinitesimal spores.

The earliest recognized, and by far the most ordinary method, is that of binary division. In the majority of cases this fission takes a transverse direction. A groove or constriction makes its appearance in the centre of the body, which becomes deeper and deeper until the two bodies become entirely separated, each half moving away as an independent animalcule.

This method is characteristic of the Vorticellidæ, and by means of this the tree-like colony-stocks are built up.

As the infusorial body, with all its various modifications, has only the structure and functions of a simple cell, so this special mode of reproduction is merely a reflex of that exhibited by all cellular elements of higher structures. In all cellular structures, from the simplest to the most complex, increase of growth and size is always effected by binary or duplicative division of the cells of which it is composed.

By this method, *Epistylis grandis* produces colonial aggregations many feet in extent. The Spongida, or sponges, are now regarded by some writers as being merely modified aggregations of flagellate

monads, and the increase of size is effected in this manner. The astonishingly rapid growth of the Infusoria is truly wonderful. Ehrenberg computed that in the case of one animalcule (*Stylonychia mytilus*) no less than one million of independent beings were derived from the simple and repeated fission of a single zooid in the course of ten days; and in another (*Paramecium aurelia*), he reckoned that 268 millions might be similarly developed within a single month. Substantial evidence of this prodigious increase is afforded by the Spongida, and the other previously-mentioned examples, each colony representing the binary division of a single unicellular zooid.

I have never seen any instance of gemmation. It is, I believe, the rarest method of reproduction; and I believe is unknown in the pantostomatous section. Sporular multiplication is much more common. The term is applied to those reproductive phases in which the animalcule assumes a quiescent encysted condition, and subsequently bursts into a number of spore-like bodies. In some instances the number of spores may be counted, and will be found to vary in numbers of two, four, eight, sixteen, and thirty-two, when they are termed *macrospores;* but when they exceed this number and are innumerable, they are called *microspores.* In some instances many thousands of these spores are included in the parent capsule, or *sporocyst*, as it is called, and so extremely minute is their individual calibre that even with the highest powers of the microscope their individuality cannot be discerned.

In both cases each particle or spore ultimately developes to the parent form.

This sporular stage of existence is at the present time attracting the attention of the most eminent biologists; new and startling facts are continually recorded, showing its universal prevalence, and the important part it plays in the origin of diseases.

Having now arrived at some idea of the organisation of the Infusoria, we will, after a few words on their distribution, turn our attention to those species which have been observed in the neighbourhood.

The majority of the Infusoria are to be found either in fresh or salt water, either free-swimming, attached to submerged plants and other objects, or parasitically attached to other living organisms; many of these do not, as in the ordinary cases of parasitism, maintain themselves at the expense of their host, nor are they in any way injurious, but are simply co-associated, merely using the ectoplasm of their host as a fulcrum of attachment. For these habits Prof. Van Beneden has invented the title of *commensalism.* The Entomostraca are generally the entertainers of these guests. Mr. Saville Kent considers that the Daphniadæ, or water-flea tribe, are an exception to this rule, but about a month ago I came across an example (*Daphnia vetula*) which was covered with parasites. It must not, however, be considered that the Infusoria are to be found in water only. All the Opalinidæ lead a parasitic life within the alimentary canals of frogs and other Amphibia. The

genus *Entodinium* is, I believe, confined to the stomachal cavity of cows. *Herpetomonas Lewisi* has been recently discovered in the blood of healthy rats. *Trypanosoma* is found in the rectum of poultry. *Balantidium coli* even honours the human subject with its presence. The Infusoria are to be found in enormous numbers in dew, and indeed their presence may be said to be universal.

The animalcules which are now to be brought before your notice have been found in the neighbourhood by myself or other members of the Society.

The order Amœbina is the first of the six orders which compose the class Rhizopoda.

*Amœba proteus* is the starting-point in the animal kingdom; it appears to be the simple parent stock from which all the Protozoa have been evolved. It may be described as a simple mass of jelly-like sarcode, or protoplasm, having no definite form, its outline being as changeable as that of the fabled Proteus, from which it takes its name. It simply creeps through the water by means of lobate projections or pseudopodia (false feet), which are protruded indifferently from any part of the body, incepting its food by rolling over it and wrapping it up, as it were, within its body. This is the commonest type of the Rhizopoda, and is to be found everywhere, especially where decaying vegetable matter exists.

Advancing a step, we come to the Gregarinida, curious animal-parasites, consisting of a simple cell, usually of an ovate form. These mostly inhabit the intestines of the earth-worm and the larvæ of insects—a field which up to the present time I have not explored, and I cannot, therefore, report upon them.

The next order is the Arcellinida. Here we have amœbiform rhizopods, inhabiting a shell or test. Of this order I have found five representatives. The first is *Gromia oviformis*. This animalcule inhabits an egg-shaped brownish envelope, about 1-10th of an inch in length, which has a single round orifice, from which the protoplasm streams forth, ramifies, and inosculates until a network is formed, and when any minute protophyte or food-substance is entrapped the pseudopodia are withdrawn into the interior, and the nutritive substance assimilated. *Gromia* creeps about by means of these pseudopodia. The next I have found is *Arcella vulgaris*. Here the shell or test is circular, of a horny nature, and of a bright chestnut hue, bearing markings resembling the engine-turning at the back of a watch. These two were found in Ball's Park; the latter is very common. Another less common species is *Arcella aculeata*, the test of which is furnished with peculiar curved spines.

Other examples of this order are *Difflugia oblonga* and *Difflugia proteiformis*, in which the test is made up of very minute sand-grains cemented together. The pseudopodia in this genus and in *Arcella* are short and lobate, not often exceeding the length of the body, thus differing from *Gromia*, where they are very fine and spread out to about four times the length of the body.

The next two orders, FORAMINIFERA and RADIOLARIA, are, I believe, entirely marine.

The sixth order, HELIOZOA, includes the well-known sun-animalcule, *Actinophrys Sol.* It may be distinguished by the naked eye as a whitish-grey particle, from which, when under the microscope, a number of slender spines are seen to radiate.

The central part of the body consists of simple sarcode. The body is nearly motionless, but derives its food through the agency of the pseudopodia; as soon as an animalcule comes in contact with these, it appears for a moment to be stunned, but if it is strong and vigorous it soon recovers its powers, and struggles to break away from the adhesive source of entanglement, but is rarely successful; when the struggle is great the neighbouring pseudopodia bend over to assist in securing the captive, and then by their joint retraction it is drawn into the substance of the body, its struggles become weaker and weaker, and it is soon assimilated. *Actinophrys* is a very voracious animalcule; I have seen it engaging four such victims at once.

In company with *Actinophrys Sol*, I have also found *A. Ehrenbergi*, a variety characterized by the shortness of its spines.

Somewhat resembling this is *Actinosphærium Eichhornii*, which was formerly described as an *Actinophrys*, but an important difference exists in the nature of the pseudopodia. Through the centre of each runs a firm spine which penetrates the superficial zone, and rests upon the surface of the central sphere. Several other representatives have been found in Wales and Ireland, by Mr. Archer, which closely resemble the exquisite marine Polycystina, but up to the present time I have not had the good fortune to come across them.

We now leave the Rhizopoda, and come to the second class, Flagellata; here the appendages, instead of being pseudopodic, are flagellate or lash-like, and these flagella are the sole organs of progression. The first order of this class is called TRYPANOSOMATA.

A Trypanosoma may be briefly described as an *Amœba* of a flattened shape, which flaps through the water by the undulations of one extremity which is prolonged into a rudimentary flagellum. There are two species in this genus, *Trypanosoma sanguinis* and *T. Eberthi*. The first inhabits the blood of frogs; the second is found within the intestinal viscera of domestic poultry. I was anxious to find this connecting-link with the Rhizopoda, and searched for it in the last-named habitat. I found what I believe to be *T. Eberthi*, but could not make out the form so satisfactorily as I could wish.

The second order is called RHIZO-FLAGELLATA, and includes animalcules progressing by means of pseudopodia, but bearing one or more flagella.

In the third order, RADIO-FLAGELLATA, the animalcules emit ray-like pseudopodia and possess flagella. I have not yet found any examples of these two orders.

The fourth order is called FLAGELLATA-PANTOSTOMATA; here we lose the rhizopodous character, all the appendages being flagellate. This is a very large order divided into eighteen families.

The first family, Monadinæ, is the simplest and perhaps lowliest organized of all the Infusoria: the animalcules are simply minute specks of protoplasm of variable and unstable form moving about by means of a single thread-like flagellum issuing from the anterior extremity, and deriving their food by simple absorption of the inhabited fluid. The characteristics of all the species are so uncertain that I must refrain from further description; they are to be found everywhere, and are especially abundant in infusions of vegetable matter.

The animalcules belonging to the next family, Pleuromonadinæ, differ from the foregoing only in being of a kidney shape, the flagellum issuing from the concave side.

In the third family, Cercomonadinæ, the animalcules develop at will a thread-like extension of the body, serving as a pedicle. I have found one representative of this family, *Oikomonas mutabilis.* The animalcule is of a variable ovate form, and when attached by its slender pedicle or footstalk, the flagellum is vibratile; but when swimming it is rigidly extended in front. This object was found in an aquarium.

The next family is Codonæcidæ; here the animalcules inhabit a horny sheath or lorica.

In the fifth family, Dendromonadinæ, we find an advancement in form; two flagella are developed, and the animalcules are usually found in colonies, attached to tree-like branching pedicles. In this family I have met with two highly-interesting examples. The first, *Dendromonas virgaria,* was found in a pond in Mangrove Lane, attached to the leaves of *Myriophyllum* and growing most luxuriantly in what appeared to be perfect forests of tiny crystal trees. A more beautiful sight I have never seen. In this species colonies of over a hundred zooids of a pear shape are attached to a rigid hyaline pedicle, each zooid quivering by the action of the two flagella which it possesses.

The next example is *Anthophysa vegetans;* here the animalcules are pear-shaped, and attached in rosette-like mulberry-shaped clusters of fifty or sixty zooids to the terminations of an irregular branching pedicle (or zoodendrium, as it is often called), which is of a dark brown colour and horny consistence, longitudinally striated and stiff. In weakly specimens the pedicle is simply granular and flexuous. This curious pedicle is the product of excreted particles, from which the nutritive matter has been extracted. Its substance has a close affinity to keratose, the horny framework of sponges.

I found a specimen a short time ago containing eight clusters of monads, and I noticed that the pedicle at the point of junction with the cluster was sufficiently soft and flexible to allow of a partial gyration backwards and forwards, caused by the vibrations of the innumerable flagella. By following up Mr. Kent's investigations I was able to see the exact manner in which this pedicle was built up. I fed the group with very fine carmine, the particles of which were greedily incepted; each monad was soon gorged with the

material, which showed itself as several brilliant crimson globules moving about in their bodies. The monads soon discovered that carmine was not nutritious, and began to discharge it at the posterior extremity, where this extremity joins the pedicle. The rejected matter soon accumulated round the pedicle, and was utilized as material for building it up and prolonging it. The pedicle increased rapidly in length, the brownish colour disappearing, and the newly-formed continuation of the stem being composed entirely of carmine particles, agglutinated by some material from the body of the monad; in less than an hour the length of the pedicle was doubled.

The true nature of this most interesting animalcule was for a long time mistaken. Pritchard confounds it with *Uvella;* by Kützing it was regarded as an aquatic fungus; he considered the branching stem to be the mycelium, and the clusters of monads to be gonidia.

We next come to the sixth family, *Bikæcidæ;* here all the animalcules secrete horny loricæ or sheaths. This family is divided into three genera. The first is *Hedræophysa.* This genus differs from the one following in having no stalk to the lorica. Only a single species is recorded (*H. bulla*), which was found by Mr. Saville Kent attached to Confervæ from sea-water collected at St. Heliers, Jersey. I have, however, recently found a fresh-water species differing slightly from this. The animalcule was attached to the lorica by a thread-like contractile ligament, or footstalk, whereas in the former it simply rests in a sessile manner at the base of the lorica; in my species the lorica was oval, but in Mr. Kent's it is spherical. It was found in pond-water from Broxbournebury.

The second genus, *Bicosœca*, is principally marine; one species, *B. lacustris*, I have found in water from Brickendonbury. The lorica and its supporting stalk are about equal in length; there are two flagella, one long and one short, the latter being difficult to see without employing a very high magnifying power; in the descriptions of Stein, Bütschli, and Prof. H. James Clark it is not shown. The animalcule, as in the former genus, is attached to the lorica by a contractile ligament; when it retreats within the lorica, the long flagellum is thrown into an elegant spiral coil, reminding one of the proboscis of a butterfly.

In the third genus, *Stylobryon*, the animalcules are social, and are united to one another by slender independent foot-stalks, or pedicles, which are produced within the cavity of the preceding lorica. The lorica is of a wineglass shape, and the animalcules resemble the former genus in contour; there is, however, one important matter to be noticed. According to Mr. Saville Kent they are identical with the species figured by Friedrich Stein in his recently-published volume 'Der Organismus der Infusionthiere' (1878), under the name of *Poteriodendron petiolatum*, which agrees with *Stylobryon* in nearly all particulars, but possesses a supplementary membranous expansion, somewhat resembling the funnel-

shaped collar of the Choano-Flagellata. He (Mr. Kent) says that he believes that Stein has misinterpreted this structure. He has examined an extensive series of examples, and he says: "In no instance could any such independent organ be detected, but in place of this it was observed that the anteriorly-developed lip-like prominence occupied a conspicuous position, and might be with ease identified with the looked-for 'collar.'"

From personal observation I am able to substantiate the correctness of Stein's description. Whilst working with Mr. Robinson one evening a short time ago, we found a colony of nine zooids, three of which showed this "collar" most clearly. I could see the peripheral contour as distinctly as possible; all the others, however, showed only the characteristic lip-like prominence; after a short time, whilst making a note of the matter, the collar was withdrawn, and the zooids presented the same appearance as the others; the animalcules were all extremely plastic and changeable in shape, and from this I infer that the so-called "collar" really exists, but can be withdrawn or extended at will.

There are twelve other families of the Pantostomatous Infusoria, but I have found no representatives, and as our time is short I shall refrain from further remarks upon this section, reserving the remaining families as matter for a future paper.

In conclusion I may mention that the method of illumination which I have employed with most success is that of *direct* light proceeding through the condenser without the intervention of the mirror, and by this means I can make out such delicate structures as flagella and the collar, with a half-inch objective, easily and most distinctly. The powers which I employ are a half-inch and a one-tenth inch objective fitted to a double nose-piece in such a manner that when interchanged for each other they are in focus without further adjustment. For confining the most restless species when under examination I place a little spyrogyra or some other conferva between the cover-glass and slide.

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## XVII.

# NOTES ON THE UPPER PORTION OF THE RIVER RIB AND ITS AFFLUENT THE QUIN.

By R. P. Greg, F.S.A., F.G.S., F.R.A.S., and
R. B. Croft, R.N., F.L.S., F.R.M.S.

*Read at Ware, 30th March*, 1882.

The River Rib rises as far north as Kelshal Woods, near Therfield, and another of its head-waters can be traced to Reed End. Therfield Hill, on the water-parting of the basins of the Thames and Great Ouse, is nearly 550 feet above sea-level.

From the junction of its head-waters the Rib flows through Chipping and Corneybury, but in summer is often dry as far as the latter place, and thence to Buntingford (301 feet), where its stream formerly worked a small water-mill. During the summer of 1874, for the first time in the memory of living man, the body of the stream was entirely dry as far as Westmill railway-station, more than a mile below this town, and in 1879 occurred the greatest flood ever remembered, 3·2 inches of rain falling at Buntingford in four hours, and very much damage being done.

Buntingford, according to local tradition, received its name from one Bunt, or Bunting, a smith, whose house was near the ford over the Rib, but it is worthy of speculation whether, considering that the town is very near the boundary of the hundreds of Braughing and Edwinstree, its name may not formerly have been Bounding-ford, *i.e.* the ford bounding or dividing the hundreds. It is also situated at the junction of three parishes. The first notice we have of the town is the 21st of Edward the Third, when a market and fair were granted.

Below Buntingford the Rib is increased by a small stream from Tannis and Wakeley farms, often dry in summer, which passes through Aspenden village near Aspenden Hall, the seat of Sir Henry Lushington, which is prettily situated at the head of a little glen. Below this junction the scenery is of a very pleasing character. The first village through which the river runs is Westmill, and here it receives a considerable addition to its stream from various perennial springs which rise in a meadow on the farm of Westmill Bury; below this, as above stated, the river is never dry. The next place of interest is Coles Park; here are vestiges of two water-mills; and from Domesday we learn that in Westmele (Westmill) there were three such mills. It is curious to note that although the water in the park is slightly dammed back, yet it has hardly ever been known to freeze, probably on account of the amount of spring-water received at Westmill. The Rib next flows through Hamels. The mansion, described by Chauncy as "glorying on the western hill," is on the right bank, and a very fine avenue of elms and limes extends therefrom to the river near Hamels Mill. An old man,

now living on the estate, remembers the last deer being removed from Hamels, which was formerly an extensive deer-park.

Nearly opposite Hamels the Rib receives its most important tributary, the Quin, and on the promontory formed by their junction are the remains of an ancient fortification, probably Roman. Salmon, in 1728, in his 'History of Hertfordshire' (p. 227), thus describes the camp as it existed in his day; and, by attentively examining the ground, much of this description can still be recognized:—

"As to Remains, the Town [*Braughing*] has been antient Demense, and hath still some Ruins of its Grandeur, giving Name to the Deanry and Hundred. On the West Side the *Ermine-street*, now the *Cambridge* Road, we find the Traces of a *Roman* Camp. In *Larks Field*, which faceth the South East Sun, is a kind of Promontory above the Confluence of the *Rib* and the *Quin*, by Nature defended by a steep and high Bank. Yet the Fortification of the Camp is not at the Precipice, but fifteen or twenty Yards within it. There are yet to be seen, notwithstanding the scratching of the Plough and Harrow, and turning of Carts for Harvest and Manuring, from the Road Westward, a *Vallum* almost cross the Field, and about ten Yards without that, another. These may probably have been levelled to the Height they are at present, to make way for the Plough. On the South was the Entrance, and there yet seems between the opening of each *Vallum*, another across to obstruct the Passage, so that one must make a semi-lunar Turn to get into the Camp. At the South West Corner it is rounded off, and carried on again Northward to the End of the Field, defended by a triple *Vallum*. No more of the Dimensions are to be followed; but by the Figure of the Ground, and its lying so much above the common Field, I should take it to be an Oblong, extending itself as far as *Down Field*: And that it took in what is called the *Saffron Ground*, and the small Inclosures between that and *Larks Field*, bounded by the Military Way: And that the Lane going at present from *Hull* to *Braughing*, went through the middle of it. The whole I guess might be 40 Acres. Next to *Down Field* is another called *West Attick*, derived probably from Aultwick or Auldwick, from the high or the antient Building there, in which were in 1725 ploughed up two large Stones, which look as if they were the Foundation of a Building: And in the upper Corner of the same, the Earth lies in Holes and Hillocks, as if some Foundations had been dug up. Just by is a Wood called *Camps Wood*, which might formerly have been larger, and extended itself to the Camp."

On the right bank of the Rib, not far from the railway-station, are apparently vestiges of another fortification, possibly an advanced work to protect the ford, or the exterior line of a system of which the works on Bingley Wood (for so the hill is named) might have been the citadel.

Within fifty yards of the railway-station have been found very many coins, much pottery, and other remains, all evidently Roman, so there can be but little doubt that this was a Roman station,

probably of considerable importance from its position close to, if not absolutely on, the intersection of two of the great military highways, viz. that now called the Herman or Ermine Street, leading from Newhaven, in Sussex, to the north; and that which is marked on the ordnance maps as the Via Militaris, which may be traced from Colchester through Stortford to Braughing, thence north-westward to near Baldock, where it joins the Ickneild Way. Opinions differ as to the name of this ancient station. Salmon has no doubt that it is Cæsarmagodum, whilst other authorities, amongst whom is Mr. Cussans, our latest historian, consider that it is Ad Fines, which name is given to the site of the camp in the last ordnance survey.

To those to whom such studies afford pleasure, the name Braughing (Brachinges in 'Domesday') affords a fruitful field for speculation. Some writers consider it was originally Bourough, *i.e.* a fortified place, with the Anglo-Saxon termination *ing;* others are of opinion that it derives its name from the fact of its being situated on a brook—*Brooking;* whilst a third trace by substitution and transposition of letters, Adfines to Dafines; hence to Brafines and Braughing.

The proper source of the River Quin is at Rushing Well, near Nuthampstead; but below this, and near Biggen Farm, it is joined by a watercourse which can be traced close to the Essex border, near Little Chishall, not far from which place is the source of one of the tributaries of the River Cam. At Biggen Moor are several springs. At Stapleford Bridge the Quin is joined by another branch, which rises in Scales Park Wood, in or close to which wood also rises the River Stort, the most important of the affluents of the Lea.

Until the Quin arrives at Braughing, the scenery through which it passes is not very attractive, and the stream is but little more than an open watercourse, often dry in summer. In a field above Braughin Vicarage there is a considerable spring, and the river is further augmented by the overflow of a spring which forms a pond in the Vicarage garden, which has never been known to freeze; below this the river is never dry.

After flowing through the village of Braughing, which is pleasantly situated in a hollow on either bank, the Quin joins the Rib, and the stream, now known by the latter name, after passing Gatesbury Mill, near the village of Puckeridge, reaches Standon, where its history will be taken up by another pen.

The trout in the waters we have been considering are numerous and remarkably fine. The Rev. J. A. Ewing has seen one weighing 4lbs. 3oz. taken out of the stream at Coles Park, and knows of trout of 3lbs. being not infrequently caught. No fish now go above the old mill at Buntingford, and pike are not known above Gatesbury. Roach occur in the Hamels water near the mill.

In two or three woods in Westmill and Braughin parishes the badger is still comparatively numerous. One was recently killed on the railway by being run over by one of the evening trains.

Kingfishers are happily very numerous, and this following what has been said above about trout leads one to hope that they are after all not such great enemies to the pisciculturist as some people imagine. Water-hens and dab-chicks are common; occasionally water-ouzels, snipe, ducks, and herons may be seen.

Wyddial Church, close by Wyddial Hall, the residence of the Ellis family, is about the centre of the double water-system of the Upper Rib and Quin. From the junction at Braughing, to Therfield and Barkway, the distances are 11½ and 10 miles respectively; the widest part from near Thocking to Anstey, nearly seven miles. The entire basin of the Rib from its junction with the Lea consists of about 64 square miles, and is 15 to 16 miles in length, by an average breadth of about 4¼ miles.

Geologically, the entire basin of the Rib and Quin lies over the chalk; the London Clay only in one or two places extending north of the Lea. The valleys trend north and south, and there is little of interest in a scientific point of view in the geology hereabouts. Clays, till, and gravel, and occasionally sand, predominate, and sometimes the chalk comes close to the surface, and is worked for lime. No flint implements, whether surface or *palæolithic*, have occurred in the neighbourhood of Buntingford that we are aware of. The chalk about Buntingford is not rich in fossils. Boulders occasionally occur in the clay, and on the surface. One very large one may be seen in the street at Standon, of the usual Hertfordshire plum-pudding stone; and smaller ones, occasionally striated or glaciated, of Mountain Limestone, in the open fields when draining is going on. These latter probably came from Leicestershire or Derbyshire.

The volume of water coming down the Rib and Quin in summertime must be decidedly less than in the last century; this, no doubt, arises chiefly from more draining of the land, as well as cutting down of large hedgerows, and also from there being rather less of woodland and grass. The several small water-mills already referred to could never have been worked under present average conditions. The following extract from Cussans' 'History of Hertfordshire' (Edwinstree Hundred, p. 83), may be interesting.

"The most interesting feature connected with the sketch [the engraving of Little Court, between Corneybury and Buntingford, given in Chauncy] is the River Rib, which flows before the house. It is represented as being nearly on a level with the banks, and three figures appear fishing in the stream. At the present time the bed of the river is quite dry for the greater part of the year . . . Fishing, it need hardly be said, is out of the question; though I am informed by William Butt, Esquire [of Corneybury], that forty years ago the river contained an abundance of pike, roach, perch, and trout."

Cussans adds in a note, in reference to this reduction in the volume of the Rib of late years, owing to increased field-draining and stubbing-up of the fences and springs, that there is also a great scarcity of water in many parts during the summer months, especially in parts of Buckland, Therfield, and Sandon.

The meadow-pasturage in the valley liable to occasional flooding is generally of a much superior quality to the pastures of the higher lands.

On the rising ground along the river-banks, and on the flatter lands beyond, drinking-water is seldom obtainable, except from wells about 150 feet in depth, probably at about the level of the river-beds of the Rib and Quin.

Webb and Coleman, in their 'Flora Hertfordiensis,' state that there are about 460 species of plants found in the Rib and Buntingford district.

In Halliwell's 'Dictionary of Archaic and Provincial Words,' *rib* is given as an old East-Anglian word for water-cress; showing that possibly the River Rib is equivalent to the cress-brook or water; the common water-cress being still common in its waters, as well as in those of the Lea, and in the same work the word *quin* is given as an old name for the spikenard, and may refer either to *Conyza squarrosa*, or to the flea-bane, *Pulicaria dysenterica*. It is, however, the opinion of many who have made the subject their especial study that rivers are very rarely named after trees or flowers, and although it is very difficult to arrive at a satisfactory derivation of the word Rib, yet *quin* or *quern* is an ancient name for a mill, and Quinbury is a place where a mill might well have been in former times. This seems to be a more satisfactory account of the name of the river and place than the former tradition that an Anglo-Saxon queen had a residence there. Rib may possibly be derived from the Saxon verb *rippan*, to cut through, or it may be connected with the Norman *rive*, a bank, from which our modern word *riparian* is derived.

XVIII.

# NOTES ON THE RIVER RIB FROM STANDON TO ITS JUNCTION WITH THE LEA.

By Arthur Giles Puller, M.A., F.S.A., F.Z.S., F.R.G.S.

*Read at Ware, 30th March,* 1882.

The River Rib, about one mile below Puckeridge, flows past the village of Standon, which possesses two mills worked by the water of the stream, one a corn-mill which stands immediately above a bridge built in the year 1858 (to replace a former bridge destroyed by a flood of unusual height in the month of October, 1857); the other, for many years used as a paper-mill, but lately converted into a saw-mill, stands a few yards above a ford and foot-bridge by which the river can be crossed, about a quarter of a mile below the bridge referred to above.

In following the course of the river below Standon, the next point most worthy of notice which we come to is the site of the mansion or palace, completed in 1546 by Sir Ralph Sadler, called Standon Lordship. It originally was of great size and contained three courtyards, and according to local tradition King James the First was entertained there one night on his journey from Scotland to London. But small traces remain of this extensive pile of buildings, save the arch of the principal entrance, and some parallel terraces now covered with grass which formed part of the pleasure-ground and suggest the idea of a vineyard.

As we proceed down the course of the river, an extensive wood called Plashes becomes visible on the right bank. This wood, now reduced to 150 acres, was formerly of much greater extent, and has long been reputed to be one of the last refuges of badgers in this part of England. A small mound of earth covered with brushwood adjoining a neighbouring cover called Blackie Meads still bears the name of the Badger-pit; and in confirmation of the above tradition a remarkably fine badger, both in size and colouring, being beautifully marked by black and white stripes, was caught in a trap about half a mile from the pit in the month of March, 1869, on land belonging to the author, and the specimen is now in his possession. A little below the village of Latchford, on the left bank of the stream, stands Arches Hall, built about fifteen years ago by the late Mr. James Chapman, on land belonging to him; and after passing the village of Hanging Wood, which bears the same name as one of the Duke of Wellington's covers immediately adjoining, the river passes the boundary of the Youngsbury estate, the farms on the right and left banks being respectively called Great and Little Barwick. Great Barwick farmhouse is the manor-house of an ancient manor named Berewyk, which was separated from the manor of Standon at a very early date.

It will be interesting for a few moments to trace the boundaries of the ecclesiastical districts which meet at Barwick Ford and

Bridge. First, along the centre of the road leading from Standon and Hanging Wood to Barwick Ford lies the boundary between the ecclesiastical district of High Cross and the remaining part of the original parish of Standon, which is (ecclesiastically) attached to the parish church. Below Barwick Ford and Bridge the river Rib (except at one or two places) is itself the boundary between the district of High Cross and the parish of Thundridge. The wall or fence which divides the garden of Little Barwick Farm from the roadway in front of it, is the boundary between the parishes of Standon and Thundridge, and this wall or fence is exactly in a line with the handrail which protects the footbridge. In September, 1849, the footbridge, either from decay or accident, became impassable, and, owing to a dispute between the two parishes, twelve months elapsed before the river was again spanned by a wooden bridge. This was swept away by a flood of unusual height on the 3rd of August, 1879, and has been replaced by one more substantially built.

In the home-meadow or pasture-field next below Great Barwick homestead we find an evidence of the great antiquity of the place in a row of ancient pollards—hornbeams—to which no precise date can be assigned, but which, from their number (six) and position, must at some former time have formed part of, or stood in the line of, some fence or boundary. Proceeding a hundred yards in the direction thus indicated, we find indications of a roadway having formerly existed in a depression twenty feet broad leading to and terminating in the bed of the river, about twenty yards above the spot where, in the memory of living persons, stood some floodgates. Exactly at this spot another clearly-marked depression in the turf, twenty feet in breadth, marks the site of a second roadway, and this convergence of roads, now no longer used, can only be explained by supposing that in former times a water-mill stood where the remains of the floodgates are still visible.

Half a mile below Barwick, an ancient manor-farm named Sawtrees crowns the hill on the left bank of the stream, whilst on the highest point of the hill on the right bank stand two cottages which bear the name of Haven End; in the last century a small farmhouse and homestead existed here, and earlier still a village which gave its name to the surrounding district, there being a local tradition that in the reign of King Alfred the Danes came up the river as far as Haven End.

One quarter of a mile lower down, after passing an ox-fence which marks the boundary between Great Barwick and the Youngsbury Home Farm, we come upon a pair of targets, with a marker's mantlet inclosed by an iron fence, and at 700 yards distance a red brick building with two turrets called the armoury; for more than twenty years this has been the private rifle-range of the owners of Youngsbury, and during the greater part of the time the Volunteers from the neighbouring town of Ware, the 9th Herts R.V. (now D Company 1st Herts Rifle Volunteers), have practised at this range and held here their annual prize-competition, by leave of the

present writer. In the year 1846 a plan was agitated for converting the whole of this valley from Standon Lordship to the armoury into a freshwater lake, to be used in conjunction with other lakes on the Ash and the Lea for supplying London with water; a few years later, before the present branch-line to Buntingford was constructed, a proposal was made to bring the line of railway from Hertford to Buntingford along the valley of the Rib, and at this part of the valley which we are now considering the railway would have crossed the rifle-range on an embankment, and would have passed over the spot where the targets now stand; happily neither project was carried out, and it may be hoped that cattle will pasture, and the Volunteers from Ware practise rifle-shooting at Thundermarsh for many years to come. A short distance below the armoury, the boundary of Thundridge parish crosses the river, the spot being marked by a cross-cut on an aged ash-tree, below which the boundary-line between the two parishes—Standon and Thundridge—is marked by a ditch until it rejoins the river a quarter of a mile lower down; the probable cause of this deviation of the parish boundary from the channel of the river is the undoubted existence in past times of a water-mill called the Fish House Mill, the site of which is fixed by an old lane which led to it, which has long ago become a water-course, and may even now be called a bourne.

A few hundred yards lower down on the borders of Youngsbury Park stands the keeper's lodge and kennels, once a farmhouse, named Fabdens, and at this point the river divides into two branches. The right-hand branch, after passing two boat-houses and a bath-house built upon its banks, is artificially widened in that part of its course which is visible from the front door and windows of Youngsbury House. The house was built in 1745 by Serjeant Poole; it was enlarged in 1770 by Mr. David Barclay, and completed early in this century by Mr. Daniel Giles, an ancestor of the present owner. In a field called "Hilly Field," immediately adjoining the shrubbery and arboretum at Youngsbury, are two large tumuli or barrows, which Salmon, in his history, attributed to the Danes. When, however, one of them was opened in 1788 by Mr. David Barclay, the possessor of Youngsbury at that time, it was found to be of Roman origin, as the coins and pottery therein discovered abundantly proved. The second barrow has never been opened. A tesselated pavement was discovered in 1736, in close proximity to the barrows. No efforts seem to have been made to preserve the pavement, and, after heavy rain, the tesseræ of which it was composed were occasionally to be met with on the surface, within the memory of persons still living. The left-hand branch of the river brings us in less than a quarter of a mile to a chain of moats, four in number, which before the Reformation were used to contain fish for consumption on fast-days by the monks of a priory which immediately adjoined Old Thundridge Churchyard, and was used as a summer residence by the monks of Ware Priory. After the Reformation the priory was converted

into a country house, which was pulled down in the year 1811. One chimney, believed to be the kitchen-chimney, was left standing at the time, and still exists. Many traces of the country house, called Thundridge Bury, still remain—the lawn, on which stand two wide-spreading hickory trees; the gardens, now used as a nursery for forest trees and shrubs; the coach-house, converted into a cottage; the chimney before referred to; and the well. Of old Thundridge church, pulled down in the year 1853, only the tower remains standing. From the principal entrance to the churchyard one avenue leads up the hill to a farmhouse called Thundridge Hill Farm; whilst another avenue of elms, 600 yards in length, leads along the valley in the direction of Wadesmill. There are many points of interest connected with Wadesmill and its neighbourhood, of which a complete account is given in Cussans' 'History of Hertfordshire.'

On a hill on the left bank of the river, immediately above the village, stands the new parish church of Thundridge, and less than one mile distant is Poles, the seat of Robert Hanbury, Esq. At Wadesmill stands the Feathers Inn, which previous to the year 1849 was the halfway house between London and Cambridge, and just beyond it stood the turnpike-gate, which was one of the first three gates erected in England, in the year 1662. A short distance up the hill stands an obelisk, which was unveiled on October 9th, 1879, and which was placed there to commemorate the spot on which Thomas Clarkson, in the month of June, 1785, resolved to devote his life to bringing about the abolition of the slave trade. At the summit of the hill, which is said to be the steepest between London and Cambridge, stands the village of High Cross, and about half a mile beyond High Cross, a stone, with an inscription upon it, marks the spot where the aeronaut Vincent Lunardi made his descent on the occasion of the first balloon voyage in England, on the 15th of September, 1784. The bridge over the river at Wadesmill was built in the year 1825. Previous to that year the stage coaches were accustomed to ford the river when the water was not too high.

A little above Westmill the boundary of Thundridge parish is reached, and from that point the river, after passing the Herts Reformatory, built in the year 1857, for the remainder of its course continues to divide the parishes of Ware and Bengeo, until, after running round the border of Ware Park, the seat of Commander J. H. Parker, R.N., it falls into the River Lea, turning as it does so the water-wheel of Ware Park Mill, which stands at the confluence of the Lea—the chief river of the county—and its tributary the Rib, whose course from Standon-bridge to this, its termination as a separate stream, I have thus succeeded in tracing.

And here I might bring this paper to a close, but before doing so I should like to add a few remarks on certain subjects especially connected with the purpose and object of the Natural History Society of Hertfordshire. Any geologist who might ascend this valley for the first time would be struck by finding in the first mile

above Wadesmill no less than four disused gravel-pits (two of them planted with timber and underwood) and two gravel-pits in use now—one close to new Thundridge church and one by the keeper's lodge at Fabdens. Proceeding higher up the valley he would find a chalk-pit near the armoury-building in Thundermarsh; a chalk-pit and gravel-pit (both in use) at the foot of the hill on which stands Sawtrees Farm; at Little Barwick, again, a chalk-pit and gravel-pit (both in use); near Great Barwick an ancient gravel-pit called the Herring Dell; and a quarter of a mile below Standon another gravel-pit of great size, which has only been worked out in the course of the last twenty years: or, to sum up, in less than five miles he would notice six disused gravel-pits, besides three chalk-pits and four gravel pits in use at the present time. Immediately after passing the homestead of Little Barwick Farm, the new road from Barwick Ford to Kettle Green, in Great Hadham parish, ascends the hill by a cutting, of which the inclination is 1 in 30. Mr. W. H. Penning, F.G.S., has drawn for the Geological Survey of England and Wales a section of this cutting, which may be thus described:—At the lower end of the cutting glacial drift rests directly on the chalk: the drift consists of light-coloured sand, with a thin layer of gravel between it and the chalk; 180 feet above the lower end of the cutting the chalk dips below the level of the roadway, and the section consists first of glacial drift, *i.e.* light-coloured sand, with a layer of gravel below it, and, for fifty yards after the sand ceases, of gravel alone. The next 130 yards of the section is thus described by Mr. Penning: "Gravel, with intercalated patches of sand, and a contorted bed of boulder-clay." At the upper end of the cutting the section consists of gravel and sand. The cutting exceeds 500 feet in length, and was made in the year 1871.

Any one to whom trees were a greater object of interest than the soil of the valley, would notice first the long avenue of elms leading to old Thundridge Church, and the wide-spreading hickory-trees on the former lawn of Thundridge Bury. By the side of one of the moats he would find one wych-elm and three or four common elms, to which no date later than the Reformation can be assigned; and in Youngsbury Park he would find more than one plane-tree planted by the water-side, a group of abeles which date from the last century, and one pollard-oak believed by calculation made from its girth to have stood for eight centuries whilst the Rib has flowed by within one hundred yards of its trunk.

The fish whose names are given in the following list may on any day be taken from the waters of the Rib: trout, jack or pike, perch, chub, dace, gudgeon, minnows, eels; and occasionally tench and roach, and more rarely carp, have been captured. In all, eleven species of fish inhabit the waters of the Rib. In 1856 a trout weighing 8 lbs. was caught near Youngsbury. Pike have been taken of 17 and 22 lbs., and one caught with rod, line, and artificial bait, by the late Mr. Daniel Giles the younger, weighed 27 lbs.

Of crustaceans, the crayfish or crawfish, *Astacus fluviatilis*, is frequently met with at all parts of the Rib, and is especially abundant near Latchford.

Of animals, *feræ naturæ*, there are twelve species, as follow: mice, hedgehogs, squirrels, barn-rats, water-rats, foxes, hares, rabbits, badgers, stoats, weasels, and canes, the last three belonging to the family of the *Mustelidæ*—and the different species have received the distinguishing names of *Mustela Erminea*, *Mustela vulgaris*, and *Mustela nivalis*.* The ferret, *Mustela Furo*, is also found in the valley, but in a state of captivity, and must therefore not be reckoned amongst the indigenous natives of the valley.

Lastly, in enumerating those members of the feathered tribe which have at different times been met with in this valley, it seems to me that I shall do well not to give a list of ordinary British birds, but to confine myself to game-birds, water-fowl, and birds of prey. Of game-birds there are but five species—the common and the red-legged partridge, the pheasant, the quail, and the land-rail; of water-fowl and marsh birds there are eleven species, as will be seen by the following list: water-rail, moorhen, kingfisher, woodcock, snipe, wild goose, wild duck, teal, heron, swan, and common gull; of birds of prey there are seven species—one raptor, the kestrel-hawk, or *Falco tinnunculus*, and six Insessores, all belonging to the family of the Corvidæ, namely the carrion-crow (*Corvus Corone*), the hooded or Royston crow (*Corvus Cornix*), the rook (*Corvus frugilegus*), the jay (*Garrulus glandarius*), the magpie (*Corvus Pica*), and lastly the jackdaw (*Corvus Monedula*). I may add with regard to the above list of birds that the common gull has only once been seen in the valley, and was no doubt blown so far inland from the coast of Essex in stormy weather; in two seasons wild ducks have bred, and for several years in succession a pair of swans, believed to have flown over from Brocket Hall, thirteen miles distant, have brought up a family of cygnets in Youngsbury Park.

These brief notes on the Natural History of the Valley of the Rib I must now bring to a close, and can only wish that fuller details and greater knowledge of the subject had made them more interesting, and therefore more worthy of acceptance by the Society.

* It should, perhaps, be mentioned that *Mustela nivalis* is not strictly a species but a white variety of *Mustela vulgaris*, and that "cane" is a local name more often applied to the female weasel than, as here, to the white variety.—Ed.

## XIX.

## NOTES ON THE RIVER ASH.

By Hellier Gosselin.

*Read at Hertford, 27th April,* 1882.

The river Ash, though perhaps the smallest of the tributary streams that fall into the Lea, may nevertheless compare favourably with its larger rivals in the beauty of its charming valley, the lower portion of which, from Little Hadham to the outfall of the river into the Lea, contains as picturesque a tract of country as will be found in any part of the county. The valley is not only famous for the beauty of its scenery, but also has an interest both historical and literary, which I will endeavour to bring before you in tracing out its course.

The northernmost portion of the county, drained by the river Ash, is not bounded by the water-parting of the basins of the Thames and Great Ouse, but is overlapped by two affluents of the Lea, namely, the Stort and the Quin, whose watersheds meet in Scales Park Wood; and the surface-drainage does not make its way to the Ash, till some two miles to the southward, near Meesdon Church, and in close proximity to the Essex borders. The total length of country drained by our river may be roughly stated to be about thirteen miles, with an average width of three. Between Meesdon and Brent Pelham a bourne may be traced, skirting round the north and west sides of the hill, on which the latter village stands, to the neighbourhood of White Barns, where it joins another bourne, which brings down the surface-drainage from the east side of Brent Pelham. From this point there is no proper water-course, and in wet seasons the drainage from above runs down the road for a considerable distance towards Furneaux Pelham, until it again forms for itself a channel and passes through the hamlet of Barleycote End, and thence southward. Before tracing the water-course any further, a few remarks on the Pelhams may be of interest. The derivation of the name borne by these villages seems rather obscure. Salmon, in his 'History of Hertfordshire' (p. 285), observes: "*Ham* signifies a House, but what the *Pel* or *Pele* can mean, I am at a Loss to know. Mr. *Norden* would derive the Name *de Scatebris*, which he calls *Pels* or *Springs;* but there are no Springs here that are to be reckoned remarkable, nor any Summer Current." Our historian then somewhat sarcastically adds: "If he could have made out any thing from Sloughs, he might have found enow hereabouts, especially in *Brent Pelham*." This village derives its distinguishing name of Brent or Burnt from a fire which consumed the church in the reign of Henry the First.

Continuing down the valley, the next hamlet the bourne passes through is Clapgate, in the parish of Albury. Shortly after passing through Clapgate, the water-course crosses the road, where another tributary bourne joins it, which may be traced, on the

Ordnance Survey Map, to Bearden in Essex. Thence it continues its way through the meadows till it arrives at Little Hadham. A few hundred yards above this village, the real source of the Ash is to be found. Hitherto, in descending the valley, we have been merely tracing a bourne, which brings down the surface-drainage in the rainy seasons and is dry during the greater portion of the year; but on arriving at this point above Little Hadham there is a spring, the first we meet with in the bed of the bourne. It is a weak one, and ceases to flow during the summer months. Little Hadham is frequently called Hadham-on-Ash. The river is here crossed by the Roman military road from Colchester to Braughing. About fifty yards above the hamlet of Hadham Ford is a strong spring, which considerably augments the stream. The scenery in this part of the valley is remarkably picturesque, and it is especially pleasing a little further to the south, where the river flows through the Rectory gardens at Much Hadham. During the extremely hot summer of 1868, the Ash was dry at the back of Hadham Palace; but it has never been known to become dry below the Odel meadows, near the lower road to Bishop's Stortford. Hadham is by far the most important place in the valley of the Ash. The large old-fashioned red-brick houses, the fine timber in front of the lordship, the palace at one end of the village, and the grand old elms of Moor Place at the other, all help to make Much Hadham one of the most charming of our Hertfordshire villages.

Our river, which has now assumed considerable proportions, shortly after flowing through the Rectory gardens, where it forms a fine piece of ornamental water, crosses the Stortford Lane. Here it receives its principal tributary bourne. This water-course, as far as I have been able to find out, is known by no particular designation. It rises in the grounds of the once celebrated Hadham Hall, and passes through Berry Green and Dane Bridge; thence it continues its course to the river, which it eventually joins by running down the lane, making it perfectly impassable when the floods are out.

It may be well here to mention that the waters from these bournes only reach the river in the rainy seasons. At other times, though there may be a considerable stream in the upper portions, where the bed is on clay, the water gradually disappears on arriving at the chalk or gravel in the valley. Of course, during the summer months, many of the tributary bournes are completely dry.

We next come to the sheet of ornamental water above Hadham Mill Farm, the well-timbered wood forming a fine background to this charming part of the valley. Hadham Bourne, which rises near Green Tye, falls into the river close to the weir. A remarkably pretty walk or ride may be taken up the lane, alongside of this water-course, through Perry Green and down a steep hill into Much Hadham. Before leaving this bourne I wish to draw attention to an error that has been repeated over and over again in the maps of this county. Of course I do not refer to the old ordnance-survey, which is more or less correct. In some of the maps,

printed about the end of the last century and the commencement of this, among which I must include those in Newcome's 'History of St. Albans' (1793) and Clutterbuck's 'History of Hertfordshire' (1815), a river is drawn from Hadham Mill to the Stort, and usually figures as far more important than the Ash itself. It is unnecessary to add that nothing of the sort exists, though the tributaries of the two rivers approach very near to each other in Green Tye. The mistake may be excusable in maps of fifty or a hundred years ago, but it is not so at the present day. One of the modern maps in which this error occurs is Cruchley's map of Herts.

At Hadham Mill Farm the Ash passes under the high road, and immediately afterwards enters the Hundred of Braughing and Parish of Widford. About half a mile further down, on the right, may be seen a large tumulus, 440 feet in circumference, and the remains of a smaller one. Whether these are of Danish or British origin, I will not venture an opinion. A careful excavation of the larger one under an experienced hand might supply us with some clue as to its constructors. In the Blakesware meads, below a wood called Crackneys, are two very strong springs, which were formerly considered by the country-folk to possess certain valuable medical qualities. Near Widford Station the old road, before the making of the Buntingford Railway, passed through the river below the floodgates. It was either this ford or the one which formerly existed at Hadham Mill, before the present bridge was built, that gave the name to the adjacent village, *Wide-Ford*, or Widford.

While speaking of this village, it is impossible to pass over in silence one who has shed a halo on the literature of his time by his extremely pleasing and poetical essays; and who will not cease to be admired, notwithstanding the cynical abuse of Mr. Carlyle. I refer to Charles Lamb, who spent many a day in this neighbourhood. It was at Blenheims, some cottages near Hellam Green, where lived Rosamund Gray, the child heroine of one of his most charming stories. At Blakesware, Mrs. Field, his maternal grandmother, was housekeeper, and Lamb, when a child, was allowed to range over the old deserted house, which he so graphically describes in his "Blakesmoor," one of the 'Last Essays of Elia.' In this he writes in most touching language of his visit in after life to this "Eden" of his childhood. The house, which stood on the north side of the old high-road from Widford to Ware, had been then lately pulled down; and Lamb found nothing, save a few bricks, to mark the spot where it had stood. He brings his essay to a close with the following sentence: "Was it for this, that I kissed my childish hands too fervently in your idol-worship, walks and windings of Blakesmoor! For this, or what sin of mine, has the plough passed over your pleasant places? I sometimes think that as men, when they die, do not die all, so of their extinguished habitations there may be a hope—a germ to be revivified." This prophetic wish, if I may call it so, has come to pass, and a modern Blakesware has been built only a short distance from the site of the old deserted house of Lamb's days.

After passing Blakesware the Ash receives another tributary bourne, called Nimney or Nimley, which may be traced through Wareside and Babs Green for some distance to the north of the Buntingford Branch of the Great Eastern Railway, about midway between the stations of Hadham and Standon. This is perhaps the most charming of any of our bournes. For a considerable distance it runs at the bottom of a deep ravine, where wild flowers abound and high trees overshadow the steep banks. In winter-time and after a heavy rain a considerable quantity of water flows down this bourne, but during the greater portion of the year it is completely dry. Our river next flows through Mardox and the lower portion of Easneye Park, where a large sheet of ornamental water has been formed, and empties itself into the old bed of the Lea nearly opposite the village of Amwell. As we approach this latter river, our valley becomes much broader and the scenery proportionately finer. One of the best views in the County is obtained from the hill dividing the two rivers behind Widbury Farm.

Before bringing this paper to a close, a few words on the fish and water-fowl may not be out of place. Formerly there were plenty of trout in the river between the two Hadhams, but now no fish can be found there. Trout, however, are still sometimes caught in the water below Much Hadham Rectory. Above Hadham Mill Farm, jack are occasionally caught weighing as much as 6lbs. Between this farm and the railway-bridge near Widford are a few trout, but generally not larger than 2½lbs. They seldom appear in the deeper water below the bridge, where the current is checked by the Widford Mill floodgates, but in this portion of the river are a few rudd; and dace, perch, and roach abound. On the lower side of Widford Mill and under Easneye Park, where there is a clear and rapid stream, trout again make their appearance. Our chief water-fowl are dabchicks and moorhens; they are especially plentiful in the waters near Widford, and I am glad to say that the kingfisher is by no means a *rara avis* in the valley.

With regard to the flora of the district, the late Mr. R. A. Pryor, in a paper read before this Society in 1875, tells us that the true forget-me-not (*Myosotis sylvatica*) grows wild only in this valley.

In concluding this paper, I feel bound to state that my best thanks are due to Mr. R. B. Croft, one of the honorary secretaries of this Society, and Mr. Charles Gayton of Much Hadham, for their valuable assistance in supplying me with information concerning this valley. At the same time I cannot but express my regret that, owing to my lack of knowledge of the science for which this Society is justly celebrated, I have been unable to place before its members a more interesting account of the Valley of the Ash.

XX.

# METHODS BY WHICH MEMBERS CAN ASSIST THE RECORDER OF THE ARACHNIDÆ.

By F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.

*Read at Hertford, 27th April,* 1882.

In endeavouring to record the Arachnidal fauna of Hertfordshire, I propose to give my first attention to the Araneidea, or true spiders, and my observations in this paper refer to that class only. If I may judge from my own immediate neighbourhood, there is every prospect of our county yielding excellent results to the careful collector. Out of 526 species of British spiders, I have obtained, within a few miles circuit of Hoddesdon, 160, including one new species. I delay the nomenclature in the hope of considerably increasing the number during the year. I should be much obliged to any member who would send me collections from other parts of the county. About here there is no real heath soil, nor surface chalk, and spiders caught at different seasons in such districts would be very acceptable. With a view of obtaining such kind assistance I beg to offer the following remarks.

To capture spiders a small glass test-tube about two inches long and half an inch in diameter is placed over or under the spider, as the exigencies of the occasion require, and the orifice is closed with one of the fingers as soon as the creature has entered. The mouth of the tube is now placed just within the lip of a small bottle, half filled with ordinary methylated spirit, reduced in strength by about a sixth of its volume of water, and into this liquid the spider is shaken. The bottle is now re-corked, and opened from time to time to receive further specimens.

Spiders are to be obtained at all seasons of the year, but as all species do not arrive at maturity at the same time, the same spot may be searched with advantage on different occasions. Rare species are frequently to be caught on the top of iron railings or wood fences on which the sun is shining. A windless day gives the best results, and the hour varies with the season. I have been most successful in such places between 10 and 11 a.m. It is then that spiders start for their aerial excursions, and it is a pretty sight to watch them allowing even the slightest breeze to draw from their spinnerets a thread, up which they run as they are being wafted away. Moss and debris of all kinds should be shaken over a square yard of calico. Stones, boards, pieces of turf, matting, etc., should be lifted and carefully examined, especially in damp places. Bushes, branches of trees, reeds, etc., should be swept by, or beaten over an entomological net or umbrella. Roots of heather, grasses, and such growths should not be neglected. An enthusiastic collector will think nothing of going on hands and knees in marshy places to examine the surface of the soil as he pushes the vegetation aside, or turns over the dead rushes. It is scarcely to be expected

that any one not specially interested in the Araneidea will undertake such dirty work, but some of the other means I have mentioned of obtaining them can be adopted without the slightest inconvenience, even by ladies. Occasions sometimes offer of easily capturing rare spiders as they are running over paths or basking in the sun, and the new species to which I have already referred was first noticed by me as it was crossing my study table.

Experience only can tell the collector the spiders he may pass over. It is, though, always better to catch many that are common than to lose one valuable specimen. Maturity is in very many cases necessary for identification of species, and is therefore an important consideration. If a few spiders are disturbed, the adults, if they are not "shamming death," run away the quickest, and these ought to be first secured. The mature males are easily discernible through the mouth-organs (maxillary palpi) terminating in two swellings, which, whether folded on the fangs or stretched out in front of the spider, are conspicuous. As a rule, small spiders are more worth catching than large ones, which readily attract attention. Diminutiveness is one of the causes of rarity of capture, and a fox would be valued as a scarce zoological curiosity if it were only one twenty-fifth of an inch in length, which is the measurement of many full-grown spiders. Large species should, however, not be neglected, as some are rare and others very localised. I have, for instance, not yet found in this county a single *Atypus*. Of this genus there are three species in Great Britain. The adult males are sometimes met with above ground, but the females dig a cylindrical hole about ten inches deep, and half an inch in diameter, in banks covered with vegetation. This is lined with a silken tube, which is carried two inches above the surface, and is invariably found closed. The nest is easily recognised, when the heather, grass, etc., are removed, and if carefully dug out the occupant will be found motionless at the bottom of the tube. I should much like to receive specimens of this spider either dead or alive.

Finally, let me request any one who is kind enough to send me spiders, to label the bottle which contains them with the name of the district in which they are caught.

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## XXI.

## MISCELLANEOUS NOTES AND OBSERVATIONS.

*Read at Watford, 18th April, 1882.*

### Zoology.

*The Earth-worm.*—Darwin, in his book on 'Earth-worms and Vegetable Mould,' in treating of the number of worms present in the soil, says that he does not think Hensen's estimate of 53,767 worms to an acre too high. As from this he does not appear to have actually counted the worms himself, I give the results of some observations on this point.

On the 31st of October, 1881, after a slight frost (28°·8), a cubic yard of earth was sifted from four different places; (1st) a vine-border, where 180 worms were found; (2nd) garden-mould, containing 160 worms; (3rd) a potato-ground, 130 worms; and (4th) a meadow, very poor land, 100 worms. On the 22nd of December, after a frosty night, a cubic yard of earth was sifted in my own garden, and about 160 worms were counted. On the 4th of April, 1882, Mr. Silvester found 55 worms in a cubic yard of earth at Hedges Farm, St. Albans, the small number being due to the presence of only a foot of mould underlaid by clay (2 feet). On the 15th of April 105 worms were found in a cubic yard of earth from a vine-border. The highest number here recorded, 180 worms in a cubic yard, would give more than 800,000 in an acre, the weight of which would be about half a ton. Two worm-casts from Bricket Wood, where I recently noticed an immense quantity of them, weighed 150 grains.

Worms seem to be very fond of the smell of coniferous plants. I am told that if the ground is sprinkled with oil-of-fir it will soon be covered with worms; and also that if after much wind the leaves of the fir are scattered on the ground, a great number of worms are soon to be seen. They use the leaves to line their holes with.

I will now mention some of the uses of earth-worms. We all know that in cultivating the soil the spade is better than the plough or the hoe because it goes deeper and brings up more fresh earth. Worms are constantly bringing up fresh earth from a distance of perhaps four or five feet, and they may bring to the surface in this way from 10 to 18 tons per acre in the year, which must have a good effect. I think also that the worm-holes must do good by letting in air and water. Another use of worms is to form a good food-supply for birds. In dry weather I have often noticed rooks beating the ground with their beaks, and I am told that as worms are very sensitive to vibration this frightens them out of their holes. Mr. Littleboy tells me that rooks feed upon both earth-worms and wire-worms.

I shall be glad to receive and report to the Society any further information on worms.—*Alfred T. Brett, M.D., Watford.*

## Ornithology.

*A Brood of Pochards reared by a Diver-Duck.*—In June last a tufted diver-duck was observed on an island in the lake in my grounds, sitting on a nest of eggs which were supposed to be her own. In the course of time she hatched five young ones, which she tended with the greatest care, diving for weeds with which to feed them. They soon began to dive on their own account. It was a very pretty and interesting sight to see these active little birds diving almost continually. Frequently the mother and young ones would be down at the same time, keeping under water a good while. When they attained their full size and plumage I was greatly surprised to see that they were pochards, two drakes and three ducks, perfect in plumage. I have a pair of tame pochards on the lake, so can only presume that the pochard laid the eggs and that the tufted diver took possession of them and hatched them.—*Henry Manser, Hoddesdon.*

*The Death of a Duck caused by a Leech.*—In November last a tame shell-duck (one of a pair I have had for three years) was found dead on the island. It was in perfect health, good condition, and splendid plumage. I could not account for its death till some four days after. When a taxidermist was skinning it he discovered a leech, still alive, fastened to the roof of the mouth, where it had sucked a hole as large as a small marble, and so had caused the death of the duck.—*Henry Manser, Hoddesdon.*

XXII.

# THE AGRICULTURAL GEOLOGY OF HERTFORDSHIRE.

By J. Vincent Elsden, B.Sc. (Lond.), F.C.S.

*Read at St. Albans, 19th December*, 1882.

PLATES II and III.

## I. Introductory and General.

Having been requested to read another paper before the Society, I cannot think of a topic more likely to command general interest, in a district so essentially agricultural, than the connection between the geological and agricultural features of our county, and the natural causes which have influenced the chief industries carried on around us. For, besides the special interest which attaches itself to this subject, there is always a general satisfaction in discussing the practical utility of a science, which, like geology, is too often looked upon rather as a harmless recreation than as a means of developing the utmost resources of the soil, and of discovering those mineral products upon which so much of the wealth and power of a nation depends.

It needs but a careful examination of any district to show that its agricultural features are influenced, to a large extent, by the geological nature of the rocks which form its surface; for upon this will depend not only the natural fertility of the soil and its capabilities for improvement, but also the expense of working it, and the care and attention necessary to prevent its deterioration. Upon geological structure, also, will depend, to a certain extent, climate, water-supply, and necessity for draining, as well as the possibility of obtaining materials for improving the condition of the land by artificial admixture of soils.

It is undoubtedly the tendency of improved systems of agriculture to overcome natural obstacles to the growth of certain crops in soils which are unsuited to them, and thus to destroy, to a certain extent, the diversity of character which formerly existed in a more marked degree between the agricultural features of different geological formations. For instance, the agricultural features of the chalk districts of England are by no means so marked, now that they have been invaded by the plough, as they were when in open downs and sheep-pastures only.

But even in these cases the improvement is only artificial, and the natural conditions would soon reappear if constant attention were not paid to the maintenance of the soil in an improved state. To the ordinary observer the appearance of a naturally fertile soil, and of a soil rendered artificially productive, may be very much the same; but to the farmer the difference is extreme; for, while the former is worked with ease, the latter can only be made to yield good results by endless trouble and expense.

Hence the farmer derives assistance from a knowledge of geology in nearly every branch of agriculture. Not only can he, by its

help, form some opinion of the natural condition of a given soil and of its capabilities for improvement, but he also gains some knowledge of the probable expense of working and maintaining his land in good condition.

Before beginning the consideration of the area specially set apart for our discussion this evening, it will be well to give a very brief sketch of the general agriculture of England and Wales, in order to obtain a more comprehensive view of the causes which have determined the agricultural position of our county.

It is well known that the greater portion of the high ground of England lies towards the west, where the older geological formations occur. The rainfall, also, which is greatest in the west, gradually diminishes towards the east, being in fact nearly proportional to the height of the ground. Summer temperature, however, is highest over the eastern districts. In fact climate, in a country of such limited extent as England, depends mainly upon contour, and this we know to be determined by geological structure alone.

In consequence of this distribution of rainfall, it will be found that the western counties have a large acreage of grazing land; while the drier eastern districts have a large percentage of corn land. Owing to the influence of climate, also, the limit of arable cultivation, in England and Wales, is, in most cases, reached at an elevation of 1000 feet, above which we find only moor-land, hill-pastures, and waste. Hence the greater part of the central high land of England, extending along the Pennine range, is chiefly either pasture-land or waste according to the quality of the soil. In the Welsh mountains again there is another large unproductive area; and even in the lower parts of this district, owing to the extreme moisture of the climate, corn-growing is not a characteristic agricultural feature. The same connection between agriculture and contour may be observed in the barren tops of the granite hills of Cornwall and Devon, and the moor-lands of the Malvern Hills and Yorkshire Oolites, all of which are above the 1000 ft. contour-line.* On turning to the lower grounds of the midland and eastern counties, we find the conditions of contour and climate more uniform, and the agricultural features, therefore, more dependent upon soil. Extensive beds of clay are chiefly pastures, while light and mixed soils have a preponderance of arable land. Hence the chief dairy-farming districts of England are situated upon the heavy clays of the Secondary formations, and the most extensive corn crops are grown upon the drift-covered formations of the eastern counties.

This general relation between the corn-growing and grazing districts of England and Wales is well illustrated by the following table, showing the percentage-number of acres under corn and grass respectively for ten counties, arranged in a line from Essex to Merionethshire.† It will be noticed that while the eastern counties

* Topley, "Comparative Agriculture of England and Wales," Journ. Royal Agric. Soc.,' 1871.

† The percentages are calculated from the Board of Trade Agricultural Returns, 1881.

have a large percentage of corn, the dairy-farms of the midland counties and the grazing districts of the west have a large proportion of permanent pasture.

| | Merioneth. | Montgomery. | Salop. | Worcester. | Warwick. | Northants. | Bucks. | Beds. | Herts. | Essex. |
|---|---|---|---|---|---|---|---|---|---|---|
| Percentage acreage under corn. | 11·1 | 20·3 | 22·4 | 26·2 | 25·7 | 29·8 | 30·4 | 42·0 | 42·3 | 46·3 |
| Percentage acreage of permanent pasture. | 75·9 | 63·8 | 58·2 | 52·9 | 56·4 | 52·8 | 53·5 | 31·4 | 29·7 | 24·2 |

With this brief account of the agricultural position, with reference to England generally, of the district of which our county forms a part, it will be convenient to proceed at once to a description of the chief geological causes which have determined the nature of the climate, soils, and agriculture of Hertfordshire.

## II. Climate and Physical Features.

The physical features of the surface being necessarily ruled by the geological structure of the underlying rocks, we should expect, from a glance at a geological map of the county, to find a great sameness in the outward aspect of Hertfordshire, for, with the exception of a narrow strip of Eocene strata, stretching from Rickmansworth to Bishop's Stortford, and one or two small patches of Upper Greensand and Gault clay in the northern part, the whole of the county lies upon the Chalk formation. The escarpment formed by the termination of the Chalk in the north of the county forms the Royston and Dunstable Downs, one of the boldest features in the scenery of the county. A parallel though less-defined range of hills, running along the southern borders of the county, form what is known as the Tertiary escarpment, and determine the limits of the outcrop of the Eocene strata previously mentioned. But, between these two escarpments, the undulating surface of the chalk is so concealed by superficial deposits of clay, sand, and gravel, that it is only on reaching the summit of the high ground, in the extreme northern limits of the county, that we observe the rounded downs and hollow combes so characteristic of chalk scenery.

The geological disturbances to which the position of these two escarpments is due have also determined the general slope of the surface, which is, generally speaking, towards the south, the line of water-parting being more or less coincident with the summit of the chalk escarpment in the north of the county. This southern aspect is not without an appreciable influence upon the climate, and therefore upon the agricultural position of Hertfordshire; while

the undulating nature of the surface offers special facilities for the drainage of some of the heavy clay districts.

The presence of the almost universal drift-covering is of great importance from an agricultural point of view; for it is probable that we owe to this cause the well-watered condition of our county, bare chalk districts being specially remarkable for the great scarcity of water brought about by the extreme porosity of the chalk. The climate of a district so limited in area and uniform in contour could scarcely be expected to exhibit any striking variations; but even small differences in temperature are sufficient to influence agricultural operations. Thus the land on the thin chalk soils in the north is said to be not warm enough for the growth of stubble or green crops to serve as food for stock. The nature of the soil, in fact, has such an important influence upon climate, that I here give a table (p. 149) showing the more important properties of the chief soils met with in Hertfordshire which are of interest from a meteorological point of view.* An examination of this table will show how largely both the dryness and warmth of the air must be locally influenced by the nature of the soil, and will fully explain the cause for the coldness and lateness of the chalk district mentioned above, compared with the mixed soils of the drift-covered portions of the county.†

Of all the phenomena included under the term climate, not one is so important, from an agricultural point of view, as rainfall. We have seen that, generally speaking, the rainfall of England and Wales diminishes from west to east; and, in fact, Hertfordshire ranks, with Middlesex and the Eastern Counties, as one of the driest districts in England. Yet, even within the limits of our own small county, it is seen that there is a marked increase of rainfall to the westward.

| | 1876. | 1877. | 1878. | 1879. | 1880. | Average. |
|---|---|---|---|---|---|---|
| Berkhampstead | 34·10 | 33·87 | 34·16 | 34·90 | 36·12 | 34·6 |
| Watford (Oaklands) | 30·12 | 32·40 | 33·67 | 35·82 | 33·03 | 33·0 |
| Rothamsted | 32·14 | 32·83 | 31·96 | 34·18 | 33·44 | 32·9 |
| Hitchin | 30·26 | 29·68 | 28·30 | 29·13 | 28·88 | 29·2 |
| Welwyn | 30·27 | 29·78 | 29·14 | 30·40 | 29·06 | 29·7 |
| Stevenage | 28·93 | 29·86 | 28·14 | 30·60 | 29·80 | 29·4 |
| Odsey | ..... | 26·86 | 22·52 | 28·24 | 24·97 | 25·7 |
| Bayfordbury | 30·50 | 29·39 | 32·47 | 29·94 | 27·89 | 30·0 |
| Royston | 26·78 | 27·22 | 23·36 | 30·06 | 27·39 | 26·9 |
| Much Hadham | 28·85 | 29·29 | 28·94 | 29·91 | 28·85 | 29·1 |

* The figures are taken from tables published in the 'Journal of the Royal Agricultural Society.'

† See also 'Transactions,' Vol. I, p. 111.

TABLE SHOWING THE MORE IMPORTANT PHYSICAL PROPERTIES OF THE SOILS OF HERTS.

| | Power of retaining water in 100 parts by volume. | Water evaporated from 100 parts in equal times. | Time required by equal portions to dry to the same degree. | Moisture absorbed from the atmosphere by each 1000 grains in 24 hours. | Power of retaining heat. | | Warming of the Earth in the sun. Temperature of surface with same shade temperature in air. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | That of calcareous sand being = 100. | Time taken by 30 cubic inches to cool to same degree. | Surfaces of natural colour. | | With dry earth. | |
| | | | | | | | With wet earth. | With dry earth. | With white surfaces. | With black surfaces. |
| | Per Cent. | Per Cent. | H. min. | Grains. | Per Cent. | H. min. | Deg. | Deg. | Deg. | Deg. |
| Siliceous sand | 37·9 | 88·4 | 4· 4 | 0 | 95·6 | 3·20 | 99·1 | 112·6 | 109·9 | 123·6 |
| Calcareous sand | 44·1 | 75·9 | 4·44 | 3 | 100·0 | 3·30 | 99·3 | 112·1 | 109·9 | 124·0 |
| Sandy clay (45 °/₀ fine sand, 55 °/₀ clay) | 51·4 | 52·0 | 6·55 | 26 | 76·9 | 2·41 | 98·2 | 111·4 | 108·3 | 121·6 |
| Loamy clay (24 °/₀ fine sand, 76 °/₀ clay) | 57·3 | 45·7 | 7·52 | 30 | 71·8 | 2·30 | 99·1 | 112·1 | 107·8 | 121·1 |
| Stiff clay (10 °/₀ sand, 90 °/₀ clay) | 62·9 | 34·9 | 10·19 | 36 | 68·4 | 2·24 | 99·3 | 112·3 | 107·4 | 120·4 |
| Pure clay (58 °/₀ silica, 36·2 °/₀ alumina, 5·8 °/₀ protoxide of iron) | 66·2 | 31·9 | 11·17 | 42 | 66·7 | 2·19 | 99·5 | 113·0 | 106·3 | 120·0 |
| Chalk | 66·1 | 28·0 | 12·51 | 31 | 61·3 | 2·10 | 96·1 | 109·4 | 109·2 | 122·9 |
| Humus (or humic acid) | 69·8 | 20·5 | 17·33 | 97 | 49·0 | 1·43 | 103·6 | 117·3 | 108·5 | 120·9 |
| Fertile garden mould | 67·3 | 24·3 | 14·49 | 45 | 64·8 | 2·16 | 99·5 | 113·5 | 108·3 | 122·5 |
| Common arable soil | 57·3 | 32·0 | 11·15 | 22 | 70·1 | 2·27 | 97·7 | 111·7 | 107·6 | 122·0 |

Although the excellent reports, published in our 'Transactions,' make it quite unnecessary for me to dwell upon this point, yet I have thought it advisable to illustrate this law of the distribution of rainfall by a brief summary of the rainfall of the above ten places, which are arranged according to their longitudes, from west to east.

It must not be forgotten, however, that the replenishment of our springs and rivers depends rather upon percolation than upon actual rainfall. Experiments with the percolation-gauge show that there are extremely great variations in the amount of percolation during different seasons of the year, and that in summer it is almost *nil*.* Observations kept for nearly 30 years, by means of a Dalton's gauge, at Apsley Mills, Hemel Hempstead, showed the average annual percolation to be not more than 7·5 inches,† proving that a large proportion of the rainfall is evaporated again into the air. The water supplied by our springs, therefore, is derived chiefly from winter rains, and their replenishment may fall short if the rainfall should happen to be abnormally distributed through the different seasons. Thus a very wet summer and dry winter would result in a diminished supply to our springs and wells, even although the total rainfall were greater than usual.‡ Percolation is also largely influenced by the nature of the soil, upon which indeed nearly all the local peculiarities of our climate ultimately depend.

Although the somewhat heavy clay soils, which cover so large an area of our county, may tend to render our climate colder and wetter than would be expected in a district situated to such a large extent upon the Chalk formation, yet the porous nature of the underlying rock materially assists drainage, and the superficial deposits themselves in many places consist of permeable sands and gravels, which contribute much to the warmth and dryness of the atmosphere. To the nature of the soil, in fact, we must ascribe that salubrity for which Hertfordshire has long enjoyed a reputation. Hence we see that the rainfall, temperature, and physical features of Hertfordshire are in accordance with its main geological character.

## III. Geological Relations and Classification of the Chief Soils.

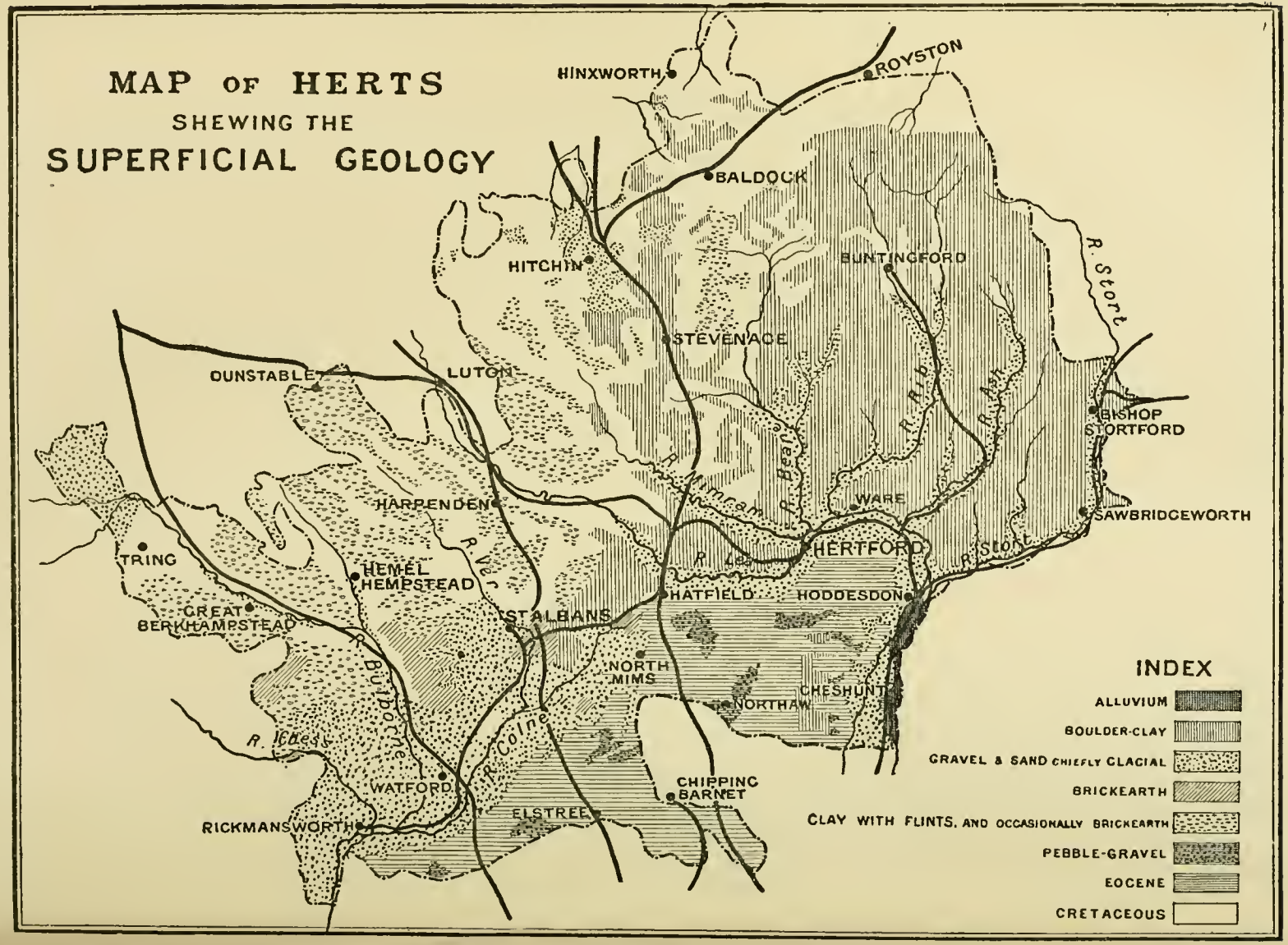
To the agriculturist it is of even greater importance to know the nature of the superficial deposits than to understand the geological structure of the rocks below; for, where drift deposits are present to any extent, the agricultural features will be completely changed.

Soils, in fact, can be divided into two classes according to their mode of origin, viz., *soils of disintegration* and *soils of transport*. The character of the former depends solely upon the nature of the underlying rock, from which they have been derived; whereas the latter, including drift and alluvial soils, have been carried from a distance, and are in general totally distinct in character and composition from the strata upon which they lie.

* 'Proc. Inst. Civ. Eng.,' vol. xlv, pt. iii, p. 19.

† 'Journal of the Royal Agricultural Society,' vol. xxv, pt. ii, p. 304.

‡ For a complete account of the rainfall in Hertfordshire see 'Trans. Herts. Nat. Hist. Soc.,' Vol. I, p. 151.


MAP OF HERTS
SHEWING THE
SUPERFICIAL GEOLOGY
HINXWORTH
ROYSTON
BALDOCK
HITCHIN
BUNTINGFORD
STEVENAGE
DUNSTABLE
LUTON
R. Stort
BISHOP STORTFORD
R. Rib
R. Ash
R. Beane
R. Mimram
WARE
SAWBRIDGEWORTH
HARPENDEN
R. Lea
HERTFORD
R. Stort
TRING
HEMEL HEMPSTEAD
R. Ver
HATFIELD
HODDESDON
GREAT BERKHAMPSTEAD
ST ALBANS
NORTH MIMS
CHESHUNT
NORTHAW
R. Bulbourne
R. Colne
R. Chess
WATFORD
CHIPPING BARNET
ELSTREE
RICKMANSWORTH
INDEX
ALLUVIUM
BOULDER-CLAY
GRAVEL & SAND CHIEFLY GLACIAL
BRICKEARTH
CLAY WITH FLINTS, AND OCCASIONALLY BRICKEARTH
PEBBLE-GRAVEL
EOCENE
CRETACEOUS

By the courtesy of the authorities at the Geological Survey Office I have been able to examine MS. maps of the superficial geology of those portions of our county which have not yet been published; and I have endeavoured to show the main features of these superficial beds upon the map forming Plate II. It will be seen that while on the east side of the county the valleys are cut through boulder-clay exposing the Mid-glacial sands and gravels beneath, on the west side the valleys are cut chiefly through the clay-with-flints. In the southern portion of the county we find the Colne valley occupied chiefly by sands and gravels of glacial age, while the London-Clay area is comparatively free from drift deposits except a few isolated patches of pebble-gravel, and a little boulder-clay in the east. In discussing the nature and origin of the soils of our county, it will be convenient to consider in turn the soils overlying each geological formation.

*The Eocene District.*—As will be seen from the geological map, the London Clay stretches across the south-eastern borders of the county approximately south of a line drawn from Bishop's Stortford, through Ware, Hatfield, St. Albans, and Rickmansworth; but it is only in the extreme southern portion of the county that the soil is found to be of that stiff, tenacious character, which indicates a clay formation. This stiff clay country will be found inclosed within a line drawn through Shenley, Letchmore Heath, and Bushey, to Moor Park. Another strip of heavy yellow clay extends along the flanks of the Lea valley from Bayford and Hoddesdon in the north to Goff's Oak and Northaw in the south. The remainder of the London-Clay district is covered up by superficial deposits which completely alter the character of the soil. Of these soils, the most noticeable are the sandy loams formed by the alluvium of the Lea valley, and the loamy clay in the valley of the Stort, derived from the Essex boulder-clay which spreads over the eastern boundaries of our county. The heavy soils in this district are often improved by admixture with the Mid-glacial sands and gravels which crop out in the lower parts of the valleys.

The Woolwich and Reading beds, although they have a very thin outcrop, yet contribute materially to the improvement of the heavy soils overlying the London Clay. Probably, also, it is from the breaking up of these beds that much of the drift, which covers the chalk, was originally derived. The lower beds of this series are, in many cases, of pure sand and rolled pebbles, from which the hard conglomerate, known as the Hertfordshire plum-pudding-stone, was derived. The "blue-pebble-and-clay" soil of the district extending from Hatfield to Northaw may possibly be due to the disintegration of some of these lower portions of the Woolwich and Reading series.

*The Chalk District.*—The Chalk formation covers very nearly the whole of the remainder of the county, except a few patches of Upper Greensand and Gault on the borders of Buckinghamshire, Bedfordshire, and Cambridgeshire. But, with the exception of a narrow strip of land extending through Lilley, Hitchin, and Baldock, to

Royston, superficial deposits almost universally alter the agricultural features of the surface. Much of the western part of this chalk district is covered by a stiff flinty loam or clay, which has probably resulted from a disintegration and solution of the chalk, by the aid of water and carbonic acid, leaving behind the flints and the insoluble clay present in the chalk. The origin of this "clay-with-flints," as it is called, is especially interesting both from an agricultural and a geological point of view; for when we examine analyses of chalk from different localities we are struck with the small percentage of alumina present.

TABLES SHOWING PERCENTAGE COMPOSITION OF CHALK.

| Upper Chalk (Norfolk).* (Playfair.) | | Upper Chalk (Hampshire).† (Way and Paine.) | |
|---|---|---|---|
| Calcium carbonate | 95·50 | Sand and insoluble matter | ·66 |
| ,, sulphate | ·37 | Carbonic acid | 42·98 |
| ,, phosphate | ·10 | Sulphuric acid | trace |
| Magnesium carbonate | ·19 | Phosphoric acid | ·08 |
| Sodium chloride | ·13 | Chlorine | none |
| Alumina | ·64 | Lime | 55·24 |
| Protoxide of iron | 1·70 | Magnesia | ·10 |
| Silica | ·51 | Potash | ·06 |
| Moisture | ·70 | Soda | ·14 |
| | | Oxide of iron and alumina | ·74 |

When we consider, therefore, the large amount of chalk which must have been dissolved away before a thickness of even a few feet of this flinty clay could accumulate, we cannot but be struck with the immense time during which the slow process of disintegration must have been going on. It is probable that the "clay-with-flints" covers a much more extensive area than would appear from the map; for in many places it is covered up beneath thick accumulations of drift-deposits. It is a characteristic soil on the top of chalk plateaux in nearly all parts of England. The flints are frequently picked off the surface; but it is doubtful if any real benefit is attained by this means, as those underneath soon appear at the surface. In some cases the mass of clay present in this soil can only be explained by the presence of drift-deposits in addition; but, in many cases, we may look upon this flinty clay as the insoluble residuum of a large thickness of Upper Chalk which once existed there.

The remaining soils covering up the Chalk district are chiefly drift-deposits, which cover nearly the whole of the eastern side of the county. The stiff boulder-clays of Essex extend over the border, and give a general clayey character to a large portion of the basins of the Stort, Ash, Rib, and Beane. This district, which is described on the map as loamy clay, is much improved, both mechanically and chemically, by the large amount of chalk present

* 'Journ. Roy. Agric. Soc.,' vol. xvi, p. 170.
† *Ib.* vol. xii, p. 553.

in it, in the form of boulders and pellets. The valleys of the Lea and Mimram are marked throughout their course by gravelly soils, peat marshes, and alluvium, which form some of the lightest soils in the southern portion of the county.

*The Gault District.*—This formation covers but a small portion of the northern borders of the county; but its influence is clearly seen on descending the chalk ridge northwards towards Ashwell and Caldicott. Although the stiff nature of the Gault clay is here masked by a thin covering of drift from the chalk hills, which are in close proximity; yet there is a marked difference between the soils of this district and the light soils of the adjoining chalk hills. If we compare the areas of the different soils given above, we shall find that, generally speaking, heavy soils predominate.* This is undoubtedly due to the large occurrence of the chalky boulder-clay in the east, to the presence of the London Clay formation in the south, and to the generally heavy nature of the superficial deposits covering the Chalk in the west. The greatest extent, however, of heavy land is found in the northern half of the county, and south of the Hitchin and Royston chalk hills. Near the outcrop of the sandy beds of the Woolwich and Reading Series the soils are rendered lighter in character, and a similar result is also found from admixture with the Mid-glacial sands and gravels, which are frequently exposed beneath the boulder-clay in most of the valleys on the eastern side of the county.

In the foregoing sketch of the origin of the chief soils met with in our county, there have, from necessity, been omitted many mixed soils which it would be almost impossible to classify. No clear line of demarcation can be drawn between each kind of soil; but, on the contrary, there is an insensible gradation from one into the other. The characters of the soil are also in many places locally modified from various causes. Thus the heavy loams of the eastern boulder-clay district are frequently rendered lighter by the exposure of the underlying Mid-glacial sands and gravels in the lower parts of the valleys. Outlying patches of Eocene beds, and various drift-deposits also, give quite a mixed character to the soils of a great part of the south-western corner of the county lying to the north of the Tertiary escarpment.

The soils of Hertfordshire have been surveyed and mapped by Arthur Young,† and by G. A. Deane.‡ (See Plate III.) In the following table an attempt is made to give a summary of these soils, with the probable geological origin of each.

* It must not, however, be imagined that the general character of Hertfordshire soils is at all comparable to that of the heavy soils of Sussex. Owing to the large admixture of flints, chalk-boulders, etc., many of the clays are in reality but heavy loams. It is only the London-Clay district in the south which at all resembles a stiff clay country.

† See 'Report on Agriculture of Hertfordshire,' prepared for the Board of Agriculture, and published in 1804.

‡ See 'Improvement of Landed Estates,' by G. A. Deane.

TABLE OF THE SOILS OF HERTFORDSHIRE.

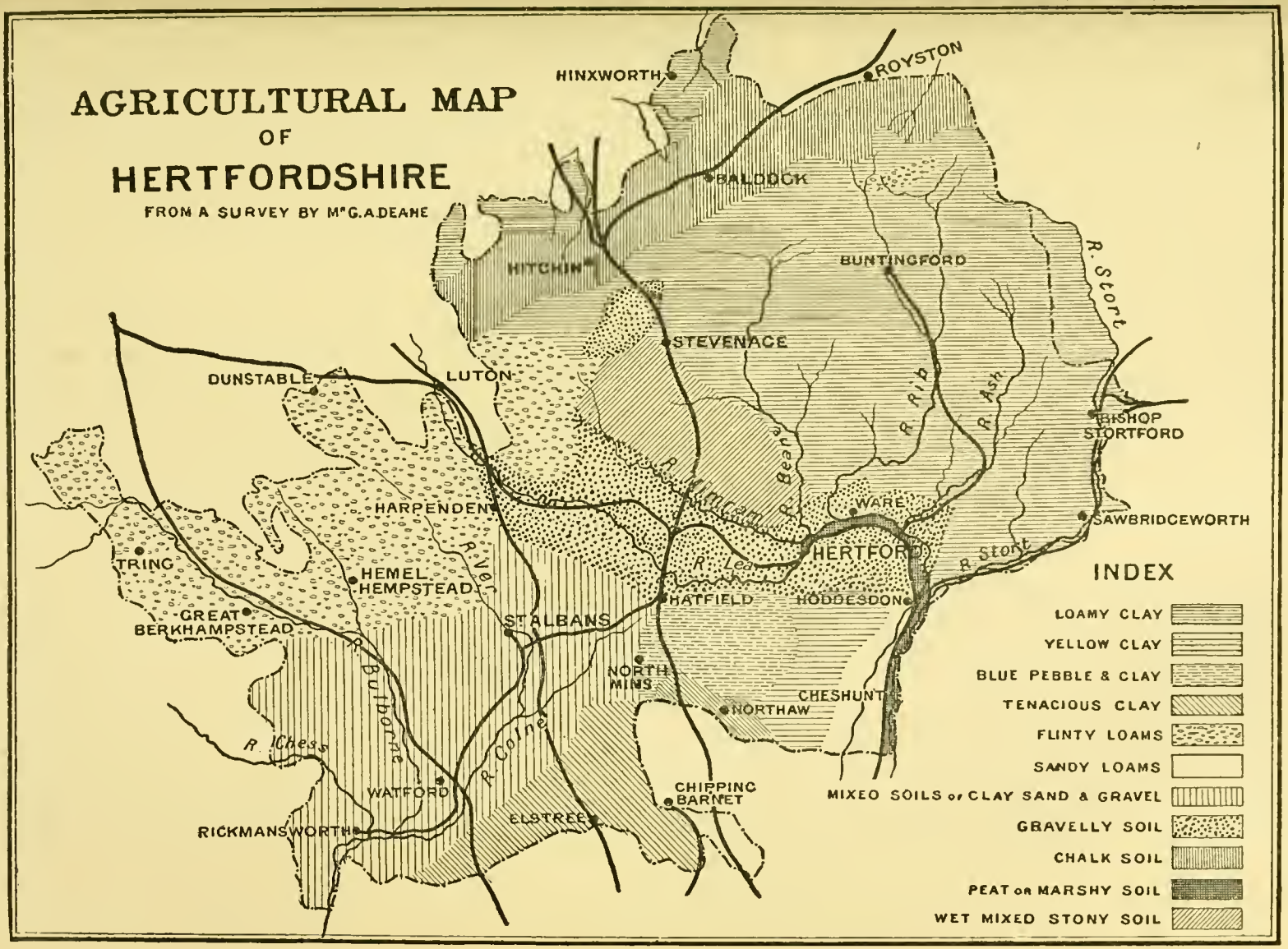
| Nature of Soil. | Area occupied. | Probable Geological Origin. |
|---|---|---|
| Loamy clay ..... ..... | 132,818 acres | Great Chalky Boulder-clay of East Anglia, except on N. of the Chalk escarpment, on the outcrop of the Gault. |
| Yellow clay ..... ..... | 5365 ,, | London Clay. |
| Blue pebble and clay | 5851 ,, | Drift derived from Woolwich and Reading beds. |
| Tenacious clay ..... | 20,193 ,, | London Clay. |
| Flinty loam ..... ..... | 57,802 ,, | Disintegration of the Chalk; "Clay-with-flints;" and drift. |
| Sandy loam ..... ..... | 13,340 ,, | Alluvium of the Lea. |
| Mixed soils; clay, sand, gravel ..... | 66,080 ,, | Drift derived from Lower Tertiaries, also "Clay-with-flints." |
| Gravelly soil ..... ..... | 35,647 ,, | Mid-glacial sands and gravels, and alluvial gravels. |
| Chalk soil ..... ..... | 32,834 ,, | Disiutegration of the Chalk. |
| Peat or marshy soil..... | 3000 ,, | Alluvium of existing rivers. |
| Mixed stony soil ..... | 14,550 ,, | Glacial drift, and "Clay-with-flints." |

## IV. The Influence of Geology upon the Agricultural Features of Hertfordshire.

*The London-Clay District.*—Both from the general heavy nature of the soil and from its proximity to the London markets, the western part of this district is almost entirely devoted to grass-farming. It has before been noticed that such a clear line of division exists between the London-Clay soils and the gravelly loams overlying the Chalk, that the boundary can in many places be traced by the sudden termination of the grass-land and hay-farms so characteristic of the north of Middlesex. The characteristic trees in this part are oak, ash, and elm, with occasional patches of fir, marking the position of a more barren, gravelly soil derived from the drift.

On reaching the Lea valley, however, a great change is observed where the London Clay is covered with the fertile sandy loams which form the alluvium of the Lea.

This has been considered to be the richest tract in the whole county, and from Hoddesdon to Wormley is characterised by nurseries and market-gardens. The fertility of alluvium is


AGRICULTURAL MAP
OF
HERTFORDSHIRE
FROM A SURVEY BY Mr G. A. DEANE
HINXWORTH
ROYSTON
BALDOCK
HITCHIN
BUNTINGFORD
R. Stort
STEVENAGE
DUNSTABLE
LUTON
R. Rib
R. Ash
BISHOP STORTFORD
R. Beane
R. Lea
WARE
HARPENDEN
SAWBRIDGEWORTH
HERTFORD
R. Stort
TRING
HEMEL HEMPSTEAD
R. Ver
HATFIELD
HODDESDON
GREAT BERKHAMPSTEAD
ST ALBANS
R. Bulbourne
NORTH MIMS
CHESHUNT
NORTHAW
R. Chess
R. Colne
WATFORD
CHIPPING BARNET
ELSTREE
RICKMANSWORTH
INDEX
LOAMY CLAY
YELLOW CLAY
BLUE PEBBLE & CLAY
TENACIOUS CLAY
FLINTY LOAMS
SANDY LOAMS
MIXED SOILS or CLAY SAND & GRAVEL
GRAVELLY SOIL
CHALK SOIL
PEAT or MARSHY SOIL
WET MIXED STONY SOIL

universal in all parts of England. The fine state of subdivision in which rivers deposit sediment where they overflow their banks, is almost as favourable to the growth of crops as that natural admixture of rocks of different characters and composition which is the chief feature of alluvial deposits. It has even been noticed that the alluvium carried down by rivers from rocks which are by nature unproductive, often forms a most fertile soil.

The remainder of this district, extending along the valley of the Stort to the boundary of the county at Sawbridgeworth, is chiefly under arable cultivation, this neighbourhood being far better suited for corn than the western part of this area, since the London Clay is covered with the same chalky boulder-clay which covers such a wide extent and forms some of the best corn-land of Essex.

It has before been said that where the Woolwich and Reading beds come to the surface, the soil is, in many cases, improved by the admixture, the upper portions consisting of stiff clay and the lower parts of sand and pebble-beds. But, upon the outcrop of these beds, there is, around Hatfield and North Mimms, a wet clay full of rounded flint-pebbles, marked on Young's map as poor gravel, and described as the worst soil in the county. Young, himself the holder of a farm at North Mimms, said of this soil:* "I know not what epithet to give it: sterility falls short of the idea—a hungry vitriolic gravel. I occupied for nine years the jaws of a wolf. A nabob's fortune would sink in the attempt to raise good crops in such a country." Mr. Clutterbuck, also, says of this same district:† "The soil of the upper levels of the clay district, marked by the rounded flint-pebbles embedded in sand, is wet and unkindly, not capable of bearing grass of any value, and ungrateful under the most liberal treatment as arable land. This gravel, with its characteristic blue pebble, is transported, in many cases, below the higher levels, where the sterility of the soil is in proportion to the thickness of the bed." This barren district is said to be improved by chalking.

The draining, so necessary over most of this London-Clay district, is assisted by the gentle undulations of the surface, and by the numerous water-courses. The frequent gravel-beds furnish a water-supply for many hamlets, and cause many surface-springs at the junction of the underlying clay. It has been pointed out, by Mr. Clutterbuck,‡ that, as the streams of this district pass over the outcrops of the sands of the Woolwich and Reading Series, they frequently sink by *swallow-holes* into the chalk, thus materially assisting in the prevention of floods. This is especially to be observed near Bushey and Aldenham; and it has even been necessary to prevent the waste of water, in the water-courses leading from the reservoir at Elstree, by artificially stopping these swallow-holes. It has been suggested that the drainage of the clay districts, as well as the replenishment of the deep-seated

* 'Journ. Roy. Agric. Soc.,' vol. xxv, p. 271.

† "Agricultural Notes on Hertfordshire," 'Journ. Roy. Agric. Soc.,' vol. xxv, p. 306.

‡ *Ib.*, p. 306.

springs, might be facilitated by the construction of artificial swallow-holes.

*The Chalk District.*—Prof. Prestwich says of this area:* "The chalk hills which bound the Tertiary area on the north, unlike the chalk of Salisbury Plain, present but a small extent of open downs, and are well wooded on their summits. This arises in part from a covering of clay-drift, and in part from thin cappings of the Lower Tertiary beds." Whitaker also says:† "In the north-western corner of our district, in Bucks and Herts, there is absolutely no down-land, and the greater part of the tract consists of ploughed land diversified by woods and parks." The only portion of the county, indeed, which can be said to have agricultural features at all characteristic of the Chalk formation, is the narrow strip forming the Royston and Dunstable Downs. Here, although sheep-farming is the characteristic feature, yet much corn is grown, and the quality of the straw grown on these chalk soils is so suitable for the manufacture of straw-plait, that an important industry has sprung up around Dunstable and Luton, and a considerable market for the sale of wheat-straw has been established at Hitchin and other places in the northern part of the county. Of this district it has been said:‡ "The strip of thin chalk-land crossing the northern part of the county, with its wide, open fields, and turnip- and sheep-farming, is so suggestive of Cambridgeshire that the boundary of the counties at Royston may well be passed without being remarked. The natural division is found in the hills near Therfield, on the great North road, when you plunge at once into Hertfordshire proper, with its woods, small enclosures, and heavily timbered fences."

To the south of this narrow strip of chalk-soil, however, the nature of the underlying rock is completely concealed by the heavy clays which cover its surface, the district drained by the Beane, Rib, and Ash being uniformly covered by loamy clay, derived chiefly from the upper glacial drift; while the western portions of this area are occupied by a flinty loam, which seems in places to consist almost entirely of stones, and which generally corresponds to the "clay-with-flints" previously described. Thus, although there appears to be a great mixture of drift-soils over the portion of the chalk area which lies between the Eocene beds in the south and the high ground in the north, important differences may be established between the eastern and western halves of the county; for, while the soils of the eastern boulder-clays are heavier in character, and more calcareous, they are to a great extent free from that abundance of flints which especially characterises the north-western corner of the county. Some of the worst land of the whole district lies towards the east and south-east of Stevenage, where the clay forms so bad a soil that it cannot easily be improved,

* 'Quart. Journ. Geol. Soc.,' vol. x, p. 19.

† 'Guide to the Geology of London,' p. 21.

‡ Evershed, "Agriculture of Hertfordshire," 'Journ. Roy. Agric. Soc.,' vol. xxv, p. 271.

although chalking is said to be of great advantage. But further towards the east, the calcareous nature of the clay, owing to the presence of chalky boulders, is so well adapted for the growth of barley, that Ware malt is not excelled in any other part of the kingdom.

The character of the soil overlying the chalk district, is, in some places, totally changed by the occurrence of outlying patches of the Eocene beds, as at Sarratt, Abbot's Langley, and St. Albans.

On the whole, this drift-covered district is well separated by its general arable culture, both from the hay-farming districts of the south, and the sheep-farming hills in the north. Although beech-trees flourish well, the oak and elm are more stunted in growth than on the London-Clay soils; but, on the whole, the district is well-wooded and totally different in external aspect from other parts of England where the chalk is uncovered with drift. An unusually fine growth of timber frequently marks the position of an Eocene outlier which affords a more favourable soil.

So much has been written upon the chalk water-supply that little need be said here upon that subject.* The extreme porosity of the chalk renders it a most valuable reservoir for the storage of water; and the possibility of its exhaustion, by the increasing demands of the metropolis, is a question of the highest importance. From an agricultural point of view, however, the main points to be considered with regard to water-supply are the possibility of procuring an adequate supply at moderate cost, as well as the quality of the water and its suitability for irrigation purposes. It is a characteristic feature of chalk districts generally to be so destitute of streams that the formation can almost be traced upon a map by this peculiarity alone. So much, indeed, is the scarcity of water felt by farmers on chalk-soils, that either artificial dew-ponds have to be constructed, or deep borings have to be made, at a considerable expense, to below the water-level in the chalk beneath. In the chalk district of Alabama even the social condition of the people is influenced by this feature; for only farmers of large means can afford the deep boring necessary for successful farming. But, happily, in our own county we have an abundance of streams, owing to the fact that we have scarcely any bare chalk at the surface. The almost universal covering of drift-deposits has completely changed the hydrographical features of the county; and, owing to the frequent occurrence of gravel and sand in the beds which rest upon the chalk, water is in many places accessible at moderate depths, and our Hertfordshire farmers are relieved of many of the troubles with regard to water-supply which are experienced in other less-favoured chalk districts.

In many parts of this district the streams are turned to agri-

* See 'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 125; 'Proc. Inst. Civ. Eng.,' vol. lv, p. 252; Lucas, "The Chalk Water System," 'Proc. Inst. Civ. Eng.,' vol. xlvii; Prestwich, 'Anniversary Address to the Geol. Soc. 1872;' Evans, 'Anniversary Address to the Geol. Soc. 1876;' Clutterbuck, "Water Supply," 'Journ. Roy. Agric. Soc.,' series 2, vol. i, p. 271.

cultural use both in irrigating and in driving corn-mills; but many of the water-meadows, which line the rivers, are little more than swamps, and require draining before they can be made productive. The general slope of the surface gives to many of the streams sufficient velocity to make them of considerable use as water-power, the fall of the Gade having been estimated as 14 feet per mile. The following is an estimate of the discharge of the four chief rivers which meet near Hertford:*—

| | | |
|---|---|---|
| Lea at Horn's Mill | 2185 | cubic feet per minute. |
| Beane at Molewood | 1483 | ,, ,, |
| Rib at Ware Park | 959 | ,, ,, |
| Mimram at Panshanger | 1532 | ,, ,, |
| Total | 6159 | ,, ,, |

It must not be forgotten, however, that the same cause which gives to the county this abundance of surface-water, diminishes to a certain extent the percolation into the chalk below, and tends to retard the replenishment of the deep-seated springs and wells.

With respect to drainage, although many of the heavy soils of this area require thorough draining, the porous nature of the chalk-stratum below is often of great assistance. In the eastern boulder-clay district, the presence of chalk-boulders renders the subsoil sufficiently open to diminish considerably the outlay necessary for draining the land. The same benefit is derived from the presence of the permeable Mid-glacial sands and gravels.

*The Gault District.*—Although this formation covers but a small portion of Hertfordshire, its situation immediately beneath the chalk escarpment is extremely favourable for a most fertile admixture of soils. The alluvial drift from the chalk hills covers nearly the whole of this area, and so far improves the quality of the soil that it has long been famous as a corn-growing district. The Vale of Ringtale, which lies partly in this district, has been thus described by Sir Henry Chauncy, in the 'Historical Antiquities of Hertfordshire.' He says: "The Vale of Ringtale, or Wringtale, which lies north of the great ledge of hills crossing the northern part of this county (extending from Barkway to Offley), where the soil is mixed with white marl, yields the choicest wheat and barley, such as makes the best mault that serves the King's Court or the City of London, which caused Queen Elizabeth often to boast of her Hitchin grape." But Mr. Clutterbuck remarks of this same area:† "Although the Vale of Ringtale, in the north of the county, gained a name of old for the Hertfordshire white flour, the land generally is better adapted to the coarser red wheats, and high farming cannot in this respect overrule the inherent quality of the soil."

The stiff impermeable subsoil of this district necessitates greater

* 'Proc. Inst. Civ. Eng.,' vol. xiv, p. 42.

† "Agricultural Notes on Hertfordshire," 'Journ. Roy. Agric. Soc.,' vol. xxv, p. 315.

trouble and expense in draining than in those soils which rest upon the chalk. Hinxworth, indeed, has long been known to all readers of agricultural literature as the site of the mixed system of drainage carried out by Mr. Bailey Denton.*

The Gault is often called the Oak-tree Clay, and certainly the oak thrives better in this part than anywhere else in the county, and from the summit of the chalk escarpment the outcrop of this formation is often visible as a line of densely-wooded country.

The true agricultural character of the Gault soils is best seen in the neighbouring county of Buckinghamshire, where the land overlying this formation is a cold, wet soil, most expensive to cultivate as arable land, and therefore chiefly in pasture. In our own county this character is destroyed by the extensive alluvial drift which covers its surface.

## V. The Economic Products of Hertfordshire useful in Agriculture.

It may generally be noticed that an advanced state of agriculture not only does not coincide with grand features of scenery, but also is usually inversely proportional to the mineral importance of a district. We shall not, therefore, expect a long list of economic products from the rocks of our own county.

From the strata below the Chalk there is little that can be converted to practical utility, except perhaps the firestone of the Upper Greensand and the phosphatic nodules (coprolites) which occur at the bottom of the Chalk-marl. These coprolite-beds are worked near Lilley Hoo, and at various places between Hitchin and Cambridge.†

From the Chalk many useful products are obtained. The flints are largely used for road-metal and for building purposes; and, when burnt and ground, they can be employed for pottery admixtures. The chalk itself is extensively burnt for lime, and to the many pits excavated for this purpose geologists are indebted for many interesting sections of this formation. It is also used a great deal in some districts for chalking fields, its addition being considered a great improvement in heavy soils. Chalking is a very old custom in Hertfordshire. Its chief merits depend upon its mechanical effect upon the soil, but it is said also to assist in destroying troublesome weeds, such as may-weed and sorrel. Its effects, too, are lasting, and the process seldom needs repetition during the same tenancy. At the top of the Chalk-marl is a bed of sandy limestone, which is sufficiently hard to be used as a building-stone. This band, called the Totternhoe stone, may be traced from Tring by Miswell, Marsworth, Pirton, and Cadwell, to Ashwell. It is used in St. Albans Cathedral, in some of the older parts of Windsor Castle, and in many churches in the county. When

* See 'Journ. Royal Agric. Soc.,' vol. xx, p. 273.

† See Clutterbuck on "The Coprolite Beds at Hinxworth," 'Transactions of the Watford Nat. Hist. Soc,' Vol. I, p. 238.

protected by an outer coating of flint, it is very durable; but otherwise it is not well suited for exteriors, as may be seen from an inspection of the west front of Dunstable Priory Church. At the top of the chalk-rock, a hard band separating the Upper from the Lower Chalk, is a layer of phosphatic nodules, containing about ten per cent. of calcium-phosphate.

From the Eocene beds the most important economic products are the sands and clays, which are extensively used for brick-making. A line of brickfields marks the outcrop of these beds, and they frequently also denote an outlier of Eocene strata lying upon the chalk. The brickfields at Bennet's End, Bernard's Heath (St. Albans), and on Berkhamstead Common, are all upon Eocene outliers.

The sands of the lower parts of the Woolwich and Reading beds are often of sufficient purity to make them of value for horticultural purposes.

The nodules, known as "septaria," which are of value in the manufacture of Roman cement, occur occasionally in the London Clay, but not in sufficient quantity to make them of commercial importance in this county. Near Radlett occur masses of the conglomerate known as Hertfordshire plum-pudding-stone, which were formerly made into querns or hand-mills for grinding corn, for which purpose they were admirably adapted, since the softer parts between the pebbles would wear away a little faster than the pebbles themselves, thus keeping the surface rough. The superficial beds yield chiefly gravels, which are used for footpaths, roadways, filter-beds, and in the manufacture of concretes; but some of the brick-earths are extensively worked for making bricks, tiles, and drain-pipes.

But although the economic products from the rocks of Hertfordshire are so few and comparatively unimportant, we must not forget that a ridge of Palæozoic rocks extends beneath us, and that the discovery of workable coal in the south-east of England may at some future date alter the whole aspect of the country. Although the borings recently made at Ware and Turnford are against the probability of finding coal beneath our own county, yet our agricultural position would be materially influenced by the proximity of a coal-mining district; for it is the opinion of geologists that coal, if present at all, will be found somewhere between Hertford and Redhill, resting in isolated patches amongst the folds of the Palæozoic ridge.

Amongst the economic products it would not perhaps be out of place to mention here the few cases in which medicinal and mineral springs occur in Hertfordshire. But these have already been so fully described by Mr. Pryor that I must be content with a reference to his paper on this subject.*

* See 'Transactions of the Watford Nat. Hist. Soc.,' Vol. I, p. 109.

## VI. Summary and Conclusion.

In the foregoing imperfect description of the chief agricultural features of Hertfordshire, we have been able to assign geological causes for the prevailing industries which characterise each district. We have seen that the hay-farms on the heavy soil of the south, overlying the London Clay, give place to the market-gardens and nurseries of the fertile alluvium of the valley of the Lea; while, still further towards the east, the character of the soil is so changed by the presence of the chalky boulder-clay, that arable culture predominates, and a large malting industry has sprung up upon one of the best barley-soils in England. The same geological characters, also, which have combined to stamp the northern part of the county as a wheat-growing district, have also been the means of establishing an important industry in the manufacture of straw-plait, the main source of the wealth of the districts around Luton and St. Albans.

But still another feature of interest is presented to us, when we compare our county with other districts, similar in their main geological features. For the purpose of assisting in this comparison I have calculated the percentage acreage devoted to each crop, as well as the proportion of permanent pasture, bare fallow, orchards, market-gardens, woods, and nurseries in the twelve south-eastern counties which bear the closest geological resemblance to Hertfordshire. These calculations have been based upon the Agricultural Returns for 1881, issued by the Board of Trade.

An examination of this table will show that, of these twelve counties, only two, viz., Cambridgeshire and Wiltshire, have a larger percentage of land devoted to agricultural purposes than Hertfordshire; while Hertfordshire ranks with the eastern counties generally as the largest corn-growing district in England, a position which it owes almost entirely to the nature of its drift-deposits, and to the comparative dryness of its climate. We have seen that it is to these drift-deposits that we owe the generally heavy nature of our soils. In fact, if we briefly survey the distribution of the glacial drift in the eastern counties, we find that in Norfolk there is a comparatively small area of clay, and that is chiefly the chalky boulder-clay. In Suffolk the area covered by this clay is larger than in Norfolk, while in Essex and Hertfordshire, in addition to a comparatively large area of boulder-clay, there is also a considerable district of stiffer London Clay. The land in fact becomes stiffer from north to south, the soil of Hertfordshire being on the whole, however, not quite so stiff as that of Essex, both on account of the chalk soils of the north, and the lighter nature of the superficial deposits in some of the western portions of the county.

The influence of this change of soil is well shown by the table (p. 162). Clover and other rotation grasses decrease towards the south, being 15·1 in Norfolk, 11·1 in Suffolk, and only about 10 per cent. in Hertfordshire and Essex. The proportion of bare fallow, also, an unmistakeable index of heavy soils, increases largely

COMPARATIVE AGRICULTURE OF THE CHIEF CRETACEOUS AND EOCENE DISTRICTS OF ENGLAND.

| | Herts. | Essex. | Norfolk. | Suffolk. | Cambs. | Middlesex. | Bucks. | Berks. | Kent. | Surrey. | Wilts. | Hants. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage area applied to agriculture | 86·6 | 78·8 | 80·0 | 82·0 | 92·0 | 64·2 | 86·4 | 83·6 | 74·1 | 61·1 | 88·1 | 68·6 |
| Percentage under Wheat ..... ..... ..... | 17·0 | 18·8 | 16·5 | 17·3 | 23·0 | 5·4 | 12·0 | 14·3 | 11·3 | 11·7 | 10·7 | 13·1 |
| ,, ,, Barley ..... ..... ..... | 13·3 | 14·7 | 18·1 | 19·5 | 14·4 | 2·3 | 6·7 | 10·4 | 6·7 | 5·6 | 8·2 | 8·6 |
| ,, ,, Oats ..... ..... ..... | ·8 | 4·9 | 3·3 | 2·4 | 8·0 | 4·1 | 7·0 | 7·8 | 7·0 | 8·5 | 5·6 | 9·7 |
| ,, ,, Rye ..... ..... ..... | ·04 | ·1 | ·4 | ·6 | ·1 | ·1 | ·05 | ·1 | ·05 | ·3 | ·2 | ·2 |
| ,, ,, Beans ..... ..... ..... | 2·1 | 4·5 | 1·5 | 4·9 | 4·9 | 1·0 | 2·9 | 2·5 | 2·3 | 1·0 | 1·2 | ·5 |
| ,, ,, Peas ..... ..... ..... | 1·1 | 3·1 | ·5 | 2·7 | 1·2 | 1·3 | 1·4 | 1·4 | 2·6 | 1·8 | ·7 | 1·3 |
| Total percentage given to corn crops..... | 42·3 | 46·3 | 40·5 | 47·6 | 51·7 | 14·4 | 30·4 | 36·7 | 30·8 | 28·5 | 26·8 | 33·7 |
| Percentage under Potatoes..... ..... ..... | 1·3 | 1·2 | ·4 | ·3 | 1·8 | 2·4 | ·3 | ·4 | 2·3 | 1·6 | ·4 | ·7 |
| ,, ,, Turnips, Swedes ..... | 6·7 | 3·2 | 12·3 | 7·4 | 3·9 | 1·5 | 4·5 | 8·6 | 3·6 | 5·6 | 7·6 | 11·1 |
| ,, ,, Mangold ..... .... | 1·5 | 3·3 | 4·4 | 4·4 | 3·9 | 1·5 | 1·0 | 1·2 | 1·6 | 3·0 | ·6 | 1·6 |
| ,, ,, Carrots ..... ..... ..... | ·02 | ·08 | ·04 | ·07 | ·4 | ·2 | ·02 | ·03 | ·06 | ·2 | ·03 | ·04 |
| ,, ,, Cabbage, etc. ..... | ·5 | ·62 | ·3 | ·3 | 2·3 | ·8 | ·3 | ·6 | ·7 | ·5 | 1·3 | 1·1 |
| ,, ,, Vetches, etc. ..... ..... | 2·2 | 3·6 | 1·2 | 2·5 | 3·6 | 5·1 | 1·5 | 3·2 | 2·9 | 2·9 | 3·0 | 3·4 |
| Total percentage under green crops ..... | 12·3 | 12·1 | 18·9 | 15·3 | 16·3 | 11·7 | 7·9 | 14·2 | 11·4 | 14·1 | 13·1 | 18·2 |
| Percentage under Clover, etc. ..... ..... | 10·6 | 10·0 | 15·1 | 11·1 | 9·3 | 2·9 | 7·5 | 10·8 | 7·1 | 9·5 | 10·0 | 15·7 |
| Permanent pasture ..... ..... ..... .... | 29·7 | 24·2 | 23·9 | 21·2 | 17·1 | 70·2 | 53·5 | 33·3 | 43·8 | 42·0 | 46·9 | 28·0 |
| Percentage under Flax ..... ..... ..... | ·001 | ·07 | ·01 | ·1 | ·1 | ..... | ..... | ..... | ..... | ..... | ·001 | ·0008 |
| ,, ,, Hops ..... ..... ..... | ·0005 | ·002 | ..... | ·08 | ..... | ..... | ..... | ·003 | 5·5 | ·7 | ..... | ·4 |
| ,, of bare fallow ..... ..... ..... | 5·5 | 7·1 | 1·4 | 4·5 | 4·7 | ·6 | 3·7 | 4·6 | 1·7 | 4·8 | ·3 | 3·7 |
| ,, Orchards ..... ..... ..... | ·3 | ·1 | ·1 | ·1 | ·3 | 1·9 | ·4 | ·4 | 1·6 | ·3 | ·3 | ·1 |
| ,, Market gardens ..... ..... | ·1 | ·5 | ·07 | ·04 | ·1 | 3·4 | ·06 | ·07 | ·4 | ·3 | ·02 | ·09 |
| ,, Nurseries ..... ..... ..... | ·1 | ·04 | ·01 | ·01 | ·02 | ·2 | ·02 | ·03 | ·06 | ·2 | ·01 | ·01 |
| ,, Woods ..... ..... ..... ..... | 5·8 | 2·6 | 3·7 | 3·4 | 1·0 | 1·3 | 5·8 | 6·4 | 8·2 | 8·8 | 5·2 | 10·2 |

towards the south, from 1·4 in Norfolk and 4·5 in Suffolk, to 5·5 in Hertfordshire and 7·1 in Essex. Turnips, on the other hand, which require a light soil, have a large percentage in Norfolk (12·3), and diminish to 7·4 in Suffolk, 6·7 in Hertfordshire, and 3·2 in Essex. Beans, which are 4·5 in Essex and 4·9 in Suffolk, diminish to 2·1 in Hertfordshire and 1·5 in Norfolk.

Or again, let us compare the proportion of permanent pasture in Hertfordshire, and in counties like Wiltshire, Berkshire, Kent, and Surrey, which have a large proportion of bare chalk, and we find the percentage rising from 29·7 in Hertfordshire to 46·9 in Wiltshire, 33·3 in Berkshire, 43·8 in Kent, and 42·0 in Surrey. The exceptionally large area of permanent pasture in Middlesex is due partly to the stiff nature of the London-Clay soils, but partly also to the necessities of the metropolis; both of which causes also influence the percentage of pasture-land in our own county, and tend to make it much higher than it would otherwise be. Buckinghamshire, which has also a large amount of permanent pasture, is pre-eminently a dairy county, owing chiefly to the presence of the Gault, Kimmeridge, and Oxford Clays. An abundance of interesting comparisons might be taken from the tables, but the above are enough to show how closely the agricultural products of a county are regulated by its soils.

Thus in reviewing the agricultural features of even a small country like England, one cannot but be struck with the immense influence which geological structure exerts upon the occupations and character of the people. The history of every nation has its natural beginning in the soil upon which it has sprung up; geological influences from the beginning have impressed their stamp upon it, and have determined, in a great measure, even its social and political position. The great naturalist Cuvier has said: "*Nos départements granitiques produisent sur tous les usages de la vie humaine d'autres effets que les calcaires. On ne se logera, on ne se nourrira, le peuple, on peut le dire ne pensera jamais en Limousin ou en Basse Bretagne comme en Champagne ou en Normandie.*" Nor can we deny that the chief causes which have determined the industries, the character, and even the social position of the people of Hertfordshire can be ultimately traced to geological influences; and I can only hope that the foregoing brief description of these causes, and of their results in our immediate neighbourhood, has yet been sufficient to illustrate the importance and extreme interest of this branch of Economic Geology.

## XXIII.

# THE IMPORTANCE OF MINUTE THINGS OF LIFE IN PAST AND PRESENT TIMES.

By Professor T. Rupert Jones, F.R.S., F.G.S.

*A Lecture delivered at Watford, 7th November,* 1882.

I am not going to speak of the minutiæ and trifles of Human Life—important as they are—little pleasures forming the main support of continued happiness, and little troubles being the source of great misery, just as morsels of stone make a good or a bad roadway according to the mode of their deposit—whether laid down well or ill. The rules of Macadam may appear trifling to some minds, but to the exact mind and by those interested in the matter minute accuracy is required. We are often reminded of the importance of little things in common proverbs relating to every-day affairs, as "Take care of the pence and the pounds will take care of themselves;" also, "Sands rise to mountains—moments make the year."

The moment, a point of time, and the minute, a minute space of time, mark off our existence with ceaseless exactitude, whether we recognise them with punctuality and industry or not. The minute trifles of dress and adornment have to be attended to with more or less particularity; buttons and stitches are all important in one way or another. The silkworm's filament, the wool and hair of the sheep and other useful animals, are small indeed, but how much importance belongs to their goodness and integrity and their fitness for web and woof! So the single hairs of added tresses, and the fine atoms of toilet powders, must be good and true, the one strong, the other pure, to be safe adjuncts to the fashionable head-dresses and to the delicate tints of female beauty. All of these are not things of life; nor can the atoms of chemistry be said to be vital, though of vital importance to all of us in many respects. Nor are the tiny grains of hard mineral matter in sandstone (so useful in pavements and houses) of organic origin; though some rocks allied to sandstone have been formed of the minute—very minute—siliceous framework of Diatomaceæ and Polycystina, or of the siliceous spicules of sponges. In limestones, however, nearly all, and sometimes quite all the constituent particles have once been portions of aquatic animals or of water-plants that had carbonate of lime in their structure. How important the microscopic cells and fibres of wood are the naturalist well knows; and to the carpenter and builder, little as they know of histology, their importance is great in a practical point of view, as ruling the grain of wood and its relative hardness and durability. So also we soon find out when the fine-grained dentine and enamel of our teeth become modified in their intimate tissue, and lose even the relative solidity of bone, giving us the pain of unprotected nerves, instead of the satisfaction of eating hard-celled toothsome crust or even the vesicular crumb of bread. The minute tissues, then, of our own bodies would

supply argument enough for a lecture on the importance of minute things in this life of ours; and doubtless heredity has handed down the bad effects of modified tissues in past generations of the sick and the sorry to the sufferers and idiots of to-day. But there are many less disagreeable subjects within the range of our text, taking illustrations for both the past and the present from among Common Things. We may group them thus:—Important, though minute, things of life in the Vegetable world: Nullipores, and nullipore-limestone; Corallines, and coralline shore-sand and raised beaches; Characeæ, and chara-limestone; Diatomaceæ, and diatomaceous earths; Equisetums and grasses (canes, wheat, hay, etc.); Puff-ball, Lycopodium, and spore-coal; Lichens on rock, and the formation of soil. In the Animal world: Sponges and spicules, and spicular sandstones (chert, etc.); Polycystina, and polycystine beds (Barbadoes); Entomostraca (ostracods), marine and freshwater, ostracodous limestones; Foraminifera, and foraminiferal limestones.

Now I propose to speak of some of these in order. The enormous accumulations of limestone to which the Nullipores give rise are astonishing. Perhaps the best way to realise this is to think of the island of Malta, which is of so much importance to this country. It is made up of five great beds of rock, some hard, and some softer. But the topmost bed, for many square miles, is largely made up of this kind of calcareous seaweed. The common building-stone of Vienna is made up of similar lime-bearing seaweeds in a fossil state. Paris, we may say,—speaking of the stone used for houses, —is built of Foraminifera; and London is built of mud—loam fit for bricks. Other materials of which London is built, besides the brick-earth, consist also of minute particles. The beautiful front of the new Army-and-Navy Hotel is built of fine-grained sandstone from Northumberland. St. Paul's, the Monument, Somerset House, and many large old-fashioned houses are built of Portland stone, which is composed to a great extent of particles of oyster-shells stuck together.

But to go back to the Nullipores, the calcareous seaweeds. There is a tiny, jointed, branched, white, skeleton-like seaweed, growing on the rocks of the English coast; but it occurs in such enormous abundance in the West Indies and elsewhere, that the little joints, parting away from each other, form whole beds of calcareous sand, and when hardened on the sea-beach by spring-water, rain, and sea-spray dissolving the carbonate of lime and mixing it up with the particles, they form limestone. You have heard of the human fossil from Guadaloupe which is in the British Museum,—that is imbedded in this kind of rock.

The *Chara*, very well known to Naturalists, is a little freshwater plant, with its tissues full of carbonate of lime, and when it dies this mineral matter remains behind. Not many years ago I saw a lake or pond drained in Shropshire, and the mud was quite white, the calcareous atoms becoming bleached in the sun. Such material, got by draining some Forfarshire lakes, has been used in Scotland for manuring fields.

As to the Diatoms, they are found in very many localities; but the enormous masses which accumulate from their growth in some places is something astonishing. This diagram (exhibited) shows some Bacillariæ among Confervæ, etc. They are tiny siliceous atoms finer than wheat flour. But their number is not more astonishing than their elegant shapes. In some parts of the sea, as in the Antarctic Ocean, deep soundings long ago proved that the sea-floor is covered with beds of Diatomaceæ. Fossil deposits of these minute organisms are worked for use as polishing-powder and for other purposes. Richmond and Petersburgh, in Virginia, stand on diatomaceous marls, 20 feet thick. In Bohemia, at Bilin the "polishing-slate," and at Franzenbad the "flint-froth," are well known. So also the polishing-powder got near Tripoli and so named, also the "Mountain-meal" of Sweden, and similar siliceous earths in the Isle of Mull,—near Dolgelly,—and on the banks of the river Bann and elsewhere near the Mourne mountains in the county Down, are all composed of these microphytes. That from the Bann has been sold as "Lord Roden's plate-powder." Being composed of little sharp fragments, it can take off the surface of metals, and polish them by giving them a new face. Such a material is also found in the "Dutch rush" or *Equisetum*, which has so much of silica in it, that, when dry, it can be used as rubbing material to polish iron and other metals. In the bamboo and other canes silica is also found, and grasses and wheat would not stand upright if it were not for the siliceous atoms. You know that when hay or corn is burnt accidentally, of the rick there will only remain a heap of slag, rough, scoriaceous, and glassy, due to the presence of myriads and myriads of these tiny atoms. So you see these minute atoms are very important in life for some of these plants, and often play an important part after death.

There is another form of vegetable matter occurring in very minute atoms, which is, perhaps, of still more importance. A puff-ball when dry and broken emits a cloud of delicate dust. Among the many fine specimens of Fungi on the table, some will supply what we wish to see. The atoms constituting these impalpable smoky clouds—indefinitely small to our naked eyes, and not recognizable without a microscope—are really analogous to one of the most important accumulations without which we cannot get on in every-day life. You know also that the *Lycopodium* in its fruitage gives off similar clouds of dust, or "spores," which come from little vesicles or spore-cases arranged differently from the spores of ferns, being packed in cones, in a most symmetrical and masterly manner. There are fossil remains of club-mosses which have given off such clouds of this fine spore-dust and produced such masses of the little vesicles in which the dust has been stored up and arranged, in past times, that we actually owe a great deal of our *coal*, and some of the best of it, to the organic dust you see there (Diagram referred to). The club-mosses now in the rocks were large trees, but nevertheless they were club-mosses, like lycopodiums and selaginellas, but of the kinds known as *Lepido-*

*dendron*, *Sigillaria*, etc. They grew in great abundance, and lived and died generation after generation, dropping their cones, the cones bursting and dropping the vesicles (sporangia), the sporangia bursting and giving off the dust (spores), in the quiet and warm primeval forests—grand "Wardian cases" as it were—so tranquilly, so abundantly that they accumulated thickly. Being little more than hydro-carbon (the living spores will flash in a flame), they have remained almost in the same state to the present day, but massed as useful seams, while the trunks and branches constituted the greater part of the coal. That is, perhaps, one of the most interesting and direct illustrations of minute things now living, and represented also in the fossil state, that we know of.

There is still one more vegetable matter I should like to mention as very important. I have brought a specimen to remind me of it. It is a little piece of sandstone (from one of the "Standing Stones" of Stennis) with the Lichens that grew on it. Though very small, and not growing up to rival the Fungi, yet by their coating various rocks Lichens lead to the formation of soil. These tiny plants by modifying the surface of rocks lead to their dissolution, and by adding their little bodies to the decomposed débris of the rock, actually form soil, which is washed down to a lower level, forming a great part of the alluvium of valleys, and of use in various ways.

I have given enough examples of the vegetable world, but here is a limestone—it has been limestone, but is now flint—from Paris, with *Chara* seed-vessels in it, which were called *Gyrogonites* before it was known what they were. But they are sufficiently numerous to be very important constituents in this limestone in its original state. I will also hand round some engravings of the stems and seed-vessels of *Chara*, obtained from the Scotch lakes by Sir C. Lyell many years ago. These little seed-vessels and stems (as above mentioned) add very considerably to some calcareous deposits.

Now we will turn to the animal kingdom, and see what animalcula there are which have played an important part in this world. We all know the common household Sponge. That particular kind of sponge has not had much to do with what I am speaking of. It has merely a soft horny tissue, and herein differs from other sponges. Some have the same kind of tissue to a certain extent, but, if you take different kinds, you will find that this fibrous or network tissue has distributed in it little mineral grains, points, needles, stars, etc.; and, if you trace it from one kind to another, you will find the horny tissue becoming quite mineralised, compared with that in the bath-sponge. These particles of either silica or carbonate of lime form nearly the whole of the fibre or thread of the intricate network in some cases; and they are of infinite variety. Here is a sponge with some calcareous material about it, but you can see that it is made up of little needle-like spicules. Here is a part of another, where the spicules are star-shaped, some with three arms (tri-radiate, as they are termed), and woven neatly into a tissue representing just here the margin of one of the canals or holes which exist in the common sponge. Here again is the surface

of a sponge made up of long spicules ending with three prongs. Here are diagrams of anchor-like and other spicules, some double-anchored, some club-shaped, pin-shaped, etc. When the sponges die, these mineral spicules do not cease to exist; they lie about in the sea, especially if siliceous, and form beds of material like sandstone. Here in a little bottle are some spicules from the Upper Greensand of Devonshire. There is not merely a thimbleful or a handful—there are square miles of it. Other beds made of spicules are to be found at Folkestone, and in the Isle of Wight, and elsewhere. So also you can hardly break a flint without seeing the spicules. It was once so much chalk, and retains whatever organisms were present in it originally. Not only in these Cretaceous beds, but in the Silurian rocks there are fossil sponges recognizable by the shape of their minute spicules. Spicules among other minute organisms have been found in the ooze of the Atlantic and other oceans, thousands of feet deep. This was one of Ehrenberg's discoveries. Very many scientific people have made and studied deep-sea soundings besides the voyagers in the "Challenger;" but the "Challenger" takes over much credit because the Expedition happened lately, and the public have heard much about it. One of the most useful results of the fossilization of sponges is that they lead to the formation of a kind of flint, called chert, made up of the spicules cemented together into a granular but somewhat translucent rock. It is useful for road-stone, for instance in Surrey, and whetstones for scythes were formerly made from the chert of the Blackdowns in Devon.

Amongst the marine animalcula which have hard material in their tissue or substance, probably none are more durable than the Polycystina. Many of you have specimens from Barbadoes, I have no doubt. They are washed with care, and then show most beautiful basket-work, such as Chinese carving cannot surpass. Many of these Polycystina are globular, with globe-within-globe of beautiful fenestrated, or lattice-like, basket-work. The "Challenger" expedition found that they abound more over some oceanic areas than at others. They occur in the fossil state; at Springfield in Barbadoes there is a very considerable stratum, extending several miles; they occur also in the Cretaceous rocks of Germany.

Then there is another set of creatures—the small bivalved Entomostraca. They are representative members of an enormous family, belonging to the Crustacea.

In this group of creatures there are several, essentially similar in body and limbs, but still very different in appearance. There is the little *Branchipus*, not inclosed in a shell, but showing all its numerous segments and their foliaceous appendages, whereby the creature moves in the water and obtains oxygen from the water. The *Cyclops* has a jointed horny armour from head to tail. The next little Entomostracan we can notice is *Daphnia pulex*, the water-flea, so called because it darts about in the water with a jerky movement as a flea jumps elsewhere; and it is thus put down among the best known of little jumpers, according to the

exigencies of popular English. The water-fleas (*Daphnia* and its allies) are very pretty little things—something like etherialized shrimps in delicate translucent bivalve shells or carapaces folded down on each side, and inclosing all the animal except its feathery antennæ or swimming organs. It is more scientific to say that the two halves of the carapace of the shrimp would represent the two halves of the little shell, which is very much extended, backwards and downwards on each side, inclosing the inturned hinder parts of the animal, with the limbs modified in character and number; and instead of long thin thread-like feelers in front, the creature has two pairs of modified antennæ, filamentous, beautifully jointed, and so arranged that with them the animals can either swim in the water or creep along on the mud and weeds. These antennæ protrude and work through a notch in the edge of the shell, just below the head, which is thus made to look like a kind of projecting hood. Though small, yet the *Daphniæ* occur in such enormous numbers that at one season of the year, when they take a red colour, they sometimes give a bloody appearance to ponds of water, and before now this has been taken for a prognostic of bad times; but it is only when bred under favourable circumstances in such myriads that they crowd the water and colour it until one generation dies away and gives place to others.

None of these add to the rock-material, because they are of soft tissue, slightly horny at most. The Ostracoda are a different kind of Entomostraca. They have hardish bivalve shells, which remain often in the fossil state. The *Cypris* and *Candona* live in fresh water, and have somewhat egg-shaped valves, which open wide enough to allow the two pairs of antennæ to come out and move in front, and the hooked tail to be pushed outwards and downwards behind. *Cypris* has feathered antennæ or front limbs and can swim; in *Candona* the lower antennæ are merely hooked, so that this animal can only crawl on the mud and weeds. The *Cythere* is marine, and does not swim, but crawls about. It differs from the foregoing in some of its limbs and in having stronger valves, thicker, and hinged along the back. They are like little peach-stones in some cases, and much more oblong in others; and nearly always ornamented on the surface. These creatures have added very considerably to the world's crust, little as they are. They may very readily be found living; they thrive in aquariums; they are easily collected from among the water-weeds of ponds. The mud thrown out of the river at the silk-mills, near Watford, some years ago, was grey with the little white specks of the dead valves. In the fossil state these Entomostraca are very abundant; *Cythere* and its allies in marine strata; *Cypridæ* in lacustrine beds. In the Silurian rocks there are many marine forms; and in the Devonian schists they lie very thick, but much squeezed and distorted. In the Carboniferous formation they are also abundant; some, in the Coal-measures, are estuarine. Here is a piece of Tertiary rock from Bombay; the little black spots in it are all *Cypridæ*. Here is a piece of similar limestone converted into flint, and each of these little creatures is represented by a lovely

little nodule of chalcedony. This Wealden limestone from Mountfield is full of *Cypridæ*, but they are so closely cemented that they are disclosed only on the weathered surface. Thus one of the rocks formerly used for lime-making in Sussex is composed of *Cypridæ*. Some of the Swanage building-stone is also wholly composed of them. Many of the dangerous promontories, reefs, and skerries on the south coast of the Isle of Wight, where so many of the old East-Indiamen and other vessels have been wrecked, would not have been there if it had not been for the *Cypridæ*; for where they abounded in the old fluviatile and estuarine muds which have become the Wealden strata, they gave up the lime of their shells to the mud, making numerous layers here and there in the thick clays into hard bands of rock. These remained, edge-on to the present sea-board, when the clays were washed away. Thus the muds, hardened by the calcareous material of these tiny atoms, have formed persistent reefs, helping to keep up the island, but wrecking large ships and small, with great misfortune to hundreds of families.

There are other creatures among the Microzoa, which occur in great abundance; more particularly one set, of calcareous structure, called Foraminifera. The name *Globigerina* has become almost a household word since these animalcula were found abundantly in laying the Atlantic cable. They add very largely to the material at the bottom of the ocean. Here is a sketch of the Atlantic ooze (a whitish sticky mud, when fresh) as seen under the microscope, with whole and fragmentary shells of *Globigerinæ* and other Foraminifera (*Pulvinulina* and *Orbulina*) constituting the material. *Globigerinæ* are obtained from great depths in the Atlantic, the Pacific, the Indian Ocean, Red Sea, and Australian waters, where they form there is no knowing how thick a mass. They are also found in shallow water in the Adriatic and elsewhere; and some are found floating at or near the surface of the ocean. Besides the white ooze, there are wide tracts of Diatomaceous earth and Polycystine ooze on the ocean-floor; also wide areas of red mud, from the decomposition of volcanic ashes, and alluvial deposits near the river-mouths. The Globigerina-ooze is somewhat like the Chalk; but the component shells and Foraminifera differ to a great extent.

The Foraminifera belong to a group of animalcules, called *Protozoa*, which consist of a little jelly-like mass—a minute gelatinous atom, having the faculty of moving and of feeding itself without the aid of the limbs and apparatus of the higher animals. The flesh is not really flesh, but, as it must have a name, it is called "sarcode;" it is also called "protoplasm," because it is the simplest form of living material. The well-known *Amœba* can extend and retract any portion of its body, and moves on almost like a speck of thick mucilage. When it comes to a particle suited for its food, it incloses it—making a temporary stomach—and digests or uses it up, except refractory grains, and they are got rid of by being passed off through some part of the body. Some

individuals are much more voracious than others, always cramming and gorging their bodies. One is mentioned by Dr. Leidy as happening to be in a stream near a sawmill, and as having filled itself with sawdust. These *Amœbæ* feed generally on Confervæ and Diatomaceæ. They spread out so much that they can inclose things as large as themselves, by stretching and attenuating their sarcode; and the soft parts of the food are absorbed, while the hard parts pass away through the body—for there is hardly any integument—and are lost sight of. Instead of being merely this simple, soft substance, there are some that have a horny coating, such as the *Difflugia* and *Arcella*; and there are others that have a calcareous coating (Foraminifera); others have siliceous spicules or a siliceous framework (Polycystina and other Radiolaria). The projected angles, lobes, and threads of the body, varying in the different kinds, are called "pseudopods." Some of these are slender radiating filaments, and branch and interlace. Some are hardened and strengthened with silica, and play their part as indestructible atoms, like the sponge-spicules.

Among those with calcareous shells we have the pretty *Cristellaria* with a discoidal growth, as a flat spire with sharp edge. This form is particularly seen in the Nummulites. They consist of very many cells arranged most symmetrically, one after the other, in coils, forming little flat disks, like coins; and hence they have been called "Nature's Money," "Peter's Pence," and "Devil's Coin." Some are thicker than others in the middle, and look like lentils; hence, as they are very common in Egypt, forming the building-stone of the Pyramids, they were said to be lentils dropped by the workmen and fossilized. Here are some Nummulites from the Pyramids, and some from the Crimea, and elsewhere. The hills round about Sebastopol and Balaklava are formed of Nummulites; also the Hala hills in Scinde, much of the south flanks of the Himalayas, and great masses of the Alps and Pyrenees. The Indus brings down pebbles of limestone, which are frequently cut and polished, showing the structure of the Nummulites. We have a nummulitic stratum in England,—at Bracklesham (Selsey), in Hampshire, also in the Isle of Wight. We have also another foraminiferal rock in the Mixen and Clibs off Selsey, made up of analogous shells—the *Alveolina*. Here is a bit of Paris stone from Mont Souris, made up of little shells of this sort, but chiefly *Miliola*. Many are present in the Chalk. Some kinds of chalk have 90 per cent. of *Globigerinæ*. Other limestones, such as the Mountain-limestone, are here and there very rich in *Fusulina*. In the recent condition Foraminifera are abundant enough. Here is one sort, the *Tinoporus*, which forms great banks in Torres Straits. The coral-islands also abound with Foraminifera; such as the *Orbiculina* in the West Indies and the *Orbitolites* at Fiji. In some cases the prevalent winds bank them up in shoals along the shores.

Taking the Foraminifera as examples of the influence of little things, we may remark that here then are some of the mighty hosts with which the Creator peoples and repeoples the earth and the

sea. The armies of locusts and caterpillars, fearful in their devastating powers, have been called forth to destroy. Here we have legions of minute creatures called into being for the purpose of building up, flake by flake, layer by layer, bed after bed, massive and hard foundations of islands and continents, nay, the stony floor of a great part of the existing world. Long ago the sands and ooze of primeval seas were full of the pretty shells of Foraminifera; long, long ago the warm ocean of the Carboniferous Period swarmed with them—they lived on in endless varieties of shape—and to-day still witnesses many of the same forms and many of the same species. For in every climate, on every shore, and at every depth of sea, these simply-constructed animalcules had but little difficulty in adapting themselves to the varying conditions of the sea—as the land rose here or sank there, as the sea-bed filled up with mud or was overspread with sand. Whether the sea-bed shallowed, or sank under many-fathomed waters,—whether it became the home of the tropical coral, or was grated and furrowed by the travelling iceberg, —still in it were Foraminifera existing, which could live on under the new circumstances. They continued the work of separating lime from the water, and converting it into shelly matter, which was to be in time a marble or a chalk, a nummulitic, or some other kind of limestone. Wonderful as is this process, wonderful as has been the work confided to these animalcules, wonderful as is the widespread and thickly-massed accumulation of their minute shells, massive enough for Man to build of them his tombs, his palaces, his temples—nay, even grandly great enough for Earth to build her mountains of, yet there stops our wonder; it is taken up by other parts of God's creation. If the tiny atom leaves a more enduring monument on earth than Man leaves of himself, if the Foraminifera have a grander sepulchre, if they have added more to this earth's crust than the human family has, there ends their grandeur! They have done their work, and piled up their mausoleum; but Man's life is not wholly material, his work is not buried in his tomb—his destiny has a higher goal!

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## XXIV.

## ANNIVERSARY ADDRESS

By the President, George Rooper, F.Z.S.

*Delivered at the Annual Meeting, 20th February, 1883, at Watford.*

Ladies and Gentlemen,—

The science of Natural History is at once the most important, the most interesting, and the most instructive of all the sciences. Bacon called it "The foundation of all human wisdom." It is, also, the most universal; for, as one of Molière's characters talked prose all his life without knowing it, many a man, from constant and accurate observation of animals, their habits and peculiarities, has made himself a naturalist in the best sense of the word, though he may never have studied in books, and is ignorant of technicalities and scientific terms. Indeed, the study has, in the case of some authors, degenerated into a parade of learning, and the name of naturalist has been usurped by men whose sole knowledge is comprised in technical phrases and definitions, and the power of retaining in the memory the crackjaw names invented and bestowed on animals and birds by persons no wiser than themselves. Still, to attain proficiency in the science, it is not sufficient to watch and note the habits of birds and beasts; constant and careful reading of the authors who have treated the subject is also necessary, and a knowledge of the scientific nomenclature and classification must be acquired. In short, study must be verified by observation, observation confirmed by study.

Books on Natural History have been my favourite reading from my earliest youth, and there are few that I have not, at some time, at least dipped into. I propose to-night to refer to such as have most interested me, briefly and with great diffidence commenting on their contents.

Where and with whom to commence is the question. In fact, the first man was the first naturalist. "Whatsoever Adam called every living creature that was the name thereof." It is recorded of Solomon that "he spake of beasts, and of fowls, and of creeping things, and of fishes." No record of his knowledge, however, has come down to us, and Aristotle may be considered the earliest authority on all subjects connected with the science. He it was who first investigated the relations and the differences which connect and distinguish the various tribes of animals. He reduced to form the chaos of detached, uncertain, and often fabulous descriptions of earlier writers, with a success so amazing that to

this hour no systematic view of animated beings has been attempted the principles of which have not been adapted from his 'History of Animals.' Aristotle flourished some 350 years before the Christian era. He was a private tutor in the house of Philip of Macedon, and Alexander the Great was his pupil. Alexander, who had a turn for Natural History, testified his appreciation of the pains bestowed on his education by providing a few hundred (some writers say thousand) men to travel into distant countries to collect specimens and make observations for the great work he had in contemplation. I need not say that as men possessed of neither intellect nor education were sent forth to make observations, the result was not always reliable, and numberless fables which appear in Aristotle's works may be attributed to the reports brought him by such agents. Alexander did not confine his patronage to the provision of collectors of information—he defrayed the cost of publication of his master's writings—no trifling sum. It is recorded to have been 800 talents, an enormous sum, the value of a talent in our money being variously estimated at from £200 to £600, which proves that publishing 2000 years ago was an expensive, and, no doubt, a profitable business, as it now is. The book, however, is bulky. My own copy, a folio, splendidly bound, contains more than 3000 pages closely printed. I shall not inflict any extracts upon you, but, as I said, the system laid down by Aristotle has been that adopted by all succeeding writers, and he may be regarded as the father of Natural History, as Herodotus is of History.

More than 300 years later flourished Pliny, the great Roman naturalist, who lost his life in the pursuit of the study. He was, as you know, overwhelmed in the ashes which destroyed Pompeii, whilst investigating too closely the dreadful eruption of Vesuvius. Pliny worked on the lines of his great predecessor, reducing his generalities to more concrete and specific form, and producing a work of the greatest interest and value. Of course, in a book written in an age so remote, many grave errors occur, either from incorrect information or too hasty observation. A chapter in Aristotle, entitled "De mirabilibus," and which title might have raised suspicion in Pliny's mind, was to a great extent adopted, and the wonders recorded in it repeated and amplified. His own writings, too, display a capacity for swallowing the marvellous which could hardly be exceeded. "Yet," he writes, "it is really wonderful to what a length the credulity of these Greeks will go. There is nothing so absurd that one Greek will not tell nor another believe." After which he gravely relates of the basilisk, that it is

of so venomous a nature that its breath consumes not only grass and herbage, but stones! He tells us that the young bear is born a shapeless mass, and is licked by its mother into shape; that when the crocodile opens its mouth, which it does in order to have its teeth picked by the little trochilus, the ichneumon seizes the opportunity to rush down its throat and devour its entrails! He tells us that the eagle compels her young to gaze upon the sun, and if they but wink, incontinently pushes them out of the nest; that the halcyon (the kingfisher) builds its nest on the waves, in the winter time, and that, whilst incubation proceeds, the waves are hushed and calm. There is, he says, an anonymous beast in Ethiopia, whose head is so heavy that he cannot lift it up—which is fortunate, as to meet his gaze is death. These little anecdotes lead to the conclusion that the Greeks were not alone open to the charge of credulity. Still, Pliny's work is a wonderful one, and well worthy of perusal by those who would study the science from its origin. A folio translation of his 'Natural History' was published in 1601, but a modern one has recently appeared.

There were contemporary—or nearly contemporary—writers whose names are scarcely known excepting to the student, and whose works, if they have descended to us, are of that class which it is said that "no gentleman's library should be without," and which no gentleman ever thinks of taking down from his shelves.

After Pliny some hundreds of years elapsed during which no writer of eminence appeared. Greece and Rome had waxed and waned, culminated, and gone to decay. Great Britain in the time of the Saxons was utterly barbarous and illiterate. The Normans, though more civilised, were better game-preservers than naturalists. The poacher of the present day who grumbles over a 20*s.* fine, with 10*s.* 6*d.* costs, may be thankful that he did not live under the Plantagenets. The man who killed the King's deer was bound upon the back of a wild stag, and sent forth into the wilderness to be torn or gored to death, or tied naked to a tree to form a target for the King's archers. Hanging was the mildest fate that awaited him.

The first writer of note of more recent times on the subject of Natural History was Linnæus, the Swedish naturalist, born in 1707. His classification and nomenclature, with some modification, is still adopted, and deservedly so, for it is both clear and intelligible. Indeed, one of his great merits, in my opinion, is the simplicity of his scientific nomenclature. Take, for instance, the family of the tits—the Paridæ. The great tit is "*Parus major*,"

the blue tit, "*Parus cœruleus*," and the long-tailed tit, "*Parus caudatus*." Any one at all acquainted with Latin can see the meaning of these terms, and without effort commit them to memory. That the want of such knowledge may lead to trifling inconvenience I had an instance of some years since, when a friend, knowing I was making a collection of birds' eggs, purchased at a high price and sent to me from a foreign country the eggs of "*Coccothraustes chloris*" and "*Emberiza citrinella*," under which learned names he had purchased at a long price the eggs of the greenfinch and yellow-hammer.

The Comte de Buffon, the great French naturalist, was contemporary with Linnæus—in fact, born the same year. His works, though not exactly adapted for the perusal of the young, are of great beauty and worth. He was a voluminous writer—my own edition is in 20 octavo volumes. Every beast and bird is the subject of a long and ingenious essay, in which its nature, habits, and peculiarities are set forth at great length and generally very accurately. His great failing was a disposition to make too nice distinctions, and elevate chance specimens into specific varieties. He describes, for instance, at least half-a-dozen dormice, amongst which we have the "fat dormouse," and the "gilt-tail dormouse," which presents very much the appearance of a mouse with a skinned tail. Then we find no less than sixteen bats specified. There is the "bull-dog bat," the "bearded bat," and the "horse-shoe bat," whose flesh is stated to be good to eat, at least "as good as that of the water-rat"! Indeed, the Frenchman's love of eating and his culinary propensities peep out everywhere. The flesh of the sea-bear is stated to be "tolerable eating," that of the golden eagle "though hard and fibrous, is not without merit." Young barn-owls "make a not unpleasant meal," and the flesh of the robin-redbreast is "more delicate than that of the throstle." A sentimental description of one of the pretty singing birds concludes: "You eat this little bird with bread-crumbs." The analogy Buffon draws between the nature of beasts and birds, though fanciful, is ingenious. He compares the eagle, noble and generous, to the lion; the vulture, cruel and insatiable, to the tiger; the crow, feeding on carrion, to the hyæna; the falcons, trained to sport, to the dogs; the owls, preying by night, to the cats; the herons and cormorants, fish-eaters, to the otters; birds provided with crops, to the ruminating animals.

There were many contemporary writers of note about, or shortly after, the time of Buffon, whose works, if time permitted, I would fain refer to, such as Pennant, Latham, Cuvier, and others, but I

must hasten on to comparatively modern times. One of the earliest, whose work is still an authority, and a most valuable one, is Montague. He was born in 1747, but the best edition of his book was edited by Professor Rennie in 1831. This, as you are no doubt aware, is in the form of a dictionary, the only book on ornithology, so far as I know, in that form, and a very useful one it is. A great feature in it is the synonyms. You will find, on consulting it, not only the scientific designation of each bird, but the provincial or local name. Thus you learn that the "dish-washer" is the wagtail; the "market-jew," the chough; the "screech," the missel; the "coddy-moddy," a young gull; and the "butterbump," the bittern. Montague's 'Dictionary of British Birds' is an invaluable book, especially to the young naturalist.

Perhaps the best known and most read of the comparatively modern authors is White—Gilbert White of Selborne. His work is replete with accurate information, the result of constant, well-directed observation, and is couched in the most simple and charming language. Whether for the information contained in his letters, or their epistolary style, no work is more worthy of perusal by the young than White's 'Natural History of Selborne.' I would make it a text-book for all schools. The public estimation in which this work is held is evidenced by the number of editions it has gone through—at least fifty. Perhaps the best known is that edited by Rennie, but the latest are those edited respectively by the late Frank Buckland, and by our esteemed friend and member of this Society, Mr. J. E. Harting. These are certainly the best. I have them both, and many delightful hours I have spent in their perusal. I can only call to mind a single instance of what may be considered a mistake in White's whole work. Talking of the frog, he refers to the time when the tadpole's tail "drops off." I need not tell you that the tail of the tadpole does not drop off, but is absorbed. White's accuracy and natural modesty made him state facts of which he was not absolutely assured in a hypothetical form. "I think," he says, "that white owls never hoot." To this Rennie appends a note: "White owls do hoot. I have shot one in the act." Waterton, who held a low opinion of the Professor's practical knowledge, remarks: "As Mr. Rennie asserts that he has shot a white owl in the act of hooting, I admit that that particular owl did hoot, but no other white owl since the world began ever did hoot." In this I entirely agree with Waterton. It is the brown or wood owl that hoots; the white owl screeches, and snores, and makes hideous noises, but never hoots.

The works of Waterton—the pleasantest and most accurate of

writers—are full of information of the most varied and interesting kind. No other writer has been so successful in combating vulgar errors, and in disseminating truths about birds and beasts. In the pursuit of knowledge no labour deterred, no danger daunted him. He walked barefoot through the vast forests of Guiana, regardless of the venomous snakes, to step on any one of which was certain death; careless of the winged and creeping insects which there, literally, devour a man. He camped in swamps whence arose the dreadful miasma, fatal to the lives of all uninured to the climate; where venomous beasts lurked, or savages ready to take his life for the value of the blanket, almost his only garment; and, unattended, or followed by semi-civilised coloured men, he sought, and afterwards in the most graphic manner recorded, the mighty secrets of nature which were before hidden in that unvisited region. The adventures detailed in his wanderings are of the most startling kind, some bordering on the marvellous. Of these, his conflict with the python which wound itself round his body, and his ride on the back of an alligator, are specimens, but no one who knew the man, or, I may say, his writings, ever discredited him for a moment. Sydney Smith, in reviewing his works, throws a playful doubt on one of his statements. "In the forests of Guiana, the campanero," he tells us, "tolls with a solemn sound at regular intervals, and the deep note may be heard at a distance of three miles!" "It is not for us," says Sydney Smith, "to contradict a man who has spent his life in the forests of Guiana, but when a campanero is brought to England, we will make him toll in a public situation, and *measure the distance!*"

One of the best known and most loved authors of the young is Bewick, the well-known wood-engraver of Newcastle. His illustrations, considering the time at which they appeared—a hundred years since—are admirable, and the quaint tail-pieces, each telling its own story, are beyond praise. The letterpress, however, is not of equal value.

Of American naturalists, Audubon, who was born in 1780, is perhaps the best known. His illustrations, wherever possible, are of the size of nature, and admirably drawn; but the colouring, like the descriptions, considerably exaggerated. There is a description of the passenger-pigeon which well illustrates this. The bird, although, unlike other pigeons, it lays but one egg at a time, is perhaps more numerous than any other on the American continent. Still the following description must be taken *cum grano.* "The pigeons arrived by thousands, alighted everywhere, one over the other, until huge masses, *as large as hogsheads,* were formed

on the branches. Many trees *two feet in diameter* were broken off at no great distance from the ground, and the branches of many of the lowest had given way." The whole of this description, I need not say, is grossly exaggerated. Whatever the boughs might do, it is evident that the trunks of the trees could not be broken down by the weight of any amount of pigeons. There follows an absurd account of the assemblage of men with guns, and of wild animals of every description, who combine, in happy partnership, to destroy the wretched birds.

Referring to illustrated books on ornithology, I should mention Gould's magnificent book, lately completed. It is a very grand work, and an expensive one. I took it in for some years, but eventually gave it up, apprehending that it would either never be finished, or that, if it were, I should not have room in my small house for it. Gould's nomenclature is most objectionable. He seems to adopt the longest and most meaningless terms he can lay hold of, for no other reason than that they *are* long and meaningless. Why, for instance, should the redpole be called "*Ægrophus*," or the siskin "*Chrysomptris*"? The words are neither Latin nor Greek, nor do they convey any meaning. Gould, however, was no classic, as is shown by his designating the jay by two adjectives, "*Garrulus glandarius*."

Yarrell's work is, or ought to be, in every library whose owner is a student of ornithology. It is the best book of reference extant, but Yarrell could hardly be called a naturalist, as, whatever his inclination, he had no opportuntity of observation, and you will find that his statements are invariably made on the authority of others.

There are numberless names which occur to me on which I would fain dwell, but time will not allow me to do so. One more reference and I bring this already too long and, I fear, tedious record to an end. It is to my late friend Frank Buckland—kind-hearted, genial, impulsive Frank Buckland. No more zealous, truth-loving, or painstaking man ever studied more earnestly or described more accurately the various gifts and instincts, the nature and habits of birds and beasts. A quaint vein of humour runs through his writings which must commend them to every reader, especially to the young; and few writers have conveyed more varied and useful information. His conversation, which generally turned upon subjects connected with his favourite study, was equally animated, instructive, and amusing. Who that knew him has ever forgotton his hearty, jocund laugh, and the half comic earnestness with which he enforced his favourite dogmas. Buck-

land emulated White and Waterton in never stating anything as a fact of which he had not satisfied himself by actual experiment. I once found him cooking a piece of a dead kelt. "Good gracious!" I said, "how can you eat anything so abominably nasty?" "No doubt," he said, "it is nasty enough, but how can I say so unless I have tried it?" I remember his earnest, wistful face as he contemplated a huge oyster—of what kind I know not—but it was almost as big as a cheese plate. He looked at it once or twice with an evident wish to experiment on its flavour, but, although blessed with a very strong stomach, his resolution failed him, and he resolved to make the experiment vicariously. He called in a dustman, and on the principle of "*Fiat experimentum in corpore vili*," offered him a shilling to eat it. The spirit of the dustman was willing, but his stomach weak, and he recoiled from the undertaking. Buckland increased the bribe by an added pot of porter. On this the dustman devoured half the tempting bivalve, but suddenly retired without completing the experiment; and the precise flavour of that oyster is still locked, unrecorded, in the dustman's breast. Buckland was slow of conviction. It took me seven years to persuade him that although the parr, the young of the salmon, was a barred fish, it did not follow that all the barred fish of the salmon tribe were necessarily the young of the salmon. In the end, after producing some scores of barred trouts, known in Ireland as "gubbs," in different stages of spawning, I persuaded him of the fact, and "*Salmo salmulus*" of Yarrell thenceforth held a place in his catalogue of fishes. Well, he has passed away, and has left his works behind to speak for him. I earnestly recommend their perusal to all, especially the young, who may desire to mingle knowledge with amusement. His works, as his memory, will long endure, a monument of patient, kindly, and scientific observation.

I must now conclude, thanking you most heartily for the kind attention you have bestowed. If I have, by my crude and necessarily brief notices of some few of the writers on the subject we all value so highly, aroused or increased the desire to study their works, my object will have been attained. I can only wish that the task had fallen into less incompetent hands, and that a subject so replete with interest had been handled by one more capable than myself of doing it justice.

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## XXV.

## REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1882.

By John Hopkinson, F.L.S., F.M.S., &c., Hon. Sec.

*Read at Watford, 20th March, 1883.*

The number of observers of phenological phenomena in 1882 shows a slight falling off compared with the number during the two previous years. We have to regret the loss of our observer at Berkhamstead, Mr. A. S. Eve, and our observer at Great Hormead near Buntingford, the Rev. J. S. ffoster Chamberlain, who have left our county. Although we thus lose our records from these localities, it is satisfactory to know that our former observers are still carrying on their investigations, and that the loss to our Society is a gain to science, for while Hertfordshire is very far in advance of any other county in the number of its observers of phenological phenomena, by this change two other counties, Bedfordshire and Lancashire, which before were unrepresented, now have observers who contribute their reports to the Meteorological Society. We have therefore to omit from our principal table showing the dates of flowering of plants, the two localities, Berkhamstead and Great Hormead. We have however a new observer at Royston, Mr. A. Kingston, so that this table now comprises returns from the following places:—Watford, St. Albans, Harpenden, Hoddesdon, Hertford, Ware (Fanhams Hall), Sawbridgeworth (High Wych), Odsey, and Royston.

Phenological observations have now been taken by members of our Society for the last seven years, and this year (1882) is the first in which the time of flowering of the whole of the 71 species of which records are desired has been noted. The species which has not before been observed is *Gentiana Amarella*, which was substituted some years ago for *Gentiana campestris*, a rarer species not so likely to be found in Hertfordshire.

Of these 71 species we observed 57 in the neighbourhood of Watford; 11 were observed near St. Albans by Mr. A. E. Gibbs; 56 at Harpenden by Mr. J. J. Willis; 15 at Hoddesdon by Miss Alice Warner; 63 in the neighbourhood of Hertford by Mr. R. T. Andrews; 23 at Fanhams Hall near Ware by Mr. R. B. Croft; 29 at High Wych near Sawbridgeworth by Miss Simpson; 20 at Odsey by Mr. H. George Fordham; and 36 at Royston by Mr. A. Kingston. These observations are recorded in the table on pp. 182, 183.

The observers contribute the following notes on the flowering of some of the plants:—

4. *Caltha palustris.* At Amwell and Hoddesdon 20th March, but owing to dryness of season specimens at Fanhams had not flowered at the end of the month.—R. B. C.

7. *Cardamine pratensis.* At Hoddesdon, 20th March.—R. B. C.

9. *Viola odorata.* Harpenden.—In profusion in open fields and

## Dates of Flowering of Plants observed in 1882.

| No. | Species. | Watford. | St. Albans. | Harpenden. | Hoddesdon. | Hertford. | Ware. | High Wych. | Odsey. | Royston. | Mean 1876–82. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | *Anemone nemorosa* | Mar. 12 | Mar. 18 | Mar. 11 | Feb. 21 | Feb. 24 | Mar. 10 | Mar. 13 | ..... | ..... | Mar. 13 |
| 2. | *Ranunculus Ficaria* | Jan. 12 | Feb. 19 | Feb. 25 | Jan. 22 | Jan. 19 | Feb. 14 | Feb. 20 | ..... | Mar. 1 | Feb. 22 |
| 3. | *Ranunculus acris* | ..... | ..... | Mar. 27 | ..... | Apl. 7 | Apl. 18 | Apl. 11 | ..... | ..... | Apr. 23 |
| 4. | *Caltha palustris* | Mar. 12 | ..... | Mar. 19 | Mar. 14 | Mar. 1 | ..... | Mar. 22 | ..... | Mar. 25 | Mar. 21 |
| 5. | *Papaver Rhœas* | May 21 | ..... | May 25 | ..... | May 18 | ..... | May 13 | May 19 | May 29 | May 29 |
| 6. | *Cardamine hirsuta* | Feb. 28 | ..... | Mar. 4 | ..... | Mar. 2 | ..... | ..... | ..... | Mar. 10 | Mar. 11 |
| 7. | *Cardamine pratensis* | Mar. 30 | ..... | Mar. 27 | ..... | Apl. 2 | Apl. 20 | Mar. 29 | ..... | Apl. 9 | Apl. 13 |
| 8. | *Draba verna* | ..... | Mar. 4 | Feb. 22 | ..... | Feb. 6 | ..... | ..... | ..... | Mar. 14 | Mar. 10 |
| 9. | *Viola odorata* | Jan. 1 | ..... | Jan. 8 | Mar. 15 | Jan. 23 | ..... | ..... | Feb. 27 | Feb. 20 | Feb. 17 |
| 10. | *Polygala vulgaris* | Apl. 14 | ..... | ..... | ..... | May 9 | ..... | ..... | Apl. 24 | May 1 | May 3 |
| 11. | *Lychnis Flos-cuculi* | May 24 | ..... | May 22 | ..... | May 4 | ..... | ..... | ..... | ..... | May 28 |
| 12. | *Stellaria Holostea* | Mar. 8 | Mar. 13 | Mar. 13 | Apl. 1 | Mar. 8 | Mar. 4 | Apl. 8 | ..... | Mar. 25 | Apl. 4 |
| 13. | *Malva sylvestris* | June 2 | ..... | May 27 | ..... | May 30 | ..... | May 31 | May 30 | ..... | June 5 |
| 14. | *Hypericum tetrapterum* | ..... | ..... | ..... | ..... | July 1 | ..... | ..... | ..... | ..... | July 4 |
| 15. | *Hypericum pulchrum* | July 2 | ..... | July 4 | ..... | July 1 | ..... | ..... | ..... | ..... | June 30 |
| 16. | *Geranium Robertianum* | Apl. 7 | ..... | Apl. 23 | ..... | Apl. 19 | Apl. 20 | Apl. 9 | May 7 | Apl. 30 | Apl. 27 |
| 17. | *Trifolium repens* | May 18 | ..... | Apl. 27 | ..... | May 8 | ..... | May 13 | ..... | ..... | May 17 |
| 18. | *Lotus corniculatus* | May 27 | ..... | May 27 | ..... | May 2 | ..... | May 16 | ..... | May 20 | May 20 |
| 19. | *Vicia Cracca* | June 17 | ..... | July 4 | ..... | June 7 | ..... | ..... | ..... | ..... | June 27 |
| 20. | *Vicia sepium* | Apl. 10 | ..... | ..... | ..... | Apl. 11 | Apl. 30 | May 12 | ..... | Apl. 24 | Apl. 30 |
| 21. | *Lathyrus pratensis* | June 4 | ..... | June 5 | ..... | May 24 | ..... | ..... | ..... | June 10 | June 3 |
| 22. | *Prunus spinosa* | Mar. 22 | Mar. 19 | Mar. 15 | Feb. 19 | Mar. 10 | Mar. 16 | May 19 | Feb. 18 | ..... | Mar. 22 |
| 23. | *Spiræa Ulmaria* | June 4 | ..... | June 5 | ..... | May 28 | ..... | ..... | ..... | June 22 | June 17 |
| 24. | *Potentilla anserina* | May 16 | ..... | May 16 | ..... | May 2 | Apl. 30 | May 17 | May 8 | May 8 | May 15 |
| 25. | *Potentilla Fragariastrum* | Jan. 22 | Mar. 4 | Jan. 23 | ..... | ..... | Mar. 10 | Mar. 11 | ..... | Mar. 6 | Mar. 4 |
| 26. | *Rosa canina* | June 2 | ..... | May 18 | ..... | May 20 | ..... | ..... | May 23 | May 20 | June 4 |
| 27. | *Epilobium hirsutum* | July 7 | ..... | July 9 | ..... | July 6 | ..... | ..... | ..... | ..... | July 9 |
| 28. | *Epilobium montanum* | June 17 | ..... | June 8 | ..... | June 1 | ..... | ..... | ..... | ..... | June 9 |
| 29. | *Angelica sylvestris* | ..... | ..... | ..... | ..... | July 24 | ..... | ..... | ..... | ..... | July 28 |
| 30. | *Anthriscus sylvestris* | Mar. 28 | ..... | Feb. 22 | ..... | Mar. 18 | Mar. 19 | Mar. 16 | Mar. 19 | ..... | Apl. 5 |
| 31. | *Hedera Helix* | Sept. 23 | ..... | ..... | ..... | ..... | ..... | ..... | Sept. 29 | ..... | Sept. 28 |
| 32. | *Galium Aparine* | May 14 | ..... | May 7 | ..... | May 9 | ..... | May 17 | May 8 | ..... | May 16 |
| 33. | *Galium verum* | ..... | ..... | June 30 | ..... | ..... | ..... | ..... | July 4 | June 30 | July 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 34. | *Dipsacus sylvestris* | ..... | ..... | ..... | ..... | July 24 | ..... | ..... | ..... | ..... | July 23 |
| 35. | *Scabiosa succisa* | ..... | ..... | July 6 | ..... | ..... | ..... | ..... | ..... | ..... | July 22 |
| 36. | *Petasites vulgaris* | Mar. 9 | Mar. 4 | ..... | ..... | Mar. 7 | ..... | ..... | ..... | ..... | Mar. 15 |
| 37. | *Tussilago Farfara* | Feb. 26 | ..... | Feb. 17 | ..... | Feb. 6 | Feb. 28 | ..... | Feb. 27 | Feb. 25 | Feb. 25 |
| 38. | *Achillea Millefolium* | June 14 | ..... | June 14 | ..... | June 3 | ..... | ..... | ..... | June 25 | June 24 |
| 39. | *Chrysanthemum Leucan.* | May 7 | ..... | May 5 | ..... | Apl. 17 | ..... | May 22 | ..... | May 7 | May 18 |
| 40. | *Artemisia vulgaris* | Aug. 6 | ..... | ..... | ..... | ..... | ..... | Aug. 5 | ..... | July 30 | Aug. 3 |
| 41. | *Senecio Jacobæa* | ..... | ..... | July 10 | ..... | June 25 | ..... | ..... | July 10 | June 24 | July 1 |
| 42. | *Centaurea nigra* | June 17 | ..... | June 27 | ..... | ..... | ..... | ..... | ..... | June 18 | June 21 |
| 43. | *Carduus lanceolatus* | June 11 | ..... | ..... | ..... | June 20 | ..... | ..... | ..... | ..... | June 16 |
| 44. | *Carduus arvensis* | June 24 | ..... | July 18 | ..... | June 20 | ..... | ..... | ..... | ..... | June 20 |
| 45. | *Sonchus arvensis* | July 15 | ..... | July 24 | ..... | July 6 | ..... | ..... | ..... | ..... | July 10 |
| 46. | *Hieracium Pilosella* | May 1 | ..... | Apl. 29 | ..... | Apl. 22 | ..... | ..... | ..... | May 18 | May 17 |
| 47. | *Campanula rotundifolia* | July 5 | ..... | July 6 | ..... | July 4 | ..... | ..... | ..... | July 9 | July 9 |
| 48. | *Gentiana Amarella* | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Aug. 20 | Aug. 20 |
| 49. | *Convolvulus sepium* | July 15 | ..... | July 30 | ..... | July 10 | ..... | ..... | ..... | July 10 | July 14 |
| 50. | *Symphytum officinale* | Apl. 9 | ..... | ..... | Apl. 21 | Apl. 16 | Apl. 22 | Apl. 19 | ..... | ..... | May 5 |
| 51. | *Pedicularis sylvatica* | ..... | ..... | ..... | ..... | May 2 | ..... | ..... | ..... | ..... | May 8 |
| 52. | *Veronica Chamædrys* | Mar. 12 | Mar. 13 | Mar. 13 | Apl. 21 | Apl. 7 | Apl. 30 | Apl. 9 | ..... | Apl. 18 | Apl. 22 |
| 53. | *Veronica hederifolia* | Jan. 15 | ..... | Feb. 22 | ..... | Feb. 6 | ..... | ..... | ..... | Mar. 1 | Feb. 9 |
| 54. | *Mentha aquatica* | July 30 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | July 30 |
| 55. | *Thymus Serpyllum* | ..... | ..... | July 19 | ..... | June 1 | ..... | ..... | ..... | June 8 | June 5 |
| 56. | *Prunella vulgaris* | June 17 | ..... | June 30 | ..... | June 20 | ..... | ..... | ..... | ..... | June 17 |
| 57. | *Nepeta Glechoma* | Mar. 19 | ..... | Mar. 19 | ..... | Mar. 13 | Mar. 14 | Mar. 18 | Mar. 19 | Mar. 26 | Mar. 26 |
| 58. | *Galeopsis Tetrahit* | ..... | ..... | July 31 | ..... | July 2 | ..... | ..... | ..... | June 29 | June 30 |
| 59. | *Stachys sylvatica* | June 2 | ..... | May 31 | ..... | May 31 | ..... | ..... | ..... | June 6 | June 6 |
| 60 | *Ajuga reptans* | Apl. 16 | ..... | Apl. 18 | ..... | Apl. 20 | ..... | Apl. 27 | ..... | ..... | May 1 |
| 61. | *Primula veris* | Mar. 12 | Apl. 2 | ..... | Mar. 15 | Mar. 13 | Mar. 12 | Mar. 15 | Mar. 10 | ..... | Mar. 17 |
| 62. | *Plantago lanceolata* | Apl. 1 | ..... | Apl. 9 | ..... | Apl. 3 | Apl. 11 | Apl. 10 | ..... | ..... | Apl. 21 |
| 63. | *Mercurialis perennis* | Jan. 23 | ..... | Jan. 14 | Jan. 1 | Feb. 4 | Jan. 15 | Jan. 25 | ..... | ..... | Feb. 19 |
| 64. | *Ulmus montana* | ..... | ..... | Feb. 22 | ..... | Mar. 6 | ..... | ..... | Feb. 22 | ..... | Mar. 2 |
| 65. | *Salix caprea* | Mar. 1 | Mar. 4 | Mar. 3 | Mar. 3 | Mar. 9 | Mar. 16 | Mar. 10 | ..... | ..... | Mar. 7 |
| 66. | *Corylus Avellana* | Jan. 23 | ..... | Jan. 30 | Jan. 13 | Jan. 5 | Jan. 13 | ..... | Jan. 15 | ..... | Feb. 1 |
| 67. | *Orchis maculata* | ..... | ..... | ..... | ..... | June 1 | ..... | ..... | ..... | May 29 | June 4 |
| 68. | *Iris Pseudacorus* | May 30 | ..... | May 30 | ..... | June 7 | ..... | ..... | ..... | ..... | June 3 |
| 69. | *Narcissus Pseudo-narcis.* | Mar. 1 | ..... | Mar. 5 | Mar. 3 | Feb. 26 | Feb. 28 | Feb. 14 | Feb. 26 | ..... | Mar. 6 |
| 70. | *Galanthus nivalis* | Jan. 13 | ..... | Jan. 15 | Jan. 7 | Jan. 2 | Jan. 19 | Jan. 9 | Jan. 13 | ..... | Jan. 23 |
| 71. | *Endymion nutans* | Apl. 1 | Apl. 2 | Mar. 28 | Apl. 1 | Mar. 20 | Mar. 25 | ..... | ..... | Apl. 16 | Apl. 15 |

has been for some time in flower in garden borders.—J. J. W. Hertford.—Abundant in my garden all the winter.—R. T. A.

20. *Vicia sepium.* Ware.—In valley 29th March.—R. B. C.

25. *Potentilla fragariastrum.* Hertford.—Has scarcely, if at all, left off flowering throughout the winter.—R. T. A.

63. *Mercurialis perennis.* Hertford.—A single flower on one raceme quite out 10th Jan.—R. T. A.

64. *Ulmus montana.* Hertford.—Very shy in flowering and not at all general, the cold winds having retarded it.—R. T. A.

65. *Salix Caprea.* In Sacombe woods and near High Cross, 11th March.—R. B. C.

66. *Corylus Avellana.* Hertford.—Partial until about the 18th. —R. T. A.

69. *Narcissus Pseudo-narcissus.* High Wych.—In garden.—S. S. In Dilly Wood near High Cross in profusion, 11th March.—R. B. C.

70. *Galanthus nivalis.* Hoddesdon. — In garden. — A. W. Hertford.—The garden variety was a week later.—R. T. A. High Wych.—In garden.—S. S.

EARLIEST DATES OF OBSERVATIONS OF INSECTS, BIRDS, ETC., IN 1882, WITH THE MEAN DATE FOR 1876–82.

| No. | SPECIES. | 1882. | MEAN. |
|---|---|---|---|
| 72. | *Melolontha vulgaris* (cock-chafer) appears | May 28 | May 30 |
| 73. | *Rhizotrogus solstitialis* (fern-chafer) ap. | ..... | June 6 |
| 74. | *Apis mellifica* (honey-bee) ap. | Feb. 4 | Jan. 31 |
| 75. | *Pieris Brassicæ* (large white butterfly) ap. | Apl. 12 | Apl. 14 |
| 76. | *Pieris Rapæ* (small white butterfly) ap. | Mar. 18 | Mar. 26 |
| 77. | *Epinephile Janira* (meadow-brown butterfly) ap. | June 14 | May 28 |
| 78. | *Bibio Marci* (St. Mark's-fly) ap. | ..... | Apl. 27 |
| 79. | *Trichocera hiemalis* (winter gnat) ap. | Dec. 27* | Jan. 4 |
| 80. | *Strix Aluco* (brown owl) hoots | ..... | Mar. 14 |
| 81. | *Muscicapa grisola* (spotted flycatcher) arrives | May 14 | May 19 |
| 82. | *Turdus musicus* (song-thrush) sings | Jan. 2 | Jan. 14 |
| 83. | *Turdus pilaris* (fieldfare) arrives | Nov. 3 | Nov. 6 |
| 84. | *Daulias Luscinia* (nightingale) sg. | Apl. 15 | Apl. 14 |
| 85. | *Saxicola Œnanthe* (wheatear) returns | ..... | ..... |
| 86. | *Phylloscopus Trochilus* (willow-wren) sg. | Apl. 10 | Mar. 27 |
| 87. | *Phylloscopus collybita* (chiff-chaff) sg. | Mar. 8 | Mar. 19 |
| 88. | *Alauda arvensis* (sky-lark) sg. | Jan. 2 | Jan. 19 |
| 89. | *Fringilla cœlebs* (chaffinch) sg. | ..... | Feb. 1 |
| 90. | *Corvus frugilegus* (rook) builds | Feb. 21 | Feb. 20 |
| 91. | *Cuculus canorus* (cuckoo) calls | Apl. 12 | Apl. 16 |
| | —— changes its note | June 4 | June 7 |
| 92. | *Hirundo rustica* (swallow) arrives | Apl. 9 | Apl. 14 |
| 93. | *Cypselus Apus* (swift) arrives | May 2 | May 4 |
| 94. | *Columba Turtur* (turtle-dove) coos | May 1 | May 4 |
| 95. | *Perdix cinerea* (partridge) hatches | ..... | June 19 |
| 96. | *Scolopax Rusticola* (woodcock) arrives | Oct. 14 | Oct. 26 |
| 97. | *Rana temporaria* (common frog) spawns | Mar. 5 | Mar. 15 |

* 1881.

In the table now given recording observations of insects and birds the same plan is followed as in the last report—the earliest dates in each instance are alone given, and for details Miss Ormerod's notes on the insects observed and Mr. Littleboy's notes on the birds should be referred to.

Frog-spawn was first seen at Redbourn Bury, St. Albans, on the 5th of March, at Hertford on the 9th, at Fanhams Hall, Ware, on the 15th, and at Harpenden on the 1st of April.

In the report for 1881 a table is given showing the mean dates of phenomena observed for the six years 1876–81. In the present report the means for the period 1876–82 are given in a supplementary column in the tables on pages 182–184. These dates are not all of the same value, for they are deduced from observations of from one year to seven. By referring, however, to the table on pp. 76, 77 of the present volume, the number of years of observation of any occurrence can be at once found, and the value of the mean determined in any instance.

Confining our remarks to the plants in the list it will be seen that by including the year 1882 the mean dates are materially altered, for in this year vegetation has been remarkably forward, especially in the spring. Of 38 species of plants observed in all the seven years, every one came into flower earlier in 1882 than the previous mean. Five species (*Ranunculus Ficaria*, *Viola odorata*, *Potentilla Fragariastrum*, *Anthriscus sylvestris*, and *Mercurialis perennis*) came into flower nearly two months before the previous mean date, and many opened their flowers about a month before the usual time. If the whole of the 48 species given on page 79 of the present volume are considered, it will be found that in 1882 on the average they came into flower 23 days before the previous mean; and by carrying the analysis further another fact will appear, namely, that from February to June there was a gradual diminution in the state of forwardness of vegetation. The 24 species for the spring months (February to April) were 31 days, while the 24 for the summer months (May to July) were only 15 days in advance of the previous mean. Taking each month singly, the gradual approach to a normal state of things is still more apparent. In February the period in advance is 36 days; in March, 29; in April, 27; in May, 22; in June, 12; and in July, 10. These results are in each instance deduced from the means of the group of eight species for each month given on page 79. Thus this very exceptional year has tended to confirm the rule pointed out in previous reports—the earlier in the year the greater the divergence in the state of vegetation from one year to another, the earliness or lateness becoming more or less lost in the summer months.

It should however be mentioned that the winter of 1881–82 was very mild, with a very humid atmosphere, and not much rain; and that the spring was exceptionally warm, with a humid atmosphere, a small amount of rain, not much cloud, and consequently a considerable duration of sunshine. The weather of the

winter and spring was therefore particularly favourable to the acceleration of the flowering of plants. The summer on the other hand was very cold, and, although as in the winter and spring, the atmosphere was humid and little rain fell, there was much cloudy weather and very little sunshine. It would therefore have a retarding effect upon the period of flowering.

The principal phenological feature of the year 1882 is thus seen to be the extremely forward state of vegetation in the spring, and especially in the early part of the spring. Plants were in flower at such exceptional dates that the actual date of first flowering was probably in many instances overlooked, so that the full extent of forwardness in this season may not be expressed in the table. Mr. R. T. Andrews truly remarks, in his return for April: "Observers must be unusually active this season as all plants are so early in flowering one scarcely can tell what to look for and what has already been found." In June, on the other hand, he says: "The difference of time between the flowering of plants this year and last has been entirely lost and the summer flowers are as last year." And in July Mr. J. J. Willis observes: "It is remarkable that whilst in spring and the first part of the summer plants were so much more forward in flowering than the average, most of those of July are considerably behind." This, however, which refers to Harpenden only, is scarcely borne out by observations from other localities, the earliest of which in most cases give dates for July rather earlier than the previous mean.

Not only were our wild flowers early in appearing in the spring, but they were also unusually abundant, and some were remarkable for the size of the flowers and the fullness and variety of colouring, white-coloured forms being particularly numerous. In the summer these features were lost. In December a few spring flowers reappeared, such as *Viola odorata*, *Potentilla fragariastrum*, *Mercurialis perennis*, and *Veronica hederifolia*, and also, more abundantly than usual, the primrose (*Primula vulgaris*), which has flowered rather freely through the winter of 1882–83.

In the spring, plants suffered much from blight (aphides), especially after the gale of the 29th of April, when the violent wind carried off the delicate blossoms and destroyed much of the tender foliage of such trees as were in a sufficiently advanced stage of growth to be affected by it, thus depriving them of the vigour necessary to withstand the attacks of insects.

Except aphides, and the larvæ of the winter-moth which also did considerable damage, insects were not so numerous as usual, but insect-presence need not be further referred to here, being treated of in another communication to the Society.

XXVI.

# NOTES ON INSECTS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1882.

By Eleanor A. Ormerod, F.M.S.

*Read at Watford, 20th March,* 1883.

I have now the pleasure again to lay before the Society some approach to a report of observations on insect life, made in the county by members during the past season, but I much regret that it is unavoidably very short from the small amount of available material in my hands. Mr. Silvester has been good enough to note some observations of interest, including a very practical one on turnip-fly; Mr. John Hopkinson also notes the great injury to foliage by the ravages of caterpillars; and a few records have been sent in of first appearances. I regret not to be able to add to this report from other sources, as all the notes I have received from contributors in the county which have been sent to me as matters of business, are not of course available; and the very interesting comparative report on insect-appearances in 1881 and 1882, by Mr. Willis of Harpenden, will be given by its author as a separate paper.

To proceed now with our report, Mr. Silvester says, with regard to turnip-fly: "I am glad to be able to report an entire immunity from the attack of turnip-fly this year in the swede crop. I attribute this to the genial weather at the time that the bulk of the crop was sown; germination and after-growth being of too rapid a character to render the young plants liable to injury. I was rather later in sowing white turnips than usual, owing to a protracted hay-time, and as a dry season set in after the seed was sown, the fly got too strong a hold on the crop, and only half a plant was the result." This note will be observed to be of sound practical use, for it draws attention to the way in which in suitable weather the plant outgrows the attack of the enemy, whilst in adverse circumstances, as the weakly plant cannot replace daily up to the amount the insect eats away, the crop necessarily suffers or perishes, and it thus confirms the observations of 1881 as to the importance of securing a good seed-time if possible, but at any rate by a good seed-bed, and all available agricultural measures to secure a state of things calculated to push on a good growth.

Mr. Silvester further mentions: "In July I sowed a patch of cabbage-seed, it all came up well, but on looking at it a few days afterwards I found that just half the bed had been destroyed." In this case the aggressor was not discovered, but it was doubtful whether slugs were not to blame; and further on at the end of the year Mr. Silvester mentions: "I am sorry to remark that the wheat is coming up very badly in some fields and the slugs are very busy destroying it in places."

Wireworm is mentioned as not having been at all destructive on

the observer's farm in the past season, with the following remark: "I am much inclined to think pests (bad as they are) are often credited with more damage than they do. If there is a yellow patch in barley or oats, wireworms are blamed for it, whereas a land-spring may exist there; or it may be that some special manure or mixing of soils is all that is necessary to make things right, and the patchy spot as fertile as the rest of the field."

One of the great insect-attacks of last summer was that of caterpillars on the leafage of various trees, and that Hertfordshire was not exempt was shown by a package kindly forwarded to me by Mr. Hopkinson, of such a variety of attacked leafage, which he had collected, that it might have served to illustrate the statement of the late Mr. Edward Newman, regarding the caterpillar of the winter-moth, that he "could not mention a tree the leaves of which it did not devour." As far as I am aware, the damage might for the most part be credited to those singularly destructive caterpillars—the larvæ of *Cheimatobia brumata*—but I could not undertake to say how many other kinds might also be present. The female of the winter-moth is remarkable for only possessing abortive wings; it therefore has to use its legs for progression, and consequently, if something it cannot cross be laid round the stem of the fruit-trees it attacks, these at least may be defended from it walking up their trunks to lay its eggs in the branches. Its common name is given to it from its appearance from the chrysalids in the ground taking place about the beginning of winter.

The following notes of first appearance of a few of the insects recommended for observation have been sent in by Mr. J. Hopkinson, Watford; Mrs. Arnold, Redbourn Bury, St. Albans; Mr. J. J. Willis, Harpenden; Mr. R. T. Andrews, Hertford; Miss Simpson, High Wych, Sawbridgeworth; and Mr. R. B. Croft, Fanhams Hall, Ware, for the respective localities.

*Melolontha vulgaris* (common cockchafer).—Watford, May 28.

*Apis mellifica* (honey-bee).—Watford, Feb. 4; Ware, Feb. 11*; Harpenden, Feb. 12; Hertford, Feb. 14; St. Albans, Feb. 26.

*Pieris Brassicæ* (large white cabbage-butterfly).—High Wych, Sawbridgeworth, April 12; Harpenden, April 21.

*Pieris Rapæ* (small white cabbage-butterfly).—Hertford, March, 18; Watford, April 6; St. Albans, April 8; Harpenden, April 16; Ware. April 21.

*Epinephile Janira* (meadow-brown butterfly).—Hertford, June 14; Watford, June 17.

*Trichocera hiemalis* (winter-gnat).—Watford, Dec. 27 (1881).

* Mr. Croft observes of the honey-bees that "owing to mildness of weather they have been seen at the mouths of hives nearly every day, but to-day (Feb. 11) they are out in numbers and at work."

XXVII.

# WINDSOR FOREST AND ITS FAMOUS TREES.

By the Rev. Canon Gee, D.D.

*Read at Watford, 16th January,* 1883.

(Abridged.)

Of course I understand that, in reading a paper before a Natural History Society, no information is strictly in place but such as will promote the study of Nature, whether followed out in the winter with our books at home, or pursued during the summer in the pleasant rambles of our Field Club. I have, however, for myself to-night (as on a former occasion) to ask permission to eke out my own slender acquaintance with natural history by working in such particulars of general history as may seem not unconnected with my subject.*

I will commence with Windsor Forest, as a forest, and attempt to lay out before you the extensive area which I have rashly proposed to consider. The difficulty, if you go back to early times, though not yet to the planting of its trees, is to know how to set bounds to that which was for ages boundless; at least in the sense of being unenclosed and without any visible boundaries. It is temptingly easy to suppose that in pre-historic times the whole tract of country south-west of the city of London was one large woodland or forest. I find it so laid down in some of the maps which profess to show us Roman, Saxon, and Norman Britain, as these races successively dealt with the land. Out of this wide tract were in time defined and recognised two woodland districts known to us as "Windsor Forest," in Berks, and the "New Forest," in Hants.

We are sure that William the Conqueror did not begin our forest. In the reign of Edward the First (say 200 years after the Conquest) an order was issued to the constable that he, with the assistance of the foresters and verderers, should sell the "old dead oaks" in the forest, and they hardly could have called for removal had they not seen the Saxon and Dane in the land; had they not, like Coplestine, Crewys, and Coplestane, all been "at hame when the Conqueror came." We take then Windsor Forest to have been the gradual appropriation and arrangement of all that woodland district, which stretches into Berkshire south and south-westwards of the Castle standing on the extreme east of the county. The River Thames is the boundary of the Castle domain on the east or north-east, and this river separates Bucks from Berks.

The present aspect of the forest dates from its surrender to the nation in that compact made about 1813, when commissioners, afterwards succeeded by the present Commissioners of Woods and

* The greater portion of the historical matter is omitted.—Ed.

Forests, became the landlords on behalf of the people. The Sovereign accepted a yearly sum, a civil list as we call it, in lieu of the old hereditary domains. I spare you the figures of the account in the transfer. It will be enough to specify that 1990 acres of land were then actually sold to pay compensations and expenses, and that £25,000 worth of timber was cut down and sold for the same purpose, that a certain area was reserved for the use of the Sovereign, and some 3000 acres were planted as timber-nurseries for the use of the nation, particularly as regards the navy. The forest then included eleven whole parishes and entered into six others. A modern history of Berkshire recites that the forest as Crown property still consists of 60,000 acres. This, if correct in any sense, must take in all the area through which the inclosures are scattered. We now reckon that the Little or Home Park consists of 500 acres, and the Great Park of 3,000 acres, and all enclosures of forest and park equal 14,000. Truly this is still a royal domain. An annalist of Windsor, however, thinks the arrangement of 1813–19 was the extinction of the forest. Seemingly an enclosed area ceases with him to be a forest. The forest of Windsor, therefore, he says, ceased to exist, though for convenience sake the name is given to the district south of the castle. So far as I have seen every portion of the forest is marked out now by some earth-mound and ditch if not by other fence, and if such demarcation destroy a forest, it must be confessed that the tourist will see little if any portion standing out wild and uninclosed; but there is no derivation of the word forest, whether from *foris* or *foresta*, which makes inclosure fatal to the idea. Professor Skeat, however, gives a quotation from Mediæval documents, showing that in those days the distinction between forest and park was understood to be that the one was uninclosed and the other inclosed.

I do not attempt to consider the tract geologically. It may be sufficient to say that it is not favoured as regards its soil. Large sums have every year to be spent on drainage, which scarcely appears to be remunerative. The greater portion of the forest is situated on the London Clay, a considerable area on the south is on the Bagshot Sand, while on the north a narrow strip of the clays and sands of the Reading Beds divides the London Clay from the Chalk on which the Castle stands. Where the clay predominates, the ground is very wet.

I could give many more topographical particulars if I thought that they would be useful and acceptable or even intelligible to those who are not acquainted with the locality. It may be more practical to inform an occasional visitor, such as I may suppose any of you to become next summer, how to find the forest or how to approach its nearest points. You would come to Windsor I suppose by either the Great Western or the South-Western Railway. If by the former you would see nothing with which I have to do until you stepped out into the High Street. If you came by the latter railway (the S.W.R.), you would skirt Datchet Mead, which now

forms a portion of the Little or Home Park; but, by whichever line you visit us, you have to go through the town to reach the park. Park Street is the extension of the High Street. Then when you enter at Park Gate you are at the beginning of the Long Walk. This is the largest avenue in Europe, and consists of elm-trees planted in the reign of Charles the Second, though the ground was not appropriated until the reign of Queen Anne. It was in the time of King Charles a common, and it is only within our times that the Prince Consort arranged an exchange by which a road to Datchet was closed, and all that side of the Castle became private ground. You may take note that a further avenue on your left, just seen through the Long-Walk elms, is that in which stood the famous tree, Herne's Oak.

A word on these Long-Walk elms. They are not quite so old nor so fine as those in Eton playing-fields. The Etonians were planted by Provost Rouse in the time of the Commonwealth, and the circumference of the largest is 18 feet, while that of the largest in the Long Walk is about 14 feet. Their present condition confirms the statement, which I believe I made on authority in a former paper,* that at 80 years an elm begins to decay; at about 200 or 250 years the insect specially infecting it, the elm-beetle, *Scolytus destructor*, has done his work. The tree has no deep tap roots—his roots are largely spread upon the surface, and the leverage of his full branches is immense. The wood appears to be brittle, and a heavy gale either snaps off a large limb or uproots the giant altogether. Our elms seem to be condemned. A few years ago the unexpected fall of one of their number killed a poor man sitting underneath, and since then a notice-board has warned all strangers that they sit at their own risk. The man's death has been amply avenged upon the trees, for, dating from that event, frequent removals have taken place. Not a winter passes but some three or four are executed. We look pityingly on, for the trees felled appear to an outsider to be as sound as they are grand, and they are necessarily replaced by striplings of the size of one's wrist, and the earliest to sit under the shade of such will be our grandchildren, if not our great-grandchildren. You must understand that there are two rows of trees on each side. The avenue is in that sense double and is 70 yards across from outside to outside. There were originally 1652 trees.

We have not yet reached even the Great Park; that is not entered until you arrive at the double gates. You are then supposed to be two miles from the Town Hall, and the park-ground assumes the wide-spread look of a large park. It is almost too large for pedestrians, for it takes so long to reach its beauties. If you have an hour or two to spare between the trains, it would be better to make for what we call the Crown Cottages and be content with Queen Anne's Drive. That is a charming avenue with grass between the trees, and a fair substitute for the Long Walk. In

* 'Trans. Watford Nat. Hist. Soc.,' Vol. II, p. 2.

either case you have to go through the park to get at the forest. There are grand trees in the park itself, especially on this second route; and there are, of course, charming residences within it.

I will now speak of individual trees; and I would divide or class them according to the question whether their claim to individual mention arises from their size and age or from their historical interest. In that splendid work published by a late deputy-surveyor, Mr. Menzies, the interesting trees are classed as "Veterans of the Forest," or as "Royal Trees." I shall follow something of this distinction. First, however, I would say a word or two as to the growth of trees, and of our trees in particular. It is one great interest of this park or forest that a record has been kept, at least for the last few years, of all planting. More than this, iron tablets have been placed near each plantation, so far as can be ascertained by retrospection, to inform the public of the date of its first beginnings. Our descendants will derive much information in this way as to the growth of different timber. One thing they will learn at once—that trees like children thrive differently, even under precisely the same circumstances; and, of course, very differently in different circumstances. A tree, for example, will grow very slowly in a cold clay soil. If I were to go to a dated plantation, and take the finest or the poorest tree, I should draw a very different conclusion according to which I made the measure of progress. But of course I have uniformly taken an average, but good specimen, a healthy, fair instance of what might be expected in the time that has elapsed. I find then that 60 years, dating say from the planting that followed upon the inclosure and new arrangement, is only sufficient to produce an oak four feet in circumference, or say 16 inches through or across. The growth of the oak is therefore very slow; and trees that measure 20 and 25 not to say 30 feet round may be allowed all the age with which they are credited. Mr. Menzies reckons that 15 years (*i.e.* as I understand, 15 consecutive rings) go to each inch of radius. This would give 540 years to a yard, and would make a tree six feet through and about 20 feet round (including bark and knots) to be just that age.

The whole character of a tree depends upon whether he stood at the first out in the open, or whether he were in his earliest days "cribb'd, cabined, and confined" by very close neighbours. I am inclined to think that a dense neighbourhood, such as leads the tree upwards for light and air, is very favourable for timber, otherwise the tree branches too soon. It is with regret that I find some of our largest oaks have a stem not exceeding five or six feet in height. This hardly seems the consequence of soil, as you find trees widely different in character standing within 100 yards of each other. Our tallest and best-grown oaks in this sense are at a place called "Cowpond," not far from Cumberland Lodge, and close to the rhododendron-walk. There is the oak which, perhaps, I should individualise as being at this present moment the best grown and in the best condition. It is about 70 feet high; it does not throw a branch (not counting twigs) until it reaches the height

of 40 feet; it is only 11 feet six inches in circumference, and its age is taken as about 175 years.

I may mention that a distinction is made by foresters between what they call a "Maiden" and what they designate a "Trained Tree." The former has never been moved. It stands where the acorn from which it sprang was first dropped. It also has never been browsed, or cut for food for the deer. This seems to be really the original meaning of the term "*Verte*" (rights of *Verte* and *Venison*), a cutting down of green branches for the deer in the winter. As the foresters' perquisite lay in the branches when browsed, the trees suffered sadly from wanton clipping. The latter, the trained tree, was reared somewhere else. It began life in some nursery, and then, at a suitable age, by a careful selection, was brought out and planted in its present place. It follows that while the interest of the maiden-tree is greater, the growth and size of the promoted tree are more developed. The greatest height which Mr. Menzies claims for a maiden-oak is 65 feet, while the height of a young oak which is I believe a trained tree is 100 feet.

I shall confine myself in this paper almost entirely to oaks, so I will just say here of other trees that they are to be found also in the forest and park. The beeches are very fine, and are only less interesting than the oaks. I was myself surprised to hear the very full age claimed for the beech. Admiring one beech which seemed to me in the very prime and vigour of its existence, I asked the deputy-surveyor what he considered to be the age of that tree, and he said "400 years." Then, appealing to the woodward who was following but had not heard the surveyor's figures, he received an exact confirmation of his estimate. In Mr. Menzies' book an old pollard beech is reckoned to be of the age of nearly 1000 years. This tree, though now only a shell, does not think of dying in our time. The top is vigorous, and it has hopes of seeing its 1000th birthday. There is another beech in the forest which boasts to have branches 100 feet in height.

I hardly know whether I shall reckon among the royal trees, or simply among the veterans of the forest, a tree that goes by the name of the Conqueror's Oak. Well; it is so complete a wreck that we will treat it simply as a veteran. It stands near Cranbourne Tower, and at present within an inclosure, but there is a talk of moving the fence that the public may admire, or, I may say, discover the grand old tree. I cannot find any pretence of a legend which connects it with the Conqueror. It may well have stood in his reign, and so may some others that are with us, but only as relics of their former selves. It is 37 feet in circumference, but one half of the tree is dead. The noteworthy fact is that the bark has turned and wound round the other half, as if Nature, despairing of preserving the whole of the trunk, had evacuated one half and intrenched herself in the other. This portion is quite alive, being nourished by the full embrace of the rind, and is sending out healthy shoots which have promise of leaves and branches for next year. Not far from this tree stands the largest trunk that I know,

and I am informed that there is no larger in the forest. It is, I may say, of course, a "pollard," for the pollard trees seem to go into bulk as height is denied them. I can measure this tree so as to get quite forty feet in circumference, but it is very knotty and very irregular in growth. It is hollow, and may well be allowed its 800 or 900 years of existence. I may here remark in connection with this tree that I have some doubts, when contemplating these huge wrecks, whether they are really one single tree. I remember when in Switzerland going some miles to see the great lime-tree of a village a few miles from Morat, the Burgundian battle-field. I came away with an impression that I had seen five lime-trees! I doubted whether if the wood were cut through there would not have been found five centres. Trees that grow naturally do grow sometimes into each other. In our forest we know what are called twin-trees. These may sometimes be even of different kinds. I know an oak and a beech which not only associate their branches but almost coalesce at the stems. The explanation is that a fruitful acorn and a beech-mast happened to drop into the same hole, and their produce had to adjust themselves to circumstances and share a spot out of which neither could prevail to thrust the other.

Near a gate known as the Forest Gate, just outside the Park, stands a tree which may be taken as an example of the intermediate condition of an oak, when it is no longer sound but has not begun to be a wreck. It is, say, in the 600th year of its life, answering to that age of man which we kindly call middle age, but as that means about 50 years generally, and no one reckons on having a hundred years, the term is somewhat indulgent. This Forest Gate tree is in circumference 27ft., or even 28ft., according to where you take the measurement. It is low in its branches, and altogether a good specimen of a Windsor Forest oak.

If you want to complete the gradations and to find an oak of considerable age, with the character of a veteran, but of undiminished health and undecayed bulk, you must come into the Home Park, and there, in the avenue known as Queen Elizabeth's, you find a tree, the bulk of which you do not realize until you come up to it. Then you find that it is 30ft. in circumference. It is a most interesting mass of solid timber. A limb has been torn from it by some storm or stroke, and the gardener showed me how sound was the wood where the amputation had taken place. It is not an elegant tree by any means, and throws out a real limb not more than 4ft. from the ground. It is interesting to know that this tree comes under the almost daily observation of her Majesty when in Windsor. It stands on the Royal road (a private drive) to Frogmore, where is built the mausoleum so dear to the Royal widow. Not far from this tree is another, called the Shakespeare Oak. One would like to think that the great poet had some particular connection with the tree. We know that he was well acquainted with the town. He laid here the scene of one of his plays, and gave it the local colouring which would imply

local knowledge. He must have seen it, for it is not far from the spot of Falstaff's latest disaster, or at least defeat.

I may now, with reference to the introduction of Royalty, mention what are known in our forest as the Royal trees. There are four such. They are regularly so assigned. Each has an iron tablet indicating the Queen—for they are all queenly—under whose name at least they still flourish. These are Queen Anne's, Queen Charlotte's, Queen Adelaide's, and Queen Victoria's trees. I wish I could find some authentic account of the special interest taken by the two first-named Queens in their protegés. I am not honestly possessed of such information. The trees are older than even Queen Anne. The most we can assert is that "Great Anna" or "Good Charlotte" may have specially admired these trees, and that in their time a clearing was made round them and honour paid to them. The times of Queen Adelaide and Queen Victoria are so recent that we can easily understand that particular trees were not assigned to them without their cognizance, or labelled as such without their permission. Three of the four trees are oaks, and her present Majesty has shown her judgment in selecting the tree that bears her name. It is a magnificently-grown tree, and has a stem like the mast of a ship. It runs up some 35 feet before throwing out its branches, and, as it now measures only 12 feet in circumference, has we hope a far future before it. Perhaps her Majesty purposely chose a young tree. Queen Charlotte's is 17 feet and Queen Anne's all but the same measurement. Queen Adelaide's tree is a beech; not to compare, as a timber-tree, with some other beeches in the same neighbourhood. It was obviously chosen for the sake of the view from the spot. On a clear day there is a charming picture presented of the Castle. You see its west inclosure rising before you with all the outline of a mediæval fortress, and on that side there are the oldest masonry and the earliest outlines. I may mention, to save disappointment, that not one of these trees is discoverable by a stranger, and only one of them stands in a legitimately-accessible locality. A lover of famous trees will have to make love to a keeper if he wish to be introduced to them.

There is another tree connected with that gentle lady, Queen Adelaide, which I should like to make known to you. It is called Luther's beech, and it is a child of the original beech at Altenstein, in Saxe-Meiningen, under which Luther was seized by a friendly arrest and conveyed to the Castle of Wartzburg. This tree was seemingly very dear to Queen Adelaide. King William the Fourth brought it from Germany. It was for some time planted in Bushey Park while that was her home. It was removed with her to Windsor, and has found its abiding location close to her own particular little settlement called Queen Adelaide's Cottage, having been bequeathed by will with a request to that effect. It has an iron tablet describing its kind, and relating the extraction or origin which gives it interest. The original tree at Altenstein was destroyed by lightning in 1841.

But Royal trees are common in Windsor. The ground round the Mausoleum is full of them. Every tree there has an illustrious patron and planter. The practice is kept up. There are some oaks planted in 1882 by Princess Christian's daughters, and there is one tree mournfully dear to the present Royal house as planted by her Majesty herself on the edge of the Flemish Farm at the spot where the Prince Consort ended his last day's shooting. The photograph representing that ceremony is noteworthy as being the first representation of the Princess of Wales taking any part in a transaction on English ground.

Before leaving the oaks I may mention that it is a doubted point whether any mistletoe has ever been found upon them. It seems established that the oak is, with all respect for the Druids and their golden sickle, the tree to which the mistletoe takes least kindly. London is supplied, as regards its kitchens and staircases, at Christmas, chiefly from Normandy; but in Herefordshire, where the mistletoe attracts your eye, even as you pass in the railway through the apple-orchards, there is next to none on the oak-trees. Only two instances are known in the whole county, and only six in all England have been traced by intelligent botanists. Where it is found on an oak, mistletoe has a more delicate appearance than when on other trees, with pensile leaves, as if the tonic flavour of its strong juices were hardly digestible.

I feel that though my paper almost limits me to trees, I may to a Natural History Society say something about the fauna of the forest, or rather its introduced inhabitants, the deer, herons, and wild boars. Yes, wild boars! They exist now in the Great Park, but are confined within a small enclosure of 18 acres. They are more recent than myself in their residence in Windsor. They are a present from the Prince of Wales to her Majesty, and were collected by him during his Indian and other journeys. Some are Indian, and some, I believe, are of German extraction. They are now 23 in number, including sows and pigs. I do not myself consider them impressive as specimens of the Pachydermata. The fact is that by breeding and feeding we have so increased the size of the wild animal, that the original ancestor does not seem very large when compared with his really degenerate descendant. This is very noticeable when you see the wild cattle of Chillingham or Cadzow. There is a specimen in the British Museum of the early English *Bos*, which would look very small by the side of a prize bull. The interest in visiting the boars in our park is to observe what is their power of turning up the ground when left to do this at their own sweet will. They are shot when their life has run its prescribed length, and her Majesty at Osborne has had boar's head at her Christmas table which was more nearly like that supplied to the Plantagenet Princes than is generally supposed to be the case.

Of course there are herds of deer in the park. I am told that there are 1600 head of fallow-deer maintained, besides 150 red-deer and 15 white harts. Many more persons than we have generally any notion of are entitled by precedent or long usage to venison

from the park. Some of these claims are in compensation of old rights of sport or of way in the royal domains. Visitors who see the number of deer that are sometimes grouped together will be surprised to hear that they are scarcely sufficient to supply all demands. The head-keeper, I am told, some time ago lamented that he had warrants for twelve more bucks than his herds would fairly afford. The deer, you see, are of both kinds or of all kinds. There are the pretty, small, dappled deer with some white among them, and there are the stately red-deer. As a frequenter of the park I observe very sociable habits among the two different sorts. You may see the red-deer mixed up with the others, though in James the First's time they were carefully assigned to different rides. It is grand and not quite safe in October to come upon a red stag that has not been successful in his wooing. He stalks about with the resentment of one whose advances have been rudely declined or whose claims have been brutally overpowered by one stronger, though as he thinks not handsomer than himself. There are notice-boards warning strangers of the danger of coming too near to a big stag which has been crossed in love. The deer now are in every sense of the word confined to the park, but there was a time when they ranged through the forest.

There is also a heronry. I look forward in the summer to making the acquaintance of the herons. At present I know nothing of them, and for this reason: they have moved their establishment. They did live near the sandpit-gate and in the open park, but they disapproved of the Prince Consort's workshops built somewhat near their abode. They determined to pack up and go. Happily the love of the old spot prevailed. They went no further off than Virginia Water, no doubt attracted by the fishing privileges. There they have formed on the north side an airy domicile, and there I hope they may long continue to flourish.

I should be sorry, in a paper upon Windsor Forest, to appear to be altogether unacquainted with one English classic that has immortalized the name to some. I mean Pope's poem with this very title, "Windsor Forest." You know how it begins:

> "Thy forest, Windsor, and thy green retreats,
> At once the monarch's and the muses' seats."

It has but little—may I say it with all reverence—to interest the student of natural history. It might be written about any other forest as regards the local colouring of the woods and trees. It is something like Thomson's "Seasons." It deals with matters on so large a scale that it hardly affords information to those who now examine natural objects more minutely. If the account I have read of its composition be true, the poem is not likely to add much to our knowledge of the immediate neighbourhood of Windsor. It was written when Pope was only 14 years of age, and when he was living at Binfield, some ten miles from Windsor, and the health and strength and habits of the poet were not such as to qualify him in any way to be a forester. He has some grand and

often-quoted verses upon the castle and its history, and he introduces those lines upon the rivers of England which give a descriptive notice of many a southern stream. He well associates the forest with the navy, and tells us how the water is waiting for the growth of the land:

> "Thy trees, fair Windsor! now shall leave their woods,
> And half thy forest rush into the floods."

Then he traces the voyage of the ship-shaped timber into different regions. He sees them as far off as Mexico, then returns to close his song with a reference, I understand, to the early date of this particular poem:

> "Enough for me that to the listening swains
> First in these fields, I sung the sylvan strains."

He could scarcely have meant that he was the first English poet to celebrate Windsor Forest.

Pope's mention of rivers entitles me, I think, to account for the absence of all reference to streams or streamlets in this paper. Windsor Forest is by some considered to be situated "in a bend of the Thames," but it is not now, as a forest, traversed by any stream. The river is its boundary rather than its fertiliser or occupant. There are famous river spots, however, in our close neighbourhood, and Denham, of Cooper's-hill, just outside the Park, in his poem, does justice to the historical association of the river and forest. I am always aghast at his description of the Thames. Its behaviour must have been different in his day from its demeanour in ours. Any one who, within the last few weeks, has seen the Thames rushing through Windsor Bridge like the Danube, and has looked over the Eton playing-fields and the Brocas and the Clewer fields all under water, would scarcely have written of the Thames,

> "Oh could I flow like thee and make thy stream,
> My great example as it is my theme;
> Though deep yet clear, though gentle yet not dull,
> Strong without rage, without o'er-flowing full."

But Sir G. Denham makes full mention how the forest comes down to the very banks of the Thames, and recognises Runnymede as within its boundaries. That is the meadow perhaps so called from Rune, or Council, where, according to Matthew of Westminster, before King John's time, men used to meet to decide their differences. It is just beyond Old Windsor, and is now, I expect, more or less under water. Certainly the Barons must have found it damp even on the 15th of June, 1215, and I should hardly form any plan for walking or driving which involved my crossing it at the time I am now writing. Charles Knight calls it our Marathon, and its situation and natural interest will excuse its introduction even to a Natural History Society. Denham enables me to give it a forestal allusion. Speaking of hunting over this ground, he says:

> "This a more innocent and happy chase
> Than when of old but in the self-same place,
> Fair liberty pursued and meant a prey
> To lawless power, here turned and stood at bay."

One more poet and I have done. Shelley—Percy Bysshe Shelley—according to his wife's memoir, in the summer of 1815, after his return from Devonshire and Clifton, rented a house at Bishopsgate, or more likely at Parkside, just beyond the palings of the Great Park. "Here," she says, "he enjoyed several months of comparative health and tranquil happiness. He spent his days under the oak shades of Windsor Great Park, and the magnificent woodland was a fitting study to inspire the various descriptions of forest-scenery we find in the poem of 'Alastor,' written at this time." Charles Knight takes the following extract from the poem:

"More dark
And dark the shades accumulate. The oak
Expanding its immense and knotty arms
Embraces the light beech. The pyramids
Of the tall cedar, over-reaching, frame
Mausoleum domes within; and, far below,
Like clouds suspended in an emerald sky,
The ash and the acacia floating hang
Tremulous and pale."

And now, at the end of this paper, having had frequent occasion to speak of Royalty, let me conclude with a few words on Commonalty. There is no place in the kingdom where the institution called a Bank Holiday is better known than at Windsor. The 'Times' newspaper informs us how on a Whit-Monday some 8,000 persons pass through the State Apartments. Should the day be fine, some even of these thousands pass into the park. Some hundreds, availing themselves of the railway, penetrate to the forest and Virginia Water. I am happy to be able to report that they are welcomed in both park and forest, and that there is a very kindly feeling as to their presence. Those who know the beauties of the inclosure surrounding Virginia Water—"dense masses of pine," says the guide book—and the real excellence of some specimens of the Pinus tribe there growing, may form an idea what an outing a jaded city clerk may have, weather permitting, in this right royal domain. The greater number of our visitors do not get beyond the Long Walk. It is sufficient pleasure to them, once a year, to lie at full length on the green grass, and see, as far as the eye can reach, an endless vista of tall trees. If it should so happen (and it frequently has before now) that her Majesty is in residence, and they can say, as the simple carriage passes, with its grey ponies and its one outrider, "We have been to Windsor and we have seen the Queen," then they go back quite happy and somewhat proud. We could wish that they would take their sandwich-papers back with them. It is astounding to see the next day the way in which the ground is strewn with their relics—you would think the penny newspapers could not furnish the wherewithal; but the day after that they are all removed, and no trace remains of the crowds upon whose heads you might almost walk as they go up our hill and past my house. This, I think, entitles me to claim that, on the utilitarian principle of Mr. Jeremiah Bentham—"the greatest happiness to the greatest number"

—you could do nothing with these domains that would be more to the enjoyment of the nation at large than is afforded by their present state. They belong literally to all of us. Sir R. Walpole is reported to have been interrogated by George the First as to what it would cost to make St. James's Park a turnip-field, turnips being then a new acquisition as a green crop. He replied, "Only three Crowns, your Majesty,"—so deeply would the country have resented its historical play-ground in London being interfered with. And we may confidently declare that there are no waste lands in this country in the pleasure-lands. There is nothing you could do with them that would not be a national loss. I may put it to you that it would be a loss to all Watford if Cassiobury Park were cut up for trim villas or laid out with snug cottages. What we want is that intelligent education of the people at large which may incline them to be satisfied with simple pleasures.

I will not press you with the hackneyed line of the indoors-poet Cowper, who in the "Sofa" and the "Task" wrote:

> "God made the country and man made the town."

But you will be tolerant and perhaps interested if I close with the following passage from the facetious Sydney Smith. It will be a surprise to you, probably, as showing how much more depth of feeling a man has than he is credited with. It has also a very natural-history flavour or tone, though I have taken upon me to accommodate an expression or two. "There is a moral as well as bodily wholesomeness in a [country] walk if the walker has the understanding heart and eschews picnics! It is good for a man to be alone with Nature and himself; or with a friend who knows when silence is more sociable than talk,

> 'In the wilderness above
> There where Nature worships God.'

It is well to be in places where man is little, and God is great; where what he sees around him has the same look it wore a thousand years ago, and will have the same look most likely when he shall have been a thousand years in his grave. It abates and rectifies a man, if he be worth the process. In cities, all is human policy, human foresight, human power. Nothing reminds us of invisible dominion and concealed omnipotence. It is all earth and no heaven. One cure of this is the [forest] and the solitary place. As the body harassed with the noxious air of towns seeks relief in the freedom and purity of the fields and hills, so the mind, wearied by commerce with men, resumes its vigour in solitude and restores its tone by looking up from Nature unto Nature's God."

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XXVIII.

# METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE, WATFORD, DURING THE YEAR 1882.

By John Hopkinson, F.L.S., F.M.S., etc., Hon. Sec.

*Read at Watford, 20th March*, 1883.

Longitude of station, 0° 23′ 40″ W.; Latitude, 51° 39′ 45″ N. Ground-level at thermometer-stand and rain-gauge 223 feet, and cistern of barometer 233½ feet, above Ordnance Datum. Barometer, a Fortin. Thermometers, dry-bulb, wet-bulb, Negretti maximum, and Rutherford minimum, 4 feet above the ground in a Stevenson screen, over grass. Rain-gauge, Snowdon pattern, 5 inches in diameter, rim 1 foot above the ground. Wind-vane about 25 feet above the ground, 4 feet above ridge of roof of stable, and 105 feet distant from nearest object of equal height.

Observations have been taken in 1882 in the same manner as in previous years,* and the accompanying tables (pp. 202, 203) give, as in previous reports, the monthly means of the daily observations, and other results. From these tables (for Dec. 1881 from the report for that year) the following summary for the different seasons is deduced, results for Greenwich Observatory being added for comparison as before.

Watford.

| Seasons, 1881–82. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | in. | % | ins. |
| Winter | 30·195 | 39·3 | 10·2 | ·219 | 92 | 7·17 |
| Spring | 29·953 | 49·2 | 17·6 | ·272 | 77 | 6·88 |
| Summer | 29·892 | 58·6 | 15·2 | ·390 | 78 | 8·20 |
| Autumn | 29·797 | 48·7 | 14·0 | ·305 | 87 | 11·72 |

Greenwich.

| Seasons, 1881–82. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | ins. | % | ins. |
| Winter | 30·198 | 40·7 | 9·9 | ·226 | 89 | 5·04 |
| Spring | 29·948 | 49·5 | 19·1 | ·282 | 80 | 4·91 |
| Summer | 29·897 | 58·8 | 18·3 | ·394 | 79 | 5·97 |
| Autumn | 29·798 | 49·5 | 13·5 | ·307 | 86 | 10·01 |

* See 'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 217, and Vol. II, p. 209; also 'Trans. Herts Nat. Hist. Soc.,' Vol. I, p. 121.

## Results of Meteorological Observations taken at Wansford House, Watford, in 1882.

| Months. | Pressure of the Atmosphere. | Temperature of the Air. | | | | | | | | | | Humidity of the air. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 9 a.m. | Means of | | Adopted Mean. | Mean Daily Range. | Absolute Min. and Max. | | | | Absolute Range. | Dryness. | Tension of Vapour. | Relative Humidity. |
| | | | Min. | Max. | | | Min. | Date. | Max. | Date. | | | | |
| | ins. | ° | ° | ° | ° | ° | ° | | ° | | ° | ° | in. | % |
| January | 30·373 | 39·2 | 34·8 | 44·3 | 39·4 | 9·5 | 23·2 | 25th | 51·4 | 6th | 28·2 | 2·1 | ·221 | 92 |
| February | 30·230 | 39·7 | 35·2 | 46·4 | 40·4 | 11·2 | 22·2 | 2nd | 57·1 | 25th | 34·9 | 2·2 | ·223 | 91 |
| March | 30·003 | 44·5 | 36·5 | 54·2 | 45·1 | 17·7 | 29·3 | 23rd | 65·5 | 17th | 36·2 | 5·1 | ·241 | 82 |
| April | 29·806 | 48·5 | 40·1 | 55·9 | 48·2 | 15·8 | 31·3 | 16th | 67·7 | 21st | 36·4 | 6·5 | ·267 | 79 |
| May | 30·051 | 55·3 | 44·2 | 63·4 | 54·3 | 19·2 | 33·0 | 17th | 69·3 | 22nd | 36·3 | 9·6 | ·307 | 71 |
| June | 29·898 | 57·0 | 48·6 | 63·4 | 56·3 | 14·8 | 39·7 | 17th | 70·3 | 27th | 30·6 | 7·5 | ·354 | 76 |
| July | 29·861 | 60·0 | 52·5 | 67·9 | 60·1 | 15·4 | 45·9 | 10th | 77·0 | 27th | 31·1 | 6·7 | ·408 | 79 |
| August | 29·918 | 59·8 | 51·5 | 66·8 | 59·4 | 15·3 | 42·4 | 31st | 77·9 | 12th | 35·5 | 6·5 | ·408 | 79 |
| September | 29·849 | 54·2 | 45·2 | 62·8 | 54·1 | 17·6 | 33·8 | 15th | 67·9 | 17th | 34·1 | 4·0 | ·364 | 86 |
| October | 29·836 | 49·8 | 43·2 | 56·1 | 49·7 | 12·9 | 30·0 | 26th | 68·1 | 1st | 38·1 | 2·7 | ·324 | 91 |
| November | 29·706 | 42·0 | 36·9 | 48·3 | 42·4 | 11·4 | 21·9 | 18th | 60·8 | 3rd | 38·9 | 4·2 | ·227 | 85 |
| December | 29·651 | 38·0 | 33·6 | 43·5 | 38·4 | 9·9 | 15·2 | 11th | 59·1 | 26th | 43·9 | 1·9 | ·213 | 93 |
| Year | 29·932 | 49·0 | 41·9 | 56·1 | 49·0 | 14·2 | 15·2 | Dec. 11 | 77·9 | Aug. 12 | 62·7 | 4·9 | ·297 | 84 |

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE, WATFORD, IN 1882—(*continued*).

| Months. | Rainfall. | | | | | Cloud. | | | Wind. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Fall. | Max. fall in 24 hours. | | No. of days of | | Mean Amount 0–10. | No. of days of | | Mean Force 0–12. | Number of days of | | | | | | | | |
| | Ins. | Ins. | Date. | Rain or Snow. | Snow only. | | Clear Sky. | Over-cast. | | N. | N.E. | E. | S.E. | S. | S.W. | W. | N.W. | Calm. |
| January | 1·55 | ·50 | 8th | 10 | 0 | 7·9 | 3 | 20 | 1·6 | 1 | 0 | 2 | 2 | 6 | 7 | 5 | 3 | 5 |
| February | 1·62 | ·61 | 28th | 11 | 0 | 7·4 | 3 | 15 | 1·9 | 2 | 1 | 2 | 3 | 4 | 6 | 5 | 3 | 2 |
| March | 1·59 | ·65 | 25th | 15 | 3 | 5·2 | 10 | 8 | 2·2 | 2 | 1 | 1 | 0 | 6 | 8 | 6 | 3 | 4 |
| April | 3·47 | ·87 | 25th | 15 | 0 | 5·5 | 4 | 10 | 2·4 | 1 | 5 | 4 | 5 | 5 | 6 | 3 | 1 | 0 |
| May | 1·82 | ·62 | 5th | 11 | 0 | 5·8 | 7 | 7 | 1·9 | 2 | 7 | 4 | 3 | 3 | 7 | 1 | 3 | 1 |
| June | 4·02 | ·80 | 26th | 20 | 0 | 8·3 | 0 | 15 | 2·1 | 1 | 2 | 3 | 2 | 2 | 9 | 5 | 5 | 1 |
| July | 2·39 | ·38 | 11th | 23 | 0 | 7·4 | 2 | 12 | 1·8 | 2 | 2 | 0 | 4 | 6 | 12 | 1 | 3 | 1 |
| August | 1·79 | ·37 | 22nd | 13 | 0 | 7·9 | 2 | 14 | 1·9 | 2 | 3 | 0 | 3 | 2 | 7 | 6 | 5 | 3 |
| September | 2·33 | ·76 | 19th | 14 | 0 | 5·5 | 7 | 10 | 1·8 | 4 | 7 | 2 | 3 | 1 | 5 | 1 | 3 | 4 |
| October | 6·10 | ·86 | 27th | 24 | 1 | 7·1 | 3 | 15 | 1·8 | 3 | 5 | 3 | 4 | 2 | 6 | 2 | 3 | 3 |
| November | 3·29 | ·60 | 15th | 21 | 2 | 5·8 | 6 | 8 | 2·8 | 3 | 3 | 0 | 1 | 2 | 10 | 7 | 3 | 1 |
| December | 3·60 | ·75 | 30th | 22 | 4 | 7·6 | 3 | 18 | 1·9 | 2 | 1 | 3 | 4 | 4 | 6 | 5 | 4 | 2 |
| Year | 33·57 | ·87 | Apl. 25 | 199 | 10 | 6·8 | 50 | 152 | 2·0 | 25 | 37 | 24 | 34 | 43 | 89 | 47 | 39 | 27 |

In the year 1882 the atmosphere was warm, dull, humid, and windy. The rainfall was about the average of the previous six years and therefore much in excess of the mean for a long period, and the number of days on which rain fell was unusually large. The extreme range of temperature was less than it has been in recent years, the lowest minimum recorded being considerably higher than in any of the previous four years, and the highest maximum being lower than in any of these years except 1879; the mean range of temperature was however about the average. The mean pressure of the atmosphere was below the average, but on more than one occasion the pressure was very high, and once (18th Jan.) higher than it has ever before been recorded in England, very nearly reaching 31 ins.*; there was no exceptionally low pressure, so that the mean range was not very great. The force of the wind was on the whole greater than usual; south-westerly winds were more than usually prevalent, and north-easterly winds were less frequent than usual.

Compared with the previous year, in 1882 the mean temperature was 1° higher, the relative humidity 4 per cent. greater, and the rainfall more than 3 inches heavier. Rain (or snow) fell on 14 days more in 1882 than in 1881, and snow (only) on 14 days less. The sky was more frequently completely overcast and less frequently clear of cloud. The estimated force of the wind was the same in both years. The greatest difference between the two years is perhaps in the extreme range of temperature, which in 1881 was 85°·3 and in 1882 only 62°·7.

In the winter of 1881-82 (Dec. to Feb.) the mean pressure of the atmosphere and mean temperature were unusually high, the relative humidity was great, and the rainfall rather above the average; except on one day in December no snow fell. In the spring (March to May) the mean pressure was about the average, the mean temperature and relative humidity were rather above it, and the rainfall was about the average and less than in any other season of the year. In the summer (June to August) the mean pressure was low, the mean temperature much below the average, and the relative humidity and rainfall were rather above it. In the autumn (Sept. to Nov.) the mean pressure was unusually low, the mean temperature and relative humidity were about the average, and the rainfall was much above it, and considerably heavier than in any other season of the year.

In the following notes the general character of the weather in each month, and its principal changes, are briefly referred to.

January.—Very mild, with a calm and humid atmosphere, much cloud and fog, but little rain, and no snow; the first mild January since 1878. The difference in temperature between this and the

* At St. Leonard's a height of 30·990 ins. was recorded on this date, being one hundredth of an inch higher than at Watford. Although this is the highest reading on record for England, it was exceeded by six hundredths of an inch in January, 1820, at three localities in Scotland. See "Quart. Journ. Meteorological Soc.," vol. viii (N.S.), p. 153.

previous January was very great, the mean being more than 10° higher in 1882 than in 1881, and the mean max. of 1882 being being only 0°·3 lower than the mean min. of 1881.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1882 | 9 a.m. | 39°·2 | Mean Min. | 34°·8 | Mean Max. | 44°·3 | Mean | 39°·4 |
| 1881 | ,, | 28 ·4 | ,, | 24 ·1 | ,, | 35 ·1 | ,, | 29 ·2 |
| Difference | ,, | 10 ·8 | ,, | 10 ·7 | ,, | 9 ·2 | ,, | 10 ·2 |

There were no great variations in temperature during the month. Max. above 42° on 21 days (an unusually large number for January); min. below 32° on 8 (a very small number). From 12th to 26th inclusive (15 days) no rain fell, and during the whole of this period the pressure of the atmosphere was very high; it was also marked by much fog, a sky almost completely overcast, and little or no wind. The following are the barometer-readings * at 9 a.m.:—

| | ins. | | ins. | | ins. |
|---|---|---|---|---|---|
| 12th | 30·414 | 17th | 30·948 | 22nd | 30·649 |
| 13th | ·445 | 18th | ·980 | 23rd | ·577 |
| 14th | ·565 | 19th | ·929 | 24th | ·718 |
| 15th | ·716 | 20th | ·776 | 25th | ·749 |
| 16th | ·857 | 21st | ·745 | 26th | ·600 |

The barometric pressure on the 18th, as already mentioned, is the greatest which has ever been recorded in England, and the mean for the entire month is exceptionally high.

FEBRUARY.—Very similar in character to January, having, like it, a calm and humid atmosphere, much cloud and fog, but little rain, and no snow, but as the mean temperature was scarcely any higher than in that month, the weather in February was more seasonable and though mild not exceptionally so. Pressure was again high, especially on the first few days, and from 19th to 22nd. On 26th and 27th it was very low.

| | ins. | | ins. | | ins. |
|---|---|---|---|---|---|
| 19th | 30·602 | 21st | 30·623 | 26th | 29·071 |
| 20th | ·848 | 22nd | ·668 | 27th | ·126 |

The weather was much colder at the commencement of the month, to the 9th, than towards the end, there being a very decided change on the 10th, when a calm and rather cold atmosphere with scarcely any rain (0·02in. on 5th only) gave place to warm and rather stormy weather with frequent rain. There was a very dense fog on 4th.

MARCH.—Very warm, bright, and windy, with an atmosphere of average pressure and humidity, and with little rain and only a few days of snow; the first month since the previous March in which snow fell on more than one day, and the first month in which any snow fell since December, the interval without snow being from 10th Dec. to 21st March. Temperature tolerably uniform; below 32° at 9 a.m. on 4th and 14th only. Max. above 52° on 21 days, above 62° on 4; min. below 32° on 10. There was heavy rain and a gale of wind on the night of the 1st, followed by hail on the

* In all cases the readings are corrected to 32° and reduced to sea-level.

2nd, and another gale with rain and snow occurred on the morning of the 26th.

April.—Warm and bright, very windy, with much rain (all after 11th), and with an atmosphere of average humidity and of very low pressure. The temperature throughout the month was remarkably uniform. Max. above 52° on 25 days, above 62° on 2; min. below 32° on 1 (16th). After the 11th rain fell every day except on 18th, 20th, 21st, and 26th. On the 29th there was a severe gale, with a south-west wind, which probably added to the destruction of foliage caused by its violence by depositing salt-crystals (from sea-spray carried in the air from the coast) on the leaves of trees and shrubs which in their then young and tender state were peculiarly susceptible to injury. Although it has been doubted whether the strength of the gale might not have been sufficient to account for all the injury to vegetation, the fact that salt-spray was carried over the greater part of the south of England and deposited on trees, etc., is undisputed. The deposition of salt with rain falling in stormy weather is not unusual, though seldom if ever known to have been deposited to such an extent as on this occasion, for at Rothamsted the chlorine in the rain collected "has averaged 13·42 lbs., equal to 22·12 lbs. of pure common salt per acre per annum. At Cirencester the amount is equal to 53·66 lbs. of salt." * A full account of this gale, with various opinions as to the presence and injurious effects of the salt-spray, is given in 'Symons' Monthly Meteorological Magazine' for May, 1882.†

May.—Very warm, with a very dry atmosphere (much drier than in any other month in the year), bright, rather windy, and with less than the average amount of rain. From 1st to 5th rain fell every day, then for 14 days, 6th to 19th, none whatever fell, from 20th to 26th rain again fell every day but 21st, and from 27th to the end of the month none fell, there being thus two wet and two dry periods. Max. temp. above 62° on 20 days, and as it never reached 70° it will be seen that it was very generally high, but never excessively so; min. below 42° on 9. There was a severe thunderstorm on the 22nd.

June.—Cold, very dull, the sky not once being clear of clouds at 9 a.m., and the mean amount of cloud being greater than in any other month in the year, with a rather windy atmosphere of average humidity, and with a large amount of rain; until the 26th there were not two successive days without rain. Max. temp. above 62° on 18 days, and never reaching 72°, which is exceptional for June; min. below 52° on 23, below 42° on 1 (17th). The month opened with colder weather than that with which May closed, and, as the mean temperature was only 2° higher than in that month, June was comparatively a cold month. Indeed, while from January to May the weather was warmer than usual, from June to September

* Lawes and Gilbert, 'Journ. Roy. Agric. Soc.', 2nd ser., vol. xviii, p. 66.
† Vol. xvii, p. 65.

it was just the reverse, the three summer months and the first autumnal month being colder than usual. There was a thunderstorm on 9th with 0·50 in. of rain, and on 26th with 0·80 in.

JULY.—Cold, cloudy, with a humid atmosphere, average strength of wind, and low barometric pressure. The month is remarkable for the large number of rainy days (23) in comparison with the amount of rain falling, which was only slightly above the average. To 26th the only days without rain were 1st, 2nd, 19th, and 20th. Max. temp. above 72° on 4 days; min. below 52° on 15. The extreme range of temperature, 31°·1, shows a great contrast to that in the previous July, 52°·5, and indeed both the mean and extreme range in the three summer months in this year were much less than in the corresponding period in 1881.

AUGUST.—Cold, cloudy, with a humid atmosphere as in July, and with a small amount of rainfall. Strength of wind and barometric pressure about the average. Max. temp. above 72° on 5 days; min. below 52° on 17. The earlier part of the month was finer and warmer than the latter part.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1st to 15th | 9 a.m. | 62°·0 | Mean Min. | 53°·4 | Mean Max. | 69°·9 | Mean | 61°·8 |
| 16th to 31st | ,, | 57·7 | ,, | 49·5 | ,, | 64·1 | ,, | 57·1 |
| Difference | ,, | 4·3 | ,, | 3·9 | ,, | 5·8 | ,, | 4·7 |

From 1st to 15th 0·21in. of rain fell, and from 16th to 31st, 1·58in.

SEPTEMBER.—Rather cold and bright, with a humid atmosphere of low pressure, and an average amount of rain. Max. temp. above 62° on 17 days; min. below 42° on 10. Although the lowest temperature recorded was above 32°, there was a ground-frost on the morning of the 15th. The first 3 days were much warmer than any other part of the month.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1st to 3rd | 9 a.m. | 62·5 | Mean Min. | 55·3 | Mean Max. | 66·6 | Mean | 61·5 |
| 4th to 30th | ,, | 53·1 | ,, | 43·6 | ,, | 62·5 | ,, | 53·1 |
| Difference | ,, | 9·4 | ,, | 11·7 | ,, | 4·1 | ,, | 8·4 |

There was a slight thunderstorm on the 14th.

OCTOBER.—Of average temperature, with a cloudy and very humid atmosphere of low pressure, and with an excessive amount of rain. Until after the 9th there was no heavy fall of rain, though rain fell on 4 of the first 9 days; from the 10th to the end of the month there were only two days without rain, 14th and 29th, and during this period more than half an inch fell on 5 days, with a total of 3·34 ins., and more than a quarter of an inch on 6 other days, with a total of 2·07 ins., making 11 days of heavy rainfall with an aggregate of 5·41 ins. (an average of nearly half an inch each day) out of the 24 on which rain fell. The first part of the month, to about the 14th, was warmer than the second, but there was no decided change in temperature. Max. above 52° on 23 days, above 62° on 6 (before 10th); min. below 42° on 8 (after 22nd), below 32° on 3 (26th, 27th, and 30th). There was a fine display of the aurora borealis on the 2nd; lightning was seen on the evening of

the 8th, and the first fall of snow, with hail and strong wind, occurred on the 24th.

NOVEMBER.—Rather warm and bright, with a very windy atmosphere of average humidity and very low pressure, and with rather heavy rainfall. There was a gradual diminution of temperature during the month, with a few days warmer than the rest, and two very cold ones.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3rd to 5th ..... | 9 a.m. | 53°·2 | Mean Min. | 48°·2 | Mean Max. | 60°·2 | Mean | 52°·8 |
| 12th ..... | ,, | 28 ·8 | ,, | 26 ·3 | ,, | 42 ·8 | ,, | 32 ·6 |
| Mean of Month | ,, | 42 ·1 | ,, | 36 ·9 | ,, | 49 ·2 | ,, | 42 ·4 |
| 18th ..... | ,, | 25 ·0 | ,, | 21 ·9 | ,, | 45 ·8 | ,, | 30 ·9 |
| 22nd to 24th ..... | ,, | 49 ·6 | ,, | 43 ·1 | ,, | 53 ·3 | ,, | 48 ·7 |

Max. above 52° on 9 days (between 1st and 9th, and on 22nd and 23rd); min. below 32° on 6, below 22° on 1 (18th). As in October there was, on the 17th, a fine display of the aurora borealis, and the auroral glow was seen on other evenings a few days before and after this date.

DECEMBER.—Of average temperature, with a dull and very humid atmosphere of low pressure, and with rather heavy rainfall. Max. temp. above 42° on 18 days, above 52° on 5 (after 25th); min. below 32° on 11, below 22° on 3 (10th to 12th). The month may be divided into two portions, the first, to 13th, very cold, calm, and with snow but not much rain, and the second, from 14th, unusually warm, windy, and with no snow but a considerable amount of rain, the mean temperature of these periods differing to the extent of 12°.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1st to 13th | 9 a.m. | 30°·7 | Mean Min. | 26°·8 | Mean Max. | 37°·1 | Mean | 31°·5 |
| 14th to 31st | ,, | 43 ·8 | ,, | 38 ·5 | ,, | 48 ·2 | ,, | 43 ·5 |
| Difference | ,, | 13 ·1 | ,, | 11 ·7 | ,, | 11 ·1 | ,, | 12 ·0 |

The last 6 days were exceptionally warm.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 26th to 31st ..... | 9 a.m. | 51°·6 | Mean Min. | 46°·8 | Mean Max. | 54°·5 | Mean | 51°·0 |
| Mean of Month | ,, | 38 ·0 | ,, | 33 ·6 | ,, | 43 ·5 | ,, | 38 ·4 |
| Difference | ,, | 13 ·6 | ,, | 13 ·2 | ,, | 11 ·0 | ,, | 12·6 |

The high temperature of these 6 days was even slightly exceeded on the 1st of January, 1883, after which a more normal temperature prevailed.

## XXIX.

# NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1882.

By John E. Littleboy.

*Read at Watford, 20th March,* 1883.

It is once more my pleasant duty to bring before our members a few particulars respecting birds observed in Hertfordshire during the past year. There are, in addition to these, a few species which occurred prior to 1882, but which, having been reported subsequently to the reading of my last paper, will also claim our attention. I am glad to announce that I have registered thirteen additional species since my last report, and, in accordance with my previous custom, I shall briefly notice these species seriatim. Before proceeding with my task, I wish to acknowledge, with sincere thanks, the valuable assistance that I have received from Mr. John Cordeaux, Mr. John H. Gurney, Mr. Harting, and Mr. Sharpe of the British Museum. Five of the notices I am about to read are from the pen of Mr. Cordeaux, and for one our Society is again indebted to Mr. Gurney.

The Tree-Sparrow (*Passer montanus*).—Mr. A. F. Griffith reports that the tree-sparrow is met with regularly, in small flocks, in the neighbourhood of Sandridge. It also frequents the willows by the side of the river Lea, near Brocket Hall. Mr. William Norman, of Royston, informs me that it is not uncommon near that town, and that he has several specimens in his possession.

Mr. John H. Gurney has kindly supplied the following note:—"The tree-sparrow is a wide-ranging species, extending, it is believed, all over Europe and Asia. It is by no means a parasite, like the house-sparrow, and its distribution is probably the same now as it was 500 years ago. In their habits the two sparrows differ essentially. In this part of England the true home of the tree-sparrow is in the marshes, and I suppose the examples which I now and then see on the coast are migrants. That it is migratory is well known, for instances are recorded of large numbers being met with at sea, and in the North Sea I have heard of its being several times seen. I know a locality on our Norfolk 'Broads,' near a venerable ecclesiastical building, or what remains of it, where a colony of these birds nest in a cow-shed, not in large numbers, but enough for their habits to be observed. They frequent the thatch of the shed, and come down to the water's edge to drink. I lately paid a visit to this colony and obtained an egg and a nestling; the latter, though extremely young, was distinguishable at a glance from a nestling house-sparrow. The old idea that every nest in a tree was a tree-sparrow's is quite exploded; they generally nest in sheds, boat-houses, or pollard-willows. In July, 1871, I was shown a nest in a hole in a low thorn-bush about 3½ feet from the ground; some young birds had

been taken from it, which, I heard, readily ate chopped egg, and soon learnt to feed themselves. This was in West Norfolk, where the bird is also common. Common as white, pied, buff, and even black house-sparrows are, I do not remember more than about two varieties of the tree-sparrow. One of these is in my collection; it was killed in Warwickshire, and shows all the natural markings, only of a very pale delicate tint."

2. The Wood-lark (*Alauda arborea*).—Mr. A. F. Griffith reports the occurrence of the wood-lark during the month of March, both in 1878 and 1879. It was observed in a field close to Symond's Hyde Wood, in the parish of Sandridge. Mr. Griffith writes as follows:—"It was, I have no doubt, about to breed, as it is a very early nester, but I left too early each year to find the nest."

The wood-lark is semi-migrant in its habits: it is comparatively a rare bird, and when met with is, without doubt, frequently mistaken for its congener the sky-lark. It may readily be distinguished, writes Professor Newton,* from the sky-lark "by its smaller size, its shorter tail, its more distinctly-marked breast, and by a conspicuous light-coloured streak over the eye and ear-coverts." It appears to prefer rich woodland districts, but frequents both heaths and downs when bordered by woods or copses.

3. The Pied Flycatcher (*Muscicapa atricapilla*).—During the summer of 1879 a pied flycatcher was shot near Royston; it was mounted by Mr. William Norman of that town, and is still in his possession. Although more or less common in some of our northern counties, the pied flycatcher is a rare bird in Herts, Beds, and Oxon. It is a summer migrant, and generally arrives in England during the month of April. "In many of its movements," writes Mr. H. Seebohm,† "the pied flycatcher resembles its dingy congener. It may frequently be seen hovering, in butterfly-like flight, in the air. Sometimes it sits quietly on some decayed limb, ever and anon uttering its call-notes, and incessantly jerking its tail and half opening its wings, as though anxious to sally into the air."

4. The Rustic Bunting (*Emberiza rustica*).—A rustic bunting was taken on the 20th of November, near Elstree Reservoir, in the nets of a bird-catcher. It was sold to a dealer in Wardour Street, and from him purchased, in the flesh, by Lord Lilford. It is now ('Zoologist,' January, 1883) in his Lordship's possession. The bird captured near Elstree is only the third specimen known to have occurred in the British Isles. The first was taken in October, 1867, near Brighton, and is now in the collection of Mr. Monk, of Lewes; the second occurred in September, 1881, in Yorkshire, and is reported in the 'Ibis' (1882, p. 182), by Mr. W. E. Clarke.

Mr. Sharpe, of the British Museum, informs me that the rustic bunting inhabits north-eastern Europe and northern Siberia, straying as far as northern Italy and Japan. There is no British specimen in the collection under his care. In general appearance

* Yarrell's 'British Birds,' 4th edition, vol. i, p. 625.
† 'British Birds,' vol. i, p. 329.

the rustic bunting somewhat resembles a female yellow-hammer, but in place of yellow, a reddish-brown colour appears to predominate, and behind the eyes there is a stripe of pure white.

5. The Peregrine Falcon (*Falco peregrinus*).—The peregrine falcon has frequently occurred in Herts, prior to the date of our register. I have now the pleasure to record it in regular course. Mr. G. Shrimpton, of Port Vale, Hertford, reports the capture of two of them. The first was shot at Stoney Hills, near Bengeo, on the 18th of September, 1881, and the second, at Bramfield, near Hertford, on the 23rd of November, in the same year.

The peregrine, described by Montagu* as "the Tyrant of the air," takes its place among the largest and most daring of British Raptors. "In the wideness of its distribution," writes Mr. Seebohm,† "the peregrine is equalled by few other raptorial birds. Its haunt is the open country—the moorlands, mountain sides and commons, and waste lands near the sea being its favourite places. Truly, indeed, the peregrine is a noble bird, his courage when on the wing, and his proud bearing when seated on some naked branch or rock-pinnacle, stamp him as one of the most lordly of his race." In days when falconry was a fashionable pastime, the peregrine was prized, protected, and petted beyond all his compeers. At present a retributive destiny appears to have overtaken him, and he shares the common fate that awaits, in game-preserving England, the appearance of all or any of his congeners.

Peregrines still breed occasionally in Wales and Scotland, where they select wild mountainous heights and rocky headlands as their home, but, thanks to game-keepers and gun-loafers, they are constantly becoming scarcer; and it seems more than probable that, in a few years, they may become, like the kite, rare and accidental visitors to our shores.

6. The Virginian Colin (*Ortyx Virginianus*).—An old female colin, or American quail, was shot on the 12th of August, near Stevenage, and is reported by Mr. Marlborough R. Pryor.

The Virginian colin is, as its name implies, a native of America, and can only be regarded as an introduced species. It has however become more or less naturalised in some of the eastern counties, and is accepted by Wharton and other authorities as a British bird. Respecting its occurrence in Hertfordshire, Mr. Harting writes to me as follows:—"No doubt the bird in question was a wanderer from Norfolk or Suffolk, where a great number have been turned out; as has been the case also in Northamptonshire, where a few years ago some hundreds were liberated by Lord Lilford."

7. The Common Curlew (*Numenius arquata*).—The common curlew has been twice reported in our county during the year. Mr. G. Shrimpton, Port Vale, Hertford, to whom we are indebted for much valuable information, informs me that a female curlew, shot during the month of May, at Sacombe Park, was brought to him to be mounted. On opening the bird he found that it con-

* Ornithological Dictionary, p. 361. † 'British Birds,' vol. i, p. 24.

tained two eggs. Mr. R. W. Brett, of Hertford, reports that the "well-known note" of the curlew was heard in that neighbourhood about Christmas Day, and that at other times it has been seen to pass over.

For the following notice, and for the four succeeding ones—on the common tern, the lesser tern, the little auk, and the puffin—our Society is indebted to Mr. John Cordeaux, of Ulceby, Lincolnshire, a prominent member of the ornithological committee of the British Association. "Curlews are common on our east coast during a great part of the year, and can only be considered scarce in the height of summer. At low-tide they feed on the muddy flats and great sand-wastes on the shore, retiring at flood to the coast-marshes, and often going far inland to the larger open fields on the Lincolnshire and Yorkshire Wolds. Large numbers, often hundreds together, pass southwards along the coast in the autumn, from the middle of July to the end of September, by a north to south flight, but the greater number appear at this season to come direct on to our coast by an east to west course—the general line followed by our autumn immigrants. In foggy weather, or on dark rainy nights, no other shore-bird is more frequently seen dashing, in a lost and bewildered manner, around the lanterns of the light-house and light-vessels. In the autumn of 1882 curlews are recorded in the migration returns, from east-coast stations, as having occurred at intervals, round the lanterns of light-houses, up to the 13th of December. The curlew nests on the high moorlands of Yorkshire and the north of England, and less frequently in the south; a few pairs also nest on Thorne Waste, near the upper waters of the Humber. A limited number may always be found on our coasts throughout the summer months."

8. The Common Tern (*Sterna fluviatilis*).—Mr. E. P. Thompson, of Elstree, informs me that he observed a common tern on the Elstree Reservoir during the month of April, and that at other times he has seen four or five together at the same place. Mr. W. Norman reports that they are occasionally met with near Royston.

"The common tern, a spring and autumn visitant to our east coast, on its passage to and from its nesting quarters but far more numerous always at the latter season, arrives about the last week in April or early in May, and is always less commonly met with than the far more numerous arctic tern—*Sterna macrura*. In stormy weather it ascends rivers, and occasionally occurs in waters far inland, which is rarely the case with the arctic tern. It nests annually on the Faroe Islands in company with the arctic tern, but the latter exceed the so-called common species by about ten to one. Both species leave their nesting-quarters in the autumn together, about the last week in August, on their migration to the south."

9. The Little Tern (*Sterna minuta*).—Mr. Frederick N. Fordham informs me that two little terns have been recently secured in the neighbourhood of the River Cam, about a mile and a half from Royston. Mr. W. Norman reports that a dead specimen was

picked up not far from that town and was brought to him by the finder. "The little tern formerly nested plentifully on the Lincolnshire and Yorkshire coast, and still nests, but in greatly reduced numbers, at Spurn, where quite recently I found thirteen nests within a short distance of each other in slight hollows of the bare shingle, twelve of which contained the full complement of three eggs. It arrives at Spurn in May, about the middle of the month, leaving again in September, a few lingering as late as the middle of October."

10. The Little Auk (*Mergulus alle*).—A little auk was picked up alive near Langley, about five miles from Hitchin. It was an old bird, and lived for some days after its capture. It is reported by Mr. William Hill, jun., of Hitchin. "The little auk is a winter visitant to the coasts of Yorkshire and Lincolnshire, and at this season may be often found in large numbers at sea off the east coast. In long-continued storms they approach the coast, even entering our tidal rivers and estuaries—not unfrequently solitary examples occurring far inland in a perfectly exhausted condition, driven in by stress of weather."

11. The Puffin (*Fratercula arctica*).—Mr. Henry Manser informs me that a puffin was caught alive about the middle of April, at Broxbourne, near Hoddesdon. It died a few hours after being caught. Two other occurrences of the same bird are reported by Mr. William Hill, jun. In the month of March a young puffin was picked up alive, but exhausted, at Pirton, near Hitchin; a second, also a young bird, was picked up at Preston, near the same town. It is worthy of remark that the bird secured at Pirton found its way inland during the fine weather that prevailed in March. "Puffins are the latest of our sea-fowl to arrive at their nesting haunts at Flamborough, which they do early in May, leaving again in August. The single egg is placed at the bottom of a deep hole or fissure in the cliffs, and the young, unlike those of the guillemot, remain on the ledge until they can fly down unassisted by the parent-birds. Often several puffins are found in the same hole, and both the male and female assist in incubation. When the young are hatched, the old birds feed them on sand-eels, and may constantly be seen coming in from the sea and flying up to the cliffs, with numbers of these bright silvery little fish dangling, beard-like, from the sides of their huge beaks. In September and October they may be found in large numbers far out at sea, moving gradually to the south, and they are rarely seen again off the coast till their return in the spring. After the autumn moult the beak of the puffin assumes quite a different character, and is neither of the same size, shape, or colour as in the breeding-season; nor are the pieces of which it is composed the same. It has been clearly proved by Dr. Louis Barran that this remarkable change is brought about by a regular moult or scaling off of the plates as well as the palpebral appendages. Like the guillemot the puffin does not breed till the third summer."

12. The Common Guillemot (*Alce troile*).—A common guillemot

was shot by Mr. F. Hicks on the Elstree Reservoir in the latter part of the year 1882. It is still in his possession.

The common, or, as it is sometimes styled in consequence of its presumed indifference to danger, the "foolish" guillemot, is only an occasional and accidental inland visitor. "It may be seen," writes Yarrell,* "in the tide-way of the open sea, all round our coast at any season; but these birds are best observed during their breeding-season, when they assemble by hundreds or thousands on many of the most extensive and highest rocks and cliffs that bound our sea-girt island."

13. The Cormorant (*Phalacrocorax carbo*).—Mr. W. Norman, of Royston, informs me that a cormorant was picked up dead on the 15th of October, 1881, within a short distance of that town. On examination it was found to have been wounded by shot.

Cormorants are rarely met with in the Midland Counties, but are common residents along the coasts of the British Isles. They feed almost exclusively on fish, and are singularly expert in the art of fishing. "To pursue," writes Morris,† "is to capture, and to overtake is death." The cormorant is a powerful bird, and, although most completely at home upon the waves, appears, when observed upon the wing, to be able to contend successfully against the wildest weather. It will however be noticed that the bird that visited our county was picked up on the 15th of October, the day following the notable storm that left behind it, in our own valleys, such terrible traces of its violence. The fact that it was wounded may account, in some measure, for its capture in Herts, but it seems difficult to disconnect its occurrence with the fearful hurricane that marked the date of its arrival. Cormorants are extremely tenacious of life, and long after they are wounded will defy capture. I have pleasure in exhibiting a cormorant that was shot on one of the lochs in Sutherlandshire, after an exciting chase, extending over the greater part of two days, by Mr. Clare Fry, of the Little Elms, Watford. When skinned, three or four bullet-holes were found in its throat and neck, besides various gun-marks.

The thirteen birds now recorded increase the number on our register to 150 species.

The dates at which the arrival and departure of our summer migrants and other visitants have been reported, together with the names of the observers, will be found in the following tables.

Summer Migrants.

| Species. | Locality. | Date. | | Observer. |
|---|---|---|---|---|
| Nightingale ..... | Hitchin ..... | Apl. | 9 | W. Hill, jun. |
| (*Daulias luscinia*) | Ashwell ..... | ,, | 14 | H.G. Fordham. |
| | Harpenden ..... | ,, | 15 | J. J. Willis. |
| | Watford..... | ,, | 16 | J. Hopkinson. |
| | Hertford ..... | ,, | 16 | R. T. Andrews. |
| | Hailey Hall ..... | ,, | 16 | H. C. Heard. |

* 'British Birds,' vol. iii, p. 344. † 'British Birds,' vol. iii, p. 63.

| Species. | Locality. | Date. | | Observer. |
|---|---|---|---|---|
| Nightingale (contd.) | Hoddesdon | Apl. | 18 | Miss A. Warner. |
| | Fanhams Hall, Ware | ,, | 20 | R. B. Croft. |
| | Redbourn Bury | ,, | 22 | Mrs. Arnold. |
| (Nest with 4 eggs) | Royston | May | 8 | P. F. Fordham. |
| Redstart (*Ruticilla phœnicurus*) | Cassiobury Park | Apl. | 30 | A. Barraud. |
| Chiff-Chaff (*Phylloscopus collybita*) | Throcking | Mar. | 8 | Rev. C. Harvey. |
| | Watford | ,, | 22 | A. Barraud. |
| | King's Langley | ,, | 24 | E. J. Lake. |
| | Royston | ,, | 27 | P. F. Fordham. |
| | Hitchin | Apl. | 2 | W. Hill, jun. |
| | Hunton Bridge | ,, | 9 | J. E. L. |
| Willow-wren (*Phylloscopus trochilus*) | Throcking | ,, | 12 | Rev. C. Harvey. |
| | Bucks Hill, Watford | ,, | 16 | F. Littleboy. |
| | Langleybury | ,, | 26 | J. E. L. |
| Wood-Wren (*Phylloscopus sibilatrix*) | Albury | ,, | 10 | Miss Littleboy. |
| Lesser Whitethroat (*Sylvia curruca*) | Hertford | ,, | 15 | R. W. Brett. |
| | Elstree | ,, | 18 | J. E. L. |
| | Hunton Bridge | ,, | 28 | Mrs. Cooper. |
| | Royston | May | 3 | P. F. Fordham. |
| Blackcap (*Sylvia Atricapilla*) | Royston | ,, | 5 | P. F. Fordham. |
| Sedge-Warbler (*Calamodus schœnobœnus*) | Hitchin | Apl. | 10 | W. Hill, jun. |
| | Hunton Bridge | ,, | 23 | J. E. L. |
| Red-backed Shrike (*Lanius Collurio*) | Royston | May | 23 | P. F. Fordham. |
| | Chorley Wood (pair shot) | July | 18 | W. Downer. |
| Spotted Flycatcher (*Muscicapa grisola*) | Hunton Bridge | May | 14 | J. E. L. |
| | Odsey Grange | ,, | 25 | H. G. Fordham. |
| (Last seen) | ,, | Sept. | 3 | H. G. Fordham. |
| Pied Wagtail (*Motacilla lugubris*) | Two Waters | Mar. | 2 | F. Littleboy. |
| | Royston | ,, | 3 | P. F. Fordham. |
| | Redbourn Bury | ,, | 12 | Mrs. Arnold. |
| (Flight of 8 or 10) | Hunton Bridge | ,, | 18 | J. E. L. |
| Swallow (*Hirundo rustica*) | Hoddesdon | Apl. | 9 | Miss A. Warner. |
| | Hertford | ,, | 11 | R. T. Andrews. |
| | Hitchin | ,, | 11 | W. Hill, jun. |
| | Rickmansworth | ,, | 12 | H. Procter. |
| | Hemel Hempstead | ,, | 13 | F. Littleboy. |
| | Elstree | ,, | 14 | E. P. Thompson. |
| | Ashwell | ,, | 14 | H. G. Fordham. |
| | Harpenden | ,, | 14 | J. J. Willis. |
| | Watford | ,, | 15 | J. Hopkinson. |
| | Ware | ,, | 15 | R. B. Croft. |
| | Hunton Bridge | ,, | 16 | E. M. Mather. |
| | Highfield House, Watford | ,, | 17 | Dr. A. T. Brett. |
| | Redbourn Bury | ,, | 18 | Mrs. Arnold. |
| | Hailey Hall | ,, | 18 | H. C. Heard. |
| | Throcking | ,, | 20 | Rev. C. Harvey. |
| (Last seen) | Ashwell | Oct. | 4 | H. G. Fordham. |
| ,, | Odsey Grange | ,, | 22 | H. G. Fordham. |
| ,, | Hertford | Nov. | 7 | R. W. Brett. |
| Martin (*Chelidon urbica*) | Hitchin | Apl. | 10 | W. Hill, jun. |
| | Redbourn Bury | ,, | 24 | Mrs. Arnold. |
| | Hunton Bridge | ,, | 26 | J. E. L. |
| | Odsey Grange | May | 1 | H. G. Fordham. |
| | Royston | ,, | 6 | P. F. Fordham. |
| (Last seen) | ,, | Oct. | 4 | P. F. Fordham. |
| ,, | Hitchin | Nov. | 15 | W. Hill, jun. |
| ,, | Hertford | ,, | 18 | R. W. Brett. |

| Species. | Locality. | Date. | | Observer. |
|---|---|---|---|---|
| Sand Martin | Rickmansworth | Apl. | 8 | H. Procter. |
| (*Cotyle riparia*) | Hitchin | ,, | 10 | W. Hill, jun. |
| (Last seen) | Hertford | Nov. | 9 | R. W. Brett. |
| Wryneck | Hoo, Great Gaddesden | Apl. | 2 | H. Procter. |
| (*Yunx torquilla*) | Hitchin | ,, | 11 | W. Hill, jun. |
| | Hamper Mills | ,, | 22 | Dr. A. T. Brett. |
| | Ashwell | May | 6 | E. S. Fordham. |
| Cuckoo | Harpenden | Apl. | 12 | J. J. Willis. |
| (*Cuculus canorus*) | Hitchin | ,, | 15 | W. Hill, jun. |
| | Watford | ,, | 15 | J. Hopkinson. |
| | Hoddesdon | ,, | 15 | Miss A. Warner. |
| | Hailey Hall | ,, | 15 | H. C. Heard. |
| | Hunton Bridge | ,, | 16 | E. M. Mather. |
| | King's Langley | ,, | 17 | E. Harwood |
| | Hertford | ,, | 17 | R. T. Andrews. |
| | Hunton Bridge | ,, | 20 | Mrs. Cooper. |
| | Throcking | ,, | 21 | Rev. C. Harvey. |
| | Royston | ,, | 21 | P. F. Fordham. |
| | Fanhams Hall | ,, | 21 | R. B. Croft. |
| | Hemel Hempstead | ,, | 22 | W. Wyman. |
| | Hamper Mills | ,, | 22 | Dr. A. T. Brett. |
| | Ashwell | ,, | 23 | H. G. Fordham. |
| Nightjar | Hitchin | Mar. | 18 | W. Hill, jun. |
| (*Caprimulgus europæus*) | Odsey Grange | ,, | 25 | H. G. Fordham. |
| | Royston | ,, | 26 | P. F. Fordham. |
| Swift | Hitchin | May | 2 | W. Hill, jun. |
| (*Cypselus Apus*) | Harpenden | ,, | 3 | J. J. Willis. |
| | Royston | ,, | 6 | P. F. Fordham. |
| | Redbourn Bury | ,, | 9 | Mrs. Arnold. |
| | Ashwell | ,, | 17 | H. G. Fordham. |
| (Last seen) | Odsey Grange | Sept. | 1 | H. G. Fordham. |
| | Ashwell | ,, | 4 | H. G. Fordham. |
| Turtle Dove | Odsey Grange | May | 1 | H. G. Fordham. |
| (*Turtur auritus*) | Hitchin | ,, | 30 | W. Hill, jun. |
| Quail | Royston | May | 2 | P. F. Fordham. |
| (*Coturnix communis*) | Ashwell | ,, | 4 | E. S. Fordham. |
| Stone Curlew | Royston | July | 2 | P. F. Fordham. |
| (*Œdicnemus scolopax*) | | | | |
| Corn Crake | Royston | May | 2 | P. F. Fordham. |
| (*Crex pratensis*) | Hertford | June | 5 | H. C. Heard. |

## Spring, Autumn, and Winter Visitants.

| | | | | |
|---|---|---|---|---|
| Redwing | Watford | Dec. | 12 | J. E. L. |
| (*Turdus iliacus*) | Hertford (abundant) | Dec. | | R. W. Brett. |
| Fieldfare | Royston | Jan. | 5 | P. F. Fordham. |
| (*Turdus pilaris*) | ,, (large numbers) | ,, | 13 | P. F. Fordham. |
| | Chipperfield | Feb. | 15 | E. Lake. |
| | Odsey Grange | Nov. | 3 | H. G. Fordham. |
| | King's Langley | ,, | 19 | J. E. L. |
| Ring Ousel | Chalk Hill, Watford | Sept. | 11 | Miss Morel. |
| (*Cinclus aquaticus*) | Caldicott Hill | Dec. | 12 | J. E. L. |
| Great Gray Shrike | Throcking | Nov. | | Rev. C. Harvey. |
| (*Lanius excubitor*) | Elstree | ,, | | Miss Selby. |
| Gray Wagtail | Hunton Bridge | Oct. | 30 | J. E. L. |
| (*Motacilla sulphurea*) | | | | |
| Siskin | Hunton Bridge | Jan. | 28 | J. E. L. |
| (*Carduelis spinus*) | King's Langley | Jan. | | E. Lake. |
| Lesser Redpole | Hunton Bridge | ,, | 28 | J. E. L. |
| (*Linota rufescens*) | | | | |

| Species. | Locality. | Date. | Observer. |
|---|---|---|---|
| Brambling ..... (*Fringilla Montifringilla*) | Hazelwood ..... | Jan. | Mr. Stannard. |
| | Shendish ..... | Feb. 21 | E. Lake. |
| Hooded Crow ..... (*Corvus Cornix*) | Odsey Grange ..... | Jan. 21 | H. G. Fordham. |
| | ,, ..... | Feb. 28 | H. G. Fordham. |
| | ,, ..... | Oct. 9 | H. G. Fordham. |
| | Berkhamstead Common | Dec. 19 | Mrs. Littleboy. |
| Short-eared Owl ..... (*Asio accipitrinus*) | Moor Park..... | Dec. | Lord Ebury. |
| Woodcock ..... (*Scolopax rusticola*) | Otterspool, Watford .... | Oct. 14 | A. F. Holland. |

I must now direct your attention to sundry reports, received during the year, from various localities throughout our county.

The Redstart (*Ruticilla phœnicurus*). — Redstarts have been more generally reported than on any previous occasion. The Rev. J. A. Ewing, Westmill Rectory, Buntingford, writes that "a pair of redstarts built a nest and brought out their young in a plantation by the side of the Rectory lane." Mr. A. Barraud reports that he observed a bird, in fine plumage, about the end of April, on the outskirts of Cassiobury Park, and that a pair of redstarts built and reared their young in Mr. C. Fry's summer-house, at the Little Elms.

The Stonechat (*Pratincola rubicola*). — Although said to be resident, stonechats are certainly more plentiful on this side of the county in the winter months and during the early spring than at other times in the year. They may generally be met with in February between Hunton Bridge and King's Langley, and I have frequently seen them near Berkhampstead and elsewhere, at about the same period of the year.

Thrushes (*Turdus musicus*, *T. iliacus*, and *T. pilaris*). — The song-thrush commenced to sing at a very early date. It is reported from all parts of the county from January 2nd to the end of February. A nest with four eggs was found by Mr. H. G. Fordham on the 26th of March. Redwings appear to have been more plentiful than has been the case since the disastrous winter of 1879–80. At the same time it is only right to state that their absence from the neighbourhood of Stevenage is specially referred to by Mr. Marlborough Pryor. Fieldfares have again been scarce. Mr. Percy F. Fordham mentions having observed considerable numbers about the 13th of January, in the Royston district, but with this exception all the reports received confirm their general scarcity in our county.

The Grasshopper-Warbler (*Locustella nævia*).— Grasshopper-warblers are reported by Mr. A. F. Griffith to breed regularly in the neighbourhood of Sandridge. I have only once before had occasion to register their occurrence; but they are difficult birds to identify unless the observer is thoroughly familiar with their peculiar note, and it is probable that they are much commoner than is generally supposed.

The Great Grey Shrike (*Lanius excubitor*).—A great grey shrike was shot during November near Throcking by Mr. Coleman.

It was mounted by Mr. Norman, of Royston, and is now in the possession of the Rev. C. W. Harvey. A second specimen was shot about the same time by Mr. H. H. Gibbs' gamekeeper, near Elstree Reservoir.

The Red-Backed Shrike (*Lanius collurio*).—Red-backed shrikes are reported to have built in an orchard at Chorley Wood, and a pair, now in the possession of Mr. W. Downer, were shot on the 18th of July at the same place. Some young shrikes were observed flying in and out of a tall hedge, near Park Street, by Dr. Hensman; and the Rev. J. A. Ewing reports that a pair built, as they have done for several successive years, in a tall hawthorn hedge, within thirty yards of the village school, but (need I add the words) inaccessible to the school-children.

The Greenfinch (*Ligurinus chloris*).—Greenfinches have been wonderfully numerous, almost competing in abundance with the chaffinch. An albino variety was shot at Chapmore End, near Hertford, about the end of September. It was mounted by Mr. G. Shrimpton, and is thus described:—"General colour creamy white; wings mostly yellow, and eyes pink."

The Crossbill (*Loxia curvirostra*).—Mr. R. W. Brett reports that a considerable flight of these interesting and peculiar birds took possession of a fir-grove, facing S.S.E., at Bengeo Warren, near Hertford. Skins of both male and female birds were obtained, in colour varying from red to dull green.

The Black-headed Bunting (*Emberiza melanocephala*).—A black-headed bunting was observed on a hedge, by the road-side, at Broadway, near Berkhamsted. I also noticed several near Stanmore, just within the borders of Middlesex, on the 7th of March.

The Magpie (*Pica rustica*).—Magpies appear to be more frequently met with than was the case a few years ago. In the neighbourhood of Elstree they are tolerably abundant, and Miss Selby reports that a pair built in a wood, close to Aldenham House.

The Jay (*Garrulus glandarius*).—Jays have been unusually numerous on this side of our county during the past winter. Mr. J. Stannard informs me that he counted more than twenty of these gaily-plumaged birds in a small wood that borders Hazelwood Park, and I have received similar reports from several other quarters. I had written these words prior to observing in the pages of the 'Zoologist' (January, 1883, p. 1), a letter from Mr. J. Cordeaux, which appears to account, in rather a remarkable manner, for the immigration I have alluded to. "On the 8th of October," writes Mr. Cordeaux, "a perfect storm of jays" was observed by Herr Gätke as they passed "over and on both sides" of the island of Heligoland. In further confirmation of this fact, Mr. J. H. Gurney, jun., has sent me an extract taken from a private letter, received by him from the same veteran observer, in which "continuous flights of thousands and thousands of jays, on the 6th, 7th, and 8th of October," are again reported. Referring

to information forwarded, Mr. Cordeaux writes to me as follows:—"I am much interested in what you say about the abundance of jays in Herts. I have now received several communications of unusual numbers seen at various localities between Flamborough Head and the New Forest in Hampshire. It is interesting to find one fact backing up another, and no observation, however trivial it may appear, is altogether useless, but may help in some way or other to strengthen and confirm others." I hope that testimony such as this, received from so careful an observer as Mr. Cordeaux, may encourage our members to attempt more continuous and careful reports than have yet been made.

The Sand-Martin (*Cotyle riparia*).—It will be remembered that on the 17th of June our members visited a large chalk-pit near Harefield. Their attention was at once arrested by a vast number of sand-martins that were flying about incessantly on the face of the chalk. A stratum of sand and gravel was observed to overlie the chalk, and to be let down into it in many places in "pipes," and in this sand an infinite number of holes, into and out of which the birds were constantly flying, were readily observable.

The Cuckoo (*Cuculus canorus*).—A cuckoo's egg is reported, by Mr. P. F. Fordham, to have been found in the nest of a meadow-pipit, near Royston.

The Wood-Pigeon (*Columba palumbus*).—Large flocks of wood-pigeons have visited our county during the winter months. This is almost invariably the case when beech-masts are abundant. Mr. Henry Lewis, of St. Albans, forwarded to me 13 hedge-nuts which, in addition to a number of beech-masts, he had taken from the crop of a single pigeon.

The Eagle-Owl (*Bubo ignavus*).—An eagle-owl was shot on the 23rd of December, 1881, on the Bayfordbury estate, about two miles from Hertford, and was reported by Mr. George Shrimpton, of Port Vale, Hertford. On making further inquiry, I ascertained that an eagle-owl had escaped, about three months previously, from the garden of Mr. Richard Hoare, Marden Hill, near Welwyn, and it seems more than probable that the bird shot at Bayfordbury was the fugitive from Marden Hill. Under these circumstances I have concluded, with considerable self-denial, not to place it on our register. Mr. Hoare informs me that he kept a pair of eagle-owls in his garden for six or seven years, and that they laid eggs in a small round hole on the ground, but never hatched young birds. On the death of the female the male bird forsook the garden and appears to have met his fate as already described. Under favourable circumstances the eagle-owl breeds successfully in confinement; Mr. Gurney writes to me that they have succeeded in breeding more than twenty at Northrepps Hall.

The Partridge (*Perdix cinerea*).—Partridges are reported, from all quarters, as unusually abundant during the season. Pheasants have also been plentiful, but, as raised at present, they appear to come more properly under the head of "domestic poultry."

The Heron (*Ardea cinerea*).—Herons are reported as observed

on August 1st and 3rd near Royston, and on September 29th near Ashwell. Lord Ebury writes that an increased number have frequented the water at Moor Park, and Mr. E. P. Thompson states that they are common at Elstree Reservoir.

The Golden Plover (*Charadrius pluvialis*).—Large numbers of the golden plover are reported by Mr. H. C. Heard and Mr. R. W. Brett as appearing during the winter months in the vicinity of Hertford. Mr. Heard reports having observed them in the months of July, August, and September (a somewhat unusual circumstance). They are reported by Mr. H. G. Fordham as observed near Ashwell, and I have heard of their occurrence, in large flights, near Rickmansworth and Pinner. Mr. Heard asks whether the early arrival of the golden plover may be considered to have presaged the wet season through which we have since passed. The question is a very interesting one; the advent, in large numbers, of the golden plover, is popularly considered always to predicate a wet season, and although we are accustomed, very properly as I think, to connect the movement of birds with motives that are real and more or less apparent, it is quite possible that the same causes which combine to produce a wet season may also combine to influence, in some unexplained manner, the keen perception of plovers, and thus teach them the time and direction in which to direct their flight.

The Stone-Curlew (*Œdicnemus scolopax*).—Both Mr. Percy F. Fordham and Mr. W. Norman report the nesting of the stone-curlew in a field contiguous to the Royston Downs.

The Corn-crake (*Crex pratensis*).—Mr. H. Lewis reports that a corn-crake was shot on the 3rd of January near St. Albans. Isolated instances of a similar character have been mentioned by Yarrell and other authorities, but they are far from common, and the present occurrence is well worthy of record in the pages of our 'Transactions.' The food of the corn-crake consists principally of slugs, snails, worms, and insects, and it is probable that the extraordinarily mild winter of 1881–82 enabled it to subsist during the winter months without much difficulty.

The Wild Duck (*Anas boschas*).—A brood of ducklings was hatched by the side of a pond at the bottom of "The Grove" grounds, Stanmore Common. Mrs. Brightwen succeeded in taming them so completely that they regularly left the water at certain times and came up to the Hall to be fed. One afternoon I watched them, when called by Mrs. Brightwen, enter the drawing-room, without the least appearance of fright, and feed freely from the hands of any one who would supply them with food.

General Remarks.—In my report for the year 1881 I referred to the influx of numerous sea-birds during the autumnal months as a distinguishing feature of that year. I have now to add the cormorant to the number then reported. There is also another circumstance that distinguished the autumn of 1881, to which I shall take the liberty to refer. I find that two honey-buzzards, two buzzards, and two peregrine-falcons, are reported as having been observed in Hertfordshire during the months of September, October,

and November. This is an unusual coincidence, but on referring to the report on migration published by the Committee of the British Association (p. 3), its explanation becomes self-evident. I quote the following sentence from this report: "Not the least remarkable feature was the influx of the larger raptorial birds in a broad fan, all along our east coast, extending from Forfarshire to the South of England, having previously crossed Heligoland on September the 22nd and two following days." I have already noticed the important migration of jays to our county, which immediately followed their reported flight over the same island, and I think it will be admitted by all, that considerable additional interest is added to ornithological returns when cause and effect can be traced in so satisfactory a manner as is the case in these instances.

I believe that it is customary in sporting circles to describe each year by the name of a favourite animal. If I may be allowed to ingraft the practice on the ornithological records of our Hertfordshire Society, I think that the year 1882 must take its place in our annals as the year of the "Rustic Bunting."

The occurrence in our county, within a few weeks of each other, of the little auk, the puffin, and the guillemot, all birds of kindred feather, appears to point to the prevalence of severe gales during the months of November and December. It will be interesting to note whether our meteorological returns will justify the inference I have drawn.

The arrival of summer migrants does not appear to have been materially affected by the mildness of the spring. A few species are reported a trifle earlier than usual, but they are exceptions to the general rule. Several of our residents, notably perhaps the thrush, the blackbird, the rook, and the robin, paired and nested earlier than is customary; while the plaintive note of the thrush, the jubilant song of the skylark, and the innocent carol of the little wren were heard almost from the commencement of the new year. One of my correspondents, who is a keen ornithologist, informs me that he counted thirty-nine species of birds, in his own small garden almost close to Watford, during the summer months. The habit of counting the number of birds observed during a walk or in a particular month, is an extremely useful one. It familiarizes the eye with the style and appearance of different birds,

"Great nature's happy commoners."

And it enables the observer to recognise and to master the charming but varied notes that welcome, so joyously, the advent of an English spring, when

"Every copse and bush,
Bending with dewy moisture o'er the heads
Of the coy choristers that lodge within,
Are prodigal of harmony."

Before I conclude, there is a subject to which, with your permission, I wish especially to allude. Thanks to our numerous correspondents, I receive from most parts of our county, regular

and very acceptable reports, of the arrival of some four or five species among our numerous summer migrants. Respecting the cuckoo, the nightingale, the swallow, the martin, and the swift, I am fortunate in always receiving definite information. May I appeal to our members to extend the sphere of their observations; the habits of the willow-wren, the chiff-chaff, the white-throats, the melodious blackcap, the sedge-warbler, the flycatcher, the wag-tails, the sand-martin, the wryneck, the turtle-dove, the corn-crake, and many others, are equally worthy of our attention; while the arrival of our spring, autumn, and winter visitors—the fieldfare, the redwing, the ring-ousel, the woodcock, the snipe, the great grey shrike, the siskin, the redpole, the brambling, the hooded crow, etc.—is, if possible, of still greater interest. In again thanking our members for their past favours, may I venture to solicit still further assistance in the direction indicated.

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XXX.

# NOTES ON THE RE-INTRODUCTION OF THE BEAVER INTO BRITAIN.

By Augustus Hawks.

*Read at Hertford, 29th March,* 1883.

(Abridged.)

My paper has, I am sorry to have to confess, nothing in it of that special local interest which is very properly looked for in the 'Transactions' of this Society, yet I have some hope that it may not be altogether devoid of general interest. We all know that after we have visited any country we feel much more interest in what we read about it. So I, having seen with my own eyes some of the work of beavers, have not only become particularly interested in them myself, but have cherished a hope that I may be able to make them interesting to others.

Being at Rothesay last autumn, we took the opportunity of visiting the beaver-settlement which Lord Bute has established on his estate, Mount Stuart, in the Isle of Bute. We found it in a pine-wood, through which runs a small stream, three or four acres of sloping ground being enclosed with stone walls and iron fences. Into this enclosure Lord Bute (after some other attempts which were unsuccessful), in January, 1875, turned seven or eight beavers which he had obtained from North America. This colony has increased and multiplied, so that now, although there have been some deaths among them, the beavers number, according to the best estimate the keeper can make, about thirty.

The first proceeding of the colonists was to adapt the locality to their wants and tasks, the principal step towards which was to construct dams across the stream. So the beavers set to work, and they have worked with such vigour that they have altogether altered the face of their adopted country. They have made several dams by which the stream is headed back into pools; the largest is at the lower end of the enclosure, upon which special pains have been bestowed, evidently for the reason that they made here their principal abode.

For material for the dams, and for food, they went to work tree-cutting—an operation which they perform with great judgment, and their tools for which are their teeth. The cutting-teeth are two in each jaw, very large and strong. On the front they are broad and flat, and of brownish-yellow or orange colour. A plate of very hard enamel covers the bone forming the principal substance of the tooth; the tooth itself is of not very hard bone, and has a ridge on the back strengthening it. Bone, though not so hard as enamel, is tougher; its softness makes it wear faster than the enamel, and its toughness renders it less liable to be broken. If the whole tooth were enamel the cutting edge would wear down faster than the rest, and the tooth become blunt; but the bone wears with less action than the enamel, and thus the enamel stands

highest, and forms a cutting edge, while the bone supports it behind. Thus the beaver's teeth are chisels, but possessing a property which no art of man can give to the carpenter's chisel; for the cutting-teeth of the beaver have not roots consisting wholly of bone, as in the teeth of most animals, and indeed in the grinders of the beaver itself. They are inserted deeply in the jaws, in a peculiar kind of socket which exists only during dentition in the teeth of other animals. These sockets continue gradually to produce the teeth in such a manner that both bone and enamel grow at the root as fast as they are worn down at the point, and thus the teeth remain in good condition during the whole life of the animal. The edges of the teeth are directly opposite each other, so that they bite clean.

With these weapons the beaver attacks a tree, which he brings down by cutting notches through its trunk, first marking the tree all round. The trees felled are made to fall directly towards the stream—that is, unless the wind upsets the beaver's calculations, which it does sometimes. In one case a tree had fallen just across the stream, so that the branches which fell undermost were made use of as framework for a dam. This is a very curious instance; for the top of the tree, as it lies, just reaches the bank of the stream farthest from the root, and Black, the keeper, told us that it has often been discussed whether the beaver knew that it would do so before the tree was attacked. I can say no more than that certainly it has fallen, or has been made to fall, exactly in the proper direction to be utilised for a dam, and the branches have been left on it and used for that purpose. Of course it is perfectly probable that the tree was, in the first instance, cut down for food, or for other purposes, and that when it was found to be useful for a dam, the intention was changed; but if so, the change of intention is not less remarkable than the other supposition.

There is another case for remark. The trees usually fall directly towards the stream, so as to lie handy for the beaver's purpose, but an instance to the contrary was pointed out to us. Two trees have been felled so that their tops, though pointing towards the stream, do not do so directly, but diverge outwards, one inclining to the top and the other to the lower end of the enclosure; the reason for this is that two other trees were standing between them and the stream, so that if these trees had fallen directly towards the stream they would have been caught in the branches of those other trees. Why then, it may be said, did they not fell the other trees first? There was no doubt a reason, for beavers appear to do nothing without; probably those trees were not such as they use for food, for they know what to eat and what to avoid. There is also another possible reason. I have an impression, though I do not find in my notes, that the trees which stood in the way were dead, and beavers will not touch a dead tree, neither, according to Black, will they interfere with one another's work. If one begins to cut down a tree he finishes it alone. Thus each works for his own hand, but all for the good of the community. If, again, a beaver

begins a tree and a man handles the cut, it will be left for some days; their sense of smell being very keen, and easily offended. However, some authorities say that beavers work together on a tree, but one finishes the work; others say that one pair only work on the same tree, and that they work turn and turn about, so that only one works at a time, the little ones helping just to get their teeth in. Indeed it is somewhat startling to find how contradictory the statements about beavers are. Take, for instance, the description of the manner in which they cut down trees. Frank Buckland says (and he refers to Mr. Bartlett's personal observation of the matter): "Attacking one side, he (the beaver) cuts by the means of his sharp chisel, a regular notch in the tree; when he has gnawed his notch as deep as he dares into the tree, the cunning fellow will test its stability by standing on his hind legs and pushing the tree to see the degree of firmness of the portion which holds the two pieces of wood together; but how is he to separate this bit which unites the wood? he simply leaves off gnawing the big notch he has made; he then goes to the other side, where the bark and wood have not been touched at all, and gnaws away until down comes the tree." Arabella Buckley says: "With his teeth he gnaws a deep notch in the trunk, as deep as he dares without fear of its falling, and then going round to the other side he begins work there till the trunk is severed and falls heavily on the side of the deep notch, and therefore away from himself." These accounts seem so clear and simple that one feels disposed to adopt them without question; but Black disturbs the harmony by remarking that beavers begin to cut at the side opposite to that to which they intend the tree to fall, which is directly contrary to what the others say. Then it does not tend to make the matter more clear when we find another authority (Morgan) saying that the process of cutting is round and round the tree continuously, and that the reduction is uniform, until it is cut on all sides more than half-way to the centre; after which the remainder of the cutting varies, in some cases being uniform until the tree falls, in others deepest on one side, towards which it is then more likely to fall. I can only add to these statements that the stumps of the felled trees at Lord Bute's show the cutting to have been all round, and I think equally so, but I am sure that the direction of the trees falling was not a mere matter of likelihood, but of certainty, unless where the wind interfered; though it must not be overlooked that the banks on which these trees stood slope towards the stream, and that therefore the trees would have had a natural tendency to fall that way.

The tree-cutting is done towards the end of the year, in order that the winter-supply of food may be provided. Having cut down the tree the beavers strip off the branches, cutting them into lengths for dragging away to the stream, where they either use them for building, having first stripped off the bark for food, or they float them down the stream and store them near their house. Their food in winter consists wholly of the bark of trees; in summer

they eat bracken, grass, or young shoots growing about the place, or they grub up roots. Their work is all done at night. They are very regular in their habits, usually coming out about seven in the evening, and going home again about seven in the morning.

By means of the principal dam they have made a large pool at the lower end of the enclosure. We examined this dam carefully; it is about 70 feet in length. Its greatest height is about 8 feet, and the breadth of its base at the deepest part of the pool, 15 to 20 feet. This they have built up piece by piece and year by year, first beginning by damming the little stream, then raising and widening the dam, and thus making the pool broader and deeper. It is constructed of wood, grass, and sand, with stones here and there, which have served to keep the other material in place until more was built on it. They carry the material with their mouths and fore-feet. They use their fore-feet like hands, in fact they are formed more like hands than feet, and with them they plaster on the mud and knead it in among the sticks. It was formerly said that they used their tails to plaster the mud smoothly. That, however, is a myth, like that of the kangaroo using his tail for leaping. Of course as the embankment increased in height and width, the pressure of the water against it much increased, and this the builders had taken care to provide for. They built it partly in arched form against the stream, with greater breadth serving as buttresses between the arches, besides which there are props behind. The embankment is not arched throughout, but in those places only where the pressure of the water is greatest. This illustrates what the Rev. J. G. Wood says (quoting I believe from Audubon, to whose work I have not been able to refer): "When the different parts of the stream run with varying velocity, the formation of the dam is really a triumph of engineering skill, for wherever the stream is gentle the dam is built straight across it, but wherever the current runs smartly the dam is curved, so as to present a convex surface to its force." This is a very neat testimony to the sagacity, the something more than instinct, of the beaver. In one place behind this large dam a tree has been cut, and has fallen towards the dam, so that the severed stem rests against the rooted trunk from which it was cut, and thus the trunk and the stem with its branches are made to serve as a buttress to the dam; behind this same dam, where it is high, they have laid round pieces of wood horizontally to serve as a ladder. They keep the top of the dam perfectly level, so that the water runs over evenly—a very important matter when flood-water comes down; but so substantially has this dam been built, that it has sustained no damage to speak of during the seven years it has been standing.

There are other smaller dams higher up, and in one of these a growing tree was made use of; the dam was carried across just above it, and about the centre rested against it. The tree was of a kind not used for food by beavers, but they knew or found out that the pressure of the wind on the upper part of the tree would by rocking it about disturb the stability of the dam, so they just cut

the tree through above the top of the dam, letting it fall to one side, so that it did not foul the stream, and left it there.

The pools formed by the dams serve as places of refuge when the beavers are disturbed at their work, and they use them as waterways for carriage of branches, etc. They have also from these pools made burrows for some distance into the banks on the water-level, each ending in a small chamber. Their principal dwelling-place or house, if I may use that expression (beaver-lodge is, I believe, the North-American term, where however they are on a larger scale), is on the bank of the large pool. For the most part the banks of the stream are steep, but a little way above the large embankment there is a small level place, and this they selected as the site. They began by burrowing into the bank from the bottom of the water for about three or four feet, then upwards about one foot, and there they scooped out a space large enough to live in, breaking a hole through the top about six inches across, which they covered with sticks and grass, placing some sticks also perpendicularly to keep it open as a ventilator; then as they continued to raise the dam, and thus raised the level of the water, they continued also to build and enlarge the house, cutting their way up. Their chamber is airy and clean, in which last respect they are very particular. They enter their house from under water, where their enemies cannot follow them, though, happily for the Bute beavers, their chief enemy, the wolverine, which Bewick says is also called the beaver-eater, has not yet been acclimatised by Lord Bute. The top of the house is raised above the ground-level, and domed. The occupiers are what auctioneers term "desirable tenants," for regularly every autumn they carefully repair the outside of their house by plastering it over with mud, and, so that they may better land with the material, they have made themselves a landing-slip two to three feet broad at the base of the house, which also answers the purpose of a foundation for its enlargement. Inside, the chamber is formed above the water-level, and they lay for their beds wood-shavings which they prepare in this manner—after using the bark of a branch for food they place the stick on end, holding it with their fore-feet, and then with their teeth they pare it down into fine shavings.

The branches of trees cut and brought down for winter food are stored up in the water near the house. The depth of the water here is now about four feet and a half, and when they begin to use the food they begin from the bottom. Thus they are not cut off from their supplies by ice or their enemies. Being mindful of the scorn and derision with which the statement that they drive stakes into the ground has been received by some writers, I dare not say more than that stakes seem to be set up, within which to store the food, and also that stakes appear to have been set up in some places behind the embankments. The object of the dam seems to be to secure a sufficient and uniform depth of water in all weather and at all seasons, and of such a depth as that it shall not be entirely frozen. A beaver will not go anywhere by land if he can go by

water. With his hind-feet webbed up to the claws and his broad tail as a rudder, he has immense swimming-power, leaving his fore-feet free for carrying. He arranges so that the level of the water where his home is shall be always about the same, by widening the stream into a large pool with a broad weir over which the surplus water quickly escapes.

Bewick says that fish is not the favourite food of the beaver; and Black says that they never touch the trout, of which there are plenty in their stream. Buckland says: "The beaver is not a fish-eater, never was, and never will be; he is a typical rodent or gnawing animal, his incisor teeth are formed like chisels to cut down boughs, his smaller teeth to eat vegetable substances only. It is about as sensible a thing to say that the beaver eats fish as to say that a rabbit or a guinea-pig does." Yet another writer says that he had tame beavers which were very fond of rice and plum-pudding, and also ate partridges and venison, and I suppose that it is not an unknown thing for graminivorous animals to become carnivorous.

The account of the beaver's domestic arrangements would not be complete without a word about the nursery. How often in the year and for how many occupants at a time the nursery is required I find again to be matters of dispute. Bewick says once a year, and for two or three little beavers at a time. Black says only one at a time, but he is certain twice a year. But Wood says three or four at a time, and does not say how often—he adds that the little creatures are born with their eyes open, which I readily believe. Then Morgan says two to five and sometimes six at a time.

In conclusion I will mention an instance of the good effect of beavers' work which I read in an article in 'Harper's Magazine,' on "Wahlámet Valley in Oregon." "All cereals," it says, "are raised here, but you will see little of anything except wheat, which for half a century has made Oregon famous. In 1831, it is related, the first wheat was sowed at French Prairie, in Marion County, and that same field yielded 35 bushels to the acre in 1879. Rich land that, but equalled in many parts of the western valleys, where the soil is a dark loam, underlaid by clay. The richest acres, of course, lie along the wooded river-bottoms, in many of which may be traced extensive beaver-dams. The beavers have long ago departed; but their occupation, by making broad reaches of still water overflowing the lowlands, and permitting wide deposits of alluvium, has produced a soil of extraordinary fertility."

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XXXI.

# SOME EXPERIMENTS ON THE PHYSICS AND CHEMISTRY OF THE SAP OF PLANTS.

By Professor John Attfield, Ph.D., F.R.S., F.C.S., etc.

*Read at Watford, 17th April*, 1883.

How plants grow, whence comes their food, what is its nature, and how it is conveyed, are questions which have interested man in all ages. And to earnest, intelligent, unprejudiced truth-seeking enquirers answers to the questions have been obtained; answers general and incomplete at first, not even yet minute and perfect.

Burn a log of wood in a grate with due access of air. The wood and the oxygen of the air together yield carbonic-acid gas, vapour of water, and nitrogenous gas, all of which pass up the chimney; ash containing various mineral matters, which falls beneath the grate; and heat, which warms and comforts us. Conversely nature brings together heat, mineral matters, nitrogenous gas, water, and carbonic acid gas, and the products are wood and oxygen. To extract temporary comfort from the wood of our trees (or from coal, which is only altered wood), we convert that wood into warmth, smoke, and ash, and at the same time use up life-giving air. Beneficent nature gathers together that warmth, and smoke and ash, and returns them to us in the form of trees and flowers, at the same time presenting us with the exact amount of life-giving air we had lost. How do plants grow? By additions of carbon, nitrogen, the elements of water, and certain mineral elements. Whence comes their food? From its storehouses, the atmosphere and the earth. How is it conveyed? By the carriers, air and water.

But these answers to the questions respecting the growth of plants, though very direct, are very crude and general. They represent only the beginning and the end of a vast number of processes. A log of wood on the one hand and the products of its burning on the other are only the terminals of two long series of substances, an analytical series beginning with the wood and ending with gases and ashes, and a synthetical series beginning with gases and ashes and ending with the wood. Reduce the wood to its elements, not by the rough and rapid method of free combustion, but by controlled heat in retorts, as at gas-works, and you will obtain a series of substances which includes scores of interesting materials—acids, spirits, colour-yielding bodies, illuminating agents, etc. Conversely, nature, between the constituents of the air or of the soil on the one hand, and the finished tree or flower on the other, forms a series of substances which includes scores of interesting materials—acids, perfumes, colours, flavours, starch, sugar, oil, etc.

In these two series or chains the products are related to each other or linked together, but in what way we do not yet perfectly know. Indeed, as to the form or character of many of the links

themselves we as yet know nothing. But chemists discover fresh links every month, and chemistry is revealing to her students some hints as to the manner in which they are joined. So that man's information on these matters is increasing year by year, and what is revealed gives great encouragement to further research.

More fascinating, possibly, than the study of the chemistry of plant-growth, either from the analytical or from the synthetical points of view, is the study of the natural philosophy, as it used to be termed, or physics or true science of the subject; that is to say, the study of the cause of the various effects, or a consideration of the explanation of the effects. Bring a log of wood and air together under proper conditions and heat is evolved. Let the vapours and solids resulting from such a combustion be brought together again under proper conditions and wood is reproduced, but one of the indispensable conditions here is that heat must be absorbed, the sun must shine on the leaves of the tree producing the wood. What happens to the heat that is absorbed before it again shows itself when the log is, in the grate, once more resolved into its elements? Does it lie dormant in the wood, latent, and for the time useless? Matter is always in motion; surely force is never quiescent. Neither matter nor force can suffer destruction, but each is ever altering its form. It is certain that the elements of which wood is formed are undergoing ceaseless alteration during the growth of the wood before combustion re-converts the wood into those elements; it is equally certain that the heat which is absorbed by plants is doing ceaseless work before it reappears as heat when the combustion takes place. Nothing in nature is useless, nothing in nature is still.

The chemistry and the physics of plant-life at no time more forcibly and unitedly arrest the attention than when one considers the character of the watery fluid or sap of plants, what it is, its functions, and how it performs those functions. For in the sap of the plant-cells the water itself and the mineral matters brought up from the roots, and the gases brought in from the air, meet and unite. In the sap is commenced the structure which when perfected forms the leaf, the flower, the fruit, the whole edifice of usefulness and beauty.

Now, knowing something of chemistry and of physics myself, and having never lost my love for botany since the pleasant days of my studentship in that science some thirty years ago, under my present colleague Robert Bentley, I recently felt my interest in sap strongly aroused by the sight of some literally raining on me from a wounded tree growing in my own garden at Watford.

On the evening of the 3rd of April, beneath a white birch I noticed a very wet place on the gravel path, the water of which was obviously being fed by the cut extremity of a branch of the birch about an inch in diameter and some ten feet from the ground. I afterwards found that exactly fifteen days previously, namely, on March 19th, circumstances rendered necessary the removal of the portion of the bough which hung over the path, 4 or 5 feet being still left on the tree. The water or sap was dropping fast from the

branch, at the rate of 16 large drops per minute, each drop twice or thrice the size of a "minim." Neither the catkins nor the leaves of the tree had yet expanded. I at once decided that some interest would attach to a determination both of the rate of flow of the fluid and its chemical composition, especially at such a stage of the tree's life. For although a good deal is already known respecting the "bleeding" of trees and the general character of the exuding fluid, very much remains to be discovered. Indeed I could scarcely myself hope to do more than confirm some previous observers and perhaps give quantitative value in just one or two directions to the qualitative experiments of others. Thus, that the birch readily yields its sap when the wood is wounded is well known. Phillips, quoted by Sowerby, says:

> "Even afflictive birch
> Cursed by unlettered youth, distils
> A limpid current from her wounded bark,
> Profuse of nursing sap."

And that birch-sap contains sugar is known, the peasants of many countries, especially Russia, being well acquainted with the art of making birch wine by fermenting its saccharine juice.

But after searching two or three large libraries of scientific societies I could not find any hourly or daily record of the amount of sugar-bearing sap which can be drawn from the birch, or that of any sap from any tree, before the tree has acquired its great digesting or rather developing and transpiring apparatus—its leaf-system; nor could I meet with any extended chemical analysis of sap, either of the birch or other tree.

But to proceed with a description of the experiments. A bottle was so suspended beneath the wound as to catch the whole of the exuding sap. It caught nearly 5 fluid ounces between eight and nine o'clock p.m. During the succeeding eleven hours of the night 44 fluid ounces were collected, an average of 4 ounces per hour. From 8·15 to 9·15 on the morning of the 4th, very nearly 7 ounces were obtained. From 9·15 to 10·15, with bright sunshine, 8 ounces. From 10·15 until 8.15 in the evening the hourly record kept by my son Harvey showed that the amount during that time had slowly diminished from 8 to a little below 7 ounces per hour. Apparently the flow was faster in sunshine than in shade, and by day than by night. The flow was observed from time to time for nearly a week, the rate mentioned being maintained. The wound was open altogether for 21 days, hence probably rather more than 17 gallons of sap exuded during 20 days of that time; for my excellent gardener, Jonathan White, assured me that the tree had been "bleeding" at about the same rate for fourteen of the fifteen days that elapsed before the matter came under my notice, the first day the branch becoming only somewhat damp.

It would seem, therefore, that this slender tree, with a stem which at the ground is only 7 inches in diameter, having a height of 39 feet, and before it has any expanded leaves from whose united surfaces large amounts of water might evaporate, is able to

draw from the ground about 4 litres or seven-eighths of a gallon of fluid every twenty-four hours. That at all events was the amount flowing from this open tap in its water-system. Even the topmost branches of the tree did not become during the three weeks abnormally flaccid, so that presumably no drainage from the upper portion of the tree had been taking place. Besides, after due calculations, I find that the amount of fluid which would exude in the three weeks would be greater than could be contained in the whole of the trunk and branches above the wound even if they were hollow. For three weeks, therefore, the tree had been drawing, pumping, sucking—I know not what word to use—nearly a gallon of food daily from the soil in the neighbourhood of its roots. This soil had only an ordinary degree of dampness. It was not wet, still less was there any actually fluid water to be seen. Indeed, usually all the adjacent soil is of a dry kind, for we are on the plateau of a hill about 270 feet above the sea; the level of the local water-reservoir into which our wells dip is about 80 feet below the surface, and the subsoil is very porous; so that, altogether, the welcome rains sink away from our garden-earth rather rapidly. The total rainfall from the 19th of March to the end of the month was, our Secretary tells me, eight-tenths of an inch, a little over eighty tons per acre. No rain had fallen in April, when, on the 9th, my gardener, with some difficulty, so closed the wound as to stop the outflow. During the earlier part of the time we had frosts at night, and sunshine but with extremely cold winds during the days. At one time the exuding sap gave, I am told by two different observers, icicles a foot long. A much warmer, almost summer, temperature prevailed afterwards, and no wind. On the 4th of April the temperature of the sap as it escaped was constant at 52° F., while that of the surrounding air was varying considerably.*

The collected sap was a clear, bright, water-like fluid. After a pint had stood aside for twelve hours, there was the merest trace of a sediment at the bottom of the vessel. The microscope showed this to consist of parenchymatous cells, with here and there a group of the wheel-like cells which botanists, I think, term sphere-crystals. The sap was slightly heavier than water, in the proportion of 1005 to 1000. It had a faintly sweet taste and a very slight aromatic odour.

* In 'Nature' for April 5th, 1883, Mr. F. M. Burton, writing, on March 28th, from Highfield, Gainsborough, says: "A remarkable instance of the strong up-rush of sap in trees at this time of the year occurred here during the late severe weather. The boughs of a sycamore overhanging a road were trimmed on the 21st of March during a very keen frost, and next day icicles of frozen sap, varying in length from a couple of inches to a foot, were hanging from the severed ends. The icicles were semi-opaque in appearance and slightly iridescent, like the sheen on the moonstone, and, when put in a bottle and melted, the product was pure sap. The sycamore, being one of the earliest trees to develope leaves, had its sap rising, notwithstanding the intense cold and late season; while a beech, which is much later in coming out, and an ash, which is usually latest of all, whose boughs had also been lopped, showed no signs of bleeding, and the cuts remained dry and bare. The icicles have been melted, reformed, and melted again since the 21st, and still the sap is dropping from the cuts."

Chemical analysis showed that this sap consisted of 99 parts of pure water with one part of dissolved solid matter. Eleven-twelfths of the latter was sugar. Besides sugar, which occurred in this sap to the extent of 616 grains, nearly an ounce and a half, per gallon, there were present a mere trace of mucilage; no starch; no tannin; 3½ grains per gallon of ammoniacal salts yielding 10 per cent. of nitrogen; 3 grains of albumenoid matter yielding 10 per cent. of nitrogen; a distinct trace of nitrites; 7·4 grains of nitrates containing 17 per cent. of nitrogen; no chlorides, or the merest trace; no sulphates; no sodium salts; a little of potassium salts; much phosphate and organic salts of calcium; and some similar magnesian compounds. These calcareous and magnesian substances yielded an ash when the sap was evaporated to dryness and the sugar and other organic matter burnt away, the amount of this residual mineral matter being exactly 50 grains per gallon. The sap contained no peroxide of hydrogen. It was faintly if at all acid. Exposed to the air, it soon swarmed with bacteria, its sugar being changed to alcohol, and this again in a few days to acetic acid. The birch-sap had changed to birch-wine and then to birch-vinegar.

It is noteworthy that the sap when drawn contained a ferment capable of transforming starch into sugar. Two former students of mine, Messrs. Dunstan and Dimmock, who have devised a method of ascertaining the power of such ferments, were good enough to apply their process to some of my sap. They found that one gallon would convert into sugar 21 grains of dry starch, the latter being first gelatinised. Here probably we get an idea of the methods which nature employs in converting one substance into another during the synthetical process or growth, and during the analytical process or more or less rapid decay or combustion of plants. Future investigation in physiological botany will doubtless include much experimenting with ferments. It is an extremely interesting branch of study. The action is well illustrated in the conversion of starch into gum, sugar, etc., during the germination of barley in the manufacture of malt.

Shortly, respecting the composition of this sap, I may state to the general members of a Natural History Society without risking the dignity of my subject, that a teaspoonful or two of, say, apple-juice, and a tablespoonful of sugar put into a gallon of such rather hard well-water as we have in our chalky district, would very fairly represent this specimen of the sap of the silver birch. Indeed in the phraseology of a water-analyst, I may say that the sap itself had 25 degrees of total, permanent hardness.

How long the tree would continue to yield such a flow of sap I cannot say. Probably until the store of sugar it manufactured last summer to feed its young buds this spring was exhausted. Even within 48 hours the sugar slightly diminished in proportion in the fluid, the specific gravity going down from 1004·92 to 1004·38.

And now with regard to the physics of the matter. What causes this outflow? Or, to put the larger question at once, what causes

the rise and general movement of sap in plants—a movement which extends from the lowest rootlet to the topmost leaf or twig?

The movement of fluid in plants has been set down to atmospheric pressure, to capillary attraction, to endosmotic action, and to the indirect influence of wind and warmth on elastic tissues.

Atmospheric pressure, however, will only sustain a column of water to a height of about 34 feet, as seen in the case of a common pump, whereas the height of my birch is 39 feet, and the top of a tree is often scores and sometimes hundreds of feet from the ground.

By capillary action water ascends in wetted tubes as narrow as hairs (*capillus*, a hair) when they dip into water; and the height attained above the level of the water outside the tube, other things being equal, is inversely proportional to the diameter of the tubes. Thus, at summer temperatures, in a wetted tube one twenty-fifth of an inch in diameter, water will rise about an inch and a quarter. Such action is apparently insufficient to account for the rise of sap in trees.

With regard to endosmose, Dutrochet found that a tied bladder containing a saline solution decreased in weight when placed in water, and that a tied bladder containing water increased in weight when placed in a saline solution. The saline solution passed through the wall of the bladder or cell in one direction quicker than water passed through it in the other direction. This action between a weaker and a stronger fluid he called endosmose. Each cell of a plant is the analogue of the tied bladder, and between one cell and another there will be the passage of fluid whenever the densities of the two fluids vary. This action proceeds from cell to cell throughout a plant, and hence may account for slow movements of fluids within plants. But the tips of roots do not necessarily dip into such an amount of water as would seem to be necessary were endosmose the prime cause of the ascent of sap. I could not discover after much careful search that the rootlets of my birch were in contact with actual fluid water. They seemed rather to terminate in minute moisture-laden air spaces. Besides, as I understand endosmose, its very existence depends on concurrent exosmose. Hence the inflow of, say, common water to a plant containing its minute proportions of saline matters should be accompanied by an outflow of a fluid of different density, either absolutely pure water on the one hand, or, on the other, sap containing elaborated material such as sugar. I am not aware, however, that the outflow of either kind of fluid has ever been observed, or that any observer contends that it takes place. I cannot, at present, accept endosmose as a satisfactory and complete explanation of the outflow from the branch of my birch.

Herbert Spencer says that wind in bending twigs, branches, and trunks gives alternate squeezings to one side and the other and corresponding extensions of tissue on the opposite sides, and that this action sets up currents of sap within the tissue. I have great respect for this eminent and far-seeing sociologist, and I doubt not that wind exerts important actions upon plants, but my birch was

yielding nearly a gallon of sap daily when no wind was blowing, and the amount was not perceptibly altered when the wind did blow.

The suggestion has been made that the warmth of spring expands the solid parts of a plant, and that nature abhorring a vacuum drives in water to supply the thus enlarged space or spaces. How any such warmth expands the solid without at the same time expanding the liquid and gaseous contents of a plant is not stated. Moreover this driving up of water or sap is only a fresh name for the pressure caused by the weight of the atmosphere, which pressure has already been shown to be insufficient to account for all the facts of the case.

"Root-pressure" is also a name which frequently occurs in the vocabulary of some writers. And a harmless name it is for describing some of the effects we are considering. But regarded as a cause I find it is only a fresh name for either atmospheric pressure or for endosmose.

Transpiration, that is, the evaporation which goes on from leaves, especially from their under surfaces, is said to be a cause of the rise of sap. It would be fairer to say, however, that rise of sap accompanies transpiration. For my birch when giving nearly a gallon of sap a day had neither leaves nor catkins upon it, and when I first noticed the outflow not a bud had burst. It follows, apparently, that there may be flow of sap in the absence of transpiration, hence that the one cause of the flow of sap is not transpiration. Doubtless transpiration plays an important part in the plant-growth, and, as I understand, is so active at certain times as to be the possible cause of such a reduction of pressure within a plant, as compared with external atmospheric pressure, that so far from any fluid being exuded from a cut branch at such times, water may even be strongly sucked in. At all events, so far as transpiration does affect the flow of sap, such part of the flow would still seem to be caused only by atmospheric pressure.

There remains only to be considered the enormously powerful attractive force termed the chemical force as lying at the bottom of the attraction of plant-tissue for sap. In a plant the molecules of carbonic acid, water, nitrogen-bearing bodies, and mineral substances are bound together by the chemical force into compounds, and these latter into more complex compounds, and so the substance of the plant or tree is formed. But the chemical force acts only when bodies are in contact, that is, at insensible distances from each other. How then can a root-tip obtain water or mineral matters? Water it will obtain from the molecules of water-vapour in contact with the tip. At the tip the molecules will coalesce to drops and these will dissolve contiguous molecules of mineral matter. Then may come in capillary attraction, which is a variety of non-chemical molecular attraction; then may come in any influence of atmospheric pressure whether set up by transpiration or otherwise; then may come in endosmose, which is indeed probably itself caused by the chemical attraction between molecules of water and of saline matter.

But the chemical force is static rather than dynamic, how then

can it set up a current? By the atttaction for each other of the components of tissue, on the one hand, and on the other, of those true compounds of water with even minute amounts of gases or solids which we know to exist. Tissue-compounds and water-compounds meeting, ordinary chemical changes occur, force, in the form of heat, is absorbed, more complex compounds are built up, and the great bulk of the water *per se*, or, it may be, water holding in solution effete matters, is left to shift for itself, perhaps even repelled, to escape in the direction of least resistance—by transpiration in summer and by slower processes in spring. The water exuding from my birch-branch may be such water, a portion of the water that might ordinarily escape from the external surfaces of the wood or otherwise, with the difference that it is carrying away matter (sugar, etc.) not wanted just now, perhaps, but which unfortunately, or, at all events, as we believe, will be wanted presently. The warrant for the remarks respecting the highly aqueous water-compounds is to be found in the known tenacity with which water retains traces of gases, as shown by Groves, and in the altered properties possessed by water when containing even traces of saline or other matters. Finally, whence comes the large quantity of chemical force or chemical attraction necessary for the binding together of such numbers and such amounts of substances as occur in the fully-formed wood of a forest tree? From the heat-force poured on to its leaves by the sun—force which will be re-converted into heat when the wood is transformed, no matter whether slowly by decay or quickly by combustion, into its constituent gases and ashes.

It would be unwise, however, to speculate further without those confirmations and checks which experiment alone could afford, and without those safe guides which experiment alone could furnish. Here as elsewhere in all departments of knowledge earnest seekers after truth are wanted, men possessing, for this enquiry, adequate knowledge of physics, chemistry, and botany, and with the necessary time and means for carrying on the work. To such men would certainly, sooner or later, be accorded the honour of discovering, or unveiling, one more of the laws by which all nature is governed. Then we shall know the true cause or causes of the movements of sap in plants.

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## XXXII.

## MISCELLANEOUS NOTES AND OBSERVATIONS.

*Read at Watford, 17th April,* 1883.

### Meteorology.

*The River Bourne.*—The intermittent streamlet known as the Hertfordshire Bourne has been admirably described by Dr. Evans in a paper read before the Society on the 8th of June, 1876; its source was inspected by several of our members on the 7th of June, 1881; and it is proposed to visit it for the second time on Saturday next, the 21st inst.

Assuming that the Bourne rises in a field just above the Harratts End lane, it covers a distance between that spot and its outpour into the Bulbourne of almost exactly 2¾ miles. I have obtained from Dr. Evans a few particulars respecting it, and at the request of our Secretary I have prepared the following record:—

1853—March 23. Source at upper end of field above Harratts End lane.
1873—February 16. Source at bottom of third field beyond Harratts End lane.
1876—June 8. Source 70 yards east of lane; flow not continuous; said to have commenced flowing in April.
1877—January 7. Commenced to flow at Bourne End during the night of January 6th.
,, —January 28. Source at bottom of third field beyond Harratts End lane.
1879—February 16. Source close to Harratts End lane, but flow not continuous. Ceased running at Bourne End on May 21st; commenced again on May 28th; and ceased finally on December 19th.
1881—May 7. Source 50 yards east of Harratts End lane; water standing in field west of lane.
1883—January 9. Commenced to flow at Bourne End; continued to increase in volume until the beginning of February.

I may mention that during thirty years prior to 1860, the Bourne only overflowed its banks in the garden through which it passes opposite the Bourne End mill on one occasion. The unusual downpour of recent years has very naturally told its tale in the little streamlet; in 1879 it burst up the culvert close to the road and covered that side of the garden with water. The culvert was restored with almost double its former capacity, but, notwithstanding this precaution, the force of the water was so great during the latter part of last January that it again burst its bounds, and a portion of the garden was once more submerged.—*John E. Littleboy, Hunton Bridge.*

### Botany.

*Flowering Plants and Ferns observed in Hertfordshire in* 1882.—The following is a list of plants observed in Hertfordshire during the past year which are of interest from their comparative rarity or from their not having previously been recorded as growing in the localities in which they have now been observed. Lists of plants have been communicated by Mr. A. S. Eve of Berkhampstead and

Mr. A. E. Gibbs of St. Albans; I have incorporated some records by Mr. B. Piffard of Hemel Hempstead, which have appeared in the 'Hertfordshire Mercury,' and I have also included my own observations. The names of the observers are indicated by their initials being appended to the localities, except in the case of my own records to which no initials are appended. The sequence followed in the list is in accordance with the seventh edition of the 'London Catalogue of British Plants.'

*Thalictrum flavum.*—River-side near Redbourn, and near the Great Northern railway-station, Harpenden.—G.

*Anemone Pulsatilla.*—Near Ravensburgh Castle, Hexton.—E.

*Myosurus minimus.*—In a field near New Barnes, St. Albans.—E.

*Ranunculus fluitans.*—In the River Bulbourn, Berkhampstead.—E.

*R. sceleratus.*—Near the Silk Mills, St. Albans.—G. In marshy ground at the Wilderness, Berkhampstead.—E.

*Helleborus viridis.*—In woods near Ashlyns, Berkhampstead.—E.

*Fumaria capreolata.*—St. Peter's Park, St. Albans.—G.

*Nasturtium palustre.*—The Wilderness, Berkhampstead.—E.

*Alyssum calycinum.*—In a field near Battler's Green, Aldenham.

*Reseda lutea.*—On railway-bank, Berkhampstead.—E.

*Polygala depressa.*—Stanmore Common.

*Stellaria aquatica.*—In the moat at Berkhampstead Castle.—E.

*Scleranthus annuus.*—Near Marlin's Chapel, Berkhampstead.—E.

*Hypericum Androsæmum.*—Knot Wood, Harpenden.—G.

*H. tetrapterum.*—Near Otterspool, Watford.

*Geranium pusillum.*—Between Harefield and Rickmansworth.

*Impatiens parviflora.*—Borders of Ashridge Park, Tring.—E.

*Genista anglica.*—Stanmore Common.

*Anthyllis vulneraria.*—The canal-side, Tring.—E.

*Onobrychis sativa.*—Near Rickmansworth.

*Prunus institia.*—Near Aldenham Abbey, Watford.

*Potentilla argentea.*—Brickhill Green, Berkhampstead.—E. Near Rickmansworth.

*Rubus Idæus.*—Brickhill Green, Berkhampstead.—E.

*Rosa rubiginosa.*—Berkhampstead Castle.—E.

*Epilobium angustifolium.*—Berkhampstead.—E.

*Ribes Grossularia.*—Near Battler's Green, Aldenham.

*Sedum Telephium.*—Between Berkhampstead Castle and the Common.—E.

*S. acre.*—On old walls, Berkhampstead.—E.

*Saxifraga granulata.*—Picott's End, Harpenden.—P.

*Hydrocotyle vulgaris.*—Stanmore Common.

*Galium cruciatum.*—Sheephanger Common, Boxmoor.—P.

*Valeriana dioica.*—In the moat at Berkhampstead Castle.—E.

*Carduus pratensis.*—Stanmore Common.

*Centaurea Cyanus.*—Berkhampstead.—E.

*Matricaria Parthenium.*—Berkhampstead.—E.

*Senecio sylvaticus.*—Near Radlett.

*Inula Conyza.*—Berkhampstead Common.—E.

*Lactuca muralis.*—Letchmore Heath, Aldenham.

*Campanula glomerata.*—Ravensburgh Castle, Hexton.—E.

*Specularia hybrida.*—In a cornfield near Park Street.

*Gentiana Amarella.*—Near Ravensburgh Castle, Hexton.—E.

*Menyanthes trifoliata.*—Near the Great Northern railway-station, Harpenden.

*Cuscuta europæa.*—Near Latimer.—P.

*Atropa Belladonna.*—Near Bovingdon.—P. Berkhampstead Common.—E.

*Limosella aquatica.*—Near Bricket Wood, Watford.—P.

*Lathræa squamaria.*—Green End, near Boxmoor.—P. Parasitic on the elm, Mackery End, Harpenden.

*Mentha hirsuta.*—In the moat at Berkhampstead Castle.—E.

*Scutellaria galericulata.*—Berry Grove, Aldenham.

*Marrubium vulgare.*—The Wilderness, Berkhampstead, and Ashridge Common, Tring.—E.

*Stachys palustris.*—In the reservoir-stream between Elstree and Radlett.

*Lithospermum arvense.*—Near Kemp Row, Aldenham.—G.

*Lycopsis arvensis.*—Near Battler's Green, Aldenham.

*Daphne Mezereum.*—Near Gaddesden.—P.

*Mercurialis annua.*—On a flint-wall, Hemel Hempstead.—P.

*Orchis ustulata.*—Near Tring railway-station.—P.

*O. Morio.*—Near Ayot St. Lawrence.—P. Hedges Farm, St. Albans; and near Radlett.

*Habenaria bifolia.*—In a wood near Ashlyns, Berkhampstead.—E.

*Ophrys muscifera.*—In a wood beyond Haresfoot Park, Berkhampstead.—E.

*Cephalanthera grandiflora.*—Ochridge Wood, Berkhampstead.—E. In a wood near Box Lane, Boxmoor.—P.

*Paris quadrifolia.*—Near Berkhampstead.—E. Near Boxmoor.

*Carex pendula.*—Near Shenley.

*Phragmites communis.*—Near Aldenham Abbey, Watford.

*Aira flexuosa.*—Stanmore Common.

*Sclerochloa rigida.*—The canal-side, Berkhampstead.—E.

*Briza minor.*—Berkhampstead.—E.

*Blechnum spicant.*—Bricket Wood, St. Albans.

*Asplenium Trichomanes.*—On the wall at Aldenham Church.

*A. Adiantum-nigrum.*—Near Kemp Row, Aldenham.

*Scolopendrium vulgare.*—Battler's Green, Aldenham.

*Cystopteris fragilis.*—Berry Grove, Aldenham.

*Lastræa Oreopteris.*—Berry Grove, Aldenham.

A curious case of retrogressive metamorphosis was observed in some specimens of *Cardamine pratensis* which were gathered in May at the Harpenden field-meeting. The stamens and pistils had both assumed a petaloid form, and the blossoms presented the appearance of so-called double flowers. These curious flowers grew in the damp meadows by the river-side at Cold Harbour amongst ordinary forms of the same plant, and were by no means scarce.—*Ada Selby, Battler's Green, Aldenham.*

*Flowering of Plants at Royston in* 1882.—The extreme mildness of the winter and spring of 1882 has been so much the subject of remark that its influence in the promotion of an unusually early maturity of flowering plants can scarcely excite any very great surprise. The flowering period has been, on an average, nearly a month earlier than usual, and many of our rarer species have been unusually abundant. The somewhat rare *Astragalus hypoglottis* or purple milk-vetch, and the elegant *Spiræa filipendula*, have been so abundant on Royston Heath as almost to cover the ground in some parts; and to a less extent the same remark applies to the rare *Cineraria campestris*, to the still rarer *Thesium linophyllum* (one of the rarest species of this county), also to the rare *Orchis ustulata* and *Gymnadenia conopsea*; while the interesting *Ophrys apifera* (bee orchis), of which there is no record for Royston Heath in the 'Flora Hertfordiensis,' appeared this year at several different spots on the heath a considerable distance apart; and at two of these spots it was so common that it would scarcely be an exaggeration to say that it could be gathered by the handful. I was somewhat puzzled by its sudden and total disappearance at one of these spots, not a vestige of the foliage being discovered a week after I had found it in such abundance. Had the plants been gathered by passers-by, one would expect to see at least some remnants. A flock of sheep had just been grazing over the spot. Does any one know if sheep are fond of orchidaceous plants? *Thalictrum minus*, *Antennaria dioica*, and *Galeopsis versicolor* have flowered freely. The orchidaceous tribe, always a capricious family, has not only upset the established record of local floras, but the commoner species, such as *Orchis maculata*, have been as common as weeds by the roadside. The cornflower (*Centaurea Cyanus*) extended its habitats enough to satisfy its imperial admirer the Emperor of Germany. *Iberis amara* was very frequently met with near the Great Northern Railway on the borders of the two counties of Hertford and Cambridge. But the effect of the exceptional season was most noticeable in the case of the somewhat rare *Gentiana Amarella*. Many parts of Royston Heath were literally covered with dwarfed specimens of this pretty blue flower, and the many thousands of its little conical buds which showed above the short herbage were very conspicuous.

During the spring and summer last year I noticed an unusual number of white-flowered varieties, including the following species:—*Hyacinthus non-scriptus*, *Polygala vulgaris*, *Valeriana officinalis*, *Centaurea nigra*, *Verbena officinalis*, and *Stachys arvensis*.

As we are thus far passing through another mild season, the above notes may perhaps be useful for purposes of comparison, and as suggesting some of the directions in which (should it continue) its modifying influence may be looked for in the great wild flower-garden.—*A. Kingston, Royston.* (*Communicated by J. Hopkinson.*)

## Entomology.

*Injurious Insects at Harpenden in* 1881 *and* 1882.—The season of 1881 was particularly prolific in insect-life, in fact the number and

variety of enemies which infested our fields and gardens in that year was appalling; this was especially noticeable during the months of May, June, and July. In 1882 there was much less to observe, only isolated specimens of the greater number of the worst kinds of insects being seen.

During the months of May and June, 1881, the wireworm (*Agrestes obscurus*) did considerable damage to the growing crops of wheat and barley, and some fields of oats were so badly injured in this neighbourhood that they had to be ploughed up; but in 1882 there was little apparent injury done by these larvæ.

In the early days of June, 1881, the pea-weevil (*Sitones lineatus*) did irreparable damage to the crops of peas, by causing the vine to die off from the roots. The turnip-fly (*Phyllotreta undulata*) was very busy this month, and particularly in the course of the first four days, which were exceedingly hot, entirely destroying large areas of turnips, and also in many instances every plant of charlock (*Sinapis arvensis*) which grew amongst the corn, so that fields which at one time threatened to be covered with this obnoxious plant were entirely freed. So ravenous was the "fly" during these scorchingly hot days of June that it attacked large coarse leaves of horse-radish (*Armoracia rusticana*) in the gardens of this neighbourhood. From numerous observations it appears that these insects have a great preference for all species of plants belonging to the Cruciferous family. The moist and colder season of 1882 kept the ravages of the "fly" in check.

In 1881, early in June, many barley-fields were observed with their growing plants covered with white froth, the so-called "cuckoo-spit" (*Aphrophora spumaria*), caused by the insect *Cicada*. The Rev. T. A. Preston, to whom some specimens were transmitted, says: "The insect produces this froth from its own body, though no doubt it obtains some of the fluid from the plants upon which it is found. It seems very harmless, and though often abundant is seldom complained of." Miss Ormerod, however, says: "I am not sure that the cuckoo-spit does not give cause for complaint, as I hear a good deal about it in the way of doubts and difficulties." It was noticed after heavy rain on the 26th of June that the whole of the spittle was washed off, and that the barley plants appeared to have sustained little if any injury. It was not observed in 1882.

In 1881 *Aphis rumicis* was observed thickly infesting plants of *Centaurea nigra*, *Carduus arvensis*, and *Urtica dioica*, and the black ant seemed to be very busy amongst them. *Anthomyia ceparum* (onion-fly) produced great havoc on the lighter soils, whole beds of onions dying off through its depredations. The crop on soils of a closer texture appeared to suffer less. *Abraxas grossulariata* (the caterpillar of the gooseberry-moth) did considerable damage to the foliage of the gooseberry during the month of June; and the gooseberry saw-fly (*Nematus Ribesii*) greatly damaged the fruit in certain localities in this neighbourhood, the ground under the trees being frequently seen thickly strewn with berries, which being examined were found perforated by this destructive insect.

*Mamestra Brassicæ* was observed at the end of June, 1881, and *Pieris Brassicæ* was very busy depositing its eggs in great quantity upon the under surface of cabbage-leaves. The caterpillars of the white butterfly did a large amount of damage in 1882 to the cabbage tribe, especially to plants in the vicinity of houses from which birds were frightened away.

*Cecidomyia tritici* and *Aphis granaria* were very abundant, and did great injury to the wheat crops of 1881; the seeds of *Alopecurus pratensis* were likewise observed with the orange grub of the wheat-midge upon them. A few were noticed in 1882, but more particularly was this the case on the white wheats.

After a slight thunderstorm on the morning of July 14th, 1881, many pods of peas were observed with a small red maggot similar to that which is frequently seen upon the leaves of the creeping thistle. Miss Ormerod conjectures that they were *Cecidomyia* (*Diplosis*) *pisæ*. On closely examining the pea-pods they were invariably found enlarged by the growth of a fungus on the inner coating of the shell. On July 24th several large caterpillars of the turnip-moth (*Agrotes segetum*) were observed travelling from one side of a roadway to the other.

Earwigs were moderately plentiful in 1881, and more so in 1882.

On July 17th, 1881, a large block of furze (*Ulex europæus*) of several yards in extent was observed with a covering composed of a most beautiful and delicately-formed web that had a very attractive appearance, and upon the upper surface of the web were myriads of microscopically-small red mites. A specimen was sent by me to the Scientific Committee at South Kensington, and pronounced by Mr. McLachlan to be *Tetranychus lincarius*. A small patch or two was seen in 1882, but not nearly so brilliant in character as those of 1881. The plants upon which the web was located did not appear to suffer to any extent, although they seemed rather sickly for a time.

When taking up the mangel-wurtzel crop in 1882, large numbers of the caterpillar of the silver Y-moth (*Plusia Gamma*) were seen. This creature appears to be very abundant in rainy seasons (such as October of the year 1882, when 3½ inches of rain more than the average was recorded for Harpenden), but is less frequent in dry years. These caterpillars do not seem to injure corn-crops, but are exceedingly destructive to newly-planted cabbages, beans, and peas; and the dying-off of young clover plants in this district during the autumn of 1882 may in part be due to their depredations.—*J. J. Willis, Harpenden.* (*Communicated by J. Hopkinson.*)

XXXIII.

# NOTES ON THE RIVER LEA BELOW HERTFORD.

By Richard B. Croft, R.N., F.L.S., Hon. Sec.

*Read at Ware, 19th April,* 1883.

The River Lea is one of the northern tributaries of the Lower Thames, rising out of springs in Leagrave Marsh situate in the county of Bedford and about three miles above the town of Luton. After falling thence through Wheathampstead and Hatfield, it receives in Woolmers Park a considerable addition from a spring rising from the chalk, on its left bank. From Hatfield downwards the Lea receives numerous torrents on its right bank, which render its stream turbid after heavy rains, but in drier weather they lose their water in the chalk before reaching the river. A little above Hertford the Lea receives the waters of the Mimram, or Maran, a stream rising in Lilley Bottom, and collecting the waters of many springs at Whitwell, Welwyn, Tewin, etc., and those of Kimpton Bottom. This river passes through many beautiful parks, amongst others through the Hoo, Kimpton, where it forms a small lake, and through Lockleys, Tewin Water, and Panshanger. Immediately below Hertford the Lea is again augmented by the waters of the Beane. This river originates in the surface-drainage of Cottered, Rushden, Ardeley, Weston, etc., which at Walkern is augmented by some springs from the chalk, and from thence running south is enlarged at Frogmore by a brook which drains Stevenage, Knebworth, etc. At Watton it is considerably augmented by springs on its left bank, and in Woodhall Park receives the Munden Brook, a winter torrent of some magnitude, though utterly evanescent in summer; and from hence its course is due south to Hertford. After receiving the Beane the Lea proceeds to Ware Park, where it is entered by the Rib, a very interesting stream, which has already been described. Below Hertford the valley widens considerably, the alluvial meadows on its right bank contrasting pleasantly with the wooded heights of Ware Park on the left.

We now come to a spot connected by tradition with the final overthrow of the Danes by King Alfred, for we learn from the old chronicles that after the consolidation of Saxon England into a Monarchy under Egbert (828), our country was subject to frequent ravages on the part of the Danes, and many parts of England suffered from their incursions. Crossing the Northern Sea in their light barques, they made their way up the streams and rivers, and we are told that one horde sailed up the Lea from Blackwall and effected a settlement at Ware, where they are supposed to have constructed a weir, to form a harbour of this portion of the valley; hence the name of the town. Here also according to some authorities they built a fort, and certain earthworks near Chadwell are pointed out as being the remains of the Danish fortifications. Right through these earth-works formerly ran the Ermine

Street, one of the principal Roman military roads, which here crossed the valley. Half a mile to the southward is a "barrow" supposed to mark a spot where the Danes defeated the citizens of London, who marched to attack them by the said Ermine Street. After frequent attempts to dispossess the Danes, King Alfred is said to have constructed two forts lower down the valley, and to have restrained the tides from flowing by means of a large dam at Blackwall, and by dividing the course of the river at Waltham. The Danish ships being stranded, their crews abandoned them, and marched to the Quat Bridge on the Severn, whither they were followed and completely overthrown by King Alfred. Leland mentions in his 'Itinerary' that when in the beginning of the seventeenth century a new bridge was being built at Stanstead Abbotts, fragments of ships were discovered in the bed of the river. The Ermine Street crossed the Lea by a ford, a little above Ware, and in a field on the north bank, across which the ancient roadway formerly went, have been found many Roman coins, besides stone coffins, and coins of a much later date. This field, now allotment-gardens, is called the Bury Field, and is surmised to have been the burial-ground of the monks of Ware Priory.

After passing through the grounds of the Priory, the Lea flows through the pleasant busy town of Ware. The staple trade here is maltmaking, and the many cowls form a curious and picturesque feature in the landscape; many barges trade from this place, conveying malt, bricks, and gravel to London, and returning laden with barley, coals, or other merchandise. Before the New River was formed the water from the Chadwell Spring used to flow into the Lea near where the bridge is now built. Below the town is a navigation-cut which rejoins the old bed of the stream near St. Margarets. The portion of the river thus cut off is very beautiful as it winds its sinuous way, fringed with pollard willows, through the rich meadows. These are the waters which old Izaak Walton loved so well and described so happily in his perfect pastoral, 'The Complete Angler;' here he assisted at the destruction of that "villainous vermin," the otter; and here he caught that wonderful chub—that chub with the white spot on his tail that we all wot of so well. These waters are still famed for their fish, they are strictly preserved, and with others in the neighbourhood are known as the Amwell Magna Fishery.

Opposite the confluence of the Ash (a stream which has already been described in the 'Transactions' of this Society) and the Lea, is situated Amwell, one of the most picturesque villages in the valley. Here is a copious spring (Emma's Well), the waters of which reinforce the New River, and here are the remains of very considerable earthworks, surmised to be those made by King Alfred during his campaign against the Danes. Nearly opposite, on the left bank of the river, is a field called "Garrison Field," where a quarter of a century ago a rampart could be traced; this is supposed to be the site of Alfred's second fort. A barrow has recently been discovered at Easneye, which occupies a wooded prominence

opposite Amwell, but it has not as yet been explored. The Lea then divides the parishes of Stanstead Abbotts and St. Margarets, and arrives at the Rye House, now celebrated as a holiday resort for Londoners, but formerly as the spot where, if a certain plot had been successful, King Charles the Second would have been murdered. Immediately below the Rye House the Lea receives the waters of the Stort, a river of such importance that I hope its history may be made the subject of a separate memoir; but in the meantime I will refer my readers to a very interesting account of it in Chauncy's 'History of Hertfordshire' (1700).

Below this the scenery is very pleasing, the broad deep slowly-running river, the pleasant meadows, the pollard willows, and the Essex hills, on which Nazing Church forms a conspicuous landmark, unite to form a picture of pastoral beauty which for ages past has given peace and quietness to the jaded Londoner who has followed the example of good old Izaak Walton, and come here a-fishing. At Dobbs Weir, the first weir below the confluence of the Lea and Stort, a trout of 12lbs. 4ozs. was caught in 1881; this is the largest Lea trout of which I have been able to obtain authentic information. After passing Carthagena Weir and lock, the river runs by Broxbourne Gardens, and here there is a beautiful row of Lombardy poplars, which have happily not succumbed, as so many of their species have, to the cold of recent winters. At Broxbourne Mill is a remarkably fine weeping willow, said to have been brought as a sapling from the tomb of Napoleon at St. Helena. Broxbourne Church on a slight eminence overlooks the river, which wends its quiet way to King's Weir, where the navigation-cut leaves the old river, which meanders pleasantly through the Government property at Waltham, where are the gunpowder factories. Here are large groves of walnut-trees, which were planted at the beginning of the present century to provide wood for the musket-stocks of the army, though I believe that it has not been found necessary to fell the timber for this purpose. Here also willows and alders are cultivated for use in the manufacture of gunpowder.

After passing numerous mills and magazines, the old river divides into many branches, passing through the town of Waltham Abbey, or Waltham Holy Cross. The navigation-cut, which leaves the bed of the old river as before mentioned at King's Weir, crosses one of the branches thereof at the aqueduct-lock; this branch, called the Small Lea, flows parallel to the river on its right bank, and does not rejoin it till some distance below Waltham. From the aqueduct-lock to Waltham the barge-river passes through two locks, and its chief interest lies on its left bank, which the old river approaches more or less closely several times.

The interesting town of Waltham Abbey is thus described by Camden. "By Ley, in the English Saxon tongue Lyzean, there stretcheth out a great way in length and breadth a Forest serving for game, stored very full with deere, that for their bignesse, and fatnesse withall, have the name above all other. In times past it was called by way of excellency Foresta de Essex, now Waltham

Forest, of the town of Waltham, in the Saxon speech Weald-ham, that is, a wild or woody habitation; this standeth upon Ley, where, by dividing his Channel, hee maketh divers Eights or Islands, and is not of any great antiquity to make boast of. For when the Kingdome of the Saxons beganne to decay, one Tovie, a man of great wealth and authority, as we reade in the private History of the place, the King's Staller, that is Standard-bearer, for the abundance of wilde beasts there, first founded it, and planted three score and sixe indwellers therein. After his death Athelstane his sonne quickly made a hand of all his goods and great estate; and King Edward the Confessour gave this town to Harold Earle Goodwin's sonne; and streightway an Abbay was erected there, the worke and Tombe both of the said Harold." The following extracts are from Farmer's 'Waltham Abbey.' "This town is seated on the east side of the Lee (which, by Act of Parliament 1 Stat. 13 Eliz. 18, was made navigable from Ware to London), which not only parteth Hertfordshire from Essex, but also parteth itself into several small rivers or rivulets coming into town, and over which are many bridges. These rivers afford plenty of fish, some salmon, trouts, eels, carp, tench, pike, perch, crawfish, and many others." . . . . . "On the one side the town itself hath large and fruitful meadows, some of which are used in common to the town, and tho' innumerable cattle are pastured thereon, the ground is so rich and fertile that the cattle that are constantly kept therein never look lean, though the grass is ever so short. One of these before-mentioned rivulets runs round the marsh, in which the Freeholders have (and none others, though some have lately pretended) a right to fish either with net or angle." Fuller says that the grass of the Waltham meadows, "when first gotten an head, is so sweet and luscious to cattle that they diet them at the first entry therein to half an hour a day, lest they over-eat themselves, which some kine yearly do and quickly die for it, notwithstanding all their keeper's care to the contrary."

At Waltham Abbey there used to be a tulip-tree in the grounds known as the Abbey gardens. In Farmer's 'History of the Abbey of Waltham' there is a picture of it and the following description: "I must not forget the tulip-tree, the largest . . that ever was seen, there being but one more in Great Britain (as I am informed), and that at Lord Peterborough's. It blows with innumerable flowers in the months of June and July." Mr. W. Winters informs me that many unsuccessful attempts were made to propagate from it, that it measured about ten feet in circumference, and that it died and was cut down more than twenty years ago. The wood was very hard and of a dark brown colour. Many pieces of furniture, ornaments, etc., were made from it.

After receiving the waters of the Cobbins brook, which rises between Northweald and Epping, the Lea continues its course to Enfield Lock, where is situate the Government Small Arms Factory; from here to Ponder's End the barge-river follows the ancient course of the stream, another portion of which, known for a part

TULIP-TREE FORMERLY GROWING AT WALTHAM ABBEY.
FROM FARMER'S 'HISTORY OF THE ABBEY OF WALTHAM.'

of its course as the Mar Dyke, branches off from its left bank. Between the towing-path and meadows on the same bank is a magnificent hawthorn hedge, quite five-and-twenty feet high, described as "a marvel of radiant May-blossom in spring." At Ponder's End the navigation, after cutting off an angle of Essex, again crosses the old channel and is continued towards London, while the pleasant old river, reinforced by the truant waters of the Mar Dyke, washes the foot of the Essex hills near Chingford, gives up much of its water to supply the reservoirs of the East London Water Works Company, and rejoins the navigation below Tottenham.

After this the river can hardly be considered interesting. The navigable cut leaves the old river at Lea Bridge, and rejoins it again at Stratford. From here a canal connects it with the Regent's Canal, and another with the Thames at Limehouse. The real mouth of the river, called Bow Creek, is at Barking, and is still used for purposes of navigation. Three streams flow into the river from its right bank below Broxbourne, namely the Turkey-street brook, the Salmon brook, and the Moselle. From the junction of the Stort to Waltham the old river divides the counties of Essex and Hertford, below this it divides the former county from Middlesex.

Having now traced the River Lea from its various sources to its junction with the Thames, it may not be amiss to glance briefly at the physiography and geology of its basin, which may be described as a triangle, its southern angle being at its junction with the Thames, and its north-western and north-eastern angles being near Houghton Regis in Bedfordshire, and Henham-on-the-Hill, in Essex, respectively. The area of this basin is about 500 square miles or 320,000 statute acres; it is bounded on the north by the Chalk range which divides the basins of the Thames and Great Ouse; on the west are the watersheds of the Colne, and other Thames tributaries; on the east that of the Roding, except for a short distance in Essex, where the water-parting divides the country drained by the Stort from that drained by the Chelmer; hence at a spot not far from Henham-on-the-Hill the watersheds of three important rivers, viz. the Thames, Great Ouse, and Blackwater, meet. The Chalk, either bare or covered with drift, takes up the portion of the basin north of an undulating line from Hertford to Henham; the London Clay, the remainder; the Lower London Tertiaries having but a narrow outcrop between them. The various divisions of the drift cover by far the larger portion of the district, the boulder-clay alone occurring over a large portion of it. The gravel and sand beneath the boulder-clay crop out mostly along the bottom and flanks of the valleys; whilst the smaller tracts of Post-glacial gravel, etc., in great part border the streams of their alluvial flats; but there are also patches of "plateau gravel" that seem to be of this age, and others of loam that clearly overlies the boulder-clay. Although most of the streams we have been considering are bordered by a flat strip of alluvium, their newest deposit, there are no large spreads of it, the greatest being where

the Stort flows into the Lea. It consists for the most part of a brown mud or silt, peat or peaty earth also occurring. Hertford is chiefly built on a flat of river-gravel. At Ware and north of Amwell are other similar flats bordering the river, and from St. Margarets southwards is a much broader stratum on an island on which the Rye House is placed. I have abstracted the above from the Memoir of the Geological Survey on sheet 47 of the map of the Survey, to which valuable and exhaustive work I must refer those who wish further to study the geology of this district.

Between Hertford and Ponder's End the Lea is reinforced by a large accession of fresh water from the land-springs which break out from the chalk into the bed of the river.

The Lea is tidal as far as Lea Bridge, and navigable for barges as far as Hertford, a distance of twenty-eight miles. It has been navigable from time immemorial, and its tidal-reaches were probably embanked at a very early date; in the reign of Queen Elizabeth the Parliament legislated for the navigation of the river. While the navigation-works on the Thames and other rivers have fallen into ruins through the abstraction of trade by railways and other causes, on the Lea the weirs, locks, and other works are in better order, the navigation is more efficient, and the trade is greater than at any former period. The Stort is navigable as far as Bishop's Stortford, thirteen and a half miles above its junction with the River Lea. Two great Water Companies, the New River Company and the East London Water Works, supply nearly half of the population of the Metropolis with water; 38,000,000 gallons being daily drawn by them direct from the Lea for this purpose, besides the water from various springs in the valley.

No account of the valley of the Lea would be complete without mention of the New River, the source of which is in the Chadwell springs, half a mile south-west of Ware, but water is now also derived direct from the River Lea, at a point between that town and Hertford. The Chadwell springs vary in volume from 200 to 700 cubic feet per minute. Besides the water from the Chadwell springs and the River Lea, the New River Company obtain water from wells and springs at various places lower down the valley. The New River Conduit was commenced by Sir Hugh Myddleton in the reign of James the First. Its length as originally laid out was 38 miles, but by cutting off bends, straightening, and improving, it is now not more than 28 miles. The cross-sectional area is about 75 square feet, and the velocity about four-tenths of a mile per hour. The fall is not more than 1 in 10,000, and the flow is checked by gates and sluices; the bed of the river-conduit is the natural subsoil with clay-puddle when required.*

* Besides the authorities mentioned in the text I have made use of the following works:—'Flora Hertfordiensis,' Fuller's 'History of the University of Cambridge' and his 'History of Waltham Abbey,' Holland's 'Camden's Britannia' (1637 ed.), and the 'Second Report of the Commissioners appointed to examine into the best means of preventing the Pollution of Rivers.'

XXXIV.

## REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1882.

By the Rev. C. W. Harvey, M.A., F.M.S.

*Read at Ware, 19th April, 1883.*

I am glad to commence my report by saying that our staff of observers is still on the increase. Fanhams Hall, Ware, finds its place among our stations for the first time this year. I regret having to omit Oaklands, Watford, this year; the register for the first part of the year having been mislaid, Mr. Harrison has not been able to supply me with the usual return.

The mean rainfall for 1882 at 29 stations (30·57 ins.) shows an excess of something like 2·50 ins. above the mean of 1870–79. This is chiefly attributable to the exceedingly wet October; and we must go back to the year 1865 to find an October at all like it. The fall in every part of the county was *more than double the mean.* It may be worth while to place the records of these two extremely wet Octobers side by side for comparison. I am able to give the records of 8 stations for 1865:—

| | 1865 ins. | 1882 ins. |
|---|---|---|
| Gorhambury | 6·95 | 7·07 |
| Rothamsted | 7·35 | 6·52 |
| Nash Mills | 6·57 | 6·97 |
| Berkhampstead | 6·55 | 6·88 |
| Bayfordbury | 6·02 | 5·54 |
| Stevenage | 6·30 | 5·81 |
| Hitchin | 7·07 | 5·62 |
| Royston | 6·55 | 5·20 |
| Mean fall | 6·67 | 6·20 |

It will be seen from this that there is not quite half an inch difference in the mean fall of each.

It is interesting to compare results with other counties. This I am able to do as I did last year as regards Wilts and Norfolk, and by the kindness of Mr. D. Radford Sharpe, of Bocking, I am able to add the mean fall of the neighbouring county of Essex. In Wilts the mean fall at 37 stations was 42·86 ins., more than 12 inches above our mean; in Norfolk the mean fall at 26 stations was 32·51 ins., nearly 2 inches above our mean; whilst in Essex the mean fall at 13 stations was 26·69 inches, or nearly 4 inches below our mean. Last year it will be remembered that our mean fall was as nearly as possible the mean of the three counties (Wilts, Herts, and Norfolk); this year, however, our mean is nearly 3 inches below that mean.

*Distribution of Rainfall throughout the Year.*—This was very unequal, the fall of April representing 10·7°/₀ of the whole fall, and that of October representing 12·3°/₀; while the fall of January only represented 4·4°/₀; October and April were respectively most in excess of the mean, whilst January and August showed the

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS.

| River District. | | Station. | Observer. | Latitude. | Longitude. | Diameter of Gauge. | Height of Gauge above Ground. | Height of Gauge above Sea-level. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ins. | ft. ins. | ft. |
| Colne. | Lower Colne | Bushey Heath | Forrester Scott | 51 38 0 N | 0 20 0 W | 5 | 1 0 | 480 |
| | | Watford—Bushey Station | Robert Savill | 51 38 50 N | 0 22 50 W | 5 | 0 6 | 220 |
| | | ,, Watford House | Alfred T. Brett, M.D. | 51 39 25 N | 0 23 35 W | 8 | 1 3 | 240 T |
| | | ,, Wansford House | John Hopkinson | 51 39 45 N | 0 23 40 W | 5 | 1 0 | 224 ↑ |
| | | Rickmansworth—Moor Park | Lord Ebury | 51 37 30 N | 0 26 20 W | 5 | 2 0 | 340 |
| | Ver | St. Albans—Gorhambury | The Earl of Verulam | 51 45 20 N | 0 23 0 W | 6 | 2 6 | 425 |
| | | Harpenden—Rothamsted | Sir J. B. Lawes and Dr. Gilbert | 51 48 10 N | 0 21 30 W | 5 | 0 9 | 420 T |
| | | ,, ,, (2nd gauge) | | 51 48 10 N | 0 21 30 W | 72 × 87 | 0 9 | 420 T |
| | | Dunstable—Kensworth | Miss Grace Jones | 51 51 30 N | 0 30 0 W | 5 | 1 0 | 600 |
| | Gade and Bulbourne. | Hemel Hempsted—Nash Mills | J. Dickinson & Co. | 51 44 0 N | 0 26 40 W | 12 | 2 9 | 237 T |
| | | ,, Great Gaddesden | Rev. W. T. Drake | 51 47 20 N | 0 30 30 W | 8 | 1 0 | 426 |
| | | Berkhampstead | William Squire | 51 45 40 N | 0 33 30 W | 8 | 1 6 | 370 B |
| | | Tring—Cowroast | Hubert Thomas, C.E. | 51 47 0 N | 0 36 30 W | 10 | 4 2 | 345 L |
| Lea. | Lower Lea | East Barnet—Southgate | George A. Church | 51 37 40 N | 0 8 0 W | 6 | 0 6 | 240 T |
| | | Hoddesdon | A. C. McKenzie | 51 45 40 N | 0 0 30 W | 8 | 1 6 | 147 |
| | Upper Lea | Ware | James Muir, C.E. | 51 48 20 N | 0 2 0 W | 12 | 3 0 | 114 T |
| | | Hertford—Bayfordbury | W. Clinton Baker | 51 46 30 N | 0 5 30 W | 8 | 0 4 | 250 |
| | | Hatfield—Brocket Hall | Hon. H. F. Cowper, M.P. | 51 48 0 N | 0 14 0 W | 8 | 1 0 | |
| | Mimram | Welwyn | Rev. C. L. Wingfield | 51 49 50 N | 0 12 30 W | 5 | 0 4 | 230 |
| | | ,, Datchworth | Rev. J. Wardale | 51 51 20 N | 0 9 50 W | 6 | 1 0 | 385 |
| | Beane | Stevenage | Rev. J. O. Seager | 51 55 5 N | 0 11 40 W | 8 | 2 0 | 319 L |
| | | ,, Knebworth | Rev. F. G. Jenyns | 51 52 30 N | 0 12 30 W | 5 | 1 0 | 390 T |
| | Rib | Buntingford—Throcking | Rev. C. W. Harvey | 51 57 5 N | 0 3 0 W | 5 | 1 0 | 484 T |
| | | Royston—Therfield | Rev. J. G. Hale | 52 1 0 N | 0 3 0 W | 5 | 4 3 | 500 |
| | Ash | Ware—Fanhams Hall | Miss Croft | 51 49 0 N | 0 1 0 W | 5 | 1 0 | 253 |
| | | ,, Much Hadham | Rev. T. W. Mott | 51 51 20 N | 0 4 40 E | 5 | 1 0 | 222 B |
| Cam. Ivel. | Hiz | Hitchin | William Lucas | 51 57 0 N | 0 16 20 W | 5 | 2 1 | 238 T |
| | | ,, High Down | Joseph Pollard | 51 57 40 N | 0 20 0 W | 5 | 1 1 | 422 T |
| | Rhee | Royston | Hale Wortham | 52 2 30 N | 0 1 0 W | 8 | 0 16 | 269 ↑ |
| | | ,, Odsey | Ernest O. Fordham | 52 1 25 N | 0 6 40 W | 5 | 0 10 | 257 |
| | | ,, Odsey Grange | H. George Fordham | 52 1 25 N | 0 6 40 W | 5 | 1 0 | 263 ↑ |

TABLE II.—SHOWING THE RAINFALL AT VARIOUS STATIONS IN HERTFORDSHIRE IN 1882.

| STATIONS. | JAN. | FEB. | MAR. | APL. | MAY. | JUNE. | JULY. | AUG. | SEPT. | OCT. | NOV. | DEC. | TOTAL. | DAYS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bushey Heath | 1·42 | 1·46 | 1·39 | 3·41 | 1·41 | 3·75 | 2·45 | 2·02 | 2·74 | 6·75 | 2·96 | 3·12 | 32·88 | 171 |
| Watford—Bushey Station | 1·54 | 1·06 | 1·93 | 3·48 | 1·76 | 3·44 | 2·77 | 1·66 | 2·87 | 6·02 | 3·08 | 3·75 | 33·36 | |
| ,, Watford House | 1·61 | 1·11 | 1·58 | 3·70 | 1·81 | 4·26 | 2·47 | 1·93 | 2·63 | 6·78 | 3·54 | 4·02 | 35·44 | 190 |
| ,, Wansford House | 1·55 | 1·62 | 1·59 | 3·47 | 1·82 | 4·02 | 2·39 | 1·79 | 2·33 | 6·10 | 3·29 | 3·60 | 33·57 | 197 |
| Rickmansworth—Moor Park | 1·58 | 1·45 | 1·50 | 4·01 | 2·86 | 3·72 | 2·36 | 2·01 | 2·46 | 6·51 | 2·97 | 3·61 | 35·04 | 208 |
| St. Albans—Gorhambury | 1·53 | 1·83 | 1·62 | 3·85 | 3·06 | 4·37 | 1·91 | 1·81 | 2·65 | 7·09 | 3·50 | 3·84 | 37·06 | 170 |
| Harpenden—Rothamsted | 1·55 | 1·99 | 1·48 | 3·82 | 2·01 | 3·90 | 2·06 | 2·06 | 2·21 | 6·47 | 3·29 | 3·03 | 33·87 | 206 |
| ,, ,, (2nd gauge) | 1·57 | 2·02 | 1·57 | 3·92 | 2·07 | 3·39 | 2·09 | 2·07 | 2·29 | 6·52 | 3·44 | 3·28 | 34·77 | 211 |
| Dunstable—Kensworth | 1·40 | 1·84 | 1·33 | 2·88 | 2·11 | 2·90 | 2·94 | 2·00 | 2·39 | 6·80 | 3·16 | 2·71 | 32·46 | 176 |
| Hemel Hempsted—Nash Mills | 1·43 | 1·54 | 1·66 | 3·92 | 2·09 | 3·99 | 2·24 | 1·78 | 2·50 | 6·97 | 3·47 | 3·63 | 35·22 | 188 |
| ,, ,, Great Gaddesden | 1·51 | 1·77 | 1·35 | 3·66 | 2·56 | 1·77 | 2·29 | 1·36 | 2·27 | 6·17 | 3·15 | 3·26 | 31·12 | |
| Berkhampstead | 1·57 | 1·96 | 1·47 | 4·20 | 1·78 | 3·46 | 2·64 | 1·58 | 2·42 | 6·88 | 3·68 | 3·67 | 35·31 | 171 |
| Tring—Cowroast | 1·71 | 1·93 | 1·70 | 3·77 | 2·04 | 3·33 | 2·88 | 1·47 | 2·33 | 6·51 | 3·63 | 3·30 | 34·60 | 164 |
| East Barnet—Southgate | 1·45 | 1·41 | 1·44 | 3·44 | 1·52 | 2·98 | 2·11 | 1·65 | 2·41 | 5·41 | 2·85 | 2·85 | 29·52 | 199 |
| Hoddesdon | 1·25 | 1·24 | 1·47 | ·67 | ·98 | 2·15 | 1·40 | 1·49 | 2·30 | 4·48 | 2·62 | 3·27 | 23·32 | 144 |
| Ware | 1·22 | 1·52 | 1·52 | 3·26 | 1·28 | 2·11 | 1·76 | 1·70 | 2·57 | 5·17 | 3·27 | 2·19 | 27·57 | 119 |
| Hertford—Bayfordbury | 1·16 | 1·45 | 1·39 | 3·24 | 1·44 | 1·69 | 1·57 | 1·56 | 2·48 | 5·54 | 3·26 | 2·86 | 27·64 | 175 |
| Hatfield—Brocket Hall | 1·08 | ·86 | 2·10 | 2·23 | 1·90 | 2·94 | 1·56 | 1·27 | 2·75 | 5·69 | 3·77 | 2·63 | 28·78 | 175 |
| Welwyn Rectory | 1·39 | 1·78 | ·97 | 3·69 | 1·80 | 2·46 | 2·36 | 1·87 | 2·36 | 5·91 | 3·07 | 2·72 | 30·38 | 197 |
| Datchworth | 1·29 | 1·70 | 1·17 | 3·29 | 1·58 | 2·22 | 1·96 | 1·87 | 2·02 | 5·54 | 2·82 | 2·24 | 27·70 | 175 |
| Stevenage | 1·34 | 1·87 | 1·27 | 3·16 | 1·52 | 2·73 | 1·83 | 2·05 | 2·03 | 5·81 | 3·09 | 2·78 | 29·48 | 184 |
| ,, Knebworth | 1·43 | 1·98 | 1·57 | 3·56 | 1·83 | 2·97 | 2·28 | 2·10 | 2·30 | 6·30 | 3·53 | 3·07 | 32·92 | 195 |
| Buntingford—Throcking | 1·34 | 1·81 | 1·09 | 3·16 | 1·08 | 2·36 | 1·93 | 1·85 | 2·02 | 5·49 | 3·13 | 2·66 | 27·92 | 193 |
| Royston—Therfield | 1·39 | 1·85 | 1·20 | 3·13 | 1·17 | 2·78 | 2·40 | 1·43 | 2·37 | 5·60 | 3·63 | 2·66 | 29·61 | 170 |
| Ware—Fanhams Hall | 1·11 | 1·45 | 1·49 | 3·49 | 1·18 | 1·77 | 2·08 | 1·70 | 3·13 | 5·07 | 3·10 | 2·79 | 28·36 | 184 |
| ,, Much Hadham | 1·37 | 1·60 | 1·32 | 3·03 | 1·03 | 2·04 | 2·07 | 1·44 | 2·75 | 5·32 | 3·29 | 2·68 | 27·94 | 192 |
| Hitchin | 1·19 | 1·64 | 1·15 | 3·14 | 1·26 | 2·93 | 2·65 | 1·87 | 1·78 | 5·62 | 3·26 | 2·75 | 29·24 | 196 |
| ,, High Down | 1·20 | 1·70 | 1·29 | 3·49 | 1·54 | 2·91 | 2·67 | 1·49 | 2·00 | 4·79 | 3·34 | 2·65 | 28·98 | 179 |
| Royston | 1·17 | 1·76 | 1·23 | 2·91 | 1·04 | 2·28 | 1·92 | 1·12 | 1·69 | 5·20 | 3·22 | 2·67 | 26·21 | 167 |
| ,, Odsey | ·83 | 1·36 | ·97 | 2·43 | ·88 | 2·10 | 1·64 | 1·64 | 1·60 | 4·98 | 2·45 | 2·05 | 22·93 | 181 |
| ,, Odsey Grange | ·96 | 1·51 | 1·15 | 2·46 | 1·00 | 2·25 | 1·81 | 1·75 | 1·68 | 4·84 | 2·64 | 2·09 | 24·14 | |
| Mean for the County | 1·36 | 1·61 | 1·44 | 3·27 | 1·66 | 2·92 | 2·18 | 1·76 | 2·33 | 5·88 | 3·21 | 2·95 | 30·57 | 181 |

TABLE III.—MEAN MONTHLY FALL IN THE RIVER DISTRICTS.

| River District. | January. | Difference from mean 1870-79. | February. | Difference from Mean 1870-79. | March. | Difference from Mean 1870-79. | April. | Difference from Mean 1870-79. | May. | Difference from Mean 1870-79. | June. | Difference from Mean 1870-79. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colne | 1·54 | —1·26 | 1·66 | —·41 | 1·62 | —·13 | 3·65 | +1·47 | 2·11 | —·11 | 3·59 | +1·19 |
| Lea | 1·30 | —1·10 | 1·58 | —·16 | 1·38 | —·24 | 3·03 | +1·11 | 1·41 | —·62 | 2·41 | + ·06 |
| Ivel | 1·19 | —1·03 | 1·67 | +·08 | 1·22 | —·26 | 3·31 | +1·36 | 1·40 | —·42 | 2·92 | + ·79 |
| Cam | 99 | —1·07 | 1·54 | —·05 | 1·12 | —·30 | 2·60 | + ·92 | ·97 | —·93 | 2·21 | + ·08 |

| River District. | July. | Difference from Mean 1870-79. | August. | Difference from Mean 1870-79. | September. | Difference from Mean 1870-79. | October. | Difference from Mean 1870-79. | November. | Difference from Mean 1870-79. | December. | Difference from Mean 1870-79. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colne | 2·42 | —·36 | 1·81 | —·96 | 2·47 | —·24 | 6·58 | +3·87 | 3·32 | +·43 | 3·45 | +1·16 |
| Lea | 1·96 | —·53 | 1·69 | —·72 | 2·42 | —·18 | 5·49 | +3·24 | 3·19 | +·54 | 2·66 | + ·58 |
| Ivel | 2·66 | —·04 | 1·66 | —·61 | 1·89 | —·58 | 5·20 | +3·03 | 3·30 | +·70 | 2·60 | + ·55 |
| Cam | 1·79 | —·32 | 1·50 | —·82 | 1·66 | —·70 | 5·01 | +3·11 | 2·77 | +·49 | 2·27 | — ·37 |

Mean annual fall in 1882 in Colne District 34·24 ins. being 4·65 *above* mean of 1870-79.
,, ,, ,, Lea ,, 28·48 ,, ,, 1·91 ,, ,, ,,
,, ,, ,, Ivel ,, 29·11 ,, ,, 3·45 ,, ,, ,,
,, ,, ,, Cam ,, 24·43 ,, ,, 0·84 ,, ,, ,,

greatest deficiency. The fall of April 25th was no doubt in a great measure the cause of April taking rank as the second wettest month in the year. The mean monthly fall for 1882 differed from the mean monthly fall for 1870–79 by the following amounts:—

| | | | | | |
|---|---|---|---|---|---|
| January | —1·21 | May | — ·46 | September | — ·30 |
| February | — ·21 | June | + ·58 | October | +3·32 |
| March | — ·22 | July | — ·46 | November | + ·46 |
| April | +1·22 | August | — ·84 | December | + ·77 |

*Distribution of Rainfall throughout the County.*—In both the main river-basins into which the county is divided the mean fall was above the mean of 1870–79. In the Thames basin it exceeded the mean by 2·71 ins.; in that of the Ouse by 1·68. In the four river-districts into which these two main river-basins are again divided the excess was most observable in the Colne district, where it was 4·64 ins. above the mean, and least so in the Cam district, where it was only ·84 above it.

In the minor districts into which the above-mentioned four are again sub-divided the mean fall was—

| | | | | | |
|---|---|---|---|---|---|
| Lea | Lower Lea | 26·51 | Colne | Lower Colne | 34·10 |
| | Upper Lea | 27·94 | | Ver | 34·53 |
| | Mimram | 29·04 | | Gade | 34·10 |
| | Beane | 30·70 | | | |
| | Rib | 28·76 | Ivel | Hiz | 29·11 |
| | Ash | 28·19 | Cam | Rhee | 24·43 |

Thus it will be seen the Ver shows this year the greatest mean rainfall; whilst as usual the Rhee shows the smallest. Generally it is the Lower Colne which shows the greatest excess.

The absolute maximum fall for each month and the station at which it occurs is as follows:—

| | | | |
|---|---|---|---|
| Jan. 8th—Therfield | ·73 | July 12th—Hitchin | ·75 |
| Feb. 14th—Therfield* | ·69 | August 14th—ditto | ·41 |
| March 25th—Hoddesdon | ·91 | Sept. 19th—Bayfordbury | 1·03 |
| April 25th—Welwyn | 1·19 | Oct. 24th—Brocket Hall | 1·92 |
| May 22nd—Gorhambury | 1·25 | Nov. 15th—Bayfordbury | 1·21 |
| June 3rd— ditto | 1·40 | Dec. 30th—Hoddesdon† | 1·03 |

To this I have to add the usual analysis of the wettest day in each month—

January 1st at 1 station; 5th at 1; 7th at 1; 8th at 24; 9th at 1.
February 13th at 1; 14th at 10; 28th at 17.
March 1st at 2; 25th at 25; 28th at 1.
April 13th at 1; 14th at 1; 17th at 1; 25th at 25.
May 5th at 14; 22nd at 6; 25th at 6; 29th at 1.
June 3rd at 4; 5th at 1; 9th at 7; 11th at 1; 18th at 1; 23rd at 1; 24th at 5; 26th at 7.
July 5th at 2; 7th at 2; 9th at 2; 11th at 19; 21st at 1; 24th at 1; 25th at 1.
August 11th at 1; 14th at 2; 15th at 11; 16th at 4; 22nd at 10; 23rd at 0.
September 19th at 13; 20th at 2; 21st at 1; 28th at 9; 29th at 2; 30th at 1.
October 16th at 1; 21st at 5; 23rd at 1; 24th at 2; 27th at 19.
November 6th at 2; 12th at 1; 15th at 20; 16th at 3; 17th at 1. The fall on the 15th was chiefly in the form of snow.
December 7th at 4; 25th at 8; 30th at 16.

* And Royston. † And Brocket Hall.

In May, June, and November, the number of wet days were not recorded at Great Gaddesden.

From this analysis it appears that the wettest day in each month was—

| | | | | | |
|---|---|---|---|---|---|
| January | 8th | May | 5th | September | 19th |
| February | 28th | June | 9th and 26th | October | 27th |
| March | 25th | July | 11th | November | 15th |
| April | 25th | Aug. | 15th and 22nd | December | 30th |

On the days of max. fall in each month the following falls of 1 inch or more have come to my notice:—

April 25th, Watford House, 1·03; Moor Park, 1·01; Rothamsted, 1·05; Southgate, 1·18; Ware, 1·11; Datchworth, 1·14; Stevenage, 1·08; Knebworth, 1·16; Throcking, 1·04; Therfield, 1·05; Hadham, 1·10; Hitchin, 1·09.
May 22nd, Moor Park, 1·16.
September 19th, Fanhams Hall, Ware, 1·00; Hadham, 1·08.
November 15th, Therfield, 1·13.
December 30th, Nash Mills, 1·02.

The other falls of 1 inch or more which occurred on days other than the days of max. monthly fall are—

June 16th, Bushey Heath, 1·03; Nash Mills, 1·16.
October 27th, Knebworth, 1·04; Nash Mills, 1·01; Hitchin, 1·12.

The mean number of wet days has next to be considered.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Jan. | wet days | 10 | being | 6 below | mean. | July | wet days | 20 | being 7 above mean. |
| Feb. | ,, | 10 | ,, | 5 below | ,, | Aug. | ,, | 13 | ,, 1 below ,, |
| Mar. | ,, | 11 | ,, | 3 below | ,, | Sept. | ,, | 13 | ,, the mean. |
| Apl. | ,, | 14 | ,, | 1 above | ,, | Oct. | ,, | 23 | ,, 8 above ,, |
| May | ,, | 10 | ,, | 3 below | ,, | Nov. | ,, | 20 | ,, 4 above ,, |
| June | ,, | 18 | ,, | 3 below | ,, | Dec. | ,, | 19 | ,, 4 above ,, |

There was therefore a deficiency in the number of wet days during the first three months of the year, and an excess during the last three.

I have again, as in 1880 and 1881, to record snow in October, at least so far as my own observation is concerned, a slight shower falling upon the 24th.

Of the heavy falls of rain the only one which appears to have been at all general is that of April 25th. Falls of over an inch occurred in 7 months—April, May, June, September, October, November, and December.

I am glad to be able to conclude my report in the same manner as last year, *i.e.* by announcing two additions to our rainfall stations, one of which is especially important, as it gives us a representative station in the river-district of the Upper Thame. The Rev. W. Quennell has commenced observations at Tring, and the Rev. C. O. Miles at Barley, near Royston.

XXXV.

# METEOROLOGICAL OBSERVATIONS TAKEN AT THROCKING, HERTS, DURING THE YEAR 1882.

By the Rev. C. W. Harvey, M.A., F.M.S.

*Read at Ware, 19th April,* 1883.

*Position of Station,* Lat. 51° 57′ N.; Long. 0° 3′ W.; Rib District.
*Height of Station above sea-level,* 484 feet.
*Times of Observing,* 9 a.m. and 9 p.m.

The most noteworthy features in the Meteorology of the year seem to be the exceptionally high pressure of January, and the excessive rainfall of October. We have not had so wet an October since the year 1865; while for a pressure above 30·9 ins. we must go back perhaps to the year 1825, when on January 9th at 9 a.m. the barometer in London registered 30·92. There was also a remarkably brilliant display of Aurora Borealis between the 13th and 24th of November, especially on the 18th.

In the subjoined table I have compared the year as far as possible with an average year:—

| Months. | Pressure. | | Temperature. | | Rainfall. | |
|---|---|---|---|---|---|---|
| | Mean * | Difference | Mean * | Difference | Mean † | Difference |
| | 1866–75 | 1882 | 1857–69 | 1882 | 1870–79 | 1882 |
| | ins. | in. | ° | ° | ° | ° |
| January | 29·86 | +·44 | 38·0 | +0·4 | 2·40 | —1·06 |
| February | 29·96 | +·26 | 40·5 | —1·0 | 1·74 | + ·07 |
| March | 29·93 | +·10 | 42·5 | +1·8 | 1·62 | — ·50 |
| April | 29·96 | —·10 | 48·5 | —2·4 | 1·92 | +1·24 |
| May | 29·98 | +·12 | 54·0 | —2·8 | 2·03 | — ·95 |
| June | 30·03 | —·18 | 60·0 | —5·7 | 2·35 | + ·01 |
| July | 29·98 | —·07 | 63·5 | —5·4 | 2·49 | — ·56 |
| August | 29·98 | —·38 | 62·5 | —4·6 | 2·41 | — ·56 |
| September | 29·93 | —·09 | 59·0 | —0·2 | 2·60 | — ·58 |
| October | 29·90 | —·08 | 52·0 | —3·5 | 2·25 | +3·24 |
| November | 29·92 | —·17 | 43·5 | —2·6 | 2·65 | + ·48 |
| December | 29·90 | —·25 | 40·5 | —3·2 | 2·08 | + ·56 |
| Year | 29·94 | —·03 | 50·5 | —4·1 | 26·57 | +1·35 |

From this table it appears that there was a general deficiency of pressure after the first five months, August showing the greatest deficiency; temperature was below the average in each month except January and March, the deficiency being greatest in the three

* London and Yarmouth. † Lea District.

## Results of Meteorological Observations taken at Throcking Rectory, Herts, in 1882.

| Months. | Pressure of the Atmosphere. | Temperature of the Air. | | | | | | | | | | Humidity of the air. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 9 a.m. | Means of | | Adopted Mean. | Mean Daily Range. | Absolute Min. and Max. | | | | Absolute Range. | Dryness. | Tension of Vapour. | Relative Humidity. |
| | | | Min. | Max. | | | Min. | Date. | Max. | Date. | | | | |
| | ins. | ° | ° | ° | ° | ° | ° | | ° | | ° | ° | in. | % |
| January | 30·30 | 37·9 | 34·5 | 43·5 | 38·4 | 9·0 | 27·9 | 26th | 50·4 | 6th | 22·5 | 0·5 | ·216 | 94 |
| February | 30·22 | 38·5 | 34·5 | 45·2 | 39·5 | 10·7 | 24·9 | 2nd | 53·4 | 26th | 28·5 | 1·9 | ·216 | 93 |
| March | 29·30 | 43·7 | 37·6 | 53·7 | 44·3 | 16·1 | 25·2 | 22nd | 65·3 | 18th | 40·1 | 3·9 | ·245 | 87 |
| April | 29·86 | 47·1 | 38·7 | 55·8 | 46·1 | 17·1 | 29·2 | 16th | 69·1 | 21st | 39·9 | 5·3 | ·265 | 83 |
| May | 30·10 | 54·2 | 43·5 | 62·1 | 51·2 | 18·6 | 33·9 | 16th | 69·6 | 28th | 35·7 | 6·6 | ·331 | 77 |
| June | 29·85 | 56·2 | 54·3 | 63·1 | 54·3 | 8·8 | 39·5 | 13th | 71·3 | 29th | 31·8 | 5·0 | ·384 | 83 |
| July | 29·91 | 59·5 | 56·7 | 67·6 | 58·1 | 10·9 | 41·3 | 27th | 75·2 | 3rd | 33·9 | 6·6 | ·401 | 80 |
| August | 29·60 | 59·0 | 51·0 | 66·8 | 57·9 | 15·8 | 44·5 | 24th | 77·6 | 6th* | 33·1 | 7·1 | ·401 | 79 |
| September | 29·84 | 53·3 | 45·9 | 61·0 | 52·8 | 15·1 | 39·4 | 15th | 69·0 | 3rd | 29·6 | 2·7 | ·377 | 91 |
| October | 29·82 | 48·6 | 43·2 | 55·3 | 48·5 | 12·1 | 29·4 | 26th | 66·7 | 1st | 37·3 | 1·5 | ·320 | 95 |
| November | 29·75 | 40·5 | 36·4 | 46·5 | 40·9 | 10·1 | 26·9 | 18th | 57·4 | 5th | 30·5 | 2·1 | ·233 | 92 |
| December | 29·65 | 36·8 | 33·5 | 42·4 | 37·3 | 8·9 | 19·1 | 11th | 53·4 | 27th | 34·3 | 0·0 | ·212 | 97 |
| Year | 29·91 | 47·9 | 42·5 | 55·2 | 46·4 | 12·7 | 19·1 | Dec. 11 | 77·6 | Aug. 6* | 58·5 | 3·7 | ·289 | 87 |

* And 12th.

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THROCKING RECTORY, HERTS, IN 1882—(*continued*).

| Months. | Rainfall. | | | | | Cloud. | | | Wind. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Fall. | Max. fall in 24 hours. | | No. of days of | | Mean Amount 0–10. | No. of days of | | Mean Force 0–12. | Number of days of | | | | | | | | | |
| | Ins. | Ins. | Date. | Rain or Snow. | Snow only. | | Clear Sky. | Over-cast. | | N. | N.E. | E. | S.E. | S. | S.W. | W. | N.W. | Calm. |
| January | 1·34 | ·51 | 8th | 12 | 0 | 8·1 | 3 | 18 | 2 | 1 | 0 | 0 | 1 | 13 | 7 | 6 | 3 | 0 |
| February | 1·81 | ·64 | 14th | 11 | 1 | 8·2 | 3 | 18 | 2 | 1 | 0 | 4 | 1 | 8 | 6 | 6 | 2 | 0 |
| March | 1·09 | ·56 | 25th | 11 | 1 | 4·6 | 9 | 8 | 3 | 1 | 0 | 0 | 1 | 1 | 8 | 13 | 6 | 0 |
| April | 3·16 | 1·04 | 25th | 16 | 0 | 6·4 | 3 | 12 | 3 | 3 | 2 | 5 | 2 | 8 | 3 | 4 | 3 | 0 |
| May | 1·08 | ·45 | 5th | 9 | 0 | 6·8 | 2 | 6 | 2 | 5 | 3 | 5 | 5 | 4 | 2 | 2 | 4 | 0 |
| June | 2·36 | ·42 | 26th | 17 | 0 | 7·6 | 0 | 11 | 2 | 4 | 0 | 5 | 0 | 3 | 4 | 5 | 9 | 0 |
| July | 1·93 | ·38 | 11th | 21 | 0 | 6·8 | 1 | 5 | 2 | 5 | 0 | 1 | 0 | 6 | 18 | 1 | 0 | 0 |
| August | 1·85 | ·43 | 15th | 13 | 0 | 7·2 | 1 | 6 | 2 | 3 | 2 | 1 | 1 | 4 | 4 | 8 | 8 | 0 |
| September | 2·02 | ·52 | 28th | 12 | 0 | 5·8 | 0 | 8 | 2 | 6 | 4 | 3 | 1 | 3 | 4 | 4 | 5 | 0 |
| October | 5·49 | ·93 | 27th | 24 | 0 | 8·0 | 1 | 16 | 2 | 1 | 2 | 6 | 4 | 7 | 2 | 5 | 4 | 0 |
| November | 3·13 | ·68 | 15th | 22 | 1 | 5·1 | 5 | 7 | 3 | 5 | 2 | 1 | 0 | 3 | 4 | 9 | 6 | 0 |
| December | 2·66 | ·61 | 25th | 25 | 3 | 8·1 | 3 | 19 | 2 | 5 | 3 | 1 | 6 | 3 | 3 | 7 | 3 | 0 |
| Year | 27·92 | 1·04 | Apl. 25 | 193 | 6 | 6·8 | 31 | 134 | 2·3 | 40 | 18 | 32 | 22 | 63 | 65 | 70 | 53 | 0 |

summer months; rainfall, which for the year was slightly below the mean for the county, was above that for the district; in six out of the twelve months the fall was above the monthly average, April and October showing the greatest excess, January and May the greatest deficiency.

Pressure.—The only occasion upon which the barometer fell below 29·0 ins. was on March 1st; on the other hand the high pressure of January and February calls for more than a passing remark; on the 17th and 18th, finding pressure unusually high, I took observations at intervals of three hours during the daytime with the following results:—

| | 9 a.m. ins. | 12 noon. ins. | 3 p.m. ins. | 6 p.m. ins. | 9 p.m. ins. |
|---|---|---|---|---|---|
| Jan. 15th | 30·68 | ..... | ..... | ..... | 30·83 |
| ,, 16th | 30·84 | ..... | ..... | ..... | 30·88 |
| ,, 17th | 30·93 | 30·85 | 30·86 | 30·88 | 30·90 |
| ,, 18th | 30·94M | 30·92 | 30·88 | 30·90 | 30·92 |
| ,, 19th | 30·88 | ..... | ..... | ..... | 30·81 |
| ,, 20th | 30·73 | ..... | ..... | ..... | 30·73 |
| ,, 21st | 30·71 | ..... | ..... | ..... | ..... |

From these values it seems that during the two days of highest pressure the barometer stood higher at 9 a.m. and 9 p.m. than during the intervening hours of the day. Pressure also exceeded 30·7 ins. on Feb. 19th and 20th, the barometer at 9 p.m. on 19th standing at 30·74 and at 9 a.m. on the following day at 30·79 ins.

Temperature.—The mean temperature of the year, 46°·4, was 0°·2 above that of 1881, but 0°·7 below that of 1880; the mean temperature of the three years is therefore about 46°·5. The following are the four highest maxima and lowest minima during the year:—

| Highest Maxima. | | Lowest Minima. | |
|---|---|---|---|
| (*a*) Aug. 6th and 12th | 77°·6 | (*a*) Dec. 11th | 19°·1 |
| (*b*) July 3rd | 75 ·2 | (*b*) ,, 12th | 19 ·7 |
| (*c*) ,, 30th | 74 ·1 | (*c*) ,, 2nd | 22 ·1 |
| (*d*) ,, 27th | 73 ·1 | (*d*) ,, 10th | 22 ·5 |

The thermometer neither rose so high nor fell so low as in either of the two preceding years; the range, which was 58°·5, was 20°·4 less than in 1881 and 11°·2 less than in 1880. The warmest and coldest periods of 14 days occurred on the first 14 days of August and the first 14 days of December respectively; of these two periods the mean daily temperatures were:—

| Warmest Period. | | | | Coldest Period. | | | |
|---|---|---|---|---|---|---|---|
| Aug. 1st | 64°·1 | Aug. 8th | 57°·1 | Dec. 1st | 30°·2 | Dec. 8th | 31°·2 |
| ,, 2nd | 61 ·6 | ,, 9th | 57 ·1 | ,, 2nd | 29 ·9 | ,, 9th | 31 ·3 |
| ,, 3rd | 55 ·3 | ,, 10th | 55 ·6 | ,, 3rd | 39 ·5 | ,, 10th | 27 ·7 |
| ,, 4th | 57 ·0 | ,, 11th | 59 ·6 | ,, 4th | 39 ·4 | ,, 11th | 21 ·7 |
| ,, 5th | 59 ·4 | ,, 12th | 68 ·6 | ,, 5th | 33 ·4 | ,, 12th | 28 ·3 |
| ,, 6th | 62 ·2 | ,, 13th | 58 ·2 | ,, 6th | 31 ·5 | ,, 13th | 34 ·4 |
| ,, 7th | 60 ·2 | ,, 14th | 64 ·4 | ,, 7th | 28 ·9 | ,, 14th | 33 ·2 |
| Mean | | | 60°·0 | Mean | | | 31°·5 |

The warmest period was about 2° below the mean for the

beginning of August, while the coldest period was something like 11°·5 below the mean for the beginning of December.

RAINFALL was slightly above that of 1880 and 1881, exceeding the fall of the former by ·51 in. and of the latter by ·60 in., the mean fall for the three years being 27·55 ins. The driest periods were between May 6th—21st, 16 days, without any rain at all; between Jan. 30 and Feb. 12th, when only ·01in. fell on 5th; and between Aug. 1st—14th, when only ·01 in. fell on 9th; on the other hand the wettest periods were between Oct. 23—28th, when 2·67 ins. fell in five out of the six days; and between April 24th —29th, 2·16 ins. falling in six days: in the former case the fall was ·42 in. above the mean fall of the month; in the latter it was ·24 above.

The following table gives the results of my observations for the seasons of 1881–82:—

THROCKING.

| Seasons, 1880-81. | Mean Pressure. | Mean Temperature. | Mean Daily Range. | Tension of Vapour. | Relative Humidity | Rainfall. |
|---|---|---|---|---|---|---|
| | ins. | ° | ° | in. | % | ins. |
| Winter | 30·16 | 38·3 | 9·2 | ·214 | 95 | 6·16 |
| Spring | 29·99 | 47·2 | 17·3 | ·280 | 82 | 5·33 |
| Summer | 29·79 | 56·8 | 11·8 | ·395 | 81 | 6·16 |
| Autumn | 29·80 | 47·4 | 12·4 | ·310 | 93 | 10·64 |

Compared with the seasons of previous years, 1880–81, this table shows that for the winter months pressure and temperature were higher, while the rainfall was slightly less, than in 1881; for the spring months pressure, while about the same as in 1881, was lower than in 1880, and temperature was higher and rainfall greater than in the two previous years; for the summer months pressure and temperature were lower and rainfall was less than in 1880–81; and for the autumn months pressure was lower than in these years, while temperature was precisely the same as in 1881, and only 0°·1 less than in 1880.

I will conclude with a few notes on the months, using the usual abbreviations, *i.e.* **B** for bright; **C** cloudy; **F** fog; **H** hail; **L** lightning; **M** misty; **R** rain; **S** snow; **T** thunder; **T S** thunderstorm.

JANUARY.—*Pressure*—highest 30·94 ins. (exceptionally high) on 18th; lowest 29·18 on 3rd. *Temperature*—warmest day 45°·2 on 6th; coldest day 31°·9 on 26th; highest in sun 84°·5 on 9th; lowest on grass 24°·3 on 25th; max. above 42° on 17 days; min. below 32° on 9 nights. The max. reached 50° on the 6th and 11th. *Rainfall*—a good deal below the average, ·26 in. on 22nd and ·25 on 29th being the chief falls besides the max. *Prevailing wind*—S. *Weather*—a good deal of **F** about the middle of the month when pressure was so very high.

FEBRUARY.—*Pressure*—highest 30·80 ins. on 20th; lowest 29·02 on 26th. *Temperature*—warmest day 48°·4 on 26th; coldest day 30°·1 on 2nd; highest in sun 93°·2 on 12th; lowest on grass 19°·9 on 2nd; max. above 52° on three days, min. below 32° on 14 nights. *Rainfall*—about the average, only ·01 in. fell until 13th, **S** fell on 15th, ·60 in. being the only fall of any consequence besides the max. *Prevailing wind*—S.-W. *Weather*—a good deal of **F** the beginning of the month, but on the whole a dry month.

MARCH.—*Pressure*—highest 30·61 ins. on 16th; lowest 28·88 on 1st. *Temperature*—warmest day 51°·2 on 18th; coldest day 32°·0 on 22nd; highest in sun 115°·9 on 31st; lowest on grass 19°·0 on 22nd; max. above 52° on 14 days, and above 62° on three days; min. below 32° on 4 nights. Max. day temperature high 16th—20th:—16th 62°·5; 17th 63°·2; 18th 65°·3; 19th 60°·4; 20th 61°·6. *Rainfall*—somewhat below the average with scarcely any fall in the middle of the month; ·22 in. on 21st only fall of consequence besides max. *Prevailing wind*—S.W. and W. *Weather*—**C** beginning and end of month, **B M** the middle. **S** fell on 21st, 22nd, and 26th, but slight.

APRIL.—*Pressure*—highest 30·46 ins. on 8th; lowest 29·15 on 28th. *Temperature*—warmest day 52°·9 on 21st; coldest day 40°·5 on 16th; highest in sun 120°·2 on 9th; lowest on grass 25°·6 on 10th and 16th; max. above 52° on 22 days and above 62° on 2; min. below 32° on 1 night, but on the grass it was below 32° on 12 nights. *Rainfall*—a good deal above the average, the end of the month being especially wet, the fall between 23rd—29th exceeding the average for the month by ·34 in.; the chief falls besides max. were ·54 in. on 13th, ·40 on 27th, and ·47 on 29th; little rain fell until 13th. *Prevailing wind*—S. rather preponderated. *Weather*—**B** until the wet period at end of month, **H** on 24th, **T S** on 24th, **L** on 5th.

MAY.—*Pressure*—highest 30·27 ins. on 30th; lowest 29·19 on 12th. *Temperature*—warmest day 58°·8 on 28th; coldest day 40°·8 on 31st; highest in sun 137°·4 on 27th; lowest on grass 25°·1 on 16th; max. above 62° on 18 days; min. never below 32°, except on grass, which occurred on 3 nights, the last trace of frost being on 17th. *Rainfall*—a good deal below the average, no rain falling between 6th—22nd; ·33 in. on 25th, the only fall of consequence besides max. *Prevailing wind*—E.—S.E. *Weather*—**B** generally throughout the month, **T** on 3rd and 22nd.

JUNE.—*Pressure*—highest 30·32 ins. on 1st, lowest 29·28 on 9th. *Temperature*—warmest day 59°·7 on 27th; coldest day 47°·1 on 13th; highest in sun 126°·0 on 23rd; lowest on grass 34°·4 on 11th; max. above 62° on 18 days, reaching 70°·0 and 71°·3 on 27th and 29th, min. below 42° on 3 nights. *Rainfall*—within ·01 in. of the average, though there were very few days on which some rain did not fall; chief falls besides max., ·30 in. on 8th and 24th, and ·27 on 13th. *Prevailing wind*—N.W. *Weather*—dull and cool, **T** on 7th, 9th, 18th, and 26th; **H** on 15th and 26th; solar halo on 17th, the only one observed during the year.

JULY.—*Pressure*—highest 30·25 ins. on 31st; lowest 29·35 on 7th. *Temperature*—warmest day 64°·3 on 3rd; coldest day 53°·3 on 13th; highest in sun 131°·2 on 17th and 27th; lowest on grass 37°·9 on 10th; max. above 72° on 4 days, reaching 70° on four other occasions. *Rainfall*—though rain occurred on most days, especially in the beginning of the month, the fall was below the average. Chief fall besides max., ·25 in. on 9th. *Prevailing wind*—S.W. *Weather*—showery and dull, **T** on 7th, 8th, 10th, 12th, and 24th, on the latter date with **L** and **H**.

AUGUST.—*Pressure*—highest 30·24 ins. on 4th; lowest 29·16 on 23rd. *Temperature*—warmest day 68°·6 on 12th; coldest day 53°·4 on 24th; highest in sun 133°·4 on 12th; lowest on grass 37°·5 on 24th; max. above 72° on 5 days, reaching 70° on 5 others. *Rainfall*—below the average, no rain fell to speak of until 15th; chief falls besides max., ·34 in. on 22nd and ·25 on 28th. *Prevailing wind*—W.—N.W. *Weather*—more or less **C**; **T** on 31st.

SEPTEMBER.—*Pressure*—highest 30·37 ins. on 7th; lowest 29·22 on 27th. *Temperature*—warmest day 61°·1 on 2nd; coldest day 47°·2 on 12th; highest in sun 125°·0 on 3rd and 9th; lowest on grass 35°·5 on 15th, max. above 62° on 13 days; min. below 42° on 5 nights. *Rainfall*—below the average, besides the max. the chief falls being ·30 in. on 5th and 19th; on 20th ·18 in. fell in 20 minutes, being at the rate of ·54 per hour, or 13 inches in 24 hours. *Prevailing wind*—N.—N.W. *Weather*—**B** with much **M**, latter part of month being **C**; **T** and **L** on 3rd, 13th, and 14th, **H** on 26th, **F** on 24th.

OCTOBER.—*Pressure*—highest 30·41 ins. on 4th and 5th; lowest 29·19 on 22nd. *Temperature*—warmest day 56°·9 on 1st; coldest day 39°·5 on 26th; highest in sun 118°·9 on 8th; lowest on grass 25°·8 on 26th; max. above 62° on three days; min. below 32° on 1 night, *i.e.* 26th, being the first trace of frost. *Rainfall*—very much above the average, 3rd, 7th, 9th, 14th, 25th, and 29th being the only days without rain; chief falls besides max. being ·34 in. on 11th, ·32 on 15th, ·25 on 19th, ·61 on 21st, ·44 on 23rd, ·70 on 24th, and ·47 on 28th. *Prevailing wind*—S.—W. *Weather*—dull and wet; **T** on 8th, **S** on 24th, **T** on 25th and 26th.

NOVEMBER.—*Pressure*—highest 30·07 ins. on 6th; lowest 29·11 on 16th. *Temperature*—warmest day 51°·3 on 5th; coldest day 33°·9 on 17th; highest in sun 118°·9 on 8th; lowest on grass 25°·7 on 26th; max. above 52° on 6 days; min. below 32° on 5 nights, on grass on 15 nights. *Rainfall*—a good deal above the average, only 8 days without some fall; chief falls besides max., ·43 in. on 3rd and ·54 on 6th. *Prevailing wind*—N.—W., N.W. preponderating greatly during the first week. *Weather*—**B M** followed by **B C** with frequent and heavy showers, **S** 4 inches deep on 16th.

DECEMBER.—*Pressure*—highest 30·26 ins. on 20th; lowest 29·08 on 6th; on 4th barometer stood at 30·01 ins.; on 6th it had fallen to 29·08, a range of ·93 in 48 hours. *Temperature*—warmest day 51°·1 on 28th; coldest day 21°·7 on 11th; highest in sun 82°·1 on 21st; lowest on grass 13°·4 on 11th; max. above 52° on 2 days,

reaching 50° on 3 others; min. below 32° on 15 nights. I have noticed the cold period at the commencement of the month, this was followed by a warm period at the close, as the following values show:—

| | Max. | Min. | Mean. |
|---|---|---|---|
| 25th | 49°·1 | 29°·7 | 41°·4 |
| 26th | 51·4 | 37·7 | 44·4 |
| 27th | 53·4 | 38·2 | 48·1 |
| 28th | 53·2 | 51·2 | 50·6 |
| 29th | 50·9 | 47·6 | 49·2 |
| 30th | 44·6 | 40·9 | 41·8 |
| 31st | 51·8 | 39·7 | 46·3 |

*Rainfall*—above the average by more than half an inch, only six days without rain; chief fall besides max., ·50 in. on 30th. *Prevailing wind*—W. and S.E. *Weather*—dull and wet with much **F**; **S** on 5th and 6th, but to no great amount.

XXXVI.

# THE SPIDERS OF THE NEIGHBOURHOOD OF HODDESDON: A CONTRIBUTION TO THE ARACHNIDAL FAUNA OF HERTFORDSHIRE.

By F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.

*Read at Hertford, 1st June*, 1883.

The following list of 201 species of Spiders caught within a few miles of Hoddesdon is my first contribution to the Arachnidal fauna of our county. Ten families and fifty-three genera are represented. There is in the immediate neighbourhood no extent of chalk, limestone, nor real heath-soil, all of which would be desirable from a collector's point of view. We have but gravel and clay-loam. Nor are there any special limits which would make the fauna particularly interesting. The Lea marshes, and the valleys and woods on this side of that river, have no exceptional characteristic, and there can be but little doubt but that all the spiders which are named could be found throughout the Lea district. Many species must, of course, have escaped me, and were I still to limit my search to this part of the county, several supplements would be necessary before the list at all approached completeness. The wind * must, at any rate, be continually bringing us fresh visitors. If, for instance, several recently-hatched broods of any one species, influenced by the same atmospheric conditions, were to place themselves in a position for "aerial flight," † it might be expected that a number of about the same weight would be wafted by a current to the same locality, where they would seek a suitable habitat where the sexes would meet.

As with insects, some spiders have exceedingly narrow limits of local distribution, which do not appear to be governed by the nature of the soil, nor by other conditions as yet known to influence either themselves or their food. Thus in 1882 I found *Walckenäera Meadii*, Cambr., in some numbers on a marshy place about 30 feet long by 20 feet broad, but I failed to meet with them in the Lea valley elsewhere, though their home was in direct connection with spots of a similar nature. Three years in succession I have only met with *Linyphia nebulosa*, Sund., in a small out-house, and not even in similar places on the same premises. There was no apparent cause for the preference.

In March and April of this year, *Linyphia errans*, Blackw., and *L. oblonga*, Cambr., were abundant, in suitable weather, on the iron railings of a large meadow, which is separated from another with a similar aspect by a narrow road and low hedge, from which runs at right angles another set of iron railings; yet on these latter

* See "Note on the probable Geographical Distribution of a Spider by the Trade Winds," by Dr. H. C. McCook, 'Proc. Nat. Sci. Philadelphia,' 1878, p. 136.

† "Observations on Spiders," 'Trans. Herts Nat. Hist. Soc.,' Vol. I (1879), p. 42.

I never observed a single representative, although *L. errans*, Blackw., would be literally swarming on the first-mentioned railings. I was much struck after repeatedly searching, on cloudy days, the field which these latter surrounded, by meeting but rarely with a single specimen. I therefore sent a boy there for two days to catch all the spiders he saw in the grass about the railings, but he returned with none of this species, although his bottles were well filled for the season. The only suggestion I can make is that these spiders were being carried by a southerly wind, when they were intercepted by the iron railings on which they were found, and which run due east and west for about 200 yards on high ground quite open to the south. The field may not have suited them, and in that case they would seek another habitat. The other iron railings are about 40 yards in length, and run almost due north and south, while they are partly sheltered from the latter by timber. I collected a considerable number of *L. oblonga*, Cambr., and of *L. errans*, Blackw., which latter were by far the most numerous of the two, and were found a few days before *L. oblonga*. The females were abundant before the males were seen, but of *L. oblonga* I only met with one male, which is here recorded for the first time. Its palpi, though smaller, are the same as those of *L. errans*, and, after a careful examination of a long series of females of these two types, I have concluded that they are varieties of the same species, although the very small eyes of *L. oblonga*, besides other characteristics, are calculated in many specimens to lead to an opposite opinion being formed. The apertures of the females, and the spermathecæ, are the same in form. The size and position of the eyes in both types vary considerably. In most specimens of *L. oblonga* the hind central pair of eyes are closer together than each of them is to the lateral eye next to it of the same row, whereas in *L. errans* these four eyes are generally equidistant or nearly so. Yet occasionally there are individuals of each type with the positions interchanged. The interval between the front central eyes is by no means constant, while the cephalothorax varies irrespective of size, as to the breadth of face and other parts, and also as to the curve of the caput. The spines are irregular in length. The oblong form of *L. oblonga* is found with the typical eyes of *L. errans*, and the more ovate form of *L. errans* with the typical eyes of *L. oblonga*; in fact, the differential characters of the two spiders as species gradually merge into one another in a long series of individuals, while *L. incerta*, Cambr. (also found on the same railings), appears to be but a step in the scale which joins the two more distinct types. I have therefore united all three, viz. *Linyphia errans*, Blackw., *L. oblonga*, Cambr., and *L. incerta*, Cambr., under the earlier specific name of *L. errans*, Blackw. It would be interesting to know how far in future years the intermediate grades of this variable species will disappear, and whether the two more differentiated forms hitherto regarded as *L. errans*, Blackw., and *L. oblonga*, Cambr., will develop such characteristics as to render them specifically distinct.

The residence of the Rev. O. P. Cambridge in Dorsetshire has naturally led to more being known of the spider fauna of that county* than of any other, and it is interesting to note a few species which are not yet recorded as being found there, but which are generally distributed or common with us. We have other spiders not yet seen in Dorsetshire, but they are rare or exceedingly local, and a fortunate capture may at any time show their presence in that county. They are, therefore, of not so much interest in the comparison of the two faunas.

The two following species are generally distributed or common about Hoddesdon, and are not recorded as being found in Dorsetshire :—

*Tegenaria Guyonii*, Guer. This is abundant in the whole London district, and is locally known as the Hertfordshire spider. It is one of our largest English species, and attracts attention when it frequents houses, as it does often, and especially during the pairing season, which begins late in the summer.† I have never found it "at home" except in the constructions by man. Its close ally, *T. atrica*, C. L. Koch, which in Weymouth is abundant,‡ must be here very scarce, for I have only met with one specimen. It is nevertheless common on the south-east side of London.

*Neriene agrestis*, Blackw., local, but always to be found in May, June, or July.

Only one specimen of each of the two following species has been found in Dorsetshire :§—

*Theridion pictum*, Hahn, which is one of our commonest spiders on holly-bushes and pailings.

*Marpessa muscosa*, Clk., abundant on these premises, and generally distributed. I have found two males in cocoons under the bark of an old fence late in October.

I am not aware of any spider except *Epeira scolopetaria*, Clk., which is fairly common in the Lea valley, but which is very rarely met with in Dorsetshire.‖

The above comparison is interesting, for these species do not require a very exceptional habitat.

The incompleteness of my list, both as to numbers and the limited district which is represented, renders it premature to name the spiders which are common to Dorsetshire and which are not found here. Their absence is in many cases accounted for by the nature of the soil. It may at least be said that this locality contains many spiders which are still considered rare, and has pro-

* In the 'Spiders of Dorsetshire' are recorded 373 species in Dorsetshire, and 518 in Great Britain.

† For some habits of this species see my paper "On the pairing of *T. Guyonii*," in 'Journ. Linn. Soc.,' Zoology, vol. xvii, p. 162, and "On a probable case of Parthenogenesis in *T. Guyonii*," in 'Journ. Linn. Soc.,' Zoology, vol. xvi, p. 536.

‡ 'Spiders of Dorset,' p. 63.

§ 'Proc. Dorset Nat. Hist. and Antiq. Field Club,' vol. iv (1882), pp. 149 and 150.

‖ 'Spiders of Dorset,' p. 278.

duced one new species, viz. *Amphissa spinigera*, Cambr.,* which (adult male) I noticed running quickly over my study-table in January, 1880. It took refuge among some old bee-frames, and as it is $\frac{1}{14}$ of an inch in length, I was fortunate in catching it. I have not met with another specimen.

The most abundant spiders in the marshy places in the Lea valley are *Clubiona grisea*, L. Koch, *C. holosericea*, De Geer, *Neriene gibbosa*, Blackw., *N. tuberosa*, Blackw., *N. bituberculata*, Wid., *Linyphia nigrina*, Westr., *L. approximata*, Cambr., *L. pullata*, Cambr., *Walckenäera permixta*, Cambr., *Pirata piraticus*, Clk., and *P. hygrophilus*, Thor. *Neriene bituberculata* may be said to swarm there.

The classification of the species in the following list is the same as that adopted by the Rev. O. P. Cambridge in 'The Spiders of Dorset,' to which work the reader may turn for descriptive details. The synonyms under which the species are described in Blackwell's 'Spiders of Great Britain and Ireland' are given, with references to the drawings.

I shall be much obliged to any members who will kindly send me collections from different parts of the county. The mode of capture and preservation is described on p. 141 of the present volume of our 'Transactions.'

## Family DYSDERIDES.

### Genus Dysdera.

*D. Cambridgii*, Thorell=*D. erythrina*, Blackw. (Spi. Gt. B. and I., pl. xxviii. f. 266).—Scarce.

*D. crocata*, C. L. Koch = *D. rubicunda*, Blackw. (Spi. Gt. B. and I., pl. xxviii, f. 267).—The only specimen from the district was kindly sent to me from The Grange, Hoddesdon, where it was taken from a cat which was playing with it.

### Genus Harpactes.

*H. Hombergii*, Scop. = *Dysdera Hombergii*, Scop. (Spi. Gt. B. and I., pl. xxviii, f. 268).—Scarce.

### Genus Segestria.

*S. senoculata*, Linn. (Spi. Gt. B. and I., pl. xxviii, f. 270).—Scarce.

### Genus Oonops.

*O. pulcher*, Templ. (Spi. Gt. B. and I., pl. xxix, f. 271).—Uncommon.

* This was originally described in the 'Spiders of Dorset,' p. 468, and placed in the genus *Lethia*. Subsequent examination led to a new genus, viz. *Amphissa*, being made for its reception. Rev. O. P. Cambridge, in 'Ann. and Mag. Nat. Hist.,' ser. v, vol. ix, p. 3 (plate 1).

## Family DRASSIDES.

### Genus Micaria.

*M. pulicularia*, Sund. = *Drassus nitens*, Blackw. (Spi. Gt. B. and I., pl. vi, f. 73).—Not uncommon.

### Genus Drassus.

*D. Blackwallii*, Thorell = *D. cericeus*, Blackw. (Spi. Gt. B. and I., pl. vi. f. 67).—Not uncommon.

*D. lapidicolens*, Blackw. (Spi. Gt. B. and I., pl. vi, f. 70).—Abundant.

### Genus Clubiona.

*C. grisea*, L. Koch = *C. holosericea*, Blackw. (Spi. Gt. B. and I., pl. vii, f. 75).—Common in Lea valley.

*C. terrestris*, Westring. = *C. amarantha*, Blackw. (Spi. Gt. B. and I., pl. vii, f. 76).—Abundant.

*C. reclusa*, Cambr.—Not uncommon.

*C. lutescens*, Westr.—Uncommon.

*C. pallidula*, Clerck = *C. epimelas*, Blackw. (Spi. Gt. B. and I. pl. vii, f. 77).—Abundant.

*C. corticalis*, Walck. (Spi. Gt. B. and I., pl. vii, f. 79).—Not uncommon.

*C. holosericea*, De Geer.—Common in Lea valley.

*C. brevipes*, Blackw. (Spi. Gt. B. and I., pl. vii, f. 80).—Not uncommon.

*C. cœrulescens*, L. Koch.—One adult male beaten off nut trees in Box Wood. This is the third adult male recorded as British. The other two were found near Bloxworth.*

*C. compta*, C. L. Koch = *C. comta*, Blackw. (Spi. Gt. B. and I., pl. vii, f. 81).—Common.

### Genus Chiracanthium.

*C. carnifex*, Fabr.—Uncommon; found on the Roman Road.

*C. nutrix*, Westr.—Rare; immature speciemen only.

### Genus Anyphæna.

*A. accentuata*, Walck. (Spi. Gt. B. and I., pl. viii, f. 83).—Common.

### Genus Hecaerge.

*H. maculata*, Blackw. = *H. spinimana*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 21).—Common.

### Genus Phrurolithus.

*P. festivus*, C. L. Koch = *Drassus propinquus*, Blackw. (Spi. Gt. B. and I., pl. vi, f. 74).—Uncommon.

* "New and Rare Spiders."—Rev. O. P. Cambridge, 'Proc. Dorset Nat. Hist. and Antiq. Field Club,' vol. iv (1882), p. 151.

## Family DICTYNIDES.

### Genus Dictyna.

*D. arundinacea*, Linn. = *Ergatis benigna*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 93).—Abundant.

*D. uncinata*, Thorell.—Common.

*D. latens*, Fabr. = *Ergotis latens*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 95).—Uncommon.

### Genus Lethia.

*L. humilis*, Blackw. = *Ciniflo humilis*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 92).—Uncommon.

### Genus Amphissa.

*A. spinigera*, Cambr., n. sp.—Male described by Rev. O. P. Cambridge in 'Spiders of Dorset,' p. 468. I have only met with this specimen, which was running quickly across my study table, Jan. 18, 1880.

### Genus Amaurobius.

*A. fenestralis*, Strœm. = *Ciniflo atrox*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 88).—Not so common as the other two of this genus.

*A. similis*, Blackw. = *C. similis*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 89).—Common.

*A. ferox*, Walck. = *C. ferox*, Blackw. (Spi. Gt. B. and I., pl. ix, f. 90).—Common.

## Family AGELENIDES.

### Genus Tegenaria.

*T. atrica*, C. L. Koch (Spi. Gt. B. and I., pl. xi, f. 106).—Only one specimen.

*T. Guyonii*, Guerin = *T. domestica*, Blackw. (Spi. Gt. B. and I., pl. xi, f. 105).—Abundant. This appears to be the "Hertfordshire Spider," and is common in the London district.

*T. Derhamii*, Scop. = *T. civilis*, Blackw. (Spi. Gt. B. and I., pl. xii, f. 107).—Very common.

### Genus Agelena.

*A. labyrinthica*, Clerck (Spi. Gt. Bt. and I., pl. x, f. 97).—This is an abundant species, and is well adapted for confinement in a square glass case, with a moveable top, to which it does not attach its threads.

### Genus Hahnia.

*H. elegans*, Blackw. = *Agelena elegans*, Blackw. (Spi. Gt. B. and I., pl. x, f. 99).—Often met with in Lea valley and other places.

*H. montana*, Blackw. = *A. montana*, Blackw. (Spi. Gt. B. and I., pl. x, f. 100).—Not uncommon.

*H. helveola*, Simon.—A single female found in Box Wood.

## Family PHOLCIDES.

### Genus Pholcus.

*P. phalangioides*, Fuesslin (Spi. Gt. B. and I., pl. xv, f. 137).—This species is not so abundant as I should have expected to find it.

## Family THERIDIIDES.

### Genus Episinus.

*E. truncatus*, Walck. = *Theridion angulatum*, Blackw. (Spi. Gt. B. and I., pl. xiv, f. 133).—Only met with as yet in one locality not far from Goose Green.

### Genus Pholcomma.

*Pholcomma gibbum*, Westr.—Only one specimen (a male) found at Easneye, Ware.

### Genus Theridion.

*T. formosum*, Clerck = *T. sisyphum*, Blackw. (Spi. Gt. B. and I., pl. xiii, f. 113).—Found occasionally on these premises and elsewhere.

*T. tepidariorum*, C. L. Koch (Spi. Gt. B. and I., pl. xiii, f. 114).—Common in greenhouses.

*T. pictum*, Hahn (Spi. Gt. B. and I., pl. xiii, f. 117).—This is abundant in this immediate locality.

*T. sisyphium*, Clerck = *T. nervosum*, Blackw. (Spi. Gt. B. and I., pl. xiii, f. 116).—Abundant.

*T. denticulatum*, Walck. (Spi. Gt. B. and I., pl. xiii, f. 118).—Common.

*T. varians*, Hahn (Spi. Gt. B. and I., pl. xiv, f. 120).—Common.

*T. tinctum*, Walck. (Spi. Gt. B. and I., pl. xiv, f. 121).—Not uncommon.

*T. pulchellum*, Walck. (Spi. G. B. and I., pl. xiv, f. 122).—Not uncommon.

*T. bimaculatum*, Linn. = *T. Carolinum*, Blackw. (Spi. Gt. B. and I., pl. xiv, f. 123).—Met with occasionally.

*T. pallens*, Blackw. (Spi. Gt. B. and I., pl. xiv. f. 125).—Common.

### Genus Nesticus.

*N. cellulanus*, Clerck = *Linyphia crypticoleus*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 148).—I have only met with one specimen, and that was in a well-house on these premises.

### Genus Phyllonethis.

*P. lineata*, Clerck = *Theridion lineatum*, Blackw. (Spi. Gt. B. and I., pl. xiii, f. 111).—Common.

### Genus Steatoda.

*S. bipunctata*, Linn. = *Theridion quadripunctatum*, Blackw. (Spi. Gt. B. and I., pl. xiii, f. 112).—Common, and found in the top of my beehives.

*S. guttata*, Wider. = *T. guttatum*, Blackw. (Spi. Gt. B. and I., pl. xiv, f. 131).—Only one specimen found in Box Wood.

## Genus Neriene.

*N. atra*, Blackw.=*N. longipalpis*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 188).—Very abundant on iron railings in calm sunshiny weather.

*N. dentipalpis*, Wider.—Very abundant in same situations.

*N. graminicola*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 186).—Not uncommon.

*N. nigra*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 185).—Frequently found on the iron railings on these premises and elsewhere.

*N. longimana*, C. L. Koch=*N. vagans*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 173).—Rare; two specimens found on these premises.

*N. rufipes*, Sundevall=*N. munda*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 180).—Not uncommon.

*N. rubens*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 184).—Local but abundant.

*N. Isabellina*, C. L. Koch=*N. rubella*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 194).—Not uncommon in the Lea valley.

*N. vigilax*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 191).—One specimen (male) of this very rare species found on iron railings at High Leigh, in March, 1883.

*N. herbigrada*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 199).—This species is occasionally met with in damp places in Box Wood.

*N. dentata*, Wider. (Spi. Gt. B. and I., pl. xviii, f. 174).—Common in Lea valley and other marshy places.

*N. fusca*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 189 and 190, and pl. xxii, f. D & E).—Abundant on iron railings on these premises and elsewhere.

*N. agrestis*, Blackw. (Exclude from Spi. Gt. B. and I., reference to pl. xix, f. 190 and pl. xxii, f. D).—The confusion between this and the foregoing species was removed by a specimen found on the banks of Spittle Brook, Hoddesdon, in May, 1880.*

*N. retusa*, Westr.—Rare; in October, 1882, three specimens were met with under stones.

*N. apicata*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 183).—Found occasionally on iron railings on these premises.

*N. gibbosa*, Blackw.—Abundant in Lea valley and other marshy ground.

*N. tuberosa*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 192).—Abundant in Lea valley and other marshy ground.

*N. cornuta*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 181).—Common but local in Lea valley and the whole district.

*N. bituberculata*, Wider. (Spi. Gt. B. and I., pl. xviii, f. 182).—Very abundant in Lea valley and other marshy places in the district.

*N. Clarkii*, Cambr.—Occasionally found on iron railings on these premises.

* See 'Spiders of Dorset,' p. 486.

*N. neglecta*, Cambr.—Four specimens of this rare species have been found in Box Wood.

*N. livida*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 169).—Not uncommon at Easneye, Ware.

*N. Sundevallii*, Westr.—Two specimens have been found near Spittle Brook, Hoddesdon, the only place in the district where this spider has been observed.

*N. viaria*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 171).—Only two specimens have been found, at The Pollards, Hoddesdon.

*N. sylvatica*, Blackw.—Both sexes of this rare spider were found in Lea marshes in October, 1882.

*N. fuscipalpis*, C. L. Koch=*N. gracilis*, and *N. flavipes*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 172 and 178).—This species varies in size, and the prominence on the inside of the base of the digital joint is not easily seen in some specimens. Not uncommon.

*N. penicillata*, Westr.—Occasionally found near Goose Green on lichens.

*N. innotabilis*, Cambr.—Occasionally found at Easneye, Ware, and on Broxbourne Common.

*N. anomala*, Cambr.—In July, 1880, and 1881, this species was abundant on an iron fence on these premises, in 1882 it was scarce. No male observed.

*N. mollis*, Cambr.—Male found on iron railing on these premises on a bright day in December, 1881.

*N. bicuspis*, Cambr.—Not uncommon on railings at High Leigh in April and May.

*N. Huthwaitii*, Cambr. (Spi. Gt. B. and I., pl. xviii, f. 176).—Two of each sex of this very rare species have been found in ditches in the Lea valley.

*N. decora*, Cambr.—Two specimens of this rare spider have been found, on the Roman Road.

*N. viva*, Cambr.—Rather rare and local.

*N. diluta*, Cambr.—Rare.

*N. pygmæa*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 177).—Only one specimen of this rare spider found on iron railings at High Leigh.

*N. rustica*, Cambr.—Three males of this rare species found on swampy ground in Box Wood.

*N. uncata*, Cambr.—A few of both sexes found in marshy places in the Lea valley.

Genus Walckenaera.

*W. brevipes*, Westr.—Rare.

*W. unicornis*, Cambr. (Spi. Gt. B. and I., pl. xx, f. 207).—Occasionally found in Lea marshes in the spring.

*W. punctata*, Blackw. (Spi. Gt. B. and I., pl. xx, f. 210).—Common in Lea valley and other marshy districts.

*W. humilis*, Blackw. (Spi. Gt. B. and I., pl. xxi, f. 223).—Rare.

*W. cristata*, Blackw. (Spi. Gt. B. and I., pl. xxi, f. 224).—Not uncommon.

*W. permixta*, Cambr.—Common in marshy places in Lea valley.

*W. antica*, Blackw. (Spi. Gt. B. and I., pl. xxi, f. 225).—One male found on iron railings on these premises.

*W. fuscipes*, Blackw. (Spi. Gt. B. and I., pl. xx, f. 209).—Rare.

*W. scabricula*, Westr.=*W. aggeris*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 216).—Rare; found on iron railings at High Leigh.

*W. parallela*, Blackw. (Spi. Gt. B. and I., pl. xx, f. 211).—In 1879 and 1880 several specimens were taken from the under side of laurel leaves on these premises close to the house. Since then I have only met with two males.

*W. pumila*, Blackw. (Spi. Gt. B. and I., pl. xxi, f. 227).—Rare; found in Box Wood.

*W. Beckii*, Cambr.—Rare; one male found in an out-house on these premises.

*W. picina*, Blackw. (Spi. Gt. B. and I., pl. xxi, f. 228).—Not uncommon on these premises, but more abundant at Easneye.

*W. erythropus*, Westr.—Not uncommon about the Roman Road and Box Wood.

*W. trifrons*, Cambr.—A single example (male) found at Easneye.

*W. altifrons*, Cambr.—Not uncommon.

*W. frontata*, Blackw. (Spi. Gt. B. and I., pl. xxii, f. 232).—Not uncommon.

*W. acuminata*, Blackw. (Spi. Gt. B. and I., pl. xx, f. 203).—The females not uncommon; the males rare, as is the case with many other species.

*W. Meadii*, Cambr.—Both sexes of this rare spider were found on a small piece of marshy ground in Lea valley in April, 1882, and they have not been met with elsewhere in this district.

*W. cucullata*, C. L. Koch and Cambr.—One male found in a marshy place in Lea valley.

*W. nemoralis*, Blackw. (Spi. Gt. B. and I., pl. xxii, f. 230).—One male caught on these premises in March, 1883.

*W. pusilla*, Wider.—One male caught on these premises in March, 1883.

*W. hiemalis*, Blackw. (Spi. Gt B. and I., pl. xxi, f. 217).—Male found on the Roman Road in March, 1883.

*W. latifrons*, Cambr.—Rare.

*W. nudipalpis*, Westr.—Rare.

### Genus Pachygnatha.

*P. Clerckii*, Sund. (Spi. Gt. B. and I., pl. xxii, f. 233).—Generally distributed.

*P. Listeri*, Sund. (Spi. Gt. B. and I., pl. xxii, f. 234).—Rare.

*P. De Geerii*, Sund. (Spi. Gt. B. and I., pl. xxii, f. 235).—Common and generally distributed.

### Genus Linyphia.

*L. frenata*, Wider. (Spi. Gt. B. and I., pl. xvi, f. 151).—Rare.

*L. thoracica*, Wider.=*L. cauta*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 145).—Not uncommon.

*L. leprosa*, Ohlert.—Common and generally distributed.

*L. zebrina*, Menge.—Not uncommon.

*L. minuta*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 144).—Rare.

*L. tenebricola*, Wider. and *L. terricola*, Blackw. = *L. tenuis*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 152, 153).—Common and generally distributed.

*L. obscura*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 162).—As yet only found on the Roman Road.

*L. nebulosa*, Sund. = *L. vivax*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 146).—Rare and very local.

*L. variegata*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 195).—Rare.

*L. socialis*, Sund. (Spi. Gt. B. and I., pl. xvi, f. 147).—Not common.

*L. pullata*, Cambr.—Common in marshy places.

*L. nigrina*, Blackw. = *L. pulla*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 156).—Common.

*L. approximata*, Cambr.—Abundant in Lea valley and common in other marshy places.

*L. dorsalis*, Wider. = *L. Claytoniæ*, Blackw. (Spi. Gt. B. and I., pl. xvi, f. 155).—Not uncommon.

*L. ericea*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 159).—Not common.

*L. circumspecta*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 165).—Common everywhere.

*L. experta*, Cambr.—Found in some abundance in marshy places in Lea valley in October, 1882.

*L. errans*, Blackw. = *N. errans*, Blackw. (Spi. Gt. B. and I., pl. xviii, f. 170).—This species is equivalent to *L. oblonga*, Cambr., and *L. incerta*, Cambr. See introductory remarks.

*L. bicolor*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 168).—Not uncommon.

*L. parvula*, Westr.—Rare.

*L. aeria*, Cambr.—Not uncommon.

*L. pallida*, Cambr.—Several examples of this rare species have been met with in different places.

*L. concolor*, Wider. = *Theridion filipes*, Blackw. (Spi. Gt. B. and I., pl. xiv, f. 136).—Not common and very local.

*L. insignis*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 160).—Rare.

*L. impigra*, Cambr.—Found in some abundance in some spots in Lea valley, but not elsewhere.

*L. clathrata*, Sund. = *Neriene marginata*, Blackw. (Spi. Gt. B. and I., pl. xvii, f. 167).—Abundant and generally distributed.

*L. bucculenta*, Clerck = *N. trilineata*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 193).—Not common.

*L. montana*, Clerck = *L. marginata*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 140).—Common and generally distributed.

*L. triangularis*, Clerck = *L. montana*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 138).—Common and generally distributed.

*L. hortensis*, Sund. = *L. pratensis*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 141).—Not common.

*L. pusilla*, Sund.=*L. fuliginea*, Blackw. (Spi. Gt. B. and I., pl. xv, f. 142).—Not common.

*L. abnormis*, Blackw.=*Neriene abnormis*, Blackw. (Spi. Gt. B. and I., pl. xix, f. 200).—One specimen.

Genus Ero.

*E. thoracica*, Wider.=*Theridion variegatum*, Blackw. (Spi. Gt. B. and I., pl. xiv, f. 134).—Not common but generally distributed.

## Family EPEIRIDES.

Genus Meta.

*M. segmentata*, Clerck=*Epeira inclinata*, Blackw. (Spi. Gt. B. and I., pl. xxvi, f. 255).—Most abundant and generally distributed.

*M. Menardi*, Latr.=*E. fusca*, Blackw. (Spi. Gt. B. and I., pl. xxvi, f. 252).—Rare.

*M. Merianæ*, Scop.=*E. antriada* and *E. celata*, Blackw. (Spi. Gt. B. and I., pl. xxvi, f. 253 and 254).—Not uncommon.

Genus Tetragnatha.

*T. extensa*, Linn. (Spi. Gt. B. and I., pl. xxvii, f. 265).—Most abundant and generally distributed.

Genus Cyclosa.

*C. conica*=*Epeira conica*, Blackw. (Spi. Gt. B. and I., pl. xxvii, f. 261).—As yet only one specimen found in this neighbourhood, and that in the Lea valley.

Genus Zilla.

*Z. X-notata*, Clerck=*Epeira similis*, Blackw. (Spi. Gt. B. and I., pl. xxv, f. 244).—Common and generally distributed.

*Z. atrica*=*E. calophylla*, Blackw. (Spi. Gt. B. and I., pl. xxv, f. 245).—Common and generally distributed.

Genus Epeira.

*E. cucurbitina*, Clerck (Spi. Gt. B. and I., pl. xxv, f. 247).—Common and generally distributed.

*E. diademata*, Clerck=*E. diadema*, Blackw. (Spi. Gt. B. and I., pl. xxvi, f. 258).—Abundant and generally distributed.

*E. scalaris*, Walck. (Spi. Gt. B. and I., pl. xxiv, f. 240).—Rare.

*E. agalena*, Blackw. (Spi. Gt. B. and I., pl. xxiv, f. 242).—Uncommon.

*E. cornuta*, Clerck=*E. apoclisa*, Blackw. (Spi. Gt. B. and I., pl. xxiii, f. 237).—Common in Lea valley.

*E. umbratica*, Clerck (Spi. Gt. B. and I., pl. xxiv, f. 241).—Common throughout the district.

*E. sclopetaria*, Clerck=*E. sericata*, Blackw. (Spi. Gt. B. and I., pl. xxiii, f. 238).—Common in Lea valley.

*E. alsine*, Walck.=*E. lutea*, Blackw. (Spi. Gt. B. and I., pl. xxv, f. 249).—Rare.

*E. arbustorum*, C. L. Koch=*E. bicornis*, Blackw. (Spi. Gt B. and I., pl. xxvii, f. 260).—One immature male caught at High Leigh in May, 1882.

## Family THOMISIDES.

### Genus Misumena.

*M. vatia*, Clerck=*Thomisus citreus*, Blackw. (Spi. Gt. B. and I., pl. iv, f. 53).—Not common.

### Genus Xysticus.

*X. cristatus*, Clerck=*Thomisus cristatus*, Blackw. (Spi. Gt. B. and I., pl. iv, f. 38).—Abundant everywhere.

*X. ulmi*, Hahn.—Not uncommon.

*X. luctuosus*, Blackw.=*T. luctuosus*, Blackw. (Spi. Gt. B. and I., pl. iv, f. 45).—Rare.

### Genus Oxyptila.

*O. praticola*, C. L. Koch=*Thomisus incertus*, Blackw. (Spi. Gt. B. and I., pl. iv, f. 51).—Rare.

*O. trux*, Blackw.=*T. trux*, Blackw. (Spi. Gt. B. and I., pl. iv, f. 50).—Not uncommon.

### Genus Philodromus.

*P. dispar*, Walck. (Spi. Gt. B. and I., pl. v, f. 55).—Not uncommon.

*P. aureolus*, Clerck (Spi. Gt. B. and I., pl. v, f. 59).—Abundant.

*P. cespiticolens*, Walck.=*P. cespiticolis*, Blackw. (Spi. Gt. B. and I., pl. v, f. 58).—Not common.

### Genus Tibellus.

*T. oblongus*, Walck.=*Philodromus oblongus*, Blackw. (Spi. Gt. B. and I., pl. v, f. 60).—Common.

## Family LYCOSIDES.

### Genus Ocyale.

*O. mirabilis*, Clerck=*Dolomedes mirabilis*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 18).—Common.

### Genus Pirata.

*P. hygrophilus*, Thor.=*Lycosa piscatoria*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 17).—Abundant.

*P. piraticus*, Clerck=*L. piratica*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 16).—Common.

### Genus Trochosa.

*T. ruricola*, De Geer=*Lycosa campestris*, Blackw. (Spi. Gt. B. and I., pl. i, f. 3).—Common.

*T. terricola*, Thorell=*L. agretyca*, Blackw. (Spi. Gt. B. and I., pl. i, f. 2).—Common.

### Genus Tarentula.

*T. pulverulenta*, Clerck=*Lycosa rapax*, Blackw. (Spi. Gt. B. and I., pl. 1, f. 5).—Not uncommon.

### Genus Lycosa.

*L. amentata*, Clerck=*L. saccata*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 9).—Abundant everywhere.

*L. lugubris*, Walck. (Spi. Gt. B. and I., pl. ii, f. 10).—Not uncommon.

*L. pullata*, Clerck=*L. obscura*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 11).—Common.

*L. riparia*, C. L. Koch.—Not uncommon.

*L. nigriceps*, Thorell.—Scarce.

*L. palustris*, Linn.=*L. exigua*, Blackw. (Spi. Gt. B. and I., pl. ii, f. 12 in part).—Not uncommon.

## Family SALTICIDES.

### Genus Epiblemum.

*E. scenicum*, Clerck=*Salticus scenicus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 24 in part).—Abundant everywhere.

*E. cingulatum*, Panz.—Not common.

### Genus Heliophanus.

*H. flavipes*, C. L. Koch.—Rare; found on the Roman Road.

### Genus Marpessa.

*M. muscosa*, Clerck=*Salticus tardigradus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 35).—Common about Hoddesdon.

### Genus Ballus.

*B. depressus*, Walck.=*Salticus obscurus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 28).—Not uncommon.

### Genus Neon.

*N. reticulatus*, Blackw.=*Salticus reticulatus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 33).—Not uncommon.

### Genus Evophrys.

*E. frontalis*, Walck.=*Salticus frontalis*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 27).—Not common.

### Genus Attus.

*A. pubescens*, Fabr.=*S. sparsus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 25).—Rare.

### Genus Hasarius.

*H. falcatus*, Clerck=*Salticus coronatus*, Blackw. (Spi. Gt. B. and I., pl. iii, f. 26).—Rare.

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## ERRATA.

Page 77, line 8, for "*Epinephele*" read "*Epinephile.*"
,, 138, ,, 5 from bottom, *for* "Perry Green" *read* "Berry Green."
,, 216, ,, 9 from bottom, for "*Cinclus aquaticus*" read "*Turdus torquatus.*"
,, 218, ,, 25, for "*melanocephala*" read "*schœniclus.*"
,, 238, ,, 3, *for* "Hertfordshire Mercury" *read* "Herts Advertiser."
,, ,, ,, 12, after "St. Albans.—" *for* "E." *read* "G."

# APPENDIX.

## LIST OF MEMBERS

OF THE

## HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

FEBRUARY, 1884.

## PAST PRESIDENTS.

1875-77. JOHN EVANS, D.C.L., LL.D., Treas. R.S., F.S.A., etc.
1877-79. ALFRED T. BRETT, M.D.
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1881-83. GEORGE ROOPER, F.Z.S.

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1875 Allman, George James, M.D., LL.D., F.R.S., F.R.S.E., F.L.S., M.R.I.A., Emeritus Professor of Natural History, University of Edinburgh, *Ardmore, Parkstone, Dorset;* and *Athenæum Club, London, S.W.*

1880 Babington, Charles Cardale, M.A., F.R.S., F.S.A., F.L.S., F.G.S., Professor of Botany in the University of Cambridge, 5, *Brookside, Cambridge.*

1883 Brown, Isaac, *Kendal, Westmoreland.*

1882 Cooke, M. C., M.A., LL.D., A.L.S., 146, *Junction Road, London, N.*

1879 Etheridge, Robert, F.R.S., F.R.S.E., F.G.S., *British Museum (Natural History), South Kensington;* and 19, *Halsey Street, Chelsea, London, S.W.*

1875 Glaisher, James, F.R.S., F.R.A.S., F.R.M.S., F.R.Met.Soc., Superintendent of the Magnetic and Meteorological Department, Royal Observatory, Greenwich, 1, *Dartmouth Park, Blackheath.*

1879 Harting, James Edmund, F.L.S., F.Z.S., 6, *Oxford and Cambridge Mansions, London, N.W.*

1876 Hayden, Ferdinand Vandeveer, A.M., M.D., United States Geologist, *Washington, U.S.A.*

1877 Henslow, Rev. George, M.A., F.L.S., F.G.S., *Drayton House, Ealing.*

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*EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.*

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*EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.*

VOL. II. PART 5.

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OF THE

# HERTFORDSHIRE NATURAL HISTORY SOCIETY

AND

# FIELD CLUB.

(A CONTINUATION OF THE TRANSACTIONS OF THE WATFORD NATURAL HISTORY SOCIETY.)

*EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.*

VOL. II. PART 8.

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| Pisces ..... | J. E. Littleboy. |
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| Insecta (injurious)..... | F. W. Silvester, F.M.S., Hedges, St. Albans. |
| Coleoptera ..... | Arthur Cottam, Watford. |
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