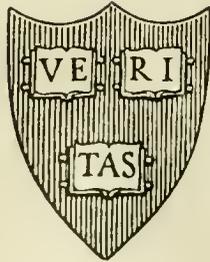




HER
3228
..o

HARVARD UNIVERSITY



LIBRARY

OF THE

MUSEUM OF COMPARATIVE ZOOLOGY

80,032

Bought

July 20, 1942.

TRANSACTIONS
OF THE
HERTFORDSHIRE NATURAL HISTORY SOCIETY.
—
VOL. VII.



OAK TREE ON HEDGES FARM, NEAR ST. ALBANS, STRUCK BY LIGHTNING, 29TH JUNE, 1893.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

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

VOLUME VII.

OCTOBER, 1891, TO OCTOBER, 1893.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD: STEPHEN AUSTIN AND SONS.

1894.

RA P

15-1-1942

15-1-1942

HERTFORD:

PRINTED BY STEPHEN AUSTIN AND SONS.

Museum of Comparative
Zoology
JUL 20 1942

80032

15-1-1942
15-1-1942
15-1-1942

CONTENTS.

	PAGE
1. Anniversary Address.—Francis Bacon. By the President, JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.	1
2. Bats and some other Beasts. By GEORGE ROOPER, F.Z.S.	37
3. Terrestrial British Quadrupeds existing in a Wild State at the Present Day. By T. VAUGHAN ROBERTS	41
4. Report on the Rainfall in Hertfordshire in 1891. By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.	53
5. Notes on Birds observed in Hertfordshire during the year 1891. By HENRY LEWIS	62
6. Meteorological Observations taken at The Grange, St. Albans, during the year 1891. By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.	69
7. A Naturalist's Calendar for Mid-Hertfordshire. By J. J. WILLIS	76
8. Report on Phenological Phenomena observed in Hertford- shire during the year 1891. By EDWARD MAWLEY, F.R.Met.Soc., F.R.H.S... .. .	85
9. Coal: its Nature, Origin, Position, and Extent; and its Range under the South of England. By Professor T. RUPERT JONES, F.R.S., F.G.S. (Plates I and II) ..	89
10. Anniversary Address.—Charles Darwin. By the President, JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.	101
11. Notes on the Mycetozoa, with a List of Species from Hertfordshire and Bedfordshire. By JAMES SAUNDERS	137
12. Ice and its Work. By JOHN MORISON, M.D., F.G.S. ..	147
13. Climatological Observations taken in Hertfordshire in the year 1891. By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc. (Plate III)	157
14. Notes on Birds observed in Hertfordshire during the year 1892. By HENRY LEWIS	161
15. Notes on some Hertfordshire Mammalia. By T. VAUGHAN ROBERTS	169

LIST OF PLATES.

I. Map and Section showing the known and probable Coal-measures in South Wales, the South of England, the North of France, and Belgium	<i>To face</i> p. 89
II. Diagram to show the possible Occurrence of Coal-measures in the Eastern Counties ..	,, ,, 97
III. Map of Hertfordshire showing its Climatological Stations	,, ,, 157
IV. Fig. 1.—Section of Chalk, Tertiaries, and Drift, Midland Railway Cutting, North of St. Albans. Fig. 2.—Hertfordshire Conglomerate, Townsend Farm, near St. Albans	,, ,, xxiv
V. Fig. 1.—“Bacon’s Mount,” near Pré Wood, St. Albans. Fig. 2.—Ruins of Old Gorhambury House, St. Albans	,, ,, xxvi
VI. Fig. 1.—Chalk-pit near Cribbs, Harefield. Fig. 2.—Chalk-pit near the “Copper Mill,” Harefield, showing pipes in the Chalk ..	,, ,, xlvi
VII. Fig. 1.—The River Colne at Colney Heath, in June, 1893. Fig. 2.—Green Lane near Colney Heath	,, ,, 1
VIII. Oak tree on Hedges Farm, near St. Albans, struck by lightning during the storm of 28th–29th June, 1893 (noticed on pp. 210 and 212)	<i>Frontispiece.</i>

Plates IV, V, VI, and VII are from photographs taken by the Editor. Plate VIII is from a photograph taken by Mr. Gerald Phipps, of St. Albans.

Dates of publication of the several parts contained in this volume :

Part 1.	Pages 1-36	.....	.....	.....	.....	.....	April, 1892.
„ 2.	„ 37-68	.....	.....	.....	.....	.....	October, 1892.
„ 3.	„ 69-100	.....	.....	.....	.....	.....	February, 1893.
„ 4.	„ 101-136	.....	.....	.....	.....	.....	April, 1893.
„ 5.	„ 137-168	.....	.....	.....	.....	.....	July, 1893.
„ 6.	„ 169-200	.....	.....	.....	.....	.....	September, 1893.
„ 7.	„ 201-236	.....	.....	.....	.....	.....	November, 1893.
„ 8.	„ ix-lii.	.....	.....	.....	.....	.....	February, 1894.
„ 9.	„ i-viii, and 237-244	.....	.....	.....	.....	.....	April, 1894.

Dates of completion of previous volumes :

TRANSACTIONS OF THE WATFORD NATURAL HISTORY SOCIETY.

Vol. I.	(pp. lxiv and 248)	.....	.....	.....	.....	.....	August, 1878.
„ II.	(pp. lx and 260)	.....	.....	.....	.....	.....	June, 1880.

TRANSACTIONS OF THE HERTFORDSHIRE NATURAL HISTORY SOCIETY.

Vol. I.	(pp. lxxviii and 272)	.....	.....	.....	.....	.....	May, 1882.
„ II.	(pp. lxxviii and 286)	.....	.....	.....	.....	.....	May, 1884.
„ III.	(pp. lxxii and 274)	.....	.....	.....	.....	.....	March, 1886.
„ IV.	(pp. lii and 224)	.....	.....	.....	.....	.....	June, 1888.
„ V.	(pp. xlvi and 224)	.....	.....	.....	.....	.....	May, 1890.
„ VI.	(pp. lxx and 204)	.....	.....	.....	.....	.....	July, 1892.

PROCEEDINGS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

BYE MEETING, 22ND OCTOBER, 1891, AT ST. ALBANS.

The study of plant-diseases and of injuries to plants, caused by fungi and insects, being of considerable economic importance, and attracting much attention at the present time, the President of the Society and Mrs. Hopkinson invited the members and their friends to a second "Evening with the Microscope"* at their residence, The Grange, to examine plants injuriously affected and to discuss some of the many interesting points connected with the subject.

Microscopes with which to view the minute fungi parasitic upon the leaves, etc., of the higher plants, were brought by several members, and many interesting objects were thus examined. These were chiefly from Mr. Hopkinson's collection and from a collection sent by Mr. R. T. Andrews of Hertford, the former being transparent, for examination by transmitted light, and the latter being opaque, for reflected light. Unmounted leaf-fungi sent by Mr. Watson Walker were also examined microscopically.

Injuries to plants caused by insects were illustrated by a number of diagrams executed and lent for exhibition by the Misses Ormerod. These diagrams represent the insects in their natural size and magnified, show the nature of the injuries they cause to our field- and garden- crops, and give the remedies for each attack.

Plants, also, injured in various ways, were sent by Mr. J. W. Odell. These included pieces of apple-stems showing injury by American blight or woolly aphis; leaves and fruit of the tomato affected with *Peronospora infestans*; leaves of *Chrysanthemum* with mildew; leaves of cabbage with white rust (*Cystopus candidus*): leaves of *Bletia*, a terrestrial orchid from China, with rust; swede turnips diseased with "club-root" (*Plasmodiophora brassicæ*); fasciated stems of *Pyrethrum uliginosum*; and three different forms of *Celosia cristata*—(1) the normal form, (2) the half-fasciated form, and (3) the "cock's comb" form, a fasciated inflorescence which florists have fixed by selecting time after time the more fasciated forms.

* The first "Evening" was devoted to the study of the eyes of insects. See 'Transactions,' Vol. V, p. xxxvi.

In the course of the evening Dr. A. T. Brett read a paper in which he urged the members of the Society to take up the study of vegetable morphology, and particularly that part of it which relates to the diseases to which plants are subject, and he showed by examples of the losses sustained through want of knowledge, how vitally important it was to the nation that plant-diseases should be studied and the remedies for them made known.

After coffee, etc., had been served, some beautifully-executed original coloured drawings of the spores of leaf-fungi, lent by Mr. George Masee, of Kew, were examined, and books treating of the subject of the evening's study, including the finely-illustrated Monographs of our British Insects issued by the Ray Society, were looked into.

About thirty members and friends were present.

ORDINARY MEETING, 13TH NOVEMBER, 1891, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mr. George Barker, Kettlewells, St. Albans; Mr. A. C. G. Cameron, Geological Survey of England, Foster Hill Road, Bedford; Mr. G. Mainwaring Robinson, Long Heath, Watford; Mr. Percy Hamilton Sainsbury, Huskards, Watford; Miss Amy Catherine Sell, Fairfield House, Watford; Mr. Arthur Smith, Hill End, Smallford, St. Albans; and Mr. Percy Jenner Weir, Lattimore Road, St. Albans, were proposed for membership of the Society.

The PRESIDENT said that most of the members present would doubtless remember that at a meeting of the Society held at St. Albans last December, the most important question affecting Hertfordshire which has lately arisen was brought forward, namely the question of the water-supply of London. At that meeting a resolution was passed requesting the Hertfordshire County Council to take steps to oppose two bills then being prepared for presentation to Parliament, which would, if they passed, very seriously affect the interests of their county by a very much larger quantity of water being abstracted from the catchment-basins of the Colne and Lea for the supply of London than is even now being taken from them. The bills were brought in and referred to a Select Committee; their County Council, after considering the resolution of their Society, officially presented to it, decided to oppose them; and the result of the opposition of the London and Hertfordshire County Councils, and the London Water Companies, was that both bills were thrown out. With regard to these bills, therefore, we had nothing more to fear. Unfortunately, however, the matter was still in abeyance. The London County Council was investigating it, and there would very probably be some similar enquiry next year. In the meantime the interests of this part of their county were much more seriously affected by the steps which were being taken by Mr. George Webster, of Harefield Grove, to abstract a

large amount of water from deep wells in the Chalk in the lower part of the valley of the Colne, below Rickmansworth, privately, for the supply of London. Mr. Webster might perhaps be quite within his legal rights in doing this if he could get easements into London, as it was stated that he had done; but it would be a most serious thing for Watford and the whole district watered by the Colne, the Ver, the Gade, and the Chess, if this plan were to be carried into effect, and an enormous quantity of water were taken for the supply of London from the reservoir of saturated chalk from the overflow of which these rivers are almost entirely fed. They would have the evils which they had already experienced to a considerable extent, greatly increased, their wells, their water-cess beds, and their streams running dry. He thought they might at some future meeting have to consider how this scheme might be effectually put a stop to, and the Society might possibly be called upon to pass some similar resolution to that of last December.

The following paper was read:—

“Bats and some other Beasts.” By George Rooper, F.Z.S. (*Transactions*, Vol. VII, p. 37.)

A discussion ensued in which the President, Professor Attfield, Dr. Brett, Mr. Rooper, Mr. Silvester, and Mr. Stradling took part.

ORDINARY MEETING, 11TH DECEMBER, 1891, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mr. George Barker, Mr. A. C. G. Cameron, Mr. G. M. Robinson, Mr. P. H. Sainsbury, Miss A. C. Sell, Mr. Arthur Smith, and Mr. P. Jenner Weir were elected Members of the Society.

Mr. William Fisk, L.D.S., Street Lodge, Watford, and Mr. Felix Sumner Knyvett, Ashwellthorpe, Watford, were proposed for membership.

The following paper was read:—

“Terrestrial British Quadrupeds existing in a Wild State at the Present Day.” By T. Vaughan Roberts. (*Transactions*, Vol. VII, p. 41.)

A discussion ensued in which the President, Dr. Brett, Mr. Rooper, and Mr. Stradling took part.

Preserved skins of several of the animals mentioned were exhibited by the author in illustration of his paper; and Dr. Brett exhibited a black rat (*Mus rattus*) with its young, a polecat (*Mustela putorius*) killed on the estate of the Earl of Essex about twenty-five years ago, and lent by Mrs. Hawkins of Hunton Bridge, and several animals from the collection of the Public Library.

Mr. STRADLING exhibited a snake suffering from a malady which he considered to be identical with or analogous to consumption in human beings.

ORDINARY MEETING, 15TH JANUARY, 1892, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The following resolution was proposed from the Chair and carried *nem. con.* :—

“That this meeting deeply sympathises with their Royal Highnesses the Prince and Princess of Wales in the sad loss they have sustained by the death of their eldest son, his Royal Highness the Duke of Clarence and Avondale.”

Mr. William Fisk, L.D.S., and Mr. F. Sumner Knyvett were elected Members of the Society.

Miss Janet Archer, St. George's Villa, Chalk Hill, Watford, and Mr. William Henry Lees, Sandonbury, Royston, were proposed for membership.

The following lecture was delivered :—

“Crocodiles and Canaries.” By Arthur Stradling, M.R.C.S., F.Z.S.

Mr. Daniel Hill and Mr. T. Vaughan Roberts were elected auditors of the accounts for 1891.

ANNIVERSARY MEETING, 19TH FEBRUARY, 1892.

(AT WATFORD.)

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The Report of the Council for 1891, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address on “Francis Bacon.” (*Transactions*, Vol. VII, p. 1.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year :—

President.—John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., etc.

Vice-Presidents.—Alfred T. Brett, M.D.; the Right Honourable the Earl of Clarendon; Richard B. Croft, R.N., F.L.S., F.R.M.S.; John Evans, D.C.L., LL.D., Sc D., Treas.R.S., Pres.S.A., etc.; William Ransom, F.S.A., F.L.S.; C. E. Shelly, M.A., M.D.

Treasurer.—John Weall.

Hon. Secretaries.—John Morison, M.D., F.G.S.; and F. M. Campbell, F.L.S., F.Z.S., F.R.M.S., F.E.S.

Librarian.—W. R. Carter, B.A.

Curator.—A. E. Gibbs, F.L.S.

Other Members.—Professor John Attfield, M.A., Ph.D., F.R.S., F.I.C., F.C.S.; A. P. Blathwayt; Percival Bosanquet; Arthur M. Brown, M.A.; Alfred Eteson, M.D.; Upfield Green, F.G.S.; Augustus Hawks; George Rooper, F.Z.S.; F. W. Silvester; Arthur Stradling, F.Z.S.; James Thornhill, F.L.S.; the Rev. E. T. Vaughan, M.A.

The thanks of the Society were accorded to Mr. F. M. Campbell and Mr. George Rooper retiring from the office of Vice-President, to Mr. Upfield Green retiring from the office of Librarian, and to Dr. F. H. Berry retiring from the Council.

REPORT OF THE COUNCIL FOR THE YEAR 1891.

The Council of the Hertfordshire Natural History Society, in presenting the 17th Annual Report, has pleasure in stating that the Society continues vigorous and prosperous, the number of evening meetings held during the year 1891 having been quite up to the average of former years, and on the whole very well attended. The field meetings, however, owing to unfavourable weather, have not been quite so numerous attended as usual.

During the year twenty-two ordinary members have been elected, four have resigned, and the Council regrets to have to record the loss of one member by death—Sir James Longden. The number of members at the end of the years 1890 and 1891 was as follows:—

	1890.	1891.
Honorary Members	20	20
Life Members	47	48
Annual Subscribers	169	185
	236	253

The following papers or lectures have been read or delivered during the year:—

- Jan. 26, at Watford.—Amongst Wild Beasts; by Arthur Stradling, F.Z.S.
 — 27, at Hertford.—On the Abstraction of Water from the Chalk of Hertfordshire; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
- Feb. 16, at Watford.—Anniversary Address: The Horse; by the President, the Right Honourable the Earl of Clarendon.
- March 13, at Hitchin.—Water and its Circulation above and beneath the Surface of the Earth; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 — 16, at Watford.—A Simple Method of taking Phenological Observations; by Edward Mawley, F.R.Met.Soc., F.R.H.S.
 — Notes on Birds Observed in Hertfordshire during the year 1890, and the early part of 1891; by George Rooper, F.Z.S.
 — Meteorological Observations taken at The Grange, St. Albans, during the year 1890; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 — Report on Phenological Phenomena observed in Hertfordshire during the years 1889 and 1890; by John Hopkinson.
- 23, at St. Albans.—The Application of Photography to Meteorology; by Arthur W. Clayden, M.A., F.G.S., F.C.S., F.R.Met.Soc.
- April 13, at Watford.—The Percolation of Rain through comparatively Light and through comparatively Heavy Soil; by Edward Mawley, F.R.Met.Soc., F.R.H.S.
 — Report on Diseases of Plants in Hertfordshire in 1890; by Alfred T. Brett, M.D.
 — Report on the Rainfall in Hertfordshire in 1890; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 — Climatological Observations taken in Hertfordshire in 1890; by John Hopkinson.
 — 20, at Watford.—Photography, Past and Present; by William Coles.

- Nov. 13, at Watford.—Bats and some other Beasts; by George Rooper, F.Z.S.
 Dec. 11, at Watford.—Terrestrial British Quadrupeds existing in a Wild State at the Present Day; by T. Vaughan Roberts.

Several short notes on meteorology, botany, and zoology have also been read.

A Bye Meeting for microscopical study was held at St. Albans, at the residence of the President—Mr. Hopkinson—on the 22nd of October, when some remarks on the diseases of plants and injuries caused to them by fungi, insects, etc., were made by Dr. Brett.

The following Field Meetings were held during the year:—

- | | |
|--|-----------------------------------|
| May 9.—Bennett's End, Hemel Hempstead. | June 11.—Broxbourne and Hertford. |
| — 13.—Dunstable and Totternhoe. | — 14.—Aldenham and Bricket Wood. |
| — 23.—Welwyn and Ayot. | July 11.—St. Albans. |
| — 30.—Cassiobury Park, Watford. | Oct. 17.—Bricket Wood. |

On the 2nd of May the Society visited the Museum of the Royal College of Surgeons in Lincoln's Inn Fields, under the guidance of Professor Stewart, F.R.S.

The thanks of the Society are due, for hospitality kindly afforded at the Field Meetings, to Mr. and Mrs. Worthington Smith, Dunstable; to Mr. and Mrs. Upton Robins, Delaport, Wheathampstead; to Mrs. James Hopkinson, Holly Bank, Watford; and to the President and Mrs. John Hopkinson, The Grange, St. Albans.

Three parts of Vol. VI of the present series of the Society's 'Transactions,' containing 100 pages and three plates, have been published during the year, and the volume will be completed in three more parts, two containing the Proceedings of the last two sessions, and the third the title-page, contents, index, etc., to the volume. In order to avoid unnecessary delay in the publication of papers read during the present session, a new volume will be commenced before this one is completed.

The resolution passed by the Society at the meeting at St. Albans in December, 1890, requesting the Hertfordshire County Council to oppose any clauses in the London Water Bills of 1891 which might be detrimental to the interests of the County, was duly brought before the County Council, and a Committee was appointed by the Council to watch the progress of the bills and if necessary to oppose them. The bills were referred to a Select Committee, and were opposed by the Hertfordshire County Council and by other public bodies, the result being that they were thrown out. Recently, through the energetic endeavours of Dr. John Evans, F.R.S., a Royal Commission has been appointed to enquire how far the present sources of water-supply are sufficient to meet the increasing needs of the Metropolis, and the Commission will soon begin its labours.

The library is in a satisfactory condition, and numerous works have been received during the year by donation or in exchange.

INCOME AND EXPENDITURE FOR THE YEAR ENDING 31st DECEMBER, 1891.

SESSION 1891-92.

xv

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1890	47	13	0	By Printing 'Transactions'	38	4	6
„ Entrance Fees	7	0	0	„ „ Circulars	8	3	8
„ Life Compositions	15	0	0	„ Expenses of Meetings [*]	13	19	0
„ Subscriptions for 1889	1	10	0	„ Library	2	17	0
„ „ 1890	5	10	0	„ Salary of Assistant	5	0	0
„ „ 1891	36	0	0	„ Postages and various small expenses	17	8	1
„ „ 1892	12	10	0	„ Fire Insurance	0	7	6
„ Dividends on £130 India 3 per cent. Stock.	3	18	0	„ Balance at Bank	44	11	10
„ Sale of Publications [‘Flora of Hertfordshire’ 9s.; ‘Transactions’ £1 1s. 7d.; less expenses]	1	10	7				
	£130	11	7		£130	11	7

Amount invested in the purchase of £130 India 3 per cent. Stock £126 15s. 6d.

Audited and found correct this 18th day of February, 1892, { DANIEL HILL,
T. VAUGHAN ROBERTS.

[* Including £5 to Watford Public Library for 1890.]

ADDITIONS TO THE LIBRARY IN 1891.

PRESENTED.

TITLE.	DONOR.
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Report for 1890. 8vo. London, 1891.	<i>The Association.</i>
BRITISH COLUMBIA. Annual Report of Minister of Mines for 1889. 8vo. Victoria, B.C., 1890.	<i>The Minister.</i>
BOLTON, Sir F. London Water Supply. New Edition. By P. A. Scratchley. 8vo. London, 1888.	<i>Mr. J. Hopkinson.</i>
INTERNATIONAL HEALTH EXHIBITION. Conferences. Water Supply and Distribution. 8vo. London, 1884.	„
LINNEAN SOCIETY. Journal. Botany. Vol. xxvii, Nos. 185, 186. Vol. xxviii, No. 192. Zoology. Vol. xxiii, No. 147. 8vo. London, 1890-91.	<i>Mr. R. B. Croft.</i>
MACGILLIVRAY, W. Lives of Eminent Zoologists. 8vo. Edinburgh, 1834.	<i>Mr. J. Hopkinson.</i>
MERIDEN (CONNECTICUT) SCIENTIFIC ASSOCIATION. Trans- actions for 1890. Vol. iv. 8vo. Meriden, 1891.	<i>The Association.</i>
MONCKTON, C. Pure Spring Water Supply for London. 4to. London, 1890.	<i>Mr. W. Whitaker.</i>
PHILLIPS, Prof. J. Rivers, Mountains, and Sea Coast of Yorkshire. 8vo. London, 1853.	<i>Mr. J. Hopkinson.</i>
SCOTT, R. H. Weather Charts and Storm Warnings. 8vo. London, 1876.	„
SYMONS, J. G. (Ed.). Monthly Meteorological Magazine. Vol. xxvi. 8vo. London, 1891.	<i>The Editor.</i>
WATER SUPPLY OF LONDON. Newspaper Cuttings. 1891.	{ <i>Mr. J. Hopkinson and Mr. W. Whitaker.</i>

RECEIVED IN EXCHANGE.

- AMERICAN MONTHLY MICROSCOPICAL JOURNAL. Vol. xi, Nos. 1-12. 8vo.
Washington, 1890.
- AMERICAN MUSEUM OF NATURAL HISTORY. Bulletin. 1890. 8vo. New
York, 1891.
- BATH NATURAL HISTORY AND ANTIQUARIAN FIELD CLUB. Proceedings.
Vol. vii, No. 1. 8vo. Bath, 1891.
- BLAKE, J. F. Annals of British Geology. 1890. 8vo. London, 1891.
- BRIGHTON AND SUSSEX NATURAL HISTORY AND PHILOSOPHICAL SOCIETY.
Abstracts and Reports, 1889, 1890. 8vo. Brighton, 1889-90.
- BRISTOL NATURALISTS' SOCIETY. Proceedings. Vol. vi, part 2. 8vo.
Bristol, 1890.
- CONCHOLOGY, JOURNAL OF. Vol. vi, Nos. 9-12. 8vo. Leeds, 1891.
- CUMBERLAND AND WESTMORELAND ASSOCIATION. Transactions for 1889-90.
Vol. xv. 8vo. Carlisle, 1890.
- EDINBURGH. GEOLOGICAL SOCIETY. Proceedings. Vol. vi, No. 2. 8vo.
Edinburgh, 1891.
- . ROYAL PHYSICAL SOCIETY. Proceedings for 1889-90. 8vo. Edin-
burgh, 1891.
- GLASGOW, GEOLOGICAL SOCIETY OF. Transactions, 1888-90. Vol. ix, No. 1.
8vo. Glasgow, 1891.
- HAMPSHIRE FIELD CLUB. Papers and Proceedings, 1890. 8vo. Southampton,
1890.
- LIVERPOOL GEOLOGICAL SOCIETY. Proceedings for 1890-91. Vol. vi, No. 3.
8vo. Liverpool, 1891.
- . NATURALISTS' FIELD CLUB. Proceedings for 1888. 8vo. Liver-
pool, 1890.

- LONDON. GEOLOGICAL SOCIETY. Abstracts of the Proceedings. Session 1890-91. 8vo. London, 1891.
- . GEOLOGISTS' ASSOCIATION. Proceedings. Vol. xi, Nos. 1-5. 8vo. London, 1891.
- . ROYAL METEOROLOGICAL SOCIETY. Quarterly Journal. Vol. xvii, No. 77-79. 8vo. London, 1891.
- . The Meteorological Record. Vol. x, Nos. 38-40. 8vo. London, 1891.
- . ROYAL MICROSCOPICAL SOCIETY. Journal. Series 2, Vol. xi. 8vo. London, 1891.
- MANCHESTER FIELD NATURALISTS' AND ARCHEOLOGISTS' SOCIETY. Proceedings for 1889 and 1890. 8vo. Manchester, 1890-91.
- . GEOLOGICAL SOCIETY. Transactions. Vol. xxi, Nos. 1-6. 8vo. Manchester, 1891.
- . LITERARY AND PHILOSOPHICAL SOCIETY. Memoirs and Proceedings. Series 4, Vol. iv, Nos. 1-3. 8vo. Manchester, 1891.
- MIDLAND NATURALIST. Vol. xiv. 8vo. Birmingham, 1891.
- NATURALIST. New Series. Vol. xvi. 8vo. Leeds, 1891.
- NEW YORK ACADEMY OF SCIENCES. Transactions. Vol. ix, Nos. 6-8. 8vo. New York, 1890-91.
- . STATE LIBRARY. 72nd Annual Report, 1888-89. 8vo. Albany, 1890.
- . STATE MUSEUM. Bulletin. Legislation, 1890. 8vo. New York, 1890.
- . Iron Mines and Iron-ore Districts in the State of New York. By J. C. Smock. 8vo. Albany, 1889.
- . Boleti of the United States. By C. B. Peck. *Ib.*
- . Beaks of Unionidæ inhabiting the Vicinity of Albany, New York. By W. B. Marshall. *Ib.* 1890.
- . Building Stone in New York. By J. C. Smock. *Ib.*
- RUGBY SCHOOL NATURAL HISTORY SOCIETY. Reports for 1889 and 1890. 8vo. Rugby, 1890-91.
- SOMERSETSHIRE ARCHEOLOGICAL AND NATURAL HISTORY SOCIETY. Transactions for 1890. 8vo. Taunton, 1891.
- UNITED STATES DEPARTMENT OF AGRICULTURE. North American Fauna. Nos. 3 and 4. 8vo. Washington, 1890.
- . GEOLOGICAL SURVEY. 9th Annual Report, 1887-88. 4to. Washington, 1890.
- . Bulletin. Nos. 51-61, 63, 64, 66. 8vo. Washington, 1890.
- . Monograph. Vol. i. On Lake Buoneville. By C. H. Gilbert. 4to. Washington, 1890.
- . Mineral Resources of the United States for 1888. *Ib.* 1890.
- WARWICKSHIRE NATURALISTS' FIELD CLUB. 34th Annual Report and Proceedings, for 1889. 8vo. Warwick, 1891.
- WILTSHIRE ARCHEOLOGICAL AND NATURAL HISTORY SOCIETY. Magazine. Vol. xxiv, No. 73. 8vo. Devizes, 1890.
- YORKSHIRE GEOLOGICAL AND POLYTECHNIC SOCIETY. Proceedings for 1890. Vol. xi, No. 3. 8vo. Halifax, 1890.

PURCHASED.

- BOTANY, JOURNAL OF. New Series. Vol. xxix. 8vo. London, 1891.
- BUCKLER, W. Larvæ of the British Butterflies and Moths. Vol. iv. (*Ray Society.*) 8vo. London, 1891.
- ENTOMOLOGIST. Vol. xxiv. 8vo. London, 1891.
- YEAR BOOK of the Scientific and Learned Societies of Great Britain and Ireland. Eighth Annual Issue. 8vo. London, 1891.
- ZOOLOGIST. 3rd Series. Vol. xv. 8vo. London, 1891.

ORDINARY MEETING, 16TH MARCH, 1892, AT HERTFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mr. Thomas Benskin, 196, High Street, Watford; Mr. John Larkin, Delrow, Aldenham; Mr. Albert Riggall, 3, Albert Terrace, Watford; Mr. A. Sainsbury Verey, M.B., C.M., Heronsgate, Rickmansworth; and the Rev. John Wardale, M.A., Datchworth Rectory, Stevenage, were proposed for membership of the Society.

The following lecture was delivered:—

“An Hour with the Microscope at a Pond Side.” By F. W. Phillips.

The lecture was illustrated by illuminated drawings prepared by the author.

ORDINARY MEETING, 18TH MARCH, 1892, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Miss Janet Archer, Mr. Thomas Benskin, Mr. John Larkin, Mr. W. H. Lees, Mr. Albert Riggall, Mr. A. Sainsbury Verey, M.B., C.M., and the Rev. John Wardale, M.A., were elected Members of the Society.

The following papers were read:—

1. “Report on the Rainfall in Hertfordshire in 1891.” By the President. (*Transactions*, Vol. VII, p. 53.)

2. “Notes on Birds observed in Hertfordshire during the year 1891.” By Henry Lewis. (*Transactions*, Vol. VII, p. 62.)

Mr. ROOPER said that it was generally supposed that there was only one hole in the nest of the long-tailed tit. If that were the case the birds would be badly off for fresh air, but he had discovered that there was a second hole in the nest, which, although covered over, admitted of a free passage for air. Referring to what he termed “the murder of the buzzard” in the county, he said that if the bird were left alone it would breed here freely. He remembered buzzards being quite common.

Mr. VAUGHAN ROBERTS remarked that buzzards were not so uncommon in this country as was generally supposed. He saw several at Barmouth last year, and was told by a local ornithologist that they were common there.

A discussion was commenced on a Scheme which had been proposed for the Regulation of Bricket Wood Common, one of its provisions being the sale and enclosure of considerable portions of the Common in order to provide funds for obtaining an Act of Parliament and for other expenses incident to the scheme. The PRESIDENT opened the discussion with an explanation of the present position and rights of the Lord of the Manor and the Copyholders; of the interest of the public and especially of naturalists in the

preservation of the Common in its entirety as common land; and of the provisions of the proposed scheme.

Dr. Morison then read a paper prepared by Mr. F. W. SILVESTER, giving an account of the steps which had already been taken in furtherance of the scheme, and urging that we should do all we can to preserve Bricket Wood Common just as it is, as being the only really open (or unenclosed) space of any considerable extent between London and St. Albans.

The discussion was continued by Mr. Rooper, Dr. Morison, and Mr. F. Wallen, and was adjourned to the next meeting of the Society at Watford.

ORDINARY MEETING, 8TH APRIL, 1892, AT ST. ALBANS.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The following lecture was delivered:—

“The Natural History of the Diamond.” By F. W. Rudler, F.G.S., M.A.I., etc., Curator of the Museum of Practical Geology.

The lecture was illustrated by diagrams, drawings on the black-board by the lecturer, and photographs, etc., shown by the oxy-hydrogen lantern kindly lent by Mr. S. Monckton White. A case of models of celebrated diamonds, in paste, was also shown by Mr. Rudler at the close of the lecture.

ORDINARY MEETING, 6TH MAY, 1892, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The discussion on the Scheme for the Regulation of Bricket Wood Common, commenced at the meeting on the 18th of March, was continued, Mr. Wallen, Mr. Guy Ellis, Mr. F. W. Silvester, Dr. A. T. Brett, Mr. W. Carter, Mr. John Weall, and the President taking part in it.

The following resolutions were carried:—

1. Proposed by Dr. Brett and seconded by Mr. Carter: “That a Committee be formed of the three Trustees of the Society and two other members to be appointed by the President and Secretaries, and that the duty of the Committee be to collect information regarding the proposed regulation of Bricket Wood Common, and to report to the Council, so that the Society may decide whether to take any further action in the matter.”

2. Proposed by the President and seconded by Mr. Silvester: “That the Society, while expressing general approval of the proposed scheme for the regulation of Bricket Wood Common, protests against the sale and enclosure of any considerable area of common-land, and against the building of houses thereon.”

The following papers were read:—

1. "Meteorological Observations taken at The Grange, St. Albans, during the year 1891." By the President. (*Transactions*, Vol. VII, p. 69.)
2. "A Naturalists' Calendar for Mid-Hertfordshire." By J. J. Willis. (Communicated by the President.) (*Transactions*, Vol. VII, p. 76.)
3. "Report on Phenological Phenomena observed in Hertfordshire in 1891." By Edward Mawley, F.R.Met.Soc., F.R.H.S. (*Transactions*, Vol. VII, p. 85.)

FIELD MEETING, 7TH MAY, 1892.

HARPENDEN AND EAST HYDE.

Meeting at Harpenden Station, the members, under the guidance of Mr. James Saunders of Luton, walked into the Lea Valley and through the meadows by the side of the river from Pickford Mill to Cold Harbour. Turning off there up the lane to Bower Heath, from the summit of the hill, about 430 feet above sea-level, an extensive view was obtained, embracing Harpenden on the south, Wheathampstead on the south-west, and Kimpton with its church forming a conspicuous object on the north-west. The gorse on Bower Heath was in flower, but a large extent of it had recently been burnt.

East Hyde Park, now the country seat of the Earl of Albemarle, was then entered, by permission, with the special object of exploring the woods for botanical treasures. The gardens also were visited. The Hertfordshire boundary was passed just before "The Hyde" was reached, and the rest of the walk through the park was in Bedfordshire.

After leaving the park, a few minutes walk brought the party to East Hyde, and tea was partaken of at the village inn near the church. Some of the members then returned to St. Albans, etc., from Chiltern Green Station, but the majority accompanied their President on foot by way of Cooter's End to Harpenden, taking a later train from there.

The most interesting plants found in flower were the toothwort (*Lathræa squamaria*), growing on the road-side hedge-bank near the Great Northern Station, Harpenden, and the green hellebore (*Helleborus viridis*) found in the East Hyde Woods (in Herts). Wood-anemones, wood-violets (*Viola Riviana*), primroses, daffodils, and bluebells, etc., were also in flower in these woods, cowslips in the meadow below "The Hyde," and the cuckoo-flower (*Cardamine pratensis*) by the Lea. Several species of Mycetozoa or Myxogastres, curious forms of life which creep about like animals in their youth, and settle down and produce spores in their mature days, were seen in or on decayed wood.

FIELD MEETING, 21ST MAY, 1892.

ALDENHAM, WATFORD.

About a mile and a half from Watford, the road to Aldenham crosses the River Colne at Bushey Mill. The "mill," however, exists only in the name, for it was long ago dismantled, and there is now scarcely sufficient flow of water in the river to drive a mill-stone. At the lowest part of the valley the land is marshy, and occasionally submerged, when pedestrians have to avail themselves of a raised wooden footpath by the side of the road. At the Aldenham end of this footpath is Bushey Mill Bridge, and here the members, about thirty in number, assembled for a walk to Aldenham Church and Delrow under the guidance of Miss Ada Selby.

The route taken was across the fields and through Berry Grove Wood. In this wood several ferns and other plants rather rare in our county have been found. Some years ago Miss Selby discovered here a single plant of *Cystopteris fragilis*, and it is one of the few stations in the county for *Lastrea spinulosa*, but now even such comparatively common ferns as *Athyrium filix-fœmina* and *Lastrea dilatata* seem to have been eradicated. The wood is one of the known haunts of the rather scarce Tinea *Adela viridella*, which has been taken amongst the beech trees, and a search was made for it, but without success, nor were any other moths seen here.

The chief object of the meeting, however, was to see Aldenham Church and learn something of its history from the Vicar, the Rev. Kenneth F. Gibbs, who received the members at the lych-gate.

Aldenham Church is dedicated to St. John the Baptist, and is an Early English building consisting of a chancel and nave, both with aisles; a north porch; and a lofty tower with central spire and beacon-tower at the north-east corner. Its interior has a peculiar one-sided appearance, due to the centre of the chancel not being in a line with the centre of the nave. It was built about the year 1250 on the site of an earlier church, was subjected to ruthless vandalism by so-called "restoration" in 1840, but within the last few years has been much improved, and its pristine features restored as far as possible, by the present patron of the living, Mr. Henry Hueks Gibbs, of Aldenham House.

The well-known altar-tombs of "Will. Hutchinson de Delrow in paroch. Aldenhamiæ, Armig.," and "Margeria" his wife, in the south-east part of the churchyard, were first inspected. They are surrounded by iron railings, and within the enclosure of four-feet square are four sycamores which have broken into many pieces the stone slabs and twisted about the iron railings, absorbing them into their trunks in several places. Two of the trees are over eight feet in circumference at three feet from the ground.

In the church the Vicar gave a history of the building, and pointed out the interesting relics it contains. He had been told that the foundations of the church were Saxon, but he had not seen them. He had no doubt of there having been a church there

in Saxon times, for the name Aldenham* pointed to the existence of a Saxon settlement. The oldest part of the present building now to be seen he believed to be a small window, the lower of two windows at the west end of the south aisle. It was pure Norman, and was, he supposed, about 700 years old. The most beautiful thing in the church, perhaps, was the roof of the nave, which was of carved and painted oak; it dated from about the year 1460. The reredos over the altar was a fine specimen of Salviati's work. All the screens were modern except the one in the south-chancel aisle. This was standing in 1810 when the church was repaired, the top of it was then taken down and thrown away, and in the restoration of the church in 1840 the remainder was removed and sold to a local builder. The parts had lately been collected together and the screen reinstated, the preservation of its fragments being due to the wood having become so hard by age as to be useless to the carpenter. The rood-screen was approached by a staircase outside the church, traces of which still remained, and it was reached by crossing the south-chancel aisle on the top of the old screen just referred to, which was quite broad enough to walk upon, and thence through the arch still remaining in the pier to the screen where stood the rood or cross. The font, of Purbeck marble, standing in the centre of the nave, and the piscina, in the chancel, were between 600 and 700 years old, dating from the building of the present church.

Referring, then, to the monuments, tablets, and brasses, Mr. Gibbs pointed out, in the south-chancel aisle, two altar-tombs, on each of which is the recumbent figure of a lady under a richly-carved canopy. These beautiful monuments, he said, were about 500 years old (*temp.* Richard II); to whom they were erected could only be surmised from the arms on six shields (three on each tomb), one bearing the arms of Sir William Crowmer, son of John Crowmer of Aldenham, and Lord Mayor of London in 1413. In brasses, both old and new, the church was very rich, though many of the inscriptions on the old brasses had been torn away in by-gone times on account of their containing prayers for the dead.

In the course of a walk round the church, Mr. Gibbs remarked upon the various stained windows, and pointed out a battle-helmet said to have been worn by the first Lord Falkland, and the unique parish chest. This is nine feet eight inches in length, has been carved out of a solid piece of oak, is strengthened with thick bands of iron which cross and re-cross each other, and has a lid opening on seventeen massive hinges and secured by eight hasps, two large bolts, and several locks. Cussans says that it is the finest parish chest he ever saw.

In the vestry several old portraits and other interesting objects

* Or "Ealdenham" as it was called when given by Wulfsinus to the Monastery of St. Albans. On the manor being divided between the Abbots of St. Albans and of St. Peter's, Westminster, "that portion which belonged to St. Albans was laid to the Hundred of Cassio, and the other portion to Dacorum, and so they still remain." (Cussans, 'Hist. Herts.,' "Dacorum Hundred," p. 239.)

were seen. The oak vestry-table is a good specimen of carved Jacobean work, and was once the communion-table.

The Vicarage grounds were next visited, and here the only moth captured during the afternoon's walk, *Eupithecia vulgata* (the common pug) was taken on a wall.

The President then conveyed the thanks of the Society to the Rev. Kenneth Gibbs, and the members left for Delrow House, where they were very kindly received and entertained by Mr. and Mrs. Larkin. The house, which is about half a mile from Aldenham Church, is believed to have been built by its first possessor, the "Will. Hutchinson" whose tomb had just been seen. Mr. Larkin pointed out the date of its construction, 1667, on the lead water-spouts. It has recently been much added to.

After tea had been partaken of, the conservatories were visited, and Mr. Larkin's very valuable collection of orchids was examined with much interest. An hour was spent in strolling about the extensive and picturesque grounds, which contain some fine old trees, and then, after thanking their host and hostess, some of the members walked to Radlett Station, and others by way of Patchett's Green and Hearts Spring Wood to Watford.

FIELD MEETING, 28TH MAY, 1892.

ST. ALBANS.

The chief object of this meeting was to enable the members of the Society to see a section of strata between St. Albans and Harpenden recently exposed by the widening of a cutting on the Midland Railway, and for this purpose permission had been obtained from the Railway Company for the party to walk along the line. The meeting was under the direction of the President and Mr. W. Whitaker, F.R.S.

The members assembled at the Midland Station, St. Albans, and, after a walk of about a mile to the north, came upon the newly-cut face of the cutting on the eastern side of the line. At this point, and once or twice afterwards in the course of the walk along the cutting, which extends for about a mile towards Harpenden, a halt was made, and Mr. Whitaker explained the interesting features of the section exposed.

The Chalk—the lowest rock here seen—was, he said, in places capped by a thin coating of sands belonging to the Reading Series, and this was covered with Drift beds. The bedding of the strata was seen to be very uneven, this being caused by the irregular dissolution of the Chalk, which in some places had been dissolved away to such an extent (by the percolation into it, through the overlying beds, of water holding carbonic acid in solution) that "pipes" were formed, and, as the Chalk was dissolved, the beds above fell in, or gradually sank, in a very irregular manner, so as to take, in section, the form of great waves, their hollows often going below the deep cutting, and their crests, and even the Chalk on which they rest, sometimes rising nearly to the top. Many

of these waves, however, were of irregular shape, being much steeper on one side than on the other, even to verticality. The Tertiary beds formed part of an outlier of which more would be seen presently, and with regard to the Drift beds he could only say that they were like beds which elsewhere had been classed as belonging to the Glacial Drift.

The line was left at the point where it intersects Beech Bottom, and this shady glen was traversed as far as the road known as Soot House Lane. Here the President remarked that much less was known about this cutting than about the railway-cutting on which Mr. Whitaker had discoursed. It was an earthwork of early British origin, extending here for rather more than a mile in a nearly straight (but slightly sinuous) line, but the portion still preserved was probably only a small part of the original earthwork, for here and there, in the same general direction, traces of a similar earthwork were to be seen. The earth had been thrown up on both sides of the trench, and the Chalk had been excavated nearly down to the present plane of permanent saturation, so that at one time, when this plane was higher than it is now, water must have stood permanently in the fosse. There was now water in it only after very wet seasons, except in one or two ponds, and these were sometimes nearly dry.*

The brickyards near Bernard's Heath were then visited, and sections of the Tertiary outlier (Reading Beds) and overlying Brick Earth, etc., were inspected. After crossing the heath, which has been extensively dug for gravel, the gravel-pits on Townsend Farm were entered. These pits are of interest chiefly as being one of the few spots where the Hertfordshire conglomerate can be seen apparently in place. The bed was not very well exposed, the section having been in a much better condition six months ago; but the conglomerate was traced for about twenty feet in one direction and five feet in a direction perpendicular to it. The puddingstone, Mr. Whitaker said, was made up of flint-pebbles in a siliceous paste, the flints being a little harder than the matrix, and that was probably the reason why the Romano-Britons used this material for their querns or grinding-mills. It is known to occur in place only at two other spots in Hertfordshire, both near Radlett Station, where its geological position is low in the Reading Beds.

From the gravel-pits the members and their friends proceeded by way of Bernard's Heath and St. Peter's Church to The Grange, where they were entertained by the President and Mrs. Hopkinson. After tea, which was partaken of in the garden, collections of fossils were examined in the library, comprising Cretaceous and Eocene fossils collected by Mr. Hopkinson, and fossils collected by Dr. Morison from the Chalk Rock of the Chiltern Green cutting on the Midland Railway, a list of which has been published in the Society's 'Transactions' (Vol. V, p. 199).

* Mr. Samuel Sharp has endeavoured to show that it formed part of the boundary of an ancient British town. ('Arch. Journal,' Vol. xxii, p. 299.)



CHALK, TERTIARIES, AND DRIFT, MIDLAND RAILWAY, ST. ALBANS.



HERTFORDSHIRE CONGLOMERATE NEAR ST. ALBANS.

The party included members of the Geologists' Association of London, and numbered upwards of sixty.

FIELD MEETING, 25TH JUNE, 1892.

GORHAMBURY, ST. ALBANS.

The life of Francis Bacon having formed the subject of the President's recent Anniversary Address,* this meeting was arranged to illustrate those portions of it which relate to our great philosopher's residence at Gorhambury, and Mr. Hopkinson acted as Director, having obtained the permission of the Earl of Verulam for Pré Wood and Gorhambury Park to be visited.

The members assembled on St. Michael's Bridge, and those who first arrived visited Kingsbury, the residence of Mr. Willshin, to see the handsomely-carved oak front door, a relic from the house which Francis Bacon built.

St. Michael's Church was then visited, and the Vicar, the Rev. N. Hutchinson, pointed out some of the more interesting features of the building, and showed the monument erected in the chancel to Bacon's memory by his Secretary, Sir Thomas Meautys. The Latin inscription, by Sir Henry Wotton, will be found in the Address referred to above. It may be thus translated:—

Thus sat Francis Bacon, Baron Verulam, Viscount St. Albans; or, by more illustrious titles, the Light of Science, the Eloquence of the Law; who, after he had revealed the secrets of Nature and of Civil Life, yielded to Nature's law that compounds must be dissolved, in the year of our Lord 1626, and in the 66th year of his age.

In memory of this great man, Thomas Meautys, his faithful friend while he lived, his admirer now that he is dead, has placed this monument.

Meautys was himself interred in the chancel, close to this beautiful monument to his patron, as is shown by the remains of an inscription on a stone near the altar-rails.

The private road to Gorhambury, once part of the high road from London to Holyhead, was then traversed as far as the park, from which Pré Wood was entered in order to see the reservoirs made by Sir Nicholas Bacon to supply water to the house he built. The site of these reservoirs, which are about an acre in extent, is indicated on our Ordnance Maps by the word "CAMP,"—but there is even now some water in them, which we should be much surprised to find in any camp of Early British, or Roman origin. The water appears to have been conveyed from each reservoir, probably by filtration through gravel, into a deep tank or well, and thence to old Gorhambury House, distant three quarters of a mile, through a leaden pipe, portions of which have been dug up and are preserved. A valley intervenes, into which the pipe had been carried, and up the opposite hill to the house, the position of which is from ten to fifteen feet lower than the reservoirs.

In the middle of a field adjoining Pré Wood, and within sight of the reservoirs, a nearly circular mound with several trees upon

* 'Transactions,' Vol. VII, pp. 1-36.

it was pointed out. It is known as "Bacon's Mount," and it is said that it was one of his favourite places for reading and meditation. It appears to be a tumulus, and by its proximity to the reservoirs may have led to the idea that they indicated the site of a camp.

Re-entering the park, the valley was crossed nearly on the line in which the water-pipe was carried, and the ruins of the old house were inspected. Only portions of the walls of the back part remain, with the entrance to the house, which was reached through a courtyard, but the extent of the quadrangle in front can still be traced by the different colour of the grass and a slight ridge here and there. A little distance to the left are the remains of a statue of Henry VIII. Were it not known that these are the ruins of a house in which occasionally resided England's greatest philosopher, and in which his father twice entertained Queen Elizabeth, it might be wondered why they are so securely fenced in and so carefully preserved, for they are of no great antiquity, being scarcely more than three centuries old, and they possess no architectural features worthy of note.

Just beyond these ruins, on the left, was seen Oak Wood, which is of interest as being the wood which Bacon was advised to have cut down in order to raise money, when he replied that "He would not be stripped of his feathers."

After endeavouring, with no certain success, to find the site of the house which Geoffrey de Gorham built about the year 1128, and which was demolished before 1400, the park was left, and the members were very kindly received and entertained at tea at Maynes by Mr. and Mrs. Purrott.

Near the house, and running through part of the garden in one direction and into the park in the opposite direction, is a dyke, named on the 6-inch Ordnance Map "Devil's Ditch." It is nearly in a line with Beech Bottom on the west and Græmes Dyke on the east, and the Director suggested that they might all be portions of the same earthwork, which was probably a defensive tribal boundary (see also p. xxiv).

A few of the members then crossed the fields to the Pond-yards, which Francis Bacon turned into "a place of pleasure," building near them a house ("Verulam House") in which to live in the summer, when the water-supply to old Gorhambury House failed, and, on an island in the middle pond, a banqueting-house.

The site of Verulam House could not be traced, but the position of it may be approximately determined from the following account in Aubrey's 'Lives of Eminent Men':—

"From the leads [on the top of the house] was a lovely prospect to the ponds, which were opposite to the east side of the house, and were on the other side of the stately walke of trees that leads to Gorhambury House; and also over that long walke of trees whose topps afford a most pleasant variegated verdure, resembling the works in Irish stich. . . . From hence to Gorhambery is about a little mile, the way easily ascending, hardly as acclive as a desk: from hence to Gorhambery in a strait line leade three parallell walkes; in the middle-most three coaches may passe abreast: in the wing-walkes two. They consist



“BACON’S MOUNT,” NEAR PRÉ WOOD, ST. ALBANS.



RUINS OF OLD GORHAMBURY HOUSE, ST. ALBANS.

of severall stately trees of the like groweth and height, viz. elme, chesnut, beach, hornbeame, Spanish ash, cervice tree, &c., whose topps doe afford from the walke on the house the finest shew that I have seen, and I sawe it about Michaelmas, at which time of the yeare the colours of leaves are most varied."

This house, according to Aubrey, "did cost nine or ten thousand the building, and was sold about 1665 or 1666 by Sir Harbottle Grimston, Baronet . . . to two carpenters for fower hundred poundes; of which they made eight hundred poundes."

The cottage close to the Pond-yards on the north is evidently part of what was once a large house, possibly existing in Bacon's time and referred to by him when he says: "In y^e middle of the laque where the howse now stands to make an Iland," that on which he built his banqueting-house.

Returning to Maynes, after thanking Mr. and Mrs. Purrott for their hospitality, the party dispersed, some walking to St. Albans past the site of Pré Mill, where the final illustration of Francis Bacon's connection with Gorhambury was given by the Director.

In 1556 Sir Nicholas Bacon erected here a "force" to supply water to Gorhambury House, which he was then building. After his death, in 1579, his widow, Lady Anne, "not finding much need of that water," probably because the water from the Pré Wood reservoirs afforded a sufficient supply, removed the "force," and erected in its place a flour-mill. This action gave rise to a law-suit, the lessee of "the Abbey Mylle," then a "water corn-mill," claiming exclusive right to grind corn for "the inhabitants of St. Albones towne." The result of this suit is unknown, for the only order in it on record is one dated 1 July, 1601, which "states that on motion made that day 'by Mr. Bacon,' who informed the Court that the cause was ready for hearing, it was ordered that the same 'shall be heard in the Exchequer Chamber next term.' " *

But the chief interest of this in connection with "Mr. Bacon" lies in the probability that the conversion by his mother of a force to supply water to Gorhambury House, into a flour-mill, led him to build Verulam House, for Dr. Rawley, his chaplain, gives the following anecdote as one of his "Additional Apophegms." †

"When Sir Nicholas Bacon the Lord Keeper lived, every room in Gorhambury was served with a pipe of water from the ponds distant about a mile off. In the lifetime of Mr. Anthony Bacon the water ceased. After whose death, his Lordship coming to the inheritance, could not recover the water without infinite charge. When he was Lord Chancellor he built Verulam House, close by the pond-yard, for a place of privacy when he was called upon to despatch any urgent business. And being asked why he built that house there, his Lordship answered that *Since he could not carry the water to his house, he would carry his house to the water.*"

Pré Mill was used as a flour-mill for nearly three centuries, having been pulled down less than twenty years ago.

* W. J. Hardy, in 'Trans. St. Albans Arch. Soc.,' 1892, p. 17.

† Spedding's 'Works of Francis Bacon,' Vol. vii, p. 169.

FIELD MEETING, 2ND JULY, 1892.

ABBOT'S LANGLEY AND BEDMONT.

The members assembled at King's Langley Station and walked to Abbot's Langley, where they were shown over the grounds of Langley House by Mr. and Miss Henty. The fine trees which adorn the lawn in front of the house were inspected with much interest. The most remarkable of these is a horse-chestnut, the lower branches of which have bent to the ground, taken root, and sprung up again with greatly-renewed vigour, their diameter being increased, after rooting, two or three times. The spread of the branches, Mr. Henty said, is forty-two yards. The Rev. Canon Gee refers to this tree in his paper on "Famous Trees in Hertfordshire,"* and says that its interest is so great that "it literally throws into the shade the cedars on the lawn, one of which is sixteen and a half feet round." Near by a fine tulip-tree was seen, now just coming into flower.

Just beyond Bedmont the beautiful grounds of Serge Hill were entered, and here the members and their friends were very hospitably entertained by Major Reynolds Solly and Mrs. Solly, and spent a considerable time in examining Mr. Solly's collection of shells, minerals, etc., and in looking over his fine library, which contains many rare and valuable works on Natural History and Archæology.

A vote of thanks having been accorded to Mr. and Mrs. Solly, on the proposition of the President, the walk was continued across the fields by Potter's Crouch to St. Albans. The party numbered about twenty.

FIELD MEETING, 8TH OCTOBER, 1892.

GORHAMBURY, ST. ALBANS.

This was a special meeting arranged with the Earl of Verulam by the President to enable the members of the Society to see the valuable collection of historical paintings, especially those of interest in connection with the life and times of Francis Bacon, which are preserved in Gorhambury House. To avoid too large a party the meeting had to be restricted to *members*, about twenty of whom availed themselves of the invitation of the Earl of Verulam. They were received and conducted through several of the apartments by the Earl, Lady Jane Grimston, and the Hon. William Grimston.

There are two portraits of Francis Bacon, one, representing him with his hat on as is usual with portraits of his time, painted by Vansomer about the year 1620; the other, without the hat, usually supposed also to be by Vansomer, but a much inferior painting, and probably a copy of Vansomer's by another hand, made at a later date when it was no longer the fashion to portray people with their heads covered. Vansomer's painting is believed by Spedding † to be

* 'Trans. Watford Nat. Hist. Soc.,' Vol. II, p. 1.

† 'Letters and Life of Francis Bacon,' Vol. iii, p. iii.

a copy of a miniature in the possession of the Duke of Buccleugh, said to be by Peter Oliver, and dated 1620. It was then the custom to have a miniature painted from life, and a life-sized copy made of it, the first artists of the day making such copies. There is also an excellent bust in terra-cotta, coloured, representing Francis Bacon in his twelfth year, and believed to be by an Italian artist. On either side are similar busts of his father and mother.

Francis Bacon was the fifth and youngest son of Sir Nicholas Bacon, who married twice, having three sons and three daughters by his first wife, and two sons by his second wife, who survived him, and resided at Gorhambury until her death in 1601. His second son, Nathaniel, had a daughter, Anne, who married first Sir Thomas Meautys, and next Sir Harbottle Grimston, who also had been married before, to Mary, daughter of Sir George Croke. From Sir Harbottle's daughter Mary, by his first marriage, the present Earl of Verulam is descended.

Sir Nathaniel Bacon was a talented artist, and two paintings by him attracted much attention. One, a likeness of himself, is believed to be one of the best ever painted in England by an amateur. The other, "the Cook-maid," is also an excellent painting, and is of special interest as probably representing his step-mother, Lady Anne, the mother of Francis, about the year 1577, when Sir Nicholas entertained Queen Elizabeth. The Cook-maid is represented holding a live turkey in her arms, and with a number of dead birds on the table before her, including ducks and pigeons, herons and bustards, yellow-hammers, bullfinches and chaffinches, and a swan. There is a distinct likeness between the bust of Lady Anne Bacon and the Cook-maid in this picture.

Sir Thomas Meautys and Sir Harbottle Grimston are also portrayed, the former by Vansomer; and amongst other paintings of the time of Francis Bacon may be mentioned one of Queen Elizabeth, painted by Hilliard in 1570, and presented by the Queen to Sir Nicholas Bacon; and one of James the First, painted for Sir Thomas Meautys.

A much older portrait than any of these is that of Sir Edward Grimston, an ancestor of the Earl of Verulam, who died in 1478. The portrait is on a panel and was painted by Petrus Christus in 1446, at Burgundy, while Sir Edward was Ambassador at that Court.

Other interesting relics were also shown by the Earl, including a work-box which formerly belonged to Mary Queen of Scots, and the famous Verulam jug, which, with a skeleton and two other glass vessels, was found in 1813 in a Roman stone coffin dug up in a field on Kingsbury Farm. This coffin was for many years lying by the road-side, and is now in St. Michael's churchyard.

On leaving the house the President conveyed the thanks of the members present to the Earl of Verulam for his kindness in not only allowing them to see his art-treasures, but also much increasing their interest by his remarks on their history and associations.

A few of the party then inspected the ruins of the house built by Sir Nicholas Bacon, and endeavoured to find the site of the still earlier house built by Robert de Gorham, while the rest returned direct to St. Albans.

FIELD MEETING, 13TH OCTOBER, 1892.

BROXBOURNE AND WORMLEY.

Only once previously, five years ago to the day, has a Fungus Foray been held in the eastern part of the county, and then in the same neighbourhood as this. On that occasion 74 species of fungi were found, this time the number was doubled, but this result is chiefly owing to work done in the morning, for about 80 species were found in Wormley Wood by a few members who met by special arrangement before the officially-announced foray commenced.

The meeting was under the direction of Mr. Henry Warner, and the species of fungi collected were determined by Mr. George Masee, of Kew, who accompanied the party.

In the afternoon the walk was from Broxbourne Station by Baas Hill and St. John's Well into Cowheath Wood and Broxbourne Wood, returning to the station by Wormley, where Mr. Warner entertained the party at tea.

The following list comprises 149 species (with two varieties), of which 51 species, to which an asterisk (*) is affixed (and both varieties), are new to the county. The rarer forms are indicated by an obelisk (†).

HYMENOMYCETES.		Agaricus (Tricholoma) albo-brunneus,	
Agaricus (Amanita)	phalloides, <i>Fr.</i>		<i>Pers.</i>
"	" mappa, <i>Batsch.</i>	"	rutilans, <i>Schæff.</i>
"	" muscarius, <i>L.</i>	"	imbricatus, <i>Fr.*</i>
"	" rubescens, <i>Pers.</i>	"	terreus, <i>Schæff.</i>
"	" spissus, <i>Fr.*</i>	"	" var. orirubens,
"	" vaginatus, <i>Bull.</i>	"	<i>Quel.*</i>
"	(Lepiota) procerus, <i>Scop.</i>	"	saponaceus, <i>Fr.</i>
"	" rachodes, <i>Vitt.</i>	"	sulphureus, <i>Bull.*</i>
"	" mastoideus, <i>Fr.*</i>	"	carneus, <i>Bull.*</i>
"	" clypeolarius, <i>Bull.</i>	"	albus, <i>Schæff.†</i>
"	" cristatus, <i>Fr.</i>	"	nudus, <i>Bull.</i>
"	" carcharias, <i>Pers.</i>	"	melaleucus, <i>Pers.</i>
"	" granulosis, <i>Batsch.</i>	"	(Clytocybe) nebularis, <i>Batsch.</i>
"	" var. rufescens,	"	clavipes, <i>Fr.</i>
"	<i>B. and Br.*</i>	"	hirneolus, <i>Fr.*†</i>
"	" amianthinus, <i>Scop.*</i>	"	odorus, <i>Fr.</i>
"	" gliodermis, <i>Fr.*†</i>	"	rivulosus, <i>Pers.*</i>
"	(Armillaria) melleus, <i>Vahl.</i>	"	cerussatus, <i>Fr.</i>
"	" mucidus, <i>Fr.</i>	"	phyllophilus, <i>Fr.</i>
"	" ramentaceus,	"	pithyophilus, <i>Fr.</i>
"	<i>Bull.*†</i>	"	candicans, <i>Fr.*</i>
"	(Tricholoma) equestris, <i>L.</i>	"	gallinaceus, <i>Scop.</i>
"	" portentosus, <i>Fr.*</i>	"	fumosus, <i>Pers.</i>
"	" resplendens, <i>Fr.*†</i>	"	infundibuliformis,
"	" flavo-brunneus, <i>Fr.</i>	"	<i>Schæff.</i>

Agaricus (Clytocybe) parilis, <i>Fr.*</i>	Agaricus (Hebeloma) sinapizaus, <i>Fr.</i>
„ „ tuba, <i>Fr.</i>	„ (Flammula) lentus, <i>Pers.*</i>
„ „ cyathiformis, <i>Fr.</i>	„ „ gummosus, <i>Lasch.</i>
„ „ brumalis, <i>Fr.</i>	„ „ aluicola, <i>Fr.*</i>
„ „ metachrous, <i>Fr.*</i>	„ (Galera) hypnorum, <i>Batsch.</i>
„ „ ditopus, <i>Fr.*</i>	„ (Psalliota) campestris, <i>L.</i>
„ „ laccatus, <i>Scop.</i>	„ „ silvaticus, <i>Schæff.</i>
„ (Collybia) radicans, <i>Rehl.</i>	„ (Stropharia) æruginosus, <i>Curt.</i>
„ „ fusipes, <i>Bull.</i>	„ „ spintriger, <i>Fr.*</i>
„ „ maculatus, <i>A. & S.</i>	„ „ merdarius, <i>Fr.*</i>
„ „ butyraceus, <i>Bull.</i>	„ (Hypholoma) sublateritius, <i>Fr.</i>
„ „ confluens, <i>Pers.</i>	„ „ fascicularis, <i>Huds.</i>
„ „ racemosus, <i>Pers.*</i>	„ (Panæolus) campanulatus, <i>L.</i>
„ „ esculentus, <i>Jacq.</i>	Coprinus fimetarius, <i>Fr.*</i>
„ „ dryophilus, <i>Bull.</i>	„ micaceus, <i>Fr.</i>
„ „ ozes, <i>Fr.*†</i>	Cortinarius crassus, <i>Fr.*</i>
„ (Mycena) pelianthinus, <i>Fr.</i>	„ largus, <i>Fr.*</i>
„ „ purus, <i>Pers.</i>	„ glaucopus, <i>Fr.*</i>
„ „ luteo-albus, <i>Bolt.*</i>	„ fulgens, <i>Fr.</i>
„ „ lacteus, <i>Pers.</i>	„ elatior, <i>Fr.</i>
„ „ rugosus, <i>Fr.</i>	„ pholideus, <i>Fr.</i>
„ „ galericulatus, <i>Scop.</i>	„ paleaceus, <i>Fr.</i>
„ „ plicosus, <i>Fr.*</i>	„ acutus, <i>Pers.</i>
„ „ alcalinus, <i>Fr.</i>	Hygrophorus eburneus, <i>Bull.</i>
„ „ metatus, <i>Fr.</i>	„ hypothejus, <i>Fr.</i>
„ „ filipes, <i>Bull.</i>	„ chlorophanus, <i>Fr.</i>
„ „ sanguinolentus,	Lactarius turpis, <i>Fr.</i>
„ „ <i>A. and S.</i>	„ flexuosus, <i>Fr.*</i>
„ „ galopus, <i>Pers.</i>	„ camphoratus, <i>Bull.*</i>
„ „ epiptyrgius, <i>Scop.</i>	Russula Linnæi, <i>Fr.*</i>
„ „ roridus, <i>Fr.</i>	„ lilacea, <i>Quel.*</i>
„ „ tenerrimus, <i>Berk.</i>	„ vesca, <i>Fr.*</i>
„ „ corticola, <i>Schum.</i>	„ citriua, <i>Gill.*</i>
„ „ hiemalis, <i>Osbeck.*</i>	„ fragilis, <i>Pers.</i>
„ (Omphalia) leucophyllus, <i>Fr.*</i>	Marasmius urens, <i>Fr.</i>
„ „ rusticus, <i>Pers.</i>	„ peronatus, <i>Bolton.</i>
„ „ griseus, <i>Fr.</i>	Boletus duriusculus, <i>Schulz.*</i>
„ (Pleurotus) striatulus, <i>Fr.*†</i>	„ chrysenterou, <i>Fr.</i>
„ „ hypnophilus, <i>Pers.*</i>	Polyporus fomentarius, <i>Fr.</i>
„ (Pluteus) cervinus, <i>Schæff.</i>	„ versicolor, <i>Fr.</i>
„ (Entoloma) sinuatus, <i>Fr.</i>	Fistulina hepatica, <i>Fr.</i>
„ „ sericeus, <i>Bull.</i>	Hydnum Weissmanni, <i>Fr.*</i>
„ (Leptonia) lampropus, <i>Fr.</i>	Corticium arachnoideum, <i>Berk.*</i>
„ „ serrulatus, <i>Pers.*</i>	„ molle, <i>Fr.*</i>
„ „ incanus, <i>Fr.*</i>	Stereum hirsutum, <i>Fr.</i>
„ (Nolania) pascuus, <i>Pers.</i>	Craterellus cornucopioides, <i>Fr.</i>
„ (Pholiota) squarrosus, <i>Müll.</i>	
„ „ spectabilis, <i>Fr.</i>	DISCOMYCETES.
„ „ adiposus, <i>Fr.</i>	Peziza aurantia, <i>Ed.</i>
„ „ Cookei, <i>Fr.*†</i>	„ scutellata, <i>L.*</i>
„ „ mutabilis, <i>Schæff.</i>	„ virginea, <i>Batsch.*</i>
„ (Inocybe) pyriodorus, <i>Pers.</i>	Helotium claro-flavum, <i>Grev.*</i>
„ „ perbrevis, <i>Weissm.*†</i>	„ æruginosum, <i>Fr.*†</i>
„ (Hebeloma) fastibilis, <i>Fr.</i>	Geoglossum viscosum, <i>Pers.*</i>

Mr. Warner afterwards found, and sent to Mr. Massee for determination, two rare species, *Tremellodon gelatinosum*, *Pers.*, and *Clavaria stricta*, *Pers.*, both being new county records.

ORDINARY MEETING, 15TH NOVEMBER, 1892, AT ST. ALBANS.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mr. E. A. L. Batters, LL.B., B.A., F.L.S., The Laurels, Wormley; Mr. H. Blackburn, Nascot Grange, Watford; Mrs. A. E. Bolton, London Road, St. Albans; Mr. C. E. Dillon, Alma Road, St. Albans; Mr. Arthur R. Gillman, Springfield, Woodridings, Pinner; Mr. George Bickersteth Hudson, M.P., Watton, Hertford; Mr. Arthur Lewis, Sparrowswick, St. Albans; Mr. W. N. Puddicombe, M.R.C.S., London Road, St. Albans; Mr. William Topley, F.R.S., F.G.S., Assoc. Inst. C.E., Geological Survey of England, 28, Jermyn Street, London, S.W., and Hurstbourne, Elgin Road, Croydon; Miss Katherine Turnbull, Rose Hill, Abbot's Langley; Mr. Frederick Wallen, 96, Gower Street, London, W.C., and Bricket Wood, St. Albans; and Miss Jane Wiles, George Street, St. Albans, were proposed for membership of the Society.

The following lecture was delivered:—

“Woodland Wanderers, or the Mycetoza.” By James Saunders.

An extempore lecture, the substance of which, with additions, was afterwards written as “Notes on the Mycetoza, with a List of Species from Hertfordshire and Bedfordshire.” (*Transactions*, Vol. VII, p. 137).

The lecture was illustrated by photographic slides, representing various species of Mycetoza in different stages of growth, shown by the oxy-hydrogen lantern kindly lent by Mr. S. Monckton White; and a slide with living plasmodium, which had thrown out pseudopodia during the preceding twenty-four hours, was also shown on the screen by the lantern-microscope. This is believed to be the first time that living plasmodium has thus been shown to a scientific society, and the President remarked that the meeting would therefore probably be a historical one.

Mr. Saunders also exhibited coloured drawings of the Mycetoza executed by the Misses Lister.

ORDINARY MEETING, 18TH NOVEMBER, 1892, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mr. E. A. L. Batters, LL.B., B.A., F.L.S., Mr. H. Blackburn, Mrs. A. E. Bolton, Mr. C. E. Dillon, Mr. A. R. Gillman, Mr. G. B. Hudson, M.P., Mr. Arthur Lewis, Mr. W. N. Puddicombe, M.R.C.S., Mr. William Topley, F.R.S., F.G.S., Assoc. Inst. C.E., Miss Katherine Turnbull, Mr. Frederick Wallen, and Miss Jane Wiles, were elected Members of the Society.

The Right Honourable George Devereux de Vere Capell, seventh Earl of Essex, Cassiobury, Watford; Mr. James Fisk, High Street, St. Albans; and Mr. E. T. Wilks, F.R.G.S., Monmouth House, High Street, Watford, were proposed for membership.

The following lecture was delivered :—

“Coal: its Nature, Origin, Position, and Extent; and its Range under the South of England.” By Professor T. Rupert Jones, F.R.S., F.G.S., Honorary Member of the Society. (*Transactions*, Vol. VII, p. 89.)

The lecture was illustrated by a large number of diagrams.

ORDINARY MEETING, 16TH DECEMBER, 1892, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The Right Honourable the Earl of Essex, Mr. James Fisk, and Mr. E. T. Wilks were elected Members of the Society.

Mrs. Kember, The Hansteads, Bricket Wood, St. Albans, was proposed for membership.

The following paper was read :—

“Ice and its Work.” By John Morison, M.D., F.G.S. (*Transactions*, Vol. VII, p. 147.)

The PRESIDENT remarked how comparatively recent it was that we had any knowledge whatever of the action of ice in this country. Only about half a century ago, in November, 1840, evidences of such action were first brought before the Geological Society, by Agassiz, Buckland, and Lyell; and in 1842 Darwin first described the effects of glaciation in North Wales. Much more recently Professor Ramsay first showed how glaciers can excavate lake-basins. For long it had been a puzzle how it was possible for a lake-basin to be scooped out of the solid rock, and it could only be accounted for by the action of ice, the great weight of ice accumulating in the steeper part of a valley pressing the ice downwards with such force in the shallower part below, that the stones embedded in it scooped out a deep hollow which gradually became shallower as the pressure was relaxed, giving the form of lake-basin which Dr. Morison had described.* He also mentioned that Professor Prestwich, about 35 years ago, in a paper in the ‘Geologist,’ first noticed the occurrence of boulder-clay in Bricket Wood, and found evidences in the gravel beneath it of the former existence of the mammoth in the county.

Dr. BRETT said that he had observed three terraces in the valley of the Colne, and he thought that a large glacier or a succession of glaciers might have filled this valley.

Dr. MORISON said that he did not think that the valley of the Colne was ever occupied by a glacier. No doubt the great ice-sheet did cover the country here, but there was no evidence that any separate glacier ever existed in this valley. Much, he added, remained to be done in this county in recording boulders and the nature of the rocky fragments which occur in the boulder-clay and drifts.

* The competency of ice, or ice-embedded stones, to scoop out a lake-basin, has recently been called in question.

The PRESIDENT then announced that this was probably the last meeting which the Society would hold in the Watford Public Library, which had been its head-quarters for the last eighteen years. It was scarcely necessary to allude to the difficulty of hearing the lectures at this and the preceding meeting owing to the noise made by the carpentering class in the part of the room separated from that in which they were assembled only by a removable partition; for after the present meeting they could not get the promise of a room at all. The Council had therefore entered into negotiations with the Governors of the Endowed Schools, and had arranged to transfer thither the head-quarters of the Society at the end of the present year.

ORDINARY MEETING, 17TH JANUARY, 1893, AT WATFORD.

JOHN HOPKINSON, Esq., F.L.S., F.G.S., etc., President, in the Chair.

Mrs. Kember was elected a Member of the Society.

Mr. R. Casson, Woodford Road, Watford; Mr. Percy Manning, North End House, Watford; and Mr. A. T. Murray, Harpley, Stratford Road, Watford, were proposed for membership.

The PRESIDENT said that he was pleased to see such a large attendance of members at the first meeting of the Society in its new quarters, the Watford Endowed Schools; and he announced that the Society's bookcases, books, and other effects would be removed on the following day to the Governors' board-room upstairs, which would be open for the exchange of books on the first Tuesday in each month from 7.30 to 8 p.m., as well as on the conclusion of the meetings of the Society, which would usually be held on the third Tuesday.

A lecture was delivered, of which the following is an abridged report:—

“Man and Ape.” By Arthur Stradling, M.R.C.S., F.Z.S.

Mr. STRADLING introduced his subject with an anecdote about Dumas, the novelist. Dumas had a decided dash of black blood in his veins, and someone once mentioned it in his presence, whereupon he retorted: “Yes, you are quite right, my father was a black man and my grandfather was a monkey, in fact, Sir, my pedigree begins where yours leaves off.” Without advocating such an immediate descent of man from the monkey or ape, for the terms were practically synonymous, he would now show some points of affinity between them.

Structurally, he said, there is less difference between man and the higher monkeys than there is between the latter and the inferior species of monkeys, the gulf between the human race and the anthropoid apes being an intellectual one only; but the recognition of this real organic similarity had been long delayed and was even now admitted with reluctance. The earliest guesses at human anatomy were derived from the study of monkeys by

Galen, but man was not scientifically classed as an animal until the middle of the last century, when Linnæus assigned him a genus and species (*Homo sapiens*). The classification now generally accepted is that of Huxley, who places man with the four highest genera of monkeys, the gorilla, chimpanzee, orang-utan, and gibbon, which are known as the Anthropoid Apes.

The difference between the old-world and the new-world monkeys was then shown, the former being known as the Catarrhine, and the latter as the Platyrrhine apes. Fossil Catarrhine apes have been found in Paraguay, from which it was inferred that there had been some southern connection between the American continent and the old world. Nearly all the American monkeys have prehensile tails, but not a single old-world species has the power of grasping by the tail. Man, as might be expected, conforms entirely to the old-world type, the Catarrhine monkeys.

In dissecting the anthropoid apes, rudiments of organs are found which have played their part in the internal economy of their remote ancestors, and it is the presence of such vestigial structures in ourselves which so conclusively proves our community of descent. Our possession, for instance, of useless rudiments of the muscles which erect and depress the ears in other animals, can only be explained by the theory of evolution.

Mr. Stradling then passed in review some of the chief characteristics of the four kinds of anthropoid, or man-like, apes—the gorilla and chimpanzee of Equatorial Africa, and the orang-utan and gibbon of Eastern Asia—showing in what respect each most nearly approaches man. In treating of the chimpanzee he said that it has a slight nasal intonation, a distinction enjoyed by no other animal but man; and that it can sing, its song, though not very musical, being as good as that of many savages. The most interesting of the chimpanzees which have lived at the Zoological Gardens was Sally, and he thought it was hardly too much to say that the services rendered to zoology by her were second only, in the present century, to those of Darwin. Sally lived with us eight or nine years, and was about eleven years old when she died. She seemed to get perfectly acclimatized. Her arithmetical attainments were well known. She counted accurately up to ten, and many savages can do no more than reckon with their fingers, but they have a greater potential capacity. When counting straws, Sally had an idea of multiplication which was quite her own; if she had not enough she would get impatient and double them over so that each straw presented two ends, and it was noticeable that she only looked at the straws and not at her keeper. She would take a definite number of bites at an apple, with a large bite for the final one, so that it is certain she made a mental note of each bite. She completely undermined man's claim to be the only animal who can laugh, for she laughed all over her face like a Negro child does, but not audibly, that doubtless being an art acquired by man. She had a decided sense of humour. He once gave her a banana, and a silvery gibbon, of

whom she was very jealous, begged for a share. Sally took the banana, peeled it, and ate it with great deliberation, and then passed the skin round in front of the gibbon. He seized it and then in a great rage flung it down, while she smiled delightedly at him.

Some of the peculiarities possessed by man and the apes, but by no other animals, were then enumerated. "We" only possess thumbs, most monkeys, but not all, having four; "we" are the only animals who have finger-nails, the nails in all animals lower than the apes forming claws or being thickened or expanded into hoofs. But a further important item of agreement in the structure of our hands had just been discovered. The back of the hand is covered with hair, a growth quite as marked in some men with strong sinewy hands as in the orang-utan; the first joint of the finger is laden with hair also, and there are several short hairs on the second joint; but on the terminal joint not even a microscope will enable us to detect any hair, nor has there ever been any on it. This peculiarity is strictly confined to "us," the apes. Every other animal with a furry paw is furred right to the tips of the fingers and toes, for this applies to both. And with regard to the foot, he did not think that the first toe forms a thumb in the anthropoids; he doubted whether they had more power of opposition with the toes than has a new-born child; nor did he think that their feet were more prehensile than ours would be if we used them freely instead of shutting them up in leather boxes.

Our teeth, also, are the same as those of the anthropoid apes, not only in number (32) but also in kind and in arrangement; and the number of first teeth (milk teeth) is the same (20) and they are shed at about the same period. The olfactory organs are similar; and "we" (the apes) are the only creatures with eyes which are encased in bone and look directly forward, the eyes in all other animals being more or less divergent. Then there is a little bone wedged in between the two upper jaw-bones (or maxillary bones) which in most animals remains distinct throughout life, but in man and the apes is welded in so as to form part of the upper jaw. Again "we five" (man, gorilla, chimpanzee, orang-utan, and gibbon) have our right lungs quite free, while in all other animals one lobule of this lung is wedged in between the heart and the diaphragm.

Passing from structure to habits, Mr. Stradling mentioned that we are naturally left-handed, as are the monkeys, but we are educated from childhood to use the right hand more than the left; that we have many diseases in common; that "we" are the only animals naturally unable to swim; the only animals afraid of snakes; and it had been said the only animals who readily develop a taste for alcohol and smoke tobacco with pleasure. Other points of agreement between us were also mentioned, such as the ability to use tools.

With regard to the points of distinction between man and the

ape, he said that the greatest difference is usually considered to be in the brain, but that in complexity there is very little difference, the furrows and convolutions in the brain of the ape being quite as many as in that of man, but altered a little in shape; the difference, in size, however, is great. No monkey habitually assumes the erect position, but there are reasons for believing that man has not always walked erect. The rudest savage can draw, and man only has the power of anticipating alternate movement.

Finally the question of "the missing link" was discussed, the conclusion arrived at being that if such a link were discovered it would be in the rocks of that cradle of the human race, Central Africa.

Mr. T. Vaughan Roberts and Mr. J. T. Broad were elected auditors of the accounts for 1892.

ANNIVERSARY MEETING, 21ST FEBRUARY, 1893.

(AT WATFORD.)

John Hopkinson, Esq., F.L.S., F.G.S., etc., President, in the Chair.

The Report of the Council for 1892, and the Treasurer's Account of Income and Expenditure, were read and adopted.

Sir William Henry Flower, K.C.B., LL.D., F.R.S., F.R.C.S., F.L.S., F.G.S., Pres.Z.S., Director of the Natural History Department of the British Museum, Cromwell Road, South Kensington, London, S.W., was elected an Honorary Member of the Society.

The President delivered an Address on "Charles Darwin." (*Transactions*, Vol. VII, p. 101.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year:—

President.—Arthur Stradling, M.R.C.S., F.Z.S.

Vice-Presidents.—Professor John Attfield, M.A., Ph.D., F.R.S., F.I.C., F.C.S.; the Right Honourable the Earl of Clarendon; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas.R.S., V.P.S.A.; John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.; William Ransom, F.S.A., F.L.S.; C. E. Shelly, M.A., M.D.

Treasurer.—John Weall.

Hon. Secretaries.—John Morison, M.D., F.G.S.; and F. M. Campbell, F.L.S., F.Z.S., F.R.M.S., F.E.S.

Librarian.—W. R. Carter, B.A.

Curator.—A. E. Gibbs, F.L.S.

Other Members.—A. P. Blathwayt; A. T. Brett, M.D.; Arthur M. Brown, M.A.; R. B. Croft, R.N., F.L.S., F.R.M.S.; Upfield Green, F.G.S.; Augustus Hawks; Daniel Hill; T. Vaughan Roberts; George Rooper, F.Z.S.; John Thornhill, F.L.S.; the Rev. E. T. Vaughan, M.A.; Percy Jenner Weir.

The thanks of the Society were accorded to Mr. John Hopkinson retiring from the office of President; to Dr. Alfred T. Brett and Mr. R. B. Croft retiring from the office of Vice-President; and to Mr. Percival Bosanquet, Dr. Alfred Eteson, and Mr. F. W. Silvester retiring from the Council.

REPORT OF THE COUNCIL FOR THE YEAR 1892.

In presenting the 18th Annual Report, the Council of the Hertfordshire Natural History Society has pleasure in stating that the Society maintains its flourishing condition, and that the number of members has increased.

During the year twenty-four ordinary members have been elected, twelve have resigned, and the Council regrets to have to record the loss by death of one honorary member, Sir Richard Owen, K.C.B., F.R.S., and two ordinary members, Sir Oscar Clayton, M.D., and the Earl of Essex.

The number of members at the end of the years 1891 and 1892 was as follows:—

	1891.	1892.
Honorary Members	20	19
Life Members	48	51
Annual Subscribers	185	192
	253	262

By the death of Sir Richard Owen we have lost the greatest comparative anatomist of our day. Born in 1804, and educated for the medical profession, in 1826 the Hunterian Museum of the Royal College of Surgeons was placed under his charge, and in 1856 he was appointed Superintendent of the Department of Natural History in the British Museum, a position he held for over 30 years. To his energy and perseverance we are chiefly indebted for the present admirable condition and the location of our national natural-history collections. He was elected an honorary member of the Society in the year 1885.

Sir Oscar Clayton had a distinguished professional career. For a considerable time he was Surgeon in Ordinary to H.R.H. the Duke of Edinburgh. He was elected a member of the Society in the year 1877.

The Right Honourable Arthur Algernon Capell, sixth Earl of Essex, was one of the original members of the Society, and one of the earliest members of the Council. He took from the first a very great interest in the Society's work, especially in the department of Meteorology, communicating to our 'Transactions' the results of his own observations at Cassiobury.* By his kind permission the Society has held many Field Meetings in Cassiobury Park, the gardens and private grounds adjoining his residence having on each occasion been thrown open to our members.

* 'Trans. Watford N. H. Soc.,' Vol. I, p. 132, Vol. II, p. 89.

The following papers or lectures have been read or delivered during the year:—

- Jan. 15, at Watford.—Crocodiles and Canaries; by Arthur Stradling, F.Z.S.
 Feb. 19, at Watford.—Anniversary Address: Francis Bacon; by the President, John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 March 16, at Hertford.—An hour with the Microscope at a Pond-side; by F. W. Phillips.
 — 18, at Watford.—Report on the Rainfall in Hertfordshire in 1892; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 — Notes on Birds observed in Hertfordshire during the year 1891; by Henry Lewis.
 April 8, at St. Albans.—The Natural History of the Diamond; by F. W. Rudler, F.G.S., M.A.I.
 May 6, at Watford.—Meteorological Observations taken at The Grange, St. Albans, during the year 1891; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.
 — A Naturalist's Calendar for Mid-Hertfordshire; by J. J. Willis.
 — Report on Phenological Phenomena observed in Hertfordshire during the year 1891; by Edward Mawley, F.R.Met.Soc., F.R.H.S.
 Nov. 15, at St. Albans.—Notes on the Mycetozoa, with a List of Species from Hertfordshire and Bedfordshire; by James Saunders.
 — 18, at Watford.—Coal: its Nature, Origin, Position, and Extent; and its Range under the South of England; by Professor T. Rupert Jones, F.R.S., F.G.S.
 Dec. 16, at Watford.—Ice and its Work; by John Morison, M.D., F.G.S.

At the meetings on the 18th of March and the 6th of May a discussion was held on the proposed scheme for the regulation of Bricket Wood Common.

The following Field Meetings were held during the year:—

- | | |
|----------------------------------|--------------------------------------|
| May 7.—Harpenden and East Hyde. | July 2.—Abbot's Langley and Bedmont. |
| — 21.—Aldenham, Watford. | |
| — 28.—St. Albans. | Oct. 8.—Gorhambury, St. Albans. |
| June 25.—Gorhambury, St. Albans. | — 13.—Broxbourne and Wormley. |

A visit was also made to the British Museum (Natural History) on the 30th of April, when Mr. Stradling gave a description of the gigantic extinct Mammalia and the Index Collection.

The thanks of the Society are due for hospitality kindly afforded at the Field Meetings to Mr. and Mrs. Larkin, Delrow, Aldenham; to the President and Mrs. Hopkinson, The Grange, St. Albans; to Mr. and Mrs. Purrott, Maynes, St. Albans; to Major Reynolds Solly and Mrs. Solly, Serge Hill, Bedmont; and to Mr. Henry Warner, Wormley. The Society is also indebted to the Earl of Verulam for his kindness in showing to the members his interesting collection of paintings and antiquities at Gorhambury in October.

The appointment of a Royal Commission on the water-supply of the Metropolis was announced in the last annual report. The Commission began its labours early in the year, and the following members of our Society have given evidence before it:—Sir John Evans, K.C.B., F.R.S., Mr. Urban Smith, and our President, Mr. Hopkinson, on behalf of the Hertfordshire County Council; Mr. G. J. Symons, F.R.S., and Mr. W. Whitaker, F.R.S., on behalf of the London County Council; and Mr. W. Topley, F.R.S., on behalf of the London Water Companies. The work of the Com-

mission is now drawing to a close, and its report will probably soon be issued. In the meantime a petition against the threatened abstraction, by the New River and East London Water Companies, of increased quantities of water from the Chalk of Hertfordshire, has been prepared by the Parliamentary Committee of the Hertfordshire County Council, and presented to Parliament.

The sixth volume of the present series of the Society's 'Transactions' has been completed and the seventh has been commenced, three parts of the former and two of the latter, containing 162 pages and one plate, having been published during the year. In the sixth volume the only papers not of local interest are one on "Seeds and Fruits," and another on "Meteorological Photography," the latter, however, appealing to local photographers to take meteorological photographs in the county. The Presidential Addresses of the Earl of Clarendon on "Field Sports," and on "The Horse," are of local interest insomuch as they recount his lordship's own observations and experiences in Hertfordshire. In the meteorology and phenology of the county there are in this volume the usual annual reports, and an analysis of "Half-a-Century's Rainfall in Hertfordshire"; and in geology there is a paper on "Geological Photography in Hertfordshire"; while hydro-geology occupies a large portion of the volume, there being four papers bearing on the subject—a record of water-level in the Chalk at Odsey, near Royston; a second instalment of "Hertfordshire Well-sections"; a paper of 33 pages on "Water and Water-supply"; and a statement of the percolation of rain through soil at Berkhamsted. In local botany the only paper is one on "Diseases of Plants in Hertfordshire." In zoology the birds observed in the county each year are reported on as usual, and the Tineina and other Lepidoptera of Sandridge are enumerated. A paper on "Local Scientific Investigation" embraces all these subjects and also anthropology. There are also a few miscellaneous notes on meteorology, botany, and zoology; and in the Proceedings are abstracts of several papers, mostly not of local interest.

The thanks of the Society are due to Mr. H. George Fordham for the two plates illustrating his paper on Water-level in the Chalk; to Mr. Hopkinson for the rainfall-station map of Hertfordshire, and the map of the Thames Basin; and to Mr. Upfield Green for the plan and section of Bennet's End brickfields.

Owing to the insufficiency of the accommodation provided for the evening meetings at the Watford Public Library, it became necessary at the end of the year to find more suitable head-quarters for the Society. Under these circumstances the Governors of the Watford Endowed Schools kindly agreed to provide the requisite accommodation in their school-buildings, and the Council has every reason to be satisfied with the provision which has been made for the evening meetings, and also for the accommodation of the Society's library.

INCOME AND EXPENDITURE FOR THE YEAR ENDING 31st DECEMBER, 1892.

SESSION 1892-93.

xli

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1891	44	11	10	By Printing 'Transactions'			50 10 0
" Entrance Fees	6	0	0	" " Circulars			7 0 11
" Life Compositions	20	0	0	" Expenses of Meetings			10 8 8
" Subscriptions for 1890	1	0	0	" Library			3 16 0
" " 1891	4	0	0	" Salary of Assistant			5 0 0
" " 1892	45	10	0	" Postages and various small expenses			17 17 4
" " 1893	13	0	0	" Fire Insurance			0 7 6
" Dividends on £130 India 3 per cent. Stock.	3	18	0	" Balance at Bank			48 8 0
" Sale of Publications ['Flora of Hertfordshire' 16s. 6d., 'Transactions' £4 12s. 1d.; less expenses]	5	8	7				
	£143 8 5						
	£143 8 5						

Amount invested in the purchase of £130 India 3 per cent. Stock . . . £126 15s. 6d.

Audited and found correct this 20th day of February, 1893, { T. VAUGHAN ROBERTS,
THOS. J. BROAD.

ADDITIONS TO THE LIBRARY IN 1892.

PRESENTED.

TITLE.	DONOR.
BACON, FRANCIS. <i>Sylva Sylvarum</i> ; or, a Natural History in Ten Centuries. 8vo. London, 1826.	<i>Mr. J. Hopkinson.</i>
———. <i>Essays; or Counsels, Civil and Moral.</i> Prof. Morley's (second) edition. 8vo. London, 1884.	„
BRIGHTWEN, MRS. <i>More about Wild Nature.</i> 8vo. London, 1891.	<i>The Authoress.</i>
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Report for 1891. 8vo. London, 1892.	<i>The Association.</i>
CAMERON, G. A. C. <i>Kelloway Beds near Bedford.</i> 8vo. London, 1892.	<i>The Author.</i>
DE CANDOLLE, A. P., and K. SPRENGEL. <i>Elements of the Philosophy of Plants.</i> 8vo. Edinburgh, 1821.	<i>Mr. J. Hopkinson.</i>
HENRY, JAMES. <i>Æneida. Indices.</i> 8vo. Dublin, 1892.	{ <i>Trustees of</i> <i>the late J. Henry.</i>
LINNEAN SOCIETY. <i>Journal. Zoology.</i> Vol. xx, Nos. 119, 121. Vol. xxi, No. 131. 8vo. London, 1888-89.	<i>Mr. R. B. Croft.</i>
NAPIER, C. O. G. <i>Lakes and Rivers.</i> 12mo. London, 1884.	<i>Mr. J. Hopkinson.</i>
PHOTOGRAPHY, <i>Pictorial Selections in.</i> By W. G. D. (<i>Croydon Micros. and Nat. Hist. Club.</i>) 8vo. Croydon.	<i>The Author.</i>
ROBERTS, G. <i>Topography and Natural History of Loft-house and its Neighbourhood.</i> Vol. ii. 8vo. Leeds, 1885	<i>Mr. J. Hopkinson.</i>
ROCHESTER (U.S.) ACADEMY OF SCIENCE. <i>Proceedings.</i> Vol. i. Brochure 2. 8vo. Rochester (U.S.), 1891.	<i>The Academy.</i>
SYMONS, J. G. (Ed.) <i>Monthly Meteorological Magazine.</i> Vol. xvii. 8vo. London, 1892.	<i>The Editor.</i>
WATER SUPPLY OF LONDON. <i>Newspaper Cuttings,</i> 1892.	{ <i>Mr. J. Hopkinson</i> <i>and</i> <i>Mr. W. Whitaker.</i>

RECEIVED IN EXCHANGE.

AMERICAN MUSEUM OF NATURAL HISTORY. <i>Reports.</i> Vol. iii, No. 2. 8vo. New York, 1891.	
———. <i>Annual Report of the President.</i> <i>Ib.</i>	
BATH NATURAL HISTORY AND ANTIQUARIAN FIELD CLUB. <i>Proceedings.</i> Vol. xii, No. 3. 8vo. Bath, 1892.	
BIRMINGHAM PHILOSOPHICAL SOCIETY. <i>Proceedings for 1890-91.</i> Vol. vii, part 2. 8vo. Birmingham, 1892.	
BOSTON (U.S.A.) SOCIETY OF NATURAL HISTORY. <i>Proceedings.</i> Vol. xxv, parts 3, 4. 8vo. Boston, 1892.	
BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY. <i>Report,</i> 8th June, 1892. 8vo. Brighton, 1892.	
BRISTOL NATURALISTS' SOCIETY. <i>Proceedings for 1891-92.</i> New Series. Vol. vii, part 1. 8vo. Bristol, 1892.	
CONCHOLOGY, <i>JOURNAL OF.</i> Vol. vii, Nos. 1-4. 8vo. Leeds, 1892.	
CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB. <i>Proceedings,</i> 1891-1892. 8vo. London, 1892.	
EALING NATURAL HISTORY ASSOCIATION. <i>Proceedings.</i> Vol. xii, part 7. 8vo. Ealing, 1892.	
EDINBURGH GEOLOGICAL SOCIETY. <i>Transactions.</i> Vol. vii, part 3. 8vo. Edinburgh, 1892.	
———. <i>Royal Physical Society. Proceedings,</i> 1890-91. 8vo. Edinburgh, 1892.	

- ESSEX FIELD CLUB. *Essex Naturalist*. Vol. vi, Nos. 4-10. 8vo. Chelmsford, 1892.
- GLASGOW NATURAL HISTORY SOCIETY. *Proceedings for 1889-90*. New Series. Vol. iii, part 2. 8vo. Glasgow, 1891.
- LIVERPOOL GEOLOGICAL SOCIETY. *Proceedings*. Vol. vi, part 4. 8vo. Liverpool, 1892.
- LONDON, GEOLOGICAL SOCIETY OF. *Abstracts of the Proceedings*. Session 1891-92. 8vo. London, 1892.
- . GEOLOGISTS' ASSOCIATION. *Proceedings*. Vol. xii, parts 6-9. 8vo. London, 1892.
- . ————. *List of Members, 1892*. *Ib.*
- . QUEKETT MICROSCOPICAL CLUB. *Journal*. Series 2. Vol. v, No. 31. 8vo. London, 1892.
- . ROYAL METEOROLOGICAL SOCIETY. *Quarterly Journal*. Vol. xvii, Nos. 80-83. Vol. xviii, No. 84. 8vo. London, 1891-92.
- . ————. *The Meteorological Record*. Vol. xi, Nos. 41-44. Vol. xii, Nos. 45, 46. 8vo. London, 1891-92.
- . ROYAL MICROSCOPICAL SOCIETY. *Journal*. 2nd Series. Vol. xii. 8vo. London, 1892.
- . ————. *Charter, Bye Laws, and List of Fellows, 1892*. *Ib.* 1892.
- MANCHESTER FIELD NATURALISTS' AND ARCHÆOLOGISTS' SOCIETY. *Proceedings for 1891*. 8vo. Manchester, 1892.
- . GEOGRAPHICAL SOCIETY. *Journal*. Vol. vii, Nos. 1-12. 8vo. Manchester, 1891-92.
- . GEOLOGICAL SOCIETY. *Transactions*. Vol. xxi, parts 14-20. Vol. xxii, parts 1, 2. 8vo. Manchester, 1892.
- . LITERARY AND PHILOSOPHICAL SOCIETY. *Memoirs and Proceedings*. Series 4, Vol. v, Nos. 1, 2. 8vo. Manchester, 1892.
- MIDDLESEX (COUNTY OF) NATURAL HISTORY AND SCIENCE SOCIETY. *Transactions, 1889-91*. 8vo. London, 1890-92.
- MIDLAND NATURALIST. Vol. xv. 8vo. Birmingham, 1892.
- NATURALIST. *New Series*. Vol. xvii. 8vo. Leeds, 1892.
- NEW YORK ACADEMY OF SCIENCES. *Transactions*. Vol. xi, Nos. 1-8. 8vo. New York, 1891-92.
- . STATE LIBRARY. *Bulletin*. Additions, No. 1. 8vo. Albany, 1891.
- . ————. *Library School, No. 1*. *Ib.*
- . STATE MUSEUM. *Memoirs*. Vol. i, No. 1. 8vo. Albany, 1889.
- . ————. *Report No. 44, for the year 1890*. 8vo. Albany, 1892.
- NORTHAMPTONSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. *Journal*. Nos. 30-48. 8vo. Northampton, 1887-91.
- RUGBY SCHOOL NATURAL HISTORY SOCIETY. *Report for 1891*. 8vo. Rugby, 1892.
- SMITHSONIAN INSTITUTION. *Annual Report of the Board of Regents to July, 1890*. 8vo. Washington (U.S.), 1891.
- SOMERSETSHIRE ARCHÆOLOGICAL AND NATURAL HISTORY SOCIETY. *Proceedings for 1891*. *New Series*. Vol. xvii. 8vo. Taunton, 1892.
- UNITED STATES FISH COMMISSION. *Bulletin for 1889*. Vol. ix. 4to. Washington, 1891.
- . NATIONAL MUSEUM. *Report for the year ending 30th June, 1889*. 4to. Washington, 1891.

PURCHASED.

- BOTANY, JOURNAL OF. *New Series*. Vol. xxv. 8vo. London, 1892.
- ENTOMOLOGIST. Vol. xxv. 8vo. London, 1892.
- YEAR BOOK of the Scientific and Learned Societies of Great Britain and Ireland. Ninth Annual Issue. 8vo. London, 1892.
- ZOOLOGIST. 3rd Series. Vol. xvi. 8vo. London, 1892.

ORDINARY MEETING, 21ST MARCH, 1893, AT WATFORD.

ARTHUR STRADLING, Esq., M.R.C.S., F.Z.S., President, in the Chair.

Mr. R. Casson, Mr. Percy Manning, and Mr. A. T. Murray were elected Members of the Society.

Mrs. Ayres, High Croft, Watford; Mr. W. Wallis Baldwin, Netherheys, Watford; Mr. C. E. Bloomer, 22 St. Albans Road, Watford; Mrs. Cobb, Garston, Watford; Mrs. Crouch, Rosslyn, Watford; Mrs. Edmonds, 86 High Street, Watford; Mr. Markham Evelegh, Essex Road, Watford; Miss Jourdain, Corran, Watford; Mr. G. P. Neele, The Lawn, Clarendon Road, Watford; Mr. E. P. Rowse, Nutley, Watford; Mr. E. J. Slinn, Lang Syne, Watford; Mr. E. P. Vaux, Densworth, Watford; and Mr. Walter C. Wyles, Carpenders, Watford, were proposed for membership.

The SECRETARY (Dr. Morison) read a letter he had received from Sir William Flower thanking the Society for his election as an Honorary Member, and adding: "Pray assure your colleagues that I much appreciate this distinction, and I highly esteem the work of the Society in keeping up an interest in intellectual pursuits in the county."

The following papers were read:—

1. "Notes on Birds observed in Hertfordshire during the year 1892." By Henry Lewis. (*Transactions*, Vol. VII, p. 161.)

2. "Notes on some Hertfordshire Mammalia." By T. Vaughan Roberts. (*Transactions*, Vol. VII, p. 169.)

The following paper was taken as read:—

"Climatological Observations taken in Hertfordshire in the year 1891." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. (*Transactions*, Vol. VII, p. 157.)

Preserved skins of the animals mentioned by Mr. Vaughan Roberts were exhibited by him in illustration of his paper.

The PRESIDENT exhibited two living specimens of the smooth snake (*Coronella levis*), a very rare species, which, he said, had only been discovered in this country about sixty or seventy years ago, but appeared now either to be getting more common or was more frequently recognised. Those he exhibited were not found in Hertfordshire, but he hoped that during the coming summer the species might be reported as occurring in the county.

ORDINARY MEETING, 18TH APRIL, 1893, AT WATFORD.

ARTHUR STRADLING, Esq., M.R.C.S., F.Z.S., President, in the Chair.

Mrs. Ayres, Mr. W. W. Baldwin, Mr. C. E. Bloomer, Mrs. Cobb, Mrs. Crouch, Mrs. Edmonds, Mr. M. Evelegh, Miss Jourdain, Mr. G. P. Neele, Mr. E. P. Rowse, Mr. E. J. Slinn, Mr. E. P. Vaux, and Mr. W. C. Wyles were elected Members of the Society.

Mr. Harold Kent, Roseberry, Watford; Mr. W. H. Norris, Bengoe, Hertford; Mr. John L. Pank, Barnet; Mr. F. W. Reader,

Glenroy, Watford; and Miss Swindon, The Hollies, St. Albans Road, Watford, were proposed for membership.

The following papers were read:—

1. "The Climate of Watford, deduced from Meteorological Observations taken during the ten years 1877-1886." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. (*Transactions*, Vol. VII, p. 219.)

2. "A Preliminary Introduction to the Investigation of Microscopic Leaf-Fungi." By John Hopkinson, F.L.S., etc.

3. "Notes on Lepidoptera observed in Hertfordshire." By A. E. Gibbs, F.L.S. (*Transactions*, Vol. VII, p. 187.)

The following papers were taken as read:—

1. "Meteorological Observations taken at The Grange, St. Albans, during the year 1892." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. (*Transactions*, Vol. VII, p. 175.)

2. "Climatological Observations taken in Hertfordshire in the year 1892." By John Hopkinson. (*Transactions*, Vol. VII, p. 199.)

3. "Report on the Rainfall in Hertfordshire in 1892." By John Hopkinson. (*Transactions*, Vol. VII, p. 203.)

4. "Observations of Temperature and Rainfall taken at Throcking Rectory, Buntingford, 1880-1889." By the Rev. C. Wigan Harvey, M.A. (*Transactions*, Vol. VII, p. 213.)

5. "Report on Phenological Phenomena observed in Hertfordshire during the year 1892." By Edward Mawley, F.R.Met.Soc., F.R.H.S. (*Transactions*, Vol. VII, p. 182.)

6. "A List of Hertfordshire Hepaticæ." By A. E. Gibbs, F.L.S. (*Transactions*, Vol. VII, p. 233.)

FIELD MEETING, 29TH APRIL, 1893.

RICKMANSWORTH AND HAREFIELD.

The Harefield Chalk-pits, to visit which was the principal object of this meeting, are in Middlesex, but just on the Hertfordshire border, and the greater part of the walk was in our own county. The Directors, Mr. Upfield Green and Mr. John Hopkinson, went over the ground in the morning, and met the party, twelve in number, at Rickmansworth Station in the afternoon.

The route taken was on the towing-path of the canal; past Mr. George Webster's pumping-station at Springwell, where water from the Chalk is being converted into mineral-water to send away to London, instead of being conveyed there in pipes or conduits as *aqua pura*, as he intends to do eventually; and, leaving the canal, to the first of the large chalk-pits cut in the face of the hill, near Cribbs, and thence to the second of these pits, a much larger one, near the old "Copper Mill." A fine section of the Upper Chalk is exposed in these pits, and several "pipes" were seen. Fossils are not numerous, but a few were found, including *Echino-*derms, *Inocerami*, and *Terebratulæ*.

The first pit is an old station for the moss *Seligeria calcarea*,

and it was found to be still growing there. On a fence near the second pit Mr. Arthur Lewis took the moth *Anticlea badiata*.

Ascending the hill to Cribbs, the fields were crossed to Woodeock Hill Kiln, where the Reading Beds and basement-bed of the London Clay were seen. Just at the edge of the outcrop of the Reading Beds a little pebble-gravel was seen on the Chalk, and then another patch of it, on, and the cause of the formation of, an isolated gorse-covered hill a little nearer Rickmansworth. The gorse was on fire and a considerable extent of it had been destroyed.

At Rickmansworth Mr. A. E. Gibbs took the moth *Habrostola tripartita*, on a fence; and in heads of *Hypericum perforatum* he found larvæ of the Tinea *Depressaria liturella*, one of which he successfully reared and it emerged in July. There was a strong wind blowing which made the day very unfavourable for entomologists.

FIELD MEETING, 13TH MAY, 1893.

BROCKET PARK, WELWYN.

At Ayot Station, the place of meeting, a small party of the members met the Director, Mr. Hopkinson, who had walked from St. Albans in the morning, and decided, owing to the intensely hot weather, to abandon the first part of the programme, the examination of sections of the Reading Beds and London Clay in Ayot brickfields, and at once proceed to Brocket Park to seek the shade its trees afford.

Permission to visit private portions of the park having been granted by Lord Mount Stephen, the path to the right was taken, but a zealous keeper would not allow the party to enter the woods here for fear of pheasants being disturbed, and it was not until the house and gardens had been passed on the left that the first wood was entered. Descending through this wood to the Lea, the river was crossed by the old flint bridge, and the walk was continued through the woods on the opposite side, and by Warren Farm to Cromer Hyde, where tea was partaken of at the village inn.

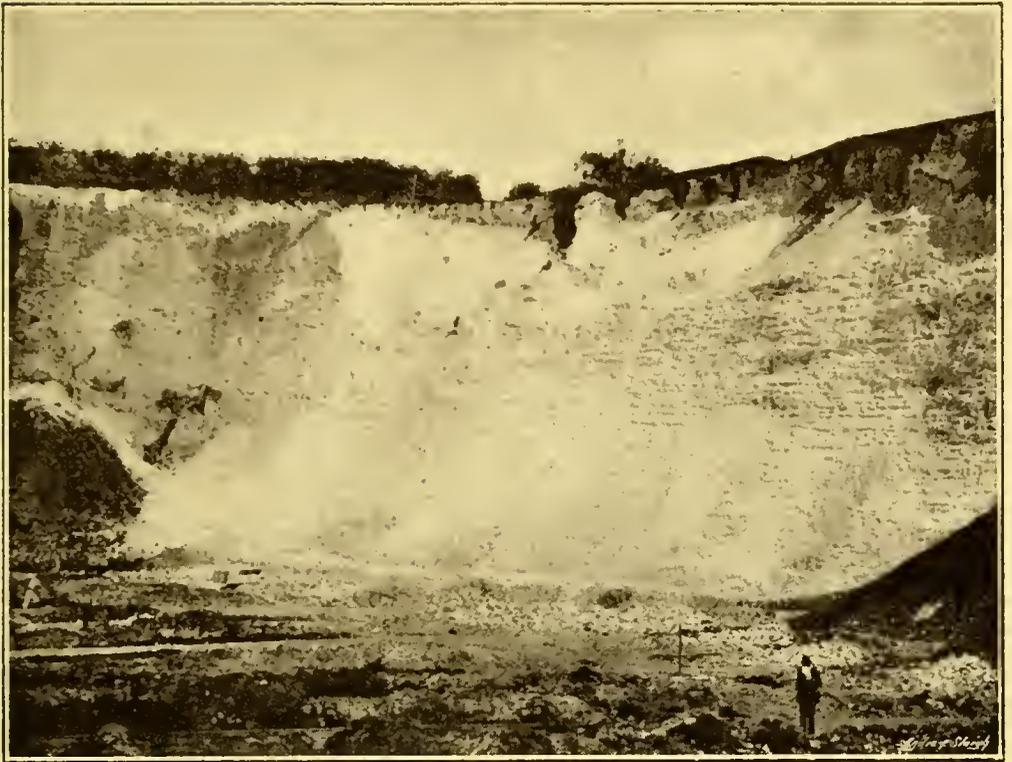
Most of the party then again entered the park to see the ornamental water and waterfall near the handsome stone bridge over the Lea, and, returning to Cromer Hyde, walked across the fields and through Symond's Hyde Great Wood to St. Albans; others drove to Hatfield Station.

The only plants observed worthy of note were *Euphorbia amygdaloides*, in Symond's Hyde Wood, and *Puccinia malvacearum*, on the leaves of the mallow (*Malva rotundifolia*) at Cromer Hyde.

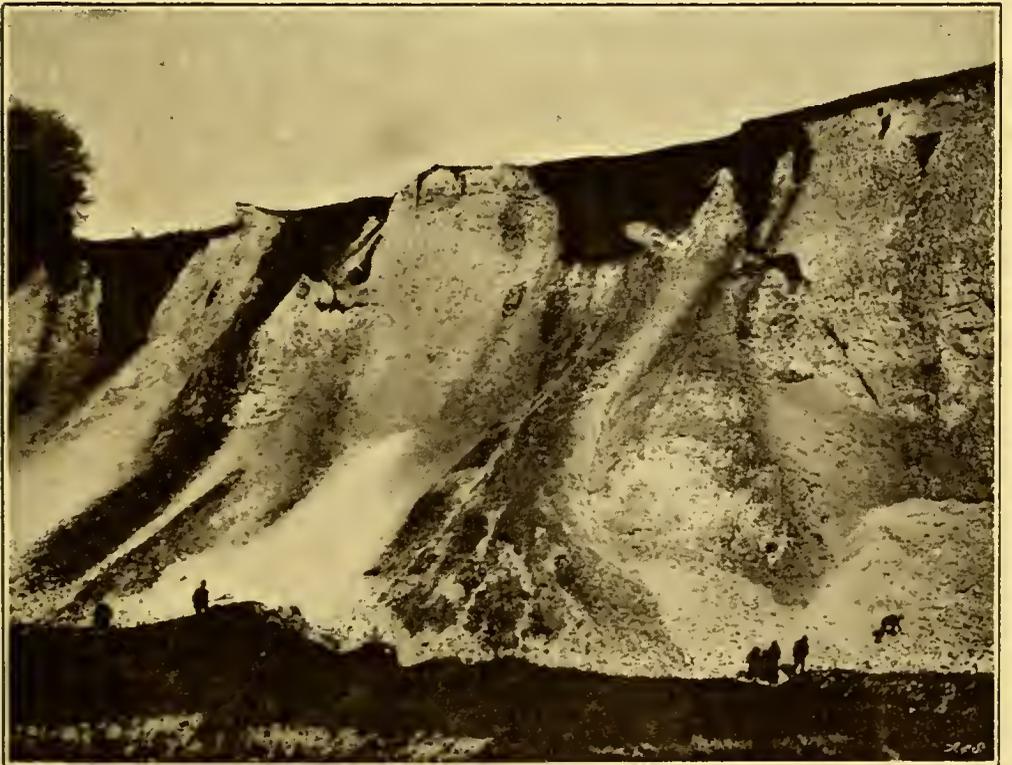
The following Lepidoptera were seen or taken by Mr. A. E. Gibbs, chiefly in Symond's Hyde Wood:—

RHOPALOCERA (*Butterflies*).

<i>Pieris brassicæ</i> .	<i>Euchloe cardamines</i> .	<i>Cœnonympha pamphilus</i> .
„ <i>rapæ</i> .	<i>Argynnis euphrosyne</i> .	<i>Lycena icarus</i> .
„ <i>napi</i> .	<i>Vanessa io</i> .	<i>Lyriichthus malvæ</i> .



CHALK-PIT NEAR CRIBBS, HAREFIELD.



CHALK-PIT NEAR THE "COPPER MILL," HAREFIELD.

15

HETEROCERA (*Moths*).

BOMBYCES.	Panagra petrarica.	TORTRICES.
Hepialus lupulinus.	Lomaspilus marginata.	Tortrix ministrana.
	Eupithecia castigata.	Pardia tripunctana.
GEOMETRÆ.	„ lariciata.	Ephippiphora Brunnichiana.
Rumia luteolata.	Melanippe montanata.	
Iodis lactearia.	„ sociata.	TINEÆ.
Asthena candidata.	„ fluctuata.	Adela viridella.
Acidalia remutaria.	Coremia designata.	
Cabera pusaria.	„ unidentaria.	

The leaves of many of the trees, the young oaks more especially, were seen to be riddled by the larvæ of various species of insects, and many larvæ and several pupæ were taken. In fact the woods seemed to be teeming with life; the insects dropping from leaf to leaf made a perpetual noise, very much like that of a summer shower, while the birds sang as if exuberant with joy at the bright sunshine and the absence of rain.

A moorhen was seen on the water in Brocket Park, and a plover near Symond's Hyde Wood. The call of the cuckoo and the song of the nightingale were heard. A water-vole was disturbed by the river-side in Brocket Park, and a hedge-hog was captured just outside Symond's Hyde Wood.

FIELD MEETING, 27TH MAY, 1893.

KNEBWORTH.

At Knebworth Station the members were met by Mr. T. B. Blow, F.L.S., the Director of the meeting, who conducted them to Knebworth House, the seat of the Earl of Lytton, but now in the occupation of Mr. H. Phipps, by whose permission it was visited.

A date carved over the doorway records that the house was built in the year 1563, but the greater part was pulled down in 1811, and the original features of the old Elizabethan mansion are retained only in the lodge-gate on the Hatfield Road, which was once the entrance, having been removed and re-built, stone for stone, in its present position. The mansion is now in an incongruous mixture of styles, bedecked with gilded minarets and grotesque animals in stucco. The fact that it was once the residence of the first Lord Lytton, gives it an attraction which may well atone for its fantastic architecture, and it was with much interest that the small study in which our great novelist wrote most of his works was inspected.

After the pictures and other heirlooms had been examined, the grounds were entered, and, under the guidance of the head-gardener, Mr. John Kipling, the gardens were inspected, including the wilderness, which contains many plants of much interest to botanists. Several members then walked to the lake and visited other parts of the park. Cussans well says: * “The principal

* ‘Hist. Herts,’ “Broadwater Hundred,” p. 114.

beauties of Knebworth are its noble park and extensive gardens. The Italian garden, with its terraces, statues, and brilliant parterres; the hedges of box and yew trimmed and twisted into curious devices in the Dutch garden; the quaint conceits of the Chinese garden; the Fernery with its cool and shady nooks and paths leading to the winter garden; the Maze; the Rosary; and last, though not least, the Horace garden—each has a peculiar grace and charm of its own.” “Forty years ago,” he adds (he wrote in 1877), “that portion of the grounds which is specially dedicated to the memory of the Venusian bard, was a dismal swamp; now, it would be difficult even to imagine a more charming spot.”

Other members visited the village, and had tea at one of the lodges, rejoining the rest of the party at the station.

Mr. James Saunders reports the finding in the park of the Mycetozoa *Stemonitis fusca* and *Physarum compressum*; and Mr. A. E. Gibbs the capture of the butterfly, *Parage megara*, on the Green between the station and the park, and of the moth, *Coremia designata*, on a wall in the gardens of Knebworth House.

FIELD MEETING, 17TH JUNE, 1893.

ZOUCHES FARM, DUNSTABLE.

From Dunstable (Church Street) Station, the members, conducted by Mr. James Saunders, of Luton, ascended the Downs to Zouches Farm. Starting from Bedfordshire, the boundary between that county and Hertfordshire was passed at the foot of the hill, and the greater part of the walk was in our own county.

After a steep climb up the slippery turf, the summit of a knoll was reached, whence an extensive view was obtained, the little town of Dunstable, with its ancient Priory Church, situated near the junction of the two Roman Roads—the Watling Street and the Icknield Way—being just below; while beyond was seen Totternhoe Beacon, an outlying Lower Chalk hill of the Dunstable Downs; the Five Knolls and Kensworth Hill, forming portions of the main range of the Downs on the Middle Chalk; and an extensive plain of Gault bounded by distant hills of Lower Greensand.

On arriving at Zouches Farm the members dispersed for a time, some to search for plants, others with their collecting-nets to capture moths and other insects, and a few to hunt for those strange organisms which lie on the border-line of the animal and vegetable kingdoms, the Mycetozoa or Myxogastres.

Mr. A. E. Gibbs reports having taken the light emerald moth, *Metrocampa margaritaria*, in the wood near the farm; that *Herbula cespitalis*, a small moth, was flying in great numbers on the Downs; and that a Tortrix, *Xanthosetia hamana*, was flying abundantly amongst the eorn.

Re-assembling, tea was partaken of under the welcome shade afforded by some of the fine beech trees for which the Chiltern Hills are famous, and then the members separated, some returning

to Dunstable, but the majority accompanying the Director in a very pleasant walk across the fields by Chawl End (or Charl End) and Dollar Farm to Luton.

FIELD MEETING, 22ND JUNE, 1893.

COLNEY HEATH AND TITTENHANGER, ST. ALBANS.

Although a beautiful day for a country walk, being bright and not too warm, very few members met at Smallford Station, many having probably been deterred from taking part in the meeting by the announcement in the circular that the distance to be walked would be six miles. There was also a counter-attraction in an excursion of the St. Albans Abbey Guild.

The route taken was across the fields by Sleepshyde and Colney Heath, and one of the green lanes so frequent in Hertfordshire, to Tittenhanger Farm, and thence through Tittenhanger Wood and Park to Bowman's Green, and by woods and meadows and another green lane to Tittenhanger Green, the Camp, and St. Albans.

Tittenhanger, variously known in former days as Tidehanger, Tydenhangre, Tyttynhangre, Tetenhanger, etc., was a residence of the Abbots of St. Albans at a very early period. When the first manor-house was built is unknown, but it was re-built between 1396 and 1411, when large fish-ponds were constructed; subsequently the park was stocked with deer by Abbot John de Wheathamstede; and in 1654 Sir Henry Blount pulled down the old abbatial residence, and on its site erected the present mansion from designs furnished by Inigo Jones.*

Remains of the fish-ponds, much overgrown with weeds, are still to be seen, but they no longer fulfil the purpose for which they were constructed. A few dips with collecting-bottle and net showed that their most numerous occupants now are Entomostraca, several species of *Daphnia* and *Cyclops* being captured, while the only fish caught were minnows of an almost microscopic size.

The park has long ceased to be a deer-park. It has some very fine timber-trees, mostly oaks and elms; and it is of interest in being the first park through which the Colne flows after it becomes a permanent river. Referring to the variation in its flow just above here, Cussans says: "To a stranger it seems almost incomprehensible that at Colney Heath (two miles higher up than London Colney), where for nine months in the year it can hardly lay claim to the dignity of a brook, it is no uncommon occurrence for the petulant stream suddenly to rise to a height of five or six feet. During the winter of 1878-79 it surpassed itself. Colney Heath was a vast lake; the road from Tittenhanger was completely submerged; and to add to the difficulties of locomotion, the substantial brick bridge, twenty feet long, and fully ten feet high from the crown of the arch to the bed of the river, was carried away." †

* Cussans, 'Hist. Herts,' "Cassio Hundred," p. 27. † *Ib.*, pp. 38, 39.

On this day the river was so low that it could be stepped across in the park a short distance below the house. It had been in this condition for at least a month, and during the summer and autumn it dwindled almost to nothing, ceasing perceptibly to flow. It is doubtful whether it has ever been in this state before.

FIELD MEETING, 7TH OCTOBER, 1893.

DIGSWELL PARK AND SHERRARDS PARK WOOD, WELWYN.

The annual Fungus Foray was announced to be held in Sherrards Park Wood in the afternoon, the place of meeting being Ayot Station, but, by previous arrangement, a few members of the Society met at Welwyn Station in the morning, to walk through Digswell Park to Sherrards. The meeting was under the direction of Mr. Hopkinson, and the species of fungi seen in the course of the walk were determined and recorded by Mr. George Masee, of Kew.

The island on the River Mimram at Digswell proved very prolific in fungi, especially in minute forms, furnishing nearly half the species recorded. Here also, under logs of wood and rotten branches of trees, the following Mollusca were collected by the Director:—

<i>Arion hortensis</i> , <i>Fér.</i>	<i>Helix hispida</i> , <i>L.</i>
<i>Limax agrestis</i> , <i>L.</i>	<i>H. sericea</i> , <i>Drap.</i>
<i>Zonites cellarius</i> , <i>Müll.</i>	<i>H. rotundata</i> , <i>Miller.</i>
<i>Z. alliarius</i> , <i>Müll.</i>	<i>Clausilia biplicata</i> , <i>Mont.</i>
<i>Z. nitidulus</i> , <i>Drap.</i>	<i>Zua lubrica</i> , <i>Müll.</i>

The walk through Digswell Park is a beautiful one at all times of the year. Now, the beauty of the scene was heightened by the rich autumnal tints of the foliage, and the attention of the party was divided between viewing the extensive sylvan prospect and searching for fungi in the well-wooded park.

After a frugal luncheon had been partaken of at the "Red Lion," near Ayot Green, Sherrard's Park Wood was entered, and before long the members were joined by others who had come to Ayot Station for the afternoon's foray. Not nearly so many species of fungi were found here as in Digswell Park, but the search for them had to be given up sooner than was intended. Early in the afternoon ominous-looking clouds had begun to gather, and distant thunder had been heard. Rain now fell steadily, and the shelter of the trees was sought, its temporary cessation being taken advantage of for the return walk through the wood, and thence by Ayot Green to the station. Later in the evening a terrific thunder-storm occurred.

The following is a list of the fungi recorded by Mr. Masee. It comprises 155 species and 3 varieties, and adds 59 species and 2 varieties to our Hertfordshire list. To these new county records an asterisk (*) is affixed; and the rare species, 15 in number, are indicated by an obelisk (†).



THE RIVER COLNE AT COLNEY HEATH, IN JUNE, 1893.



GREEN LANE NEAR COLNEY HEATH.

HYMENOMYCETES.			
Agaricus (Amanita) phalloides, <i>Fr.</i>		Agaricus (Galera) tener, <i>Schæff.</i>	
„ „ muscarius, <i>L.</i>		„ „ hypnorum, <i>Batsch.</i>	
„ „ rubescens, <i>Fr.</i>		„ (Tubaria) furfuraceus, <i>Pers.</i>	
„ (Lepiota) sistratus, <i>Fr.*†</i>		„ (Crepidotus) mollis, <i>Schæff.</i>	
„ (Armillaria) melleus, <i>Fr.</i>		„ „ applanatus, <i>Pers.*</i>	
„ (Tricholoma) equestris, <i>Fr.</i>		„ „ calolepis, <i>Fr.*†</i>	
„ „ rutilans, <i>Schæff.</i>		„ (Psalliota) campestris, <i>L.</i>	
„ „ saponaceus, <i>Fr.</i>		„ „ „ var. silvicola,	
„ (Collybia) rancidus, <i>Fr.</i>		„ „ „ <i>Vitt.</i>	
„ „ orcales, <i>Fr.*</i>		„ „ comptulus, <i>Fr.*</i>	
„ „ radicatus, <i>Rehl.</i>		„ (Stropharia) æruginosus, <i>Curt.</i>	
„ „ dryophilus, <i>Bull.</i>		„ „ melaspermus,	
„ „ tuberosus, <i>Bull.*</i>		„ „ „ <i>Bull.*</i>	
„ „ acervatus, <i>Fr.*</i>		„ „ squamosus, <i>Fr.</i>	
„ „ maculatus, <i>A. & S.</i>		„ „ „ var. auranti-	
„ „ bibulosus, <i>Mass.*†</i>		„ „ „ acus, <i>Cke.*</i>	
„ „ confluens, <i>Pers.</i>		„ „ semiglobatus,	
„ (Mycena) rugosus, <i>Fr.</i>		„ „ „ <i>Batsch.</i>	
„ „ galericulatus, <i>Scop.</i>		„ (Hypholoma) sublateritius, <i>Fr.</i>	
„ „ „ var. calopus,		„ „ epixanthus, <i>Fr.*</i>	
„ „ „ <i>Fr.*</i>		„ „ fascicularis, <i>Huds.</i>	
„ „ polygrammus, <i>Bull.</i>		„ „ hypoxanthus,	
„ „ parabolicus, <i>Fr.*</i>		„ „ „ <i>Plow.*†</i>	
„ „ amictus, <i>Fr.†</i>		„ „ velutinus, <i>Pers.</i>	
„ „ aetites, <i>Fr.*†</i>		„ „ punctulatus,	
„ „ filopes, <i>Bull.</i>		„ „ „ <i>Kalchb.*†</i>	
„ „ ammoniacus, <i>Fr.</i>		„ „ Candollianus, <i>Fr.</i>	
„ „ sanguinolentus, <i>Fr.</i>		„ (Psilocybe) sarcocephalus, <i>Fr.*</i>	
„ „ hæmatopus, <i>A. & S.</i>		„ „ „ spadiceus, <i>Schæff.</i>	
„ „ galopus, <i>Fr.</i>		„ „ „ hebes, <i>Pers.*</i>	
„ „ pullatus, <i>Berk et</i>		„ (Psyathira) conopileus, <i>Fr.</i>	
„ „ „ <i>Cke.*†</i>		„ „ „ corrugis, <i>Pers.*</i>	
„ „ gypseus, <i>Fr.*†</i>		„ (Panæolus) campanulatus, <i>L.</i>	
„ (Clitocybe) laccatus, <i>Scop.</i>		„ (Psyatherella) gracilis, <i>Fr.</i>	
„ „ fragrans, <i>Sow.</i>		„ „ „ aratus, <i>Berk.*†</i>	
„ „ cerussatus, <i>Fr.</i>		Coprinus comatus, <i>Fr.</i>	
„ „ cyathiformis, <i>Fr.</i>		„ „ atramentarius, <i>Fr.</i>	
„ „ nebularis, <i>Batsch.</i>		„ „ fimetarius, <i>Fr.</i>	
„ „ catinus, <i>Fr.*</i>		„ „ niveus, <i>Fr.</i>	
„ (Omphalia) glaucophyllus,		„ „ micaceus, <i>Fr.</i>	
„ „ „ <i>Lasch.*†</i>		„ „ radiatus, <i>Fr.</i>	
„ „ campanella, <i>Batsch.*</i>		„ „ „ plicatilis, <i>Curt.</i>	
„ (Pleurotus) ostreatus, <i>Jacq.</i>		Cortinarius glaucopus, <i>Fr.</i>	
„ „ dryinus, <i>Pers.*</i>		„ „ elatior, <i>Fr.</i>	
„ „ ulmarius, <i>Bull.*</i>		„ „ azureus, <i>Fr.†</i>	
„ (Pluteus) cervinus, <i>Schæff.</i>		„ „ armillatus, <i>Fr.</i>	
„ „ hispidulus, <i>Fr.*</i>		„ „ hæmatochelis, <i>Bull.*</i>	
„ (Leptonia) lampropus, <i>Fr.</i>		Paxillus involutus, <i>Batsch.</i>	
„ (Clitopilus) orcella, <i>Bull.</i>		Lactarius turpis, <i>Fr.</i>	
„ (Pholiota) spectabilis, <i>Fr.</i>		„ „ blennius, <i>Fr.</i>	
„ (Inocybe) rimosus, <i>Bull.</i>		„ „ cremor, <i>Fr.*†</i>	
„ „ „ asterosporus, <i>Quel.</i>		Russula nigricans, <i>Fr.</i>	
„ (Hebeloma) fastibilis, <i>Fr.</i>		„ „ adusta, <i>Fr.</i>	
„ „ mesophæus, <i>Fr.</i>		„ „ lepida, <i>Fr.*</i>	
„ „ sinapizans, <i>Fr.†</i>		„ „ emetica, <i>Fr.</i>	
„ (Flammula) lentus, <i>Pers.</i>		„ „ depallens, <i>Fr.</i>	
„ „ „ gummosus, <i>Lasch.</i>		Cantherellus cibarius, <i>Fr.</i>	
„ „ „ inopus, <i>Fr.</i>		Nyctalis caliginosa, <i>W. G. Sm.*†</i>	
„ (Naucoria) semiorbicularis, <i>Bull.</i>		Marasmius amadelphus, <i>Bull.*</i>	
		„ „ ramealis, <i>Bull.</i>	

- Marasmius androsaceus, *L.**
 „ epiphyllus, *Fr.*
 Boletus chrysenteron, *Fr.*
 „ scaber, *Fr.*
 „ loricinus, *Berk.**
 „ subtomentosus, *L.**
 Polyporus melanopus, *Fr.**
 „ hispidus, *Fr.**
 „ betulinus, *Fr.**
 „ adustus, *Fr.*
 „ chioneus, *Fr.*
 „ squamosus, *Fr.*
 „ annosus, *Fr.*
 „ applanatus, *Wallr.**
 „ rufescens, *Fr.**
 „ ulmarius, *Fr.**
 „ abietinus, *Fr.**
 „ hirsutus, *Fr.**
 „ versicolor, *Fr.*
 „ medulla-panis, *Fr.**
 „ vaporarius, *Fr.*
 Trametes gibbosa, *Fr.**
 Grandinia granulosa, *Fr.**
 „ crustosa, *Fr.**
 Radulum orbiculare, *Fr.**
 Hydnum repandum, *L.*
 Cyphella capula, *Fr.**
 Corticium roseolum, *Mass.**
 Corticium confluens, *Fr.**
 „ sambuci, *Fr.*
 „ calceum, *Fr.**
 Peniophora rosea, *Mass.**
 Ulocolla foliacea, *Bref.**
 GASTROMYCETES.
 Lycoperdon gemmatum, *Batsch.*
 „ pyriforme, *Schæff.*
 Cyathus striatus, *Hoffm.**
 Scleroderma verrucosum, *Pers.*
 „ bovista, *Fr.*
 DISCOMYCETES.
 Helotium citrinum, *Fr.*
 „ lenticulare, *Berk.**
 Peziza vesiculosa, *Bull.*
 „ ampliata, *Pers.**
 „ granulata, *Bull.**
 Phacidium calthæ, *Phil.†*
 UREDINEÆ.
 Uredo symphiti, *D.C.*
 Puccinia poarum, *Nielsen.*
 „ saniculæ, *Grev.*
 PERISPORIACEÆ.
 Sphærotheca pannosa, *Lév.**

The following mosses were collected by the Director in Digswell Park, and have been determined by Mr. A. E. Gibbs:—

- | | |
|------------------------------------|-------------------------------------|
| Dicranum scoparium, <i>L.</i> | Thuidium tamariscinum, <i>Hedw.</i> |
| Leucobryum glaucum, <i>L.</i> | Brachythecium rutabulum, <i>L.</i> |
| Tortula unguiculata, <i>Dill.</i> | Eurynchium striatum, <i>Schreb.</i> |
| Mnium hornum, <i>L.</i> | „ piliferum, <i>Schreb.</i> |
| Atrichum undulatum, <i>L.</i> | Amblystegium serpens, <i>L.</i> |
| Polytrichum formosum, <i>Hedw.</i> | Hypnum cupressiforme, <i>L.</i> |

Also the scale-moss *Cephalozia bicuspidata*, *L.*, and the lichens *Cladonia pyxidata*, *Fr.*, and *Parmelia caperata*, *L.*

Mr. James Saunders reports the finding of the following Mycetozoa:—*Physarum leucophæum*, *Fr.*, *Trichia affinis*, *De Bary*, *Hemiarcyria clavata*, *Pers.*, and *Arcyria cinerea*, *Bull.*

LIBRARY
MUSEUM OF COMPARATIVE ZOOLOGY
HARVARD UNIVERSITY

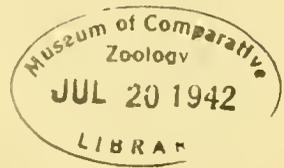
TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

80032

I.
ANNIVERSARY ADDRESS.



FRANCIS BACON.

By the President, JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S.,
F.R.Met.Soc.

Delivered at the Annual Meeting, 19th February, 1892, at Watford.

LADIES AND GENTLEMEN,—

The historian of some centuries hence, in chronicling the progress of England in science, literature, industry, and commerce, in national prosperity and international influence, will probably point out two epochs in which such progress has been most notable, each epoch marked by the reign of a Queen beloved of her subjects and sympathising with them, in each case a reign of long duration. The Elizabethan era is the earlier of these, the Victorian, the later. Which of these eras our future historian will consider pre-eminent on the whole, we cannot yet predict, but certain it is that the age of Elizabeth has been justly termed the golden era of English literature, and that no other period can boast such a galaxy of men of genius and enterprise.

For this was the age of Knox, Hooker, and Whitgift; of Shakespeare, Spenser, and Ben Jonson; of Bacon, Harvey, and Gilbert; of Holinshed, Stowe, and Camden; of Raleigh, Drake, and Martin Frobisher. And the spark of genius did not alone alight upon our own country, for in the Elizabethan age lived Tycho Brahé, Galileo, and Kepler; Guido and Rubens; and Cervantes; while at its close France saw her greatest metaphysical philosopher, Descartes, and Belgium her greatest portrait-painter, Vandyke.

Of these illustrious men two mighty intellects tower far above the rest. Shakespeare is the greatest poet, Bacon the greatest philosopher, the world has ever seen. It would be invidious, nay,

impossible, to compare their merits, but Shakespeare took no part in the stirring events of the time, while Bacon would have been for ever known to fame as a statesman and a lawyer if not a single literary or philosophical work had issued from his pen. In his life, therefore, we ought to feel the greatest interest. "One man only set aside," Hepworth Dixon says, "our interest in Bacon's fame is greater than in that of any Englishman who ever lived. We cannot hide his light; we cannot cast him out. For good, if it be good, for evil, if it must be evil, his brain has passed into our brain, his soul into our souls. We are part of him; he is part of us; inseparable as the salt the sea. His life has become our law."

To us, and to all in Hertfordshire, the life of Francis Bacon has a paramount interest. It must be known to all that although our great philosopher was born in London, he spent part of his time and wrote several of his works in our county, at Gorhambury near St. Albans. It may be questioned whether the titles which he doubtless chose for himself—"Verulam" when he was created a Baron, and "St. Alban" when the higher rank of Viscount was conferred upon him—evinced his attachment to the neighbourhood, but there can be no doubt that this is shown in his desire to be buried in St. Michael's Church. We know very little of his connection with Gorhambury, however, beyond the bare facts that he occasionally went there for a rest from the busy turmoil of London society, which ever had an irresistible attraction for him, and that he there spent some few of the last years of his life in ceaseless literary labour.

It is not an easy matter to picture to ourselves the condition of England in Bacon's time, but we cannot understand his career unless we form some idea of it. To those in his position success in life depended upon winning favour at the Court, and retaining it, a more difficult matter, for although Elizabeth equally appreciated bravery, learning, and accomplishments, she was imperious and exacting, and when her favour had been won, skilful diplomacy was required to maintain it against rivals. Thus Spenser says :

"Full little knowest thou, that hast not tride,
 What hell it is in suing long to bide :
 To lose good days, that might be better spent,
 To waste long nights in pensive discontent ;
 To speed to-day, to be put back to-morrow,
 To feed on hope, to pine with feare and sorrow ;
 To fret thy soul with crosses and with cares ;
 To eate thy heart through comfortless dispaire :
 To fawne, to crouche, to waite, to ride, to ronue,
 To spend, to give, to want, to be undonne."

In the Church, as at Court, the will of Elizabeth was supreme. She enforced implicit obedience to her behests, but although when she began to reign scarce three years had elapsed since, under a Catholic régime, Ridley, Latimer, Hooper, and Crammer had been burnt at the stake, the bishops now, so long as they were loyal, had nothing more to fear than deprivation of their sees.

In the administration of the law there was the same subserviency to the crown, which became even more marked in the succeeding reign. In all causes which affected the Court, the Sovereign intervened, and the judges did not dare to resist the pressure thus brought upon them. Their stipends were inadequate to enable them to uphold the position they were expected to take, and they freely and openly received presents from suitors. On the conclusion of a case the successful party was expected to make a present to the judge who tried it. A wealthy suitor would naturally give more than a poor one, so that there was at least a possibility of a judge being biassed in favour of the rich. The delay in the law now is nothing to what it was then, and suitors frequently made a present to the judge in order to get their case heard. This certainly savours strongly of bribery, but the system pervaded society to the highest in the land, for if a courtier had to ask a favour of his sovereign, the request was almost invariably accompanied with a present. Elizabeth graciously, nay sometimes, it has been said, eagerly, accepted such presents, even presents of money. But she was not avaricious, nor was she extravagant: such gifts were as necessary to her as to her judges.

Under the strong and careful rule of Elizabeth, England rapidly increased in wealth and prosperity. A desire for greater comfort and luxury sprang up; fortified castles were converted into palaces; wooden hovels gave place to houses of brick and stone; wicker lattices to windows of glass; and, as Harrison says, "as for stooves we have not hitherto used them greatlie, yet doo they now begin to be made in diverse houses of the gentrie." He remarks on "the multitude of chimnies lately erected;" on "the amendment of lodging, for," he says, "our fathers have lien full oft upon straw pallets, and a good round log under their heads instead of a bolster or pillow;" on the exchange of pewter platters and tin or even silver spoons for those of wood; and on the great increase of wealth amongst the farmers. In hospitality the English were then, as always, profuse. All grades in a household usually dined together, the dependants at a lower table in the banqueting-hall than their masters. Venetian glass, and china dishes and plates, were introduced, and knives and forks began to take the place of

fingers. Carpets were but seldom used except for covering tables, the floors being strewn with rushes. Dress was no less remarkable for its splendour than for its variety, for, in the absence of a national costume, various incongruous fashions of foreign countries were adopted; and the dress of the men was sometimes even richer and more costly than that of the women.

The age of Elizabeth was pre-eminently one for country sports and festivities: while Sunday, after the morning service which all were obliged by law to attend, was the habitual day for merry-making, there were several days in the year specially set apart for pageants and festivities in which all classes heartily joined; a happy state of things which was destined soon to be for ever swept away by the strict and morose yoke of puritanism.

Freedom from fear of persecution and of foreign aggression, and a rapid growth of prosperity and of consciousness of individual power and national greatness, with increased leisure and comfort, put a spur to learning and the desire for knowledge,—knowledge not only for its own sake but also as an aid to the acquisition of wealth, power, and freedom; and a spirit of enterprise sprung up such as had never before been experienced in England. Marlowe, who wrote about this time, thus expresses his ideas of the aspirations of an Englishman on being endowed with power to command spirits to obey his will:—

“ I’ll have them fly to India for gold,
 Ransack the ocean for orient pearl,
 And search all corners of the new-found world
 For pleasant fruits and princely delicates.
 I’ll have them read me strange philosophy,
 And tell the secrets of all foreign kings.

 I’ll buy soldiers with the coin they bring,
 And chase the Prince of Parma from the land,
 And reign sole King of all the Provinces;
 Yea, stranger engines for the brunt of war
 Than was the fiery keel at Antwerp bridge
 I’ll make my servile spirits to invent.”

Precision in the results of experimental research was then first made possible by the construction of accurate mathematical instruments by Gunter and Molyneux. Watches were first made in England, letters were first sent by post, and the first English newspaper was printed. It was ascertained that the magnetic needle did not everywhere point due north, and we find John Rudston, an astronomer, enquiring whether “the variation can be in any place of the world 180 degrees, or the north point of the needle stand directly to the south.” So carelessly did men observe

the face of Nature that even Galileo maintained, as the basis of an argument he had with Bacon, that there was high tide only once in about twenty-four hours, instead of twice.

Witchcraft was a capital offence, and astrology was generally believed in. Camden, in his 'Britannia,' which he completed in 1607, discussed "under the influence of what sign and planet this Britannia of ours lies," though he evidently did not place much faith in the divinations of astrologers.

The Aristotelian philosophy was still all-powerful. Authority was as it were on an unassailable pedestal, from which Bacon was destined to dethrone it. In some countries it was dangerous to controvert the generally-received opinions as to the construction of the universe. Galileo was persecuted by the Inquisition for teaching the true system of astronomy. But so it ever was and still is to some extent: every great thinker who ventures to enunciate views which appear to be opposed to the dogma current at the time is virtually excommunicated, and so the progress of our knowledge of the mysteries of Nature is retarded, and some of our most earnest seekers after truth are unjustly censured. "In theology we balance authorities," said Kepler in 1609; "in science we weigh reasons. A holy man was Lactantius, who denied that the earth could be round. A holy man was Augustine, who, granting the earth's rotundity, denied the antipodes. A holy thing to me is the Inquisition, which, allowing the smallness of the earth, denies its motion. But more holy to me is Truth; and hence I prove, by science, that the earth is round, is inhabited on every side, is of small size, and in motion among the stars." These conclusions startled the learned world, and well they might, for they were founded on observation, not on authority. Here is a specimen of the kind of reasoning to which men were then more accustomed:—"The philosophers define tyme to be *mensura motûs*. Before the heavens weare created there was no naturall motion, and, by that reason, there wold be no *mensura motûs*. That estate of beinge which was before the creacion of the woorld was called therefore eternitie."

The hollowness of such trains of thought as this was destined soon to be shown by Descartes, by his discovery of the laws of inertia and of the persistence of force, now called the conservation of energy; and by Bacon, who taught, with the authority of a Lord Chancellor of England, that the way to find out the secrets of Nature is to question her by experiments and to observe her ways, it being futile to rely upon the efforts of our own imagination or to place implicit credence on the sayings or writings of others.

Similar views to these had frequently been expressed before, notably by Roger Bacon in England in the 13th century, and by Leonardo da Vinci in Italy in the 15th, but they appear to have borne little fruit, and it seems that the greater success which attended the teaching of Francis Bacon was mainly due to the high position he held and the celebrity to which he attained. That such would be the case was clearly seen by him, and to be great for the good of mankind was the ambition of his life.

Francis Bacon was the youngest son of Sir Nicholas Bacon, Queen Elizabeth's first Lord Keeper of the Great Seal, a man of refined mind and literary and scientific tastes, and the first English statesman of eminence who was neither a warrior nor an ecclesiastic. He was born on the 22nd of January, 1561 (new style), at his father's London residence, York House, pleasantly situated in its own grounds between the Strand, not then a street, and the Thames, then a river of sufficient purity for the greater part of the Metropolis to be supplied with water pumped from it by water-wheels placed under some of the arches of old London Bridge.

Sir Nicholas Bacon married twice. By his first wife he had three sons and three daughters. His second son, Nathaniel, a talented artist, some of whose paintings are now at Gorhambury, had a daughter Anne who married first Sir Thomas Meautys and next Sir Harbottle Grimston, Master of the Rolls, who also had been married before, to Mary, daughter of Sir George Croke, by whom he had several sons and daughters, and from one of these the present Earl of Verulam claims descent. By his second wife Ann, daughter of Sir Anthony Cooke, Sir Nicholas had two sons, Anthony and Francis. In February, 1561, the month after the birth of Francis, he became possessed of the Manors of "Gorhambury, Westwyke, and Pray," together with property in Redbourn, and in the parishes of St. Michael, St. Peter, and St. Stephen, and with the advowsons of the Vicarages of Redbourn and St. Michael. If there was any house then standing at Gorhambury there is now no trace of it. The house which Geoffrey de Gorham built about the year 1128, and which stood about four hundred yards east of the present building, on the brow of the hill facing towards St. Albans, was demolished before the year 1400. But two years after Sir Nicholas Bacon acquired the manor, he commenced to build the house of which the ruins are still standing, south-west and within sight of the present mansion, finishing it in 1568. In this house he twice entertained the Queen, the second time for four days, and her entertainment cost him for this period one-third as much as the house cost him to build in five years. "In the orchard was a

little banquetting-house, adorned with great curiosity, having the liberal arts beautifully depieted on its walls, over them the pictures of such learned men as had excelled in each, and under them verses expressive of the benefits derived from their study." (*Montague.*) The very names of these arts give a curious insight into the knowledge of the time. They are Grammar, Arithmetic, Logie, Music, Rhetoric, Geometry, and Astrology.

Lady Ann Bacon was a woman of great piety and much learning, being proficient in Latin, Greek, and several modern languages. This was not so remarkable in those days as we may imagine, for Queen Elizabeth delivered an extempore oration in Latin at Cambridge University, and one in Greek at Oxford. Nevertheless it is worth mention that Francis Bacon's father and mother were both talented, and to his mother's abilities he doubtless owed his education in early life. She was devoted to her sons, gave them good advice long after they had arrived at man's estate, as loving mothers do to this day, sent them farm and dairy produce from Gorhambury, and sometimes when she had the means even paid their debts, at the same time lecturing them well on their extravagance. Anthony asks for a long carpet from Gorhambury. His mother is loth to part with it; he has had one already; what can he want with another? But she sends it to him, to his house at Twickenham; what matters it to her?—she can strew rushes on the floor as of old; and when she dies he will live at Gorhambury.

Bright, thoughtful, and rather precocious is Francis Bacon as a child, and delicate in constitution then and throughout his life. When asked his age by the Queen, he replies: "Two years younger than your Majesty's happy reign;" and she calls him her young Lord Keeper. Although frequently at Court, he must have spent many of his days of childhood "on the green slopes and in the leafy woods of Gorhambury," fully alive to the beauties of Nature, and having his interest in literature and science awakened by his father's pursuits, and perhaps his curiosity aroused by the allegorical representation of the liberal arts which adorned the walls of the banquetting-house; while we may be sure that his mother instilled into him those deeply religious feelings which, notwithstanding his failings, remained with him through life.

At the early age of twelve (in April, 1573) he goes to Cambridge with his brother Anthony to study under Whitgift, and in less than three years (at Christmas, 1575) he leaves the University with a firm conviction of the unfruitfulness of the Aristotelian philosophy, a profound disbelief in its infallibility, and a settled resolve to try to discover a better method of studying nature. But

the heavens themselves had then declared against Aristotle, a new star as bright as the planet Jupiter having appeared and disappeared in his region of the Unchangeable and Incorruptible, in the constellation of Cassiopeia.

In another six months (27th June, 1576) the two brothers are admitted into Gray's Inn as "Ancients," a privilege to which they were entitled as the sons of a judge, and three months later Francis accompanies Sir Amias Paulet to the Court of Henri Trois. Whilst in France, in 1578, when in his eighteenth year, Hilliard paints his portrait and encircles it with a Latin inscription signifying "Oh that I could but paint his mind!" Early in the following year he hears of his father's death, and leaves Paris bearing a despatch from Sir Amias to the Queen in which he is mentioned as "of great hope, endued with many good and singular parts." He now finds it necessary "to study how to live instead of living only to study," for his father had not made the provision for him which he had intended to do. Anthony has property in Redbourn, and Lady Ann has a life-interest in Gorhambury, where she lives, looking after his (Anthony's) house at Redbourn, advising him as to the letting of his farms, and sometimes interceding with him on behalf of his tenants. She evidently interested herself in the welfare of all around her, being always ready to give a word in season whether of kindly sympathy or of righteous rebuke.

Francis Bacon, having now to earn his living, decides upon the Bar, entering Gray's Inn later in this year. Here he diligently studies the law, occasionally visiting his mother at Gorhambury. In 1582, soon after attaining his majority, he is admitted an Utter Barrister at Gray's Inn; and in the following year he writes his first philosophical essay, which he entitles '*Temporis Partus Maximus*' (The Greatest Birth of Time). A year later he drafts a deed for his brother, "Anth. Bakon, of Gorhambury, in the county of Hartford, Esq.," the purport of which was to appoint attorneys and give them power to raise £3000 on the security of Gorhambury for debts he (Anthony) was incurring during his residence and travelling on the Continent.

Later in this year, or at the beginning of the next, when just twenty-four, Francis Bacon writes a 'Letter of Advice to Queen Elizabeth,' in which we see the first spark of that wealth of illustration which pervades all his future writings and speeches. He does not see how the Papists can be made absolutely content without discontenting her Majesty's faithful subjects, and, he says, "to fasten a reconciled love with the loosing of a certain, is to build houses with the sale of lands." He advises the compulsory

education of children, "virtuously and religiously," as a more efficient means of reducing the number of Papists than persecuting them, since, he says, "we find by experience that death works no such effects, but that, like Hydra's heads, upon one cut off, seven grow up, persecution being ever accounted as the badge of the Church." Similar tolerance is to be extended to the Puritans, then called Preachers, but here he knows that he is giving the Queen unpalatable advice, and he qualifies it with the tact of a courtier: "till I think that you think otherwise, I am bold to think that the bishops in this dangerous time take a very evil and unadvised course in driving them from their cures."

In his twenty-fourth year, before he writes this Letter, he first takes his seat in Parliament. He sat for Melcombe then, in 1586 for Taunton, in 1589 for Liverpool, and in 1593 for Middlesex, then as now the most wealthy and independent shire in England. By that year, at the age of thirty-two, he has made his mark in Parliament, for he is poor, holds no official position, and does not own a rood of land in the county. Merit, and merit only, has gained him this proud position. In that House "wit so radiant, thought so fresh, and lore so prompt, have not before (and have never since) been heard," but better far than this, he is trusted and admired because he pleads for measures which all in their own hearts must admit are best for the State, the Church, and the Law. He pleads against feudal privileges and unpopular powers; against the destruction, then threatened, of the Church, for, he says, "it is the eye of England; if there be a speck or two in the eye, we endeavour to take them off; he would be a poor oculist who would pull out the eye"; and he urges the reform and simplification of the law, telling a House full of lawyers that "laws are made to guard the rights of the people, not to feed the lawyers," and that they should be read by all and known to all.

Stirring times are these. The execution, in 1587, of the unfortunate and misguided Mary Queen of Scots, for being accessory to a plot for the assassination of Elizabeth, removed the chief source of danger to England from internal dissension, and the defeat of the Spanish Armada in the following year dissipated for the moment the fear of foreign aggression, and made England "Mistress of the Seas," for the supremacy of Spain, up to that time the greatest naval power in the world, was by this victory broken for ever. The great question of domestic internal policy was the management of the Church, and in 1589 Bacon essays to make peace between the Queen and her Parliament by drawing up an 'Advertisement touching the Controversies of the Church of

England,' in which he gives advice of value for all time. In 1592, just three centuries ago, he writes the letter to his uncle, Lord Burleigh, in which occurs the memorable expression: "I have taken all knowledge to be my province."

During the Parliament of 1593, England is again threatened with foreign invasion. The Spaniards, being victorious in France, having penetrated even to Calais, there is no telling how soon they may attack Dover, and while London is being decimated by the plague, and levies are being raised in England for Henri Quatre, King of France, money is required for the sinews of war. The Peers decide the amount—three subsidies, each of four shillings in the pound, in three years. To dictate to the Commons the amount they are to give is an innovation, and the tax is unprecedentedly heavy. Will no one contest the question, under peril of incurring the Queen's displeasure, and perhaps of imprisonment? For less offence one member had been immured in the Tower and another in the Fleet. Only one dare do it, and that one is Francis Bacon. "To give," he says, "is the prerogative of the people—to dictate what they shall give is not the duty of the House of Peers." A debate ensues, the House divides, and Bacon gains his point. But the money must be raised, so Sir Walter Raleigh says, and the Commons can now grant it of their own free-will; and would have done so; but Bacon again steps forward, says that he fears such a heavy tax may raise discontent, and suggests that the period shall be doubled, reducing the subsidy to two shillings in the pound each year, and that the grant shall be declared exceptional. The result is a compromise; four years are allowed, and a clause is inserted in the Bill declaring that the money "is given solely for the war against Spain." Bacon, by his independent action, has established for ever the exclusive right of the House of Commons to directly tax the people for imperial purposes, and to define the use to which the money raised shall be applied. The Sovereign was not yet, however, entirely dependent upon the Commons for supplies, having power to raise money by indirect taxation, etc., but no large amount could thus be obtained.

This same year begets a friendship which has, more than anything else, given occasion for the formation of an unjust estimate of Bacon's character, and a rivalry which, nearly thirty years hence, will cause his ruin. The friend is the Earl of Essex, grandson of a cousin of the Queen, petted and spoiled by her for lack of a grandson of her own to pet and spoil. The rival is Sir Edward Coke, then Speaker of the House of Commons, a clever lawyer, but a hot-headed, blood-thirsty bully, who sees that Bacon's

advancement would likely be his own fall, and so sneers at his philosophy and disparages his law. Francis Bacon gives Essex advice which, if he had followed it, would have saved his head. Essex appreciates it, but, where it seems likely to detract from his own glory, is too headstrong to gain by it. Though petulant, he is in his younger days generous to a fault, and he urges Bacon's claim to place and power with such vehemence upon the Queen that she will not gratify him. Though she loves to pet and spoil him at her own sweet will, she keeps him in his place as her subject and not her equal, and will not be dictated to by him, and so he goes to Bacon, tells him that he has spoilt his prospects for a time, and compensates him in some degree with the gift of a piece of land.

In the next Parliament (1597) Bacon sits for Ipswich, and makes the session memorable by bringing in bills to arrest the decay of tillage and stem the growing discontent of the yeomen. "The population lives on the soil. Mining is in its cradle. . . . Manufactures are few and scant. . . . To grow corn, to herd cattle, to brew ale and press cider, to shear sheep, to fell and carry wood, are the main occupations of every English shire. The farms are small and many; the farmers neither rich nor poor. The breeder of kine, the grower of herbs and wheat, is a yeoman born; not too proud to put hand to plough, not too pinched to keep horse and pike. . . . This sturdy class is dropping the plough for the weaver's shuttle and the tailor's goose; the rage for enclosing woods and commons, for impaling parks, for changing arable land into pasture, for turning holdings for life into tenancies at will, having driven thousands of yeomen from fields and downs which their fathers tilled before the Conqueror came in. Whole districts have been cleared. Where homesteads smoked and harvests waved, there is now, in many parts, a broad green landscape peopled by a shepherd and his dog. Where the Maypole sprung and the village-green crowded with frolic, are now a sheepwalk and a park of deer." (*Hepworth Dixon.*)

Bacon sees in this a danger to the crown and country, and he drafts two bills which provide that no more land shall be cleared without special reason and a special licence, and that all land turned into pasture since the Queen's accession, a period of forty years, shall be restored to the yeomen and the plough. The Commons pass the bills, the Lords, with the legal assistance of Coke, oppose them; but to no purpose. The astute lawyer, with his thirty-one legal quibbles, is no match for the young barrister, with his single weapon, justice, and with slight modifications the bills become law.

Early in this same year Bacon publishes the first edition of his 'Essays,' ten in number. They were reprinted in 1598, 1604, and 1606, increased to thirty-eight in 1612, and finally to fifty-eight in 1625. They are the most popular of all his works, and are replete with original thought, apt quotations, and practical advice. "They still," Prof. Fowler says, "retain their ground as classics, and, some time or other during his life, every educated Englishman is certain to read them." They are undoubtedly utilitarian, as they were meant to be, and exceptions may be taken to some passages in them as inculcating unworthy means to attain worthy ends, as when a man is advised to have "dissimulation in seasonable use, and a power to feign if there be no remedy;" but a higher moral tone usually pervades them. Selfish aims and motives are strongly deprecated, as in the following quotations (from the edition of 1625):—"I take goodness in this sense, the affecting of the weal of men, which is that the Grecians call *Philanthropia*. . . . This of all virtues and dignities of the mind is the greatest, being the character of the Deity, and without it man is a busy, mischievous, wretched thing, no better than a kind of vermin." "Wisdom for a man's self is, in many branches thereof, a depraved thing. It is the wisdom of rats, that will be sure to leave a house somewhat before it fall. It is the wisdom of the fox, that thrusts out the badger, who digged and made room for him. It is the wisdom of crocodiles, that shed tears when they would devour." "An ant is a wise creature for itself, but it is a shrewd thing in an orchard or garden. And certainly men that are great lovers of themselves waste the public. Divide with reason between self-love and society, and be so true to thyself as thou be not false to others, specially to thy King and country. It is a poor centre of a man's actions, *himself*."

A few passages culled almost at random, may convey a better idea of the general character of the Essays:—"In taking revenge a man is but even with his enemy, but in passing it over he is superior. . . . That which is past is gone and irrevocable, and wise men have enough to do with things present and to come." "Virtue is like precious odours, most fragrant when they are incensed or crushed; for prosperity doth best discover vice, but adversity doth best discover virtue." "A crowd is not company, and faces are but a gallery of pictures, and talk but a tinkling cymbal, where there is no love." "Defer not charities until death, for certainly, if a man weigh it rightly, he that doth so is rather liberal of another man's than of his own." Bacon delighted in such aphorisms as these, so concise that not a word can be spared;

but for pithiness the first essay in the first edition ("Of Studies") cannot be surpassed.

The greater part of this essay has become proverbial. "Studies serve for pastimes, for ornaments, and for abilities. . . . Craftie men contemne them, simple men admire them, wise men use them." "Reade not to contradict, nor to believe, but to waigh and consider. Some bookes are to bee tasted, others to bee swallowed, and some few to bee chewed and digested." "Reading maketh a full man, conferenee a readye man, and writing an exacte man." "Histories make men wise, poets wittie; the mathematickes subtle, naturall phylosophie deepe; morall grave, logicke and rhetoricke able to contend."

Amongst the books to be "chewed and digested," these 'Essays' will certainly always claim a prominent place.

The Irish rebellion under Tyrone next engages Bacon's attention. Shakespeare makes Richard the Second say:

"Now for our Irish wars!

We must supplant these rough, rug-headed kernes,

Which live like venom where no venom else,

But they, have privilege to live!"

In 1599 an army of twenty-thousand is raised to quell the rebellion, and Essex claims to lead it. But Bacon's remedy is the spade, not the sword. He would clear the forests, drain the bogs, lay out new roads, build new towns and ports; he would have permanently resident in the country all the highest in authority there, civil and military; and he strenuously urges the Earl of Essex to abandon the enterprise, on which, for his own glory, and that only, he is intent. But to no purpose. Essex goes and fails, disobeys his instructions, makes a traitorous truce with the rebel chief, leaves the remnant of his army without a leader, and, against the express command of the Queen, returns to London with his chief officers and staff. He is taken into custody as a traitor, but Bacon intercedes for him with the Queen and he is liberated. In another year (Feb., 1601), finding that he is not restored to favour, under pretence that his life is threatened, he attempts to raise the city against the Queen, and fails. Having played his stake and lost, nothing can save him from the block. His prosecution is entrusted to Coke and Bacon. Coke wrangles with him on immaterial points and leaves his junior to bring home to him the charge of treason. Before his death he confesses more against his confederates than could otherwise have been proved, and four of them, including two of his greatest friends, share his end. With a few notable exceptions, all historians of this event have

said that Bacon, when called upon by his Queen, as her learned counsel-extraordinary, to do his duty, should have declined, or, far worse, should purposely not have done it to the best of his ability. Bacon somewhere says that a man's love for his friend should be greater than for himself, for his Sovereign greater than for his friend, and for his country greater than for his Sovereign, and few will disagree with him; but nearly all maintain that when Essex turned traitor and endeavoured to stir up civil war, Bacon, knowing that he was powerless to save his life, should have disobeyed the commands of his Sovereign, or, while ostensibly carrying out her instructions, should have been guilty of duplicity. Much stress has been laid upon the expressions of esteem and affection which Bacon in his letters bestowed upon Essex while he remained a dutiful subject of the Queen, but it should be borne in mind that in those days such expressions were mere matters of form, almost as meaningless as the epistolary term, "Your obedient servant," is now.

Lord Campbell, in his 'Lives of the Lord Chancellors,' says that "for some time after Essex's execution Bacon was looked upon with great aversion." About six months after it he was returned as a member of Parliament for Ipswich, his former constituency, and also for St. Albans; three years after it, in the first year of the reign of James the First, this double return was repeated. Surely this is not the way the electors would show their disapproval of his conduct. It is true that Essex was popular with a certain class; that Elizabeth considered it necessary to have published fuller particulars of his treasonable proceedings than came out at his trial; and that Bacon, when, on the accession of James the First, the friends of Essex came into favour and power, had to repel the accusations of his own enemies and explain his conduct; but it is no less true that Essex proved himself to be a traitor, and that Bacon satisfied his contemporaries that he had done his best to make Essex loyal, and, having failed, had done his duty to his Queen and country.

Bacon was frequently suing for lucrative employments under the crown during the reign of Elizabeth, but, though the Queen employed him and occasionally rewarded him for his services, it seems that she either never fully forgave him for opposing her on the question of subsidies, or that, to use her own word, he did not "frame" sufficiently—she could not rely upon his implicit subjection to her imperious will. One of her rewards was the reversion of the Clerkship of the Council in the Star Chamber, worth about £1600 per annum. This, he said, was like "another man's ground

but tailing upon his house ; which might mend his prospect but did not fill his barn." He had it in prospect only for nearly twenty years. His uncle, Lord Burleigh, who was the Queen's chief adviser, never warmly espoused his suit, either, it appears probable, deeming him a better philosopher than statesman or lawyer, or thinking that his advancement would interfere with the advancement of his son, Lord Cecil, who, also, seems so have opposed his cousin from no other motive than jealousy.

James the First was known to be learned, and, on his accession in 1603, Bacon sees a chance of obtaining royal patronage for his long-cherished schemes for promoting the advancement of the arts and sciences. He hurriedly completes a work 'On the Advancement of Learning,' dedicates it to the King, and presents a copy of it in MS. to him. In this work he first brings forward testimony to the excellence of learning, and shows how it has been discredited ; and then narrates what has been done for its advancement and where it is defective. He classifies learning, first human and then divine, on the basis of the three faculties, memory, imagination, and reason, and carries out the ramification to arts which did not then exist. The literary merits of this work are not less than the scientific. Dr. Abbot says that "it will always be important for its literary value as well as for its suggestiveness and stimulating effect upon every seeker after truth." Dean Church considers it to be "the first great book in English prose of secular interest." "It is," he says, "a book which we can never open without coming on some noble interpretation of the realities of nature or the mind ; some unexpected discovery of that quick and keen eye which arrests us by its truth ; some felicitous and unthought-of illustration ; some bright touch of his incorrigible imaginativeness, ever ready to force itself in amid the driest details of his argument." Of its scientific value perhaps no higher testimony can be given than the fact that the editors of the French 'Encyclopédie' made it the basis of that great national work. "If we emerge from this vast operation," wrote Diderot in the Prospectus, "we shall owe it mainly to the chancellor Bacon, who sketched the plan of an universal dictionary of sciences and arts at a time when there were not, so to speak, either arts or sciences. This extraordinary genius, when it was impossible to write a history of what men already knew, wrote one of that which they had to learn."

Fault has been found with the classification of knowledge proposed by Bacon, but it should be borne in mind that this was the first attempt of the kind ever made. No scheme of classification, moreover, which has ever been proposed, and probably no scheme

which ever will be proposed, will stand the test of time ; for, as knowledge increases, light is thrown on the relation to each other of its various branches, and a single new fact may render necessary an entire recasting of the whole superstructure. But, although Bacon's partition of the arts and sciences has been superseded, the 'Advancement of Learning' is still a text-book in our schools, and more perhaps has been done during the latter half of the present century to carry out the recommendations made in it than during the whole of the previous two and a half centuries. The work was first published in 1605, two years after it was written.

During the first few years of the reign of James the First, Bacon makes frequent attempts to promote the union of the kingdoms of England and Scotland. He believes, as he tells the King, that "now the corner-stone is laid of the mightiest monarchy in Europe," and he fights hard against prejudice to get it firmly cemented. It seems strange to us that, in advocating the naturalisation of the Scotch, he has to argue that their immigration in large numbers need not be apprehended ; that England, with a population less than that of London in the present day, is not too thickly populated ; and that increase of population would be a source of strength rather than of weakness, for the sinews of war, he says, are not made of gold but of men, and a surplus of population, especially if due to the influx of sturdy northmen, will find a vent in foreign aggression and colonisation, and so enlarge the borders of our empire ; and he truly says that England, Scotland, and Ireland firmly united will be such a trefoil as no other king in Christendom can boast of or withstand.

Nor does he, while endeavouring to promote the advancement of learning and the consolidation of the empire, neglect the welfare of the Church, for he tenders advice to the King advocating a conciliatory policy,—pleading not for mere countenance but for a "law which may give a liberty," and maintaining that frequent ecclesiastical reforms are needed just as much as civil reforms. "If," he says, "it be said to me that there is a difference between evil causes and ecclesiastical, they may as well tell me that churches and chapels need no reparation though houses and castles do." But James would not heed Bacon's wise counsel, failing to perceive that the strength of the Church lay rather in the number of her devotees than in their uniformity of practice and ceremony, and the printed copies of Bacon's 'Considerations touching the Pacification and Edification of the Church of England' were called in. The effort, however, was not entirely without fruit, for in a conference with his bishops and the Puritan preachers—the

celebrated Hampton Court Conference—James conceded some points on which Bacon had insisted, granting certain liberties which the Church has possessed ever since.

While engaged upon these subjects—learning, the Union, and the Church—Bacon is the most active and hardworking member of the House of Commons, sitting, in the Parliament of 1604–5, on twenty-nine committees, and usually if not always being chosen as the reporter of the Commons to the Lords and the King. His advancement now was rapid: knighted in 1603, he became Solicitor-general in 1607, Attorney-general in 1613, Lord Keeper in 1617, and Lord Chancellor in 1618. This was an eventful period, the principal events being the Gunpowder Plot in 1605, the colonisation of Virginia in 1607, the completion of the New River to supply London with water from the valley of the Lea in 1608, the invention of the telescope by Lipperhay and the discovery of Jupiter's satellites by Galileo in 1610, the publication of the authorised version of the Bible in 1611, the foundation of the first English settlement in India in 1612, the invention of logarithms by Napier in 1614, the introduction of Episcopacy into Scotland in 1617, the commencement of the thirty-years' war in 1618, and the discovery of the circulation of the blood by Harvey in this or the following year.

In 1606 Bacon marries Alice Barnham, in 1607 he writes the '*Cogitata et Visa*,' in 1608 he begins the '*Novum Organum*,' and in the same year he writes an eulogy of Queen Elizabeth ('*In felicem memoriam Elizabethæ*'), which he regarded as one of the most precious efforts of his pen, and in 1609 he writes '*De Sapientiâ Veterum*' (The Wisdom of the Ancients). In 1610 his mother dies and he succeeds to Gorhambury, for his brother Anthony had died in 1601, and in 1612 he publishes the second edition of his 'Essays,' now thirty-eight in number. For the next few years he wrote nothing of importance, except that he was engaged on his greatest work, the '*Novum Organum*.'

All this time he is struggling with his creditors, for he was always short of money and continually borrowing, assiduously pursuing his professional duties, taking an active part in politics, advising the King, and mediating between him and the refractory House of Commons. No wonder that he has been accused of carelessness and haste in some of his conclusions; no wonder that he does not keep abreast with the scientific discoveries of his time. Yet it seems strange that he should reject the Copernican system of astronomy, believing that the Earth was the centre of the Universe; that he should be unaware of the astronomical work

of Kepler; and that he should contemn Gilbert's experiments in magnetism. But the Copernican system was then merely an hypothesis by which the movements of the planets could be explained in a more simple manner than by the Ptolemaic system. It was a necessary basis for Kepler's empirical laws of the distances of the planets from the sun, and the times of their revolution round it, which were known in England in the year 1610; but, although Kepler's views strongly strengthened the hypothesis of Copernicus, absolute proof was not forthcoming until Newton discovered the laws of gravitation.

In 1614 Bacon is returned as a Member of Parliament for St. Albans, Ipswich, and Cambridge, and elects to sit for his University. In the following year he takes part in a trial which but for this might have passed almost unnoticed—that of Peacham for treason. The prominence given to this trial by Bacon's chief detractors, Campbell and Macaulay, make it necessary to refer to it here. Peacham was rector of Hinton St. George in Somersetshire, and was removed from the Church for grossly libelling his bishop, and for other misdeeds. His house was searched, and in it was found a seditious pamphlet prepared for publication, inciting to the murder of the King, his son and heir, and his officers. When questioned he accuses several persons in high position of treasonable knowledge of it, and makes it appear that a formidable conspiracy is on foot. As he is known to be a bad character, doubts are raised as to his truthfulness, and the Crown appoints a Commission of eight, Bacon being one, to examine him under torture at their discretion. Bacon, also, is directed by the King to consult the judges as to whether they were of opinion that seditious writing legally amounted to treason. Peacham is tried and sentenced to death, after which he offers to tell the truth if his life is spared. His written confession is in existence, and although in it he admits that his accusation of others as his accomplices was unjust, he spins a tissue of evident falsehoods. We may certainly regret that our great philosopher should have been associated in a cruel and utterly unphilosophical means of endeavouring to elicit truth, but for him to have refused to act might in those times have been considered a treasonable offence. Suffering and death were looked upon very differently then than they are now. But a revulsion against the use of torture was springing up, in which Bacon took a prominent part. Of the eight who examined Peacham he is the only one who has raised his voice against the practice, and yet he is the only one who has been accused of inhumanity. Even the King had witnessed torture, for he was present when Guy Fawkes was stretched.

Again, there are precedents for private consultation with the judges. For instance in 1612 an Arian preacher was tried for heresy by a consistory of divines, and sentenced to be burnt alive; the judges were consulted one by one as to whether the King had power to order the sentence to be carried out; and, without trial in any civil court, Bartholomew Legate perished in the flames.

A year after the trial of Peacham, Coke disobeys an order of the King, conveyed to him by Bacon, to defer the hearing of a trial in which the court is interested. Coke lays the blame on Bacon, but Bacon shows that Coke is in the wrong, and witnesses his rival's fall. From that moment his own fall is certain. The serpent he has trodden upon and crushed will surely turn and make him feel the poison of his fang; but not yet. He is rising, and rapidly, perhaps too rapidly. Three days after this he is sworn a member of the Privy Council, taking the place from which his rival had been degraded; nine months after it he becomes Lord Keeper, and in another three months he clears off a vast accumulation of arrears in the Court of Chancery, his rulings and decisions giving general satisfaction. In another six months the high rank of Lord Chancellor is conferred upon him; and in yet another six months (12th July, 1618) he is raised to the Peerage with the title of Baron Verulam of Verulam. He has now more leisure, and devotes it to his favourite studies, carrying out the desire of his life that his greatness should redound to the benefit of mankind.

We have seen that Bacon strenuously and repeatedly advocated toleration when such advocaey was not likely to meet with the approval of his Sovereign, whether Elizabeth or James. There ought not, therefore, to have been any doubt of his sincerity, but, as it has been questioned, it may be well to mention a few episodes of about this time which go far to prove it.

His friend, Tobie Matthew, son of a bishop, grandson of an archbishop, with all his relatives in the Church, becomes a recusant—a Catholic—a few months after the discovery of the gunpowder plot, when the Catholics were in especial disfavour. Bacon tries at first to bring him back into the Church of England, but soon sees that the change in his views has made him “a better and a happier man.” He is cast out of his father's house, and Bacon takes him into his own; he is cast into jail, and Bacon visits him there, and eventually procures his release. Divergence in religious views was then considered to be an insuperable bar to friendship, but these two men are fast friends for life.

Ten years later, Sir William and Sir Thomas Monson are in the Tower on suspicion. That they are Catholics is, to Coke, a

sufficient reason to hang them, but as the evidence against Sir William is very slight, he gets together a mass of secret papers with which he hopes to incriminate him. Bacon orders him, by command of the King, to give them up to him, and the result is that Sir William is proved to be innocent and is at once set at liberty. There is some evidence against Sir Thomas, but Bacon and the Lord Chancellor (Yelverton) believe it to be inconclusive, and advise the King to pardon him, as an act of justice, mercy, and expediency. Their advice is taken, Sir Thomas Monson declares his innocence, and requests that his pardon may be read as evidence of it. His wish is gratified, and he leaves the Tower a loyal and devoted subject of the King.

Doctor Burgess, a famous Puritan preacher, has for some time been suspended from his ministry in the Church. His loss is sorely felt in London; his inspiring words and thundering denunciation of all evil ways are much needed. Many wish to hear him again; amongst others the Honourable Society of Gray's Inn. It is Bacon's first act on becoming a Privy Councillor to procure his restoration to the Church, and this is just after he has brought about the release of one of the Monsons and before he obtains the release of the other. All these acts expose him to the malignity of those in power who are intolerant and bigoted. Who can doubt his sincerity?

In 1620 an epoch in the history of philosophy is created, for in this year appears Bacon's great work, the '*Novum Organum*.' He has been working at it for "near thirty years," he says, and fragments of it, each complete in itself, had appeared in various forms, but they were probably first put together as a connected whole about the year 1608, for his chaplain, Dr. Rawley, says that he has seen "at the least twelve copies . . . revised year by year, one after another, and every year altered and amended in the frame thereof;" and in a letter to his friend Toby Matthew, as early as 1610, Bacon himself says: "My great work goeth forward; and after my manner I alter ever when I add; so that nothing is finished till all be finished."

The '*Novum Organum*,' or 'New Instrument,' was only a section—the second—of a much larger work, the '*Magna Instauratio*,' of which the greater part of the 'Advancement of Learning' in its Latin form, now called '*Partitiones Scientiarum*,' was to form the first part. This second part, Bacon says, "sets forth the art itself of interpreting nature and of a truer operation of the understanding." But he did not consider the '*Novum Organum*' to be the complete second part of the Great Instauration of Science, but

merely an introduction to, and example of, his new method of Induction, the introduction forming the first book, and the example, the nature of heat, forming the greater part of the second. In the first book the principles of correct induction are laid down, and the errors to be guarded against, the false idols, are pointed out. In concluding it he says that "if men had a just history of nature and experience, and could bind themselves by two rules, first, to lay aside received opinions, and secondly to restrain themselves from seeking at once to ascend to the highest generalisations, they would be able to interpret nature rightly." In the second book more precise rules are given with special reference to the immediate subject of inquiry. These rules have been much condemned, the chief ground of condemnation being that he ignores, in formulating them, the fact that invention and discovery as a rule require genius, thinking that, if only his rules were followed, the secrets of nature would be open to all investigators; and yet we find that, although he cannot be considered to have shown any special genius for physical research, and, unfortunately for physical science, was not a mathematician, in the one case in which he did apply his own rules, he gave a definition of heat which it would be difficult to express with greater terseness and precision at the present day. "Heat," he says, "is a motion, expansive, restrained, and acting in its strife upon the smaller particles of bodies;" and this motion "is not sluggish, but hurried and with violence." Heat then, and for two centuries afterwards, was thought to be material rather than a form of energy, and was called 'caloric,' a notion which Bacon rejected on account of its being generated by friction, and it is noteworthy that it is by experiments on friction in recent years that the correctness of his interpretation of the nature of heat has been proved, and the determination of the mechanical equivalent of heat has been made. Equally happy, and equally in advance of the knowledge of the time, is his example of the discovery of truth from a Solitary Instance, one class, out of twenty-seven, of his Prerogative Instances, another being the well-known Crucial Instance. "If," he says, "we are enquiring into the nature of Colour, prisms, crystals, which show colours not only in themselves but externally on a wall, dews, etc., are Solitary Instances. For they have nothing in common with the colours fixed in flowers, coloured stones, metals, woods, etc., except the colour. From which we gather that colour is nothing more than a modification of the image of light received upon the object, resulting in the former case from the different degrees of incidence, in the latter from the various textures and configurations of the body." The far-reaching import

of these remarkable words remained dormant until the distinction here so clearly and correctly drawn led to Newton's discovery of the composition of light, although he was mistaken as to its nature, believing it to be corpuscular instead of undulatory, in other words material rather than a mode of motion, as heat also is.

Three months after the publication of this work (in January, 1621) Bacon is created Viscount St. Alban, his eighth promotion, "a diapason in music," he says, "a good number and accord for the close." And the close soon came, for in another three months the Great Seal is taken from him, he is debarred from ever again taking any office under the Crown, or coming within the verge of the Court, fined £40,000, and imprisoned in the Tower. In his essay "Of Great Place," he says: "The rising unto Place is laborious, and by pains men come to greater pains, and it is sometimes base, and by indignities men come to dignities. The standing is slippery, and the regress is either a downfall, or at least an eclipse, which is a melancholy thing." Few men have taken greater pains to rise into "Place" than he did, and few have had a greater or more unexpected downfall. His arch-enemy, Coke, had been trying for years to find a weak spot in his armour, had managed to ingratiate himself with the favourite, Buckingham, and had found an aspirant for the Great Seal who was willing to pay handsomely for its possession. The weak spot was at last found, and Bacon was shown to have partaken of the abuses of the age, having accepted presents from suitors as his predecessors since his father's time had done. In allowing the abuses in his Court to continue, even for a single day, and in taking advantage of them himself, he was undoubtedly in the wrong, but he appears to have striven against these abuses after a time, and eventually to have overcome them, for all the charges of accepting fees from suitors that were brought against him relate to the first two years of his office. His own estimate of his conduct, written in cypher and not intended to be published, is probably correct: "I was the justest judge that was in England these fifty years, but it was the justest censure in Parliament that was these two hundred years." Not a single case was brought home to him of allowing a present to influence him in his decisions, and the charges raked up against him were from suitors to whom his decisions had been adverse; and although, after his fall, as might naturally be expected, attempts were made to obtain reversals of some of his judgments, not a single attempt was successful. But there was one instance in which, after giving a decision adverse to one of Buckingham's friends, he had, at the favourite's request, a private interview with

the parties to the suit, and prevailed upon the successful suitor to forego interest to which he had adjudged him to be entitled. That this is the solitary instance of corruption proved against him, and was not one of bribery, goes far to show that whatever were the intentions of the donors of the presents he received, not one was accepted by him as a bribe, not one influenced his judgments. The fact seems to be that the House of Commons, then in contest with the King and under the leadership of Coke, intent upon redressing abuses, had determined to make a scapegoat of the Lord Chancellor, as the King's chief adviser, and the only charge that could be substantiated against him was that of accepting fees. For this Coke would have had him hanged, citing precedents, but Lord Arundel interposed: "His offences foul; confession pitiful; life not to be touched."

Three years later the Commons had a grievance against Bacon's most virulent accuser next to Coke,—the Lord High Treasurer, Lionel Cranfield, Earl of Middlesex. "He had done more than any other man," says Gardiner, "to rescue the finances from disorder. He was a careful guardian of the public purse. But he disliked war with Spain because it would be expensive," and had done his best to avert it. The Commons wanted war with Spain, and, being determined to get rid of him, impeached him for corruption. He was deposed from his office and heavily fined. He had partaken of the abuses of the time, as Bacon did, and probably his place was wanted, as Bacon's was. In both cases money was wanted, and it had become quite an art to raise it by irregular means. The price of a baronetcy and of an earldom was then well known. Sir Henry Montagu goes to Newmarket to receive his staff of office as Lord Treasurer. "Take care, my Lord," says Bacon, "wood is dearer at Newmarket than at any other place in England." The staff cost him £20,000. So was it an easy way of raising money to depose a man from office, fine him heavily, and exact a heavy fee for the office from his successor. Truly in those days Bacon was right in saying that in great place "the standing is slippery." But by the favour of the King his fine was virtually remitted. He was, moreover, released from the Tower in two days, and the remainder of the sentence was eventually annulled, not however without remonstrance from his successor, who "stayed" his pardon for some days.

The next few years of his life are chiefly spent at Gorhambury. Here his father had endeavoured to supply water to the house he built, by making reservoirs, the remains of which may still be seen, in Pré Wood, and conveying into them water from the higher

ground around. But the gathering-ground was small, and in dry years this source of water-supply fails, and as the water will not go to him he determines to go to the water, so just before his fall he spends about £10,000 in building a house and laying out gardens in the valley by the pondyards. This is the Verulam House of which Aubrey gives an account: "the most ingeniously-contrived little pile," he says, "that ever I saw." About half a century later the house was sold by Sir Harbottle Grimston "to two carpenters for four hundred" pounds, the value of the materials, and pulled down. Its site may still be traced, but probably the only remnant of it known to be in existence is a handsomely-carved oak door, now the front door of Kingsbury, St. Albans.

Bacon has now the leisure he has always longed for, and he spends his time well. In the last five years of his life, Rawley says, "he composed the greatest part of his books and writings, both in English and Latin, which," he continues, "I will enumerate (as near as I can) in the just order wherein they were written [adding, in the Latin version of his *Life of Francis Bacon*, 1658, '*quam præsens observavi*']:—The History of the Reign of King Henry the Seventh; *Abcedarium Naturæ* . . . ; *Historia Ventorum*; *Historia Vitæ et Mortis*; *Historia Densi et Rari* . . . ; *Historia Gravis et Levis* . . . ; a Discourse of a War with Spain; a Dialogue touching an Holy War; the Fable of the New Atlantis; a Preface to a Digest of the Laws of England; the beginning of the History of the Reign of King Henry the Eighth; *De Augmentis Scientiarum*, or the Advancement of Learning, put into Latin, with several enrichments and enlargements; Counsels Civil and Moral, or his book of Essays, likewise enriched and enlarged [now 58 in number]; the Conversion of certain Psalms into English Verse; the Translation into Latin of the History of King Henry the Seventh, of the Counsels Civil and Moral, of the Dialogue of the Holy War, of the Fable of the New Atlantis, for the benefit of other nations; his revising of his book *De Sapientiâ Veterum*; *Inquisitio de Magnete*; *Topica Inquisitionis de Luce et Lumine* . . . ; lastly, *Sylva Sylvarum*, or the Natural History."

Of the 'Historie of the Raigne of King Henry the Seventh,' published in 1622, Spedding says: "None of the histories which had been written before conveyed any idea either of the distinctive character of the man or the real business of his reign. Every history which has been written since has derived all its light from this, and followed its guidance in every question of importance." The 'New Atlantis,' written in 1624, was not published until 1627, a year after his death. Of it Dr. Abbot says: "Rich,

majestic pomp; sage and solemn ceremonies; a recognition of degrees, ranks, and orders in the State as being appointed by God and necessary for the happiness of man; a religion that combines the charity and breadth of the New Testament with something of the more earthly and material thoughts and ritual of the Old; an exaltation of material wealth, comfort, and prosperity, as being the natural results of a devout pursuit of Science in an orderly and religious country—such are the salient features of this most interesting fragment.” It is credited with having suggested the foundation and programme of the Royal Society of London. ‘*Certaines Psalmes in Verse,*’ published in 1625, show that he was not a poet, for there is a want of easy flow of words in his poetry, and much of his prose is more poetically imaginative. He could no more have written Shakespeare’s ‘*Plays*’ than Shakespeare could have written the ‘*Novum Organum.*’

It appears that during the last few years of his life Bacon translated several of his works into Latin, “for the benefit of other nations,” Rawley says; but it was his idea, and an excusable one in those days, that for a book to last for all time it must be printed in the universal language. His Latin works are now least read, and they have only been preserved from almost complete oblivion by being translated into English and other modern languages.

The last of his works to be noticed is the ‘*Sylva Sylvarum,*’ written just before his death and published by Dr. Rawley in 1627. This is a collection of what he calls “Experiments,” which relate to a great variety of subjects, physical, chemical, biological, physiological, psychological, and medical, thrown together with scarcely any method. But we should bear in mind that he only intended this work to be a portion of a collection to be largely added to from time to time by others, so that at some future period a master mind might find a mass of material at hand from which to build up a system of Natural History by sifting the wheat from the chaff. In the Preface, Rawley says: “I have heard his lordship speak complainingly, that his lordship . . . should be forced to be a workman and a labourer, and to dig the clay and burn the brick; and more than that . . . to gather the straw and stubble over all the fields to burn the bricks withal.” He felt that he was not doing justice to himself in writing this book, and expressed the truth when he said to his chaplain that “if he should have served the glory of his own name, he had better not to have published this Natural History,” but he thought that it was a work which ought to be done, and “he knoweth that, except he do it, nothing will be done.” Nevertheless Prof. Fowler says of

this work: "It is probably the best and most complete collection of the kind that, up to that time, had been published." In this, as in all his writings, there is much that was in advance of the time. It is written in his favourite style—in Aphorisms, short pithy sentences, each containing a truth completely worked out. The most methodical and valuable portion of the work is the treatise on Sound comprised in Aphorisms 101 to 290. A few illustrations of his prescience may be given. The humming of bees, he says, may be "from the motion of their wings, for it is not heard but when they stir." He suggests an experiment to ascertain whether if there be two bells in unison "the striking of the one would move the other more than if it were of another accord," thus anticipating our present knowledge of sympathy of vibration. He devises an ear-trumpet "for those that are thick of hearing." (He anticipated the invention of speaking-tubes in his 'New Atlantis.') And he compares the generation and perishing of sounds with circular waves in water, which is the readiest way in which we can now explain the undulatory theory of sound. He believes in transmutation but not in annihilation, in both respects being in opposition to the opinions of his age and in accord with those of ours. He clearly shows, in Aphorisms 525, 526, etc., that he believes "the transmutation of plants one into another" to be chiefly due to their environment, and that cultivated plants will sooner "change into other species than those that come of themselves; for culture giveth but an adventitious nature, which is more easily put off" But though things may change, in the universe nothing can be lost. "There is nothing more certain in nature," he says, in Aphorism 100, "than that it is impossible for any body to be utterly annihilated;" and he then shows how bodies may be preserved from putrefaction by what we now call the antiseptic treatment, further elaborating his views in Aphorism 771, in which he says that "if you provide against three causes of putrifaction, bodies will not corrupt." The first provision is to exclude the air; the second to place the body in a preservative "heterogeneous," not "commaterial," medium; and the third that the body "be not of that gross that it may corrupt within itself." In Aphorism 341 he says: "The first means of prohibiting or checking putrifaction is cold; for we see that meat and drink will last longer unputrified, or unsoured, in winter than in summer; and we see that flowers and fruits, put in conservatories of snow, keep fresh."

This quotation is a fit prelude to the end, for in making an experiment to ascertain the preservative effect of snow, Bacon

caught the cold of which he died. About the last day in March, 1626, when snow is lying in shady places, he stops his coach on his way to Highgate, buys a fowl, and, with his own hands, so we are told, stuffs it with snow. This brings on a sudden chill, and he takes refuge in Lord Arundel's house at Highgate, where, to do him honour, the servants put him into the state bed. The bed is damp, and in a few days, on Easter Sunday the 9th of April, he dies of what we now call bronchitis. In his will he said: "For my burial, I desire it may be in St. Michael's Church, near St. Albans: there was my mother buried, and it is the parish church of my mansion house of Gorhambury, and it is the only Christian church within the walls of old Verulam. . . . For my name and memory, I leave it to men's charitable speeches, to foreign nations, and the next ages."

"This passage," says his biographer, Basil Montague, "not to be seen until he was at rest from his labours, impressed me with a feeling of his consciousness of ill usage, and a conviction that the time would arrive when justice would be done to his memory." To do such justice Montague faithfully strives, with the light at his command in 1834, but he predicts that some future historian, assisted by his labours, "with all his zeal and ten-fold his ability; with power equal to the work and leisure to pursue it, will dig the statue from the rubbish which may yet deface it; and, obliterating one by one the paltry libels scrawled upon its base, will place it, to the honour of true science, in a temple worthy of his greatness." This prediction has been amply fulfilled. James Spedding devoted thirty years to the task, and in his 'Works of Francis Bacon,' in seven volumes, in editing which he had two coadjutors, Robert Leslie Ellis and Douglas Denon Heath; and his 'Letters and Life of Francis Bacon,' also in seven volumes, he has truly raised "a temple worthy of his greatness." No one who has not read the 'Letters and Life,' or at least Spedding's shorter work, the 'Life and Times of Francis Bacon,' is entitled at the present time to express an opinion of Bacon's character, for the full materials from which a correct opinion can be formed are not to be found in any biographies but those of Spedding.

That the life of Francis Bacon was not a perfect life must be admitted, for it was a human life with human frailties. And whether we may call it a noble life is open to question. A noble life is one of self-sacrifice for the good of others. The life of David Livingstone and that of General Gordon may be cited as well-known examples of noble lives. Bacon devoted his life, as they did, to good and noble ends, but the one element required to

make it truly noble, the element of self-sacrifice, was wanting ; and he had one great failing, carelessness about money. To this all his errors and misfortunes may be traced, for it fostered in him a spirit of dependence, made him subservient to the will of others, and led him to seek preferment with a pertinacity and obsequiousness which greatly mar the nobler attributes of his character. Certainly he strove for place in order that he might have means and leisure to pursue his studies, with the laudable intention of devoting his time and talents to the benefit of mankind, but place did not bring him the leisure he thought it would do, and though it brought him means, those means were devoted to display, instead of to the payment of his debts. As he had to borrow money in his younger days to enable him to live in an humble way in his chambers in Gray's Inn, it seems strange that after having been for some years in the receipt of a princely income, twenty times as great as then, and having enjoyed a handsome pension up to the last,—it seems strange that he should die insolvent, and yet have so little idea of the state of his finances as to leave in his will a large number of legacies in money, and anticipate “ a good round surplussage ” with which to endow two professorships in either of the Universities (Oxford or Cambridge), “ hoping that the stipends . . . may amount to two hundred pounds a year for either of them.” In this connection the following bequests may be mentioned as of interest to us:—“ to the poor of St. Michael's near St. Albans . . . fifty pounds . . . ; to the poor of the abbey church parish in St. Albans, twenty pounds ; to the poor of St. Peter's there, twenty pounds ; to the poor of St. Stephen's there, twenty pounds ; to the poor of Redborn, twenty pounds ; to the poor of Hempstead . . . twenty pounds.” He reckons Gorhambury to be worth “ seven hundred pounds per annum [equal to about £3000 in our day], besides woodfells, and the leases of the houses.” Not long before his death he was advised to cut down the woods around Gorhambury in order to raise money ; but he declined, saying : “ I will not be stripped of my feathers.” The estate was conveyed to trustees for the use of Sir Thomas Meautys, after whose death it was purchased by Sir Harbottle Grimston, who had married his widow, and from whom it has descended to its present noble owner, Sir James Walter Grimston, second Earl of Verulam.

A man with so little idea of his financial position as Bacon had, so lavish in his expenditure and so extremely careless about money matters, so constantly short of money, and in fact nearly always in debt, could scarcely be expected to devote much attention to preventing the continuance of the abuses of

his Court, the Court of Chancery, when those abuses brought him in large sums of money, and we cannot wonder that he should be utterly oblivious to the fact that he was wrong in not at once putting a stop to such abuses. Spedding says: "Up to the day when the charge of corruption was brought against him, I fancy that he had thought himself, in his dealings with other men, not only unimpeachable but exemplary: a faithful and diligent servant; a considerate and indulgent master; a serviceable friend; a sound patriot, always meditating projects for the improvement and advancement of his country; an enthusiast of humanity, passionately ambitious to enlarge the powers, heal the diseases, and purify the condition of the human race; in debate, fair and courteous; in council, free, careful, candid; anxious that all things should be carried with due consideration for the just interests of all parties and without just offence to any; seeking for himself scarcely anything except work and the wages of work which he was well able to do and which he did well; receiving for himself nothing but what was freely offered, and giving more freely than he received; an honourable opponent, an indulgent censor, a faithful reporter, a laborious worker, an honest and unselfish adviser, an impartial and scrupulous judge, and filled (as himself could best witness) with tender consideration for all sentient creatures." All this he was, but it is probably a fairer summary of the opinions formed of him by his friends and associates than of his own opinion of himself, for he was not presumptuous, nor was he self-reliant; in fact it was a failing with him to place too much reliance on the opinions of those around him and too little on his own,—to yield too readily when he was in the right to the views of those who were in the wrong. Mr. Spedding elsewhere says: "The qualities for which he gave himself credit were only patience and faith, and love of truth, carrying with it confidence in the power of truth," which is very different from confidence in himself, or in his own power of divining truth. In fact he confessed that he had "misspent his talent in things for which he was least fit." In this he shows the true modesty of a great mind. If he had spent his life in seclusion, as he once contemplated, he would probably have been no better satisfied with himself. He might have completed his 'Great Instauration,' and then have come to the conclusion that after all his endeavours to provide mankind with a key with which to unlock the secrets of nature, he had "misspent his talent" and failed.

Surely, though, his life was not a failure, for since the commencement of the Christian era no one has done more than he did

to benefit mankind, while many of his projects failed merely because he could only impart knowledge, not wisdom, to those upon whom their acceptance and execution depended. Had Elizabeth and her successors, and the bishops they appointed, allowed the freedom to the Church which he advised;—had James the First and his successors freely abandoned their rights of prerogative which gave rise to abuses and grievances, and thrown themselves on the generosity of the House of Commons for supplies, in accordance with his wise counsel;—no Cromwell would have arisen, for none would have been needed, Charles the First would not have been beheaded, many an old castle and moated grange now in ruins or totally destroyed might still have been standing, the ruthless hand of the religious fanatic would not have been laid upon the beautiful carved statues and delicate tracery in wood and stone which once adorned the interior of our Cathedrals, and better still, we might now have had, in the Church of England, a truly national Church, allowing the utmost freedom of belief and divergence of ceremony not at variance with the teaching of Christ, and consequently admitting of almost the whole of the Protestant community being embraced within its folds.

In the law his influence is still felt and his judgments still have weight. Lord Campbell says that his “Orders” (100 in number) “remain a monument of his fame as a judge . . . ; are the foundation of the practice of the Court of Chancery, and are still cited as authority ;” and that in his celebrated argument in the Exchequer Chamber, in “The Case of Perpetuities,” he placed the law of real property “on the satisfactory footing on which it has remained in England ever since,—striking the happy medium between mere life interests and perpetuities, and providing at once for the stability of families, necessary in a mixed monarchy, and for freedom of commerce in land, necessary for wealth under every form of government whatever.” He also says that in the preface to his treatise ‘Upon the Elements and Use of the Common Law’ (1596) “he inculcated the doctrine which he often repeated, and which he acted upon notwithstanding his preference of other pursuits,—that there is a debt of obligation on every member of a profession to assist in improving the science in which he has successfully practised.” There is no profession to which this doctrine more pre-eminently applies than the medical, for the science of medicine is essentially empirical and experimental, and can therefore best be advanced by the publication of methods of treatment which have proved successful, and yet how many of our most successful physicians never give to the world the results of their experience.

But after all it is in the philosophical investigation of Nature that the world has received the greatest benefit from Bacon's teaching. If he has not furnished us with an infallible key with which to unlock the secrets of the universe, he has at least shown us the way in which we ought to proceed, the spirit in which we ought to work, and the end at which we ought to aim. The way to proceed is to make sure of every step, ascending cautiously from particulars to generalities, and taking nothing upon trust. "He delivered a set of cautions as to the use of the human understanding," Spedding says, "applicable to the pursuit of truth in all departments, which have scarcely been added to or improved upon since his time." The spirit which should animate us is one of humility, charity, and reverence. "It is not too much to say," remarks Dean Church, "that in temper, in honesty, in labour, in humility, in reverence, he was the most perfect example the world had yet seen of the student of nature, the enthusiast for knowledge." And the end to be attained is the improvement of human knowledge "for the glory of God and the relief of man's estate." Our aim should thus be not only to relieve man's estate, but also to raise a temple of knowledge "for the glory of God."

This idea was ever present in his mind. As Dean Church says: "Both in his philosophical thoughts and in the feelings of his mind in the various accidents and occasions of life, Bacon was a religious man, with a serious and genuine religion. . . . The solemn religious words in which his prefaces and general statements often wind up with thanksgiving and hope and prayer, are no mere words of course; they breathe the spirit of the deepest conviction." But although a spirit of reverence pervades all his writings, he never derives a scientific idea from a theological, or a theological from a scientific, nor does he ever attempt to dive into the mystery of Being. "We are told," he says, "that the heavens declare the glory of God, not that they declare the will of God." His ideas, his methods, and his aims are as different from those of Descartes as the life he led was different. He lived in the world and sought worldly advancement that he might the better promote the advancement of the world. Descartes lived as it were out of the world and despised worldly honours that he might the better withdraw his thoughts from material objects and concentrate them on his innate ideas, and almost all his errors are due to this. He thought that he could construct a system of the universe from his own cogitations, not realising the necessity of observation and experiment which Bacon has insisted upon. But both philosophers pursued their studies in a spirit of humility and reverence.

“Bacon,” says Naville, “made the necessity of observation to rest upon the Divine power, in presence of which we must humble ourselves; Descartes makes confidence in our reason to rest upon the idea of the Divine goodness, to which we must trust ourselves.” Both men strongly urged the necessity of our throwing aside all prejudice; divesting our minds of every preconceived idea. Bacon says: “It is humbly, with a sense of reverential fear, and after having, in a manner, purified themselves from every preconceived idea, that men must approach the grand book of creation and unroll its pages; regard it in long contemplation, meditate upon it, and religiously impress themselves with it.”

It seems strange that while some of Bacon’s biographers, such as Rawley, Montague, and Hepworth Dixon, extol his character and scarcely admit that he had a fault, others, such as Campbell and Macaulay, condemn it and scarcely credit him with a single virtue. Of his greatness there can be no question, but was his life a good and virtuous one for the time in which he lived? In endeavouring to answer this question we should take into consideration that the standard of morality has been vastly raised during the last three centuries, and also that it is impossible for us in this age of freedom to fully realise the difficult position of a courtier in his day, and especially of one with a strong sense of duty to his Sovereign, and a deep feeling of sympathy with the people. We probably know more about the life of Francis Bacon than we do about the life of any other man of a bygone age, for he kept nearly everything he wrote,—every rough draft of a letter, even of those he never sent, and also the memoranda he made, sometimes in cypher, for his own use only,—and nearly everything has been preserved and printed, so that we can often, as it were, read his very thoughts. But we cannot know all. For truly

“Old Time moves slowly, though he knows no stay,
And steals our voices as he creeps away,
Unseen himself, he hides from mortal view
Things that are seen, and things unseen doth shew.”

We ought therefore to form our idea of the character of a man who lived some centuries ago rather from the opinions of his contemporaries, especially his servants and most intimate friends, than from our own interpretation of the fragmentary evidence which comes down to us. It will suffice to quote a few passages from the opinions expressed of Francis Bacon by two of his intimate friends, Toby Matthew and Ben Jonson, and two of his servants, his domestic apothecary, Peter Boëner, and his chaplain, amanuensis, and biographer, Dr. Rawley.

Toby Matthew, in 1621, after an intimacy of about twenty years, says: "It is not his greatness that I admire, but his virtue: it is not the favours I have received from him (infinite though they be) that have thus enthralled and enchained my heart, but his whole life and character." Ben Jonson says that in the days of his adversity he "could never condole in a word or syllable to him—as knowing that no accident could do harm to virtue, but rather serve to make it manifest." Peter Boëner wishes "that a statue in honour of him may be erected in his country, as a memorable example to all of virtue, kindness, peacefulness, and patience." And Dr. Rawley says that he was religious, free from malice, no revenger of injuries, no heaver of men out of their places; that he was a good master to his servants, and rewarded their long attendance with good places freely (*i.e. gratis*, as in his Latin translation, an unusual thing in those days); and that "Amongst the Honourable Society of Gray's Inn, of which he was a member, he carried himself with such sweetness, comity, and generosity, that he was much revered and beloved." Lastly, his faithful secretary, Sir Thomas Meautys, not only devoted his life to his service, but on his death erected to his memory that beautiful monument in St. Michael's Church which has attracted to St. Albans scientific men from all parts of the world, who have gazed upon it with admiration—admiration not only of its excellence as a work of art, but also of the man whom it so faithfully portrays.

The inscription on this monument, by Sir Henry Wotton, runs thus:

FRANCISCVS BACON BARO DE VERULĀ. STI ALBNI VICMS
 SEV NOTIORIBVS TITVLIS.
 SCIENTIARVM LV MEN. FACVNDLÆ LEX.
 SIC SEDEBAT:
 QVI POSTQVAM OMNIA NATVRALIS SAPIENTIÆ
 ET CIVILIS ARCANA EVOLVISSET,
 NATVRÆ DECRETVM EXPLEVIT.
 COMPOSITA SOLVANTVR.
 ANº: DÑI : MDCXXVI.
 ÆTATS LXVI.
 TANTI VIRI
 MEM:
 THOMAS MEAVTYS
 SVPERSTITIS CVL TOR
 DEFVNCTI ADMIRATOR
 H. P.

APPENDIX.

EXTRACTS FROM BACON'S 'COMMENTARIUS SOLUTUS' RELATING TO GORHAMBURY.

Francis Bacon seems occasionally to have jotted down in a note-book, for his own use only, memoranda relating to various matters which he wished to have in remembrance. Such notes as he ceased to have further use for he struck out, copying the rest into a new book, and destroying the old one. One of the note-books, which he calls '*Comentarius solutus sive pandecta, sive ancilla memoriae,*' has been preserved, probably because it contains the heads of an enquiry concerning motion. Its contents have been printed *verbatim et literatim* by Mr. Spedding, in his 'Letters and Life of Francis Bacon' (vol. iv, pp. 39-95), from the original MS., now in the British Museum. The following extracts, copied on the 28th of July, 1608, from an older book, relate to the Gorhambury estate:—

TRANSPORTATA EX COMENTARIO VETERE.

To give directions of a plott to be made to turn y^e pond yard into a place of pleasure, and to speak of them to my L. of Salisbury.

The grownd to be inclosed square wth a brieke wall, and frute trees plashed upon it; on the owt side of it to sett fayre strait byrches on 2 sides and lyme trees on 2 sides, some x foote distante from the wall, so that the wall may hide most of the shaft of the tree and onely the tufts appear above.

From y^e wall to have a waulk of some 25 foote on a higher levell. Under that waulke some 4 foote to have a fyne littell stream rune upon gravell, and fyne peppell to be putt into y^e bottome, of a yard an half over, w^{ch} shall make the whole residue of the grownd an Iland; the banque to be turfed and kept cutt; the banq I mean of the ascent to y^e upper waulk: no hedg hear but some fyne standerds well kept.

Within that stream upon a lower levell to make another waulk of 25 foote, the border to be sett wth flagges of all sortes of flower de Luces and lylyes.

All the grownd within this waulk to be east into a laque, wth a fayre raile wth Images gilt rownd about it, and some low flowres specially violettts and strawberies along qu.

Then a fayre hedg of Tymber woorke till it towch the water, wth some glasses colored hear and there for the ey.

In y^e Middle of the laque where the howse now stands to make an Iland of 100 broad; An in the Middle thereof to build a howse for freshnes with an upper galery open upon the water, a tarace

above that, and a supping roome open under that; a dynyng roome, a bedd chamber, a Cabanett, and a Roome for Musike, a garden; In this Grownd to make one waulk between trees; The galleries to cost Northwards; Nothing to be planted hear but of choyse.

To sett in fitt places Ilands more.

An Iland where the fayre hornbeam standes with a stand in it and seats under Neath.

An Iland with Rock.

An Iland with a Grott.

An Iland mounted wth flowres in ascents.

An Iland paved and with picture.

Every of the Ilands to have a fayre Image to keepe it, Tryten or Nymph etc.

An Iland wth an arbor of Musk roses sett all wth double violetts for sent in Autumn, some gilovers w^{ch} likewise dispers sent.

A fayre bridg to y^e Middle great Iland onely, y^e rest by bote.

To remember the poynt of husbandry of stubbing some wood at Praye.

The making of the fayre waulk.

The appointing more ground to lye laye [? *fallow*; or *in grass*: Spedding suggests *large*] then doth, specially the feeld at comyng in præsently.

SORS SIVE FORTUNÆ PRÆSENTES.

Jul. 28, 1608.

AN ESTIMATE OR STATE OF MY STATE REALL OR VALEW IN INHERITANCE OF FREEHOLD VALUED IN GROSSE AS IN PRETIO TO HAVE MONY MADE OF IT.

My lvyng at Gorhamburye.

The parke landes of Gor. in occupat of R.	£	s.	d.	
Smith, per An.	67	3	0	per red.
The park land which was let to Thom̄ finch and is now in the ocupacion of y ^e same R. Smith	26	0	0	per æst.
Great Brook feeld Cū aliis let to Wi Finch .	18	15	0	per R
Sawyers hill let to Marson	14	0	0	per R
The Mannor of Pray let to Wi. Finch reckonyng the pvieu	38	0	0	per R
Land let to the wydow Weedes qu. of Finches rent for Ks Farme	7	10	0	per R
Of Lawrence for the grownd about the howse and the park grownd w ^{ch} went with Ks farme	12	0	0	per R

	£	s.	d.	
Of Shaford not reekonyng the grownd				
bought by Marson in Revers	2	0	0	per R
Of Axtell for Drapers Med.	2	6	8	per R
Of Crossby for Comforts Mead	6	0	0	p. R
Of Medow in myne owne hands	8	0	0	p. Ae
Of Dornall	1	16	0	p. R
Of Large	0	6	8	p. R
Of the Customary rents	22	0	0	p. R
Of the Mill besides the grist	20	0	0	p. R
Of the parquits of Cowrt a Mediū	20	0	0	p Ae
Of wood sales Annuall a Mediū	50	0	0	p Ae
Qu of Evesides w ^r it be comprised in Smithes rent				
Rem. Squirrells Busshes.				
No profite of the Howse.				
Sum̄ total. Reventionū Annaliū	319	0	0	
This at 16 years purchaze	5104	0	0	
The Howse waulkes and ponds val. at	1000	0	0	
The Tymber upon y ^e Ground val. at	1200	0	0	
So the whole valew to be sold of my lyving there	} 7304 ^{lib}			
Memorand. the wood purchaze of Pemberton				
15 ^l p An. val ut suprā	240	1		

ACCESSIONES SORTIS PER APPROBATIONEM.

Improovements.

- The raising of the rates of Woodfells at pray at lest to 5^{sls} the A.
- The taking some Tymber frō Gorhamb. yf I part with it.
- The stubbing pray, w^h may raise 1000 and in Revenue 20 p An.
more then the Mediū now is.
- The keeping of my howse Gor. chargeless by some fitt person, for
the use of a lodging there.
- The erect. of Shaford into a Farme after Kns leaving it.
- Better improovem^t of y^e medowes in myne own hand.
- Some pfitte of the desert ground by Roses, frute, phisike herbes etc.
- To improve Pray when it falles.
- Rate of the Miller for my grist or the same in kynd.
- The renuing my Lease of the Medows from Wendy.

II.

BATS AND SOME OTHER BEASTS.

By GEORGE ROOPER, F.Z.S.

Read at Watford, 13th November, 1891.

(Abridged.)

THE Bat is a very wonderful beast; perhaps, where all are wonderful, the most so of any in the creation, for it alone possesses the principal attribute of birds, the power of flight. No other beast is gifted with this power, and for its exercise the wonderful resources of nature seem to have been brought into play in an unprecedented manner. The wing of the bat, so-called from its serving, and admirably serving, the purpose of a wing, is not, properly speaking, a wing at all, to which the presence of feathers would seem to be necessary. The bat's wing is merely the bat's hand. The long slender fingers are elongated, and united by a thin elastic substance not unlike indiarubber, which, when the fingers are closed, folds up like the silk of an umbrella. This membrane is exceedingly delicate, being furnished with minute blood-vessels and a system of nerves possessing the most exquisite power of sensation. This power is developed to an extent of which we can form no definite idea. The cruel experiment has been made of putting out the eyes of a bat, and turning it loose in a room, when it was found that, though flying amongst all sorts of obstacles, it never touched one of them, but would avoid even a thread stretched across its path. At the top of what should be the thumb is a small hook, used by the animal as a means of progress when on the ground or climbing along the walls, hollow trees, or rafters which provide it with a home. The delicate elastic substance which constitutes the wing is continued to the hind feet and beyond, forming a sort of tail, of great use to the insectivorous bats in enabling them to make the sharp turns in the air necessary to catch their prey. In the frugivorous bats, of which we have none in this country, this tail is absent, there being no use for it. The hind toes are prehensile, enabling the creature to suspend itself from any inequality in beam or wall, and to take its rest in its favourite attitude, hanging head downwards.

We have in England some sixteen species of bats, such as the "whiskered," "notch-eared," "horseshoe," and "lesser horseshoe," but three only are likely to come under our observation. These are the great bat (*Vesperugo noctula*), the little bat (*Vesperugo pipistrellus*), and the long-eared bat (*Vespertilio auritus*). Of these the little bat, re-re-mouse, or flittermouse, as he is prettily called, is the most common, and the most generally seen. All hibernate, that is, retire into holes and corners, and sleep through the cold weather. When the swallows migrate, the bats hibernate;

but this species retires into winter quarters some six weeks later than the others, and is moreover sometimes tempted out by a bright winter sun to prey upon the insects, also awakened from their winter sleep on such rare occasions as when the thermometer rises to above 50 degrees. The great bat is very similar in appearance and habits, though larger, its stretch of wing being 14 inches; that of the pipistrelle is only eight inches. The long-eared bat is distinguished by the enormous size of the ear, almost equal in extent to that of the whole body. Within it is a second or supplemental ear, the use of which is not very apparent. These creatures appear to be susceptible, to some degree, of being tamed. When kept in confinement they exhibit a certain fondness for those who feed and tend them, taking flies or bits of meat from the hand or lips, and apparently distinguishing individuals. Their voracity is extreme, a bat of this species having been known to devour two-thirds of its own weight of solid meat in the course of one day.

The young of the bat, for a considerable time after birth, cling to the breast of their mother, to which they adhere like limpets to a rock, and from which not even the rapid turns in the air made by her in pursuit of her prey dislodge them. One young one only is generally produced at a birth, though twins are not uncommon. The bat, probably from its uncanny appearance, has always been the object of dislike, and sometimes of superstitious dread.

Since the disappearance of the beaver, the wolf, and the bear, the fauna of Great Britain has not contained an animal so interesting, so well-known, or, to my mind, so calumniated as the Fox. His evil deeds are magnified, his good qualities, those of an untamed, untameable, but most sagacious wild beast, ignored, and the doubtful attribute of cunning alone admitted to him. I think that this quality is credited to him principally from his cast of countenance, the erect ears, the long snout, the obliquity of the eye, and the general expression of the physiognomy being such as generally indicate in their possessor the quality of cunning. But, although evincing wonderful skill in the conception and carrying out of his marauding exploits, I do not consider the fox to be a cunning animal, at least, not in the worst sense of that derogatory epithet. No animal, unhappily, is more easily trapped or poisoned than the fox. No animal is less careful to conceal his whereabouts. His night's excursion in search of food over, he curls himself up in his earth, and sleeps peacefully until the welcome night, his "opening day," calls him forth again to pursue his natural instincts. If, on his return, he finds, perhaps for the third or fourth time, the entrance to his castle barred and closed against him, it does not seem to occur to him that the obstacle presented to his entrance is the prelude to the visit of the hounds and huntsmen next morning. On the contrary, he accepts the situation, seeking an extempore lodging in an adjacent brake or stump until aroused by the sound of the horn and the crack of the whip in the morning. Cunning would point to the necessity of seeking "fresh woods and pastures new," before the advent of his enemies, who have given such

timely notice of their hostile intentions. No, the fox is not, properly speaking, a cunning animal, but he is the boldest, wildest, fleetest, and, excepting in his disregard of the tokens of danger, the wisest of beasts. I half think that he is aware of the approach of danger when he finds his earth stopped, but despises it. Who ever knew a fox to exhibit signs of fear? When unkennelled, with 20 couple of fleet hounds close at his brush, with 100 mounted men, half of them yelling at the top of their voices, he is neither frightened nor flurried. He does not, like the hare or the deer, under similar circumstances, rush headlong away. He never loses his presence of mind for a moment, but, although awakened out of a deep slumber, he takes in the situation at a glance, and with a whisk of his saucy tail, makes off at an easy but rapid gallop in the direction of his nearest stronghold. If headed, as is frequently the case, and forced to retrace his steps, he baffles his foes by wonderful turns and doubles, creeping perhaps through the midst of the pack, or crouching down, allowing the eager hounds to jump over his back. Still, he will always return to, and, if possible, "make his point;" his "plan of campaign" was formed the instant that he became aware of his danger, and he adheres to it persistently.

Thanks to the strength and power of endurance with which they are gifted, five out of six old foxes that are hunted escape, not through cunning, the attribute of the timid hare, whose devices to escape her pursuers are ten times more elaborate than those of the fox, but by simple pluck, endurance, and sagacity. If you eliminate the cubs, the lame, and the "chopped" foxes, not one in six hunted foxes is fairly killed. I say "fairly," for to dig out a fox and give him to the hounds is, to my mind, alike cruel and unsportsmanlike. Sometimes, no doubt, poor Reynard succumbs to his enemies. I have been in at the death of many a fox, and, though I have done my best towards that end, I have always regretted it. On such occasions I have never seen a sign of fear or flurry, even when escape was apparently hopeless. Whatever the odds against him, the fox is always prepared to take advantage of any circumstance that may arise in his favour. I have seen one, which, after a hard run, had taken refuge in a farm-yard, perhaps well known to him in happier hours, the hounds all around him, slip through them all, and, jumping to the top of a wall, and from thence on to the backs of a flock of sheep, get clear away, the sheep, as they rushed together, stopping the hounds. I rejoiced greatly in the escape of that good fox. I have seen a hunted fox climb to the roof of a high barn, and lie motionless along the ridge; I have known one seek refuge in a cottage cupboard; but under no circumstances does the poor hunted beast lose heart or despair, and if, overpowered by numbers, he succumbs, he dies like a hero, fighting, struggling, biting to the last, but never uttering a cry of fear or pain. His coolness sometimes verges on impudence, and a hunted fox has been known, during the run, to snatch up a fowl and carry it away.

The fox is essentially a carnivorous animal, though not exclusively so. We all know the fable of the fox and the grapes, and he has been known to take not only grapes, but apricots, from the wall. All weaker animals and birds furnish him with sustenance, but rats and rabbits are his favourite food. The scarcity of the latter, and the virtual extirpation of the hare, drive him to shifts for his dinner which he would otherwise neglect or despise. Hence his attacks upon the poultry-yard and the pheasant-preserve, the latter of which, at least, would be comparatively safe could he but procure rabbits. When hard-pressed he will eat frogs, or mice, or even beetles. He will take a duck off the water, and fish out of it, when spawning on the shallows; in fact, when pressed by hunger, nothing in the eating way comes amiss to him.

The female produces from five to ten at a birth: the young ones attain maturity, like the dog, in about a year, their strength and sagacity increasing with age. The fox is, in fact, a typical wild beast, with all the qualities that constitute a wild beast. Strong, crafty, and active, he seeks his livelihood from whatever source it may be obtained. "The world is not his friend, nor the world's law," nor does he hold himself bound by it. Utterly untameable through a life of captivity, chained to his kennel from his cubhood, he retains his independent, savage nature, and though he may sulkily submit to the caress of those who feed him, he can never be domesticated or even tamed. On the slightest pretence he will tear the hand that strokes him, and he neither feels nor affects gratitude or affection towards his keeper. An innate love of blood and slaughter leads him to kill, when he has an opportunity, far in excess of the demands of appetite, and what he cannot eat he will bury. In this delight in indiscriminate slaughter, as in the other peculiarities I have mentioned, he differs from the dog, and resembles more nearly the weasel and the wild cat.

I have not concealed the little failings of the fox, but I venture to think that any harm the hen-wife or the game preserver may suffer at his hands is repaid a hundred-fold by the sport he affords—a sport with which I verily believe our national prosperity is bound up; and happily there are few who, for the sake of the comparatively selfish pursuit of shooting, will by his destruction deprive hundreds and thousands of their enjoyment. That the number should be so limited is creditable to human nature, for no doubt it is a trial to a non-hunting man to have a lot of pheasants, hand-reared at considerable expense, devoured by a fox, who will, unbidden, take up his abode in the home coverts; and the unselfish man, who, for his neighbours' gratification, condones the loss, and protects the robber, is entitled to the gratitude of the whole country, and he has it.

[As an example of an aquatic mammal, the Author described the Whale, giving interesting information as to its habits.—ED.]

III.

TERRESTRIAL BRITISH QUADRUPEDS EXISTING IN A WILD STATE AT THE PRESENT DAY.

By T. VAUGHAN ROBERTS.

Read at Watford, 11th December, 1891.

ON all occasions when it has been my privilege to listen to the lectures delivered before this Society, the lecturers have been gentlemen whose acquaintance with the subjects with which they dealt was matter of common notoriety. This is not the case in the present instance. My only claim (if it can be deemed one) for presuming to speak on the subject of British quadrupeds, must be based on the circumstance that I have always been a lover of animals, fond of reading about them, and, so far as my limited opportunities have allowed, an observer of their habits. Under these circumstances I have felt considerable hesitation in venturing to intrude on your attention, but I have been assured that the absence of scientific knowledge on my part will probably be condoned by at any rate some of the members of the Society. I fear that I can tell little which will be new to the majority of our members, or which cannot be learned from well-known books treating of the subject.

The interest which is undoubtedly felt in our indigenous fauna is, so far as the quadrupeds are concerned, to my mind somewhat remarkable, and must certainly be regarded as to a large extent sentimental. Some of our most conspicuous examples are rarely seen by the ordinary observer. They are nocturnal in their habits, and a man living in the country may easily spend his life without ever coming across (say) a badger or an otter, and yet those animals may be by no means rare in the locality in which he resides. That an interest, however, is felt in them by very many, and that regrets are often expressed at their possible extinction, are facts with which we are all, I think, familiar. The feeling is not confined to our own country. An Institution known as "The National Zoological Park" has been established at Washington in America, its most important object being to avert the threatened extinction of the native American fauna, and the celebrated Yellowstone Park in Wyoming is under the care of the Institution. This park, as it is termed, is an immense tract of country, rectangular in form, and containing 3,312 square miles—over 2,000,000 acres. It is a perfect paradise for wild animals, the area having been expressly reserved from settlement by the Government, for their preservation. Among the animals which find an asylum there, and which are assiduously protected, are the elk, various kinds of deer, mountain sheep, the grizzly bear, and (occasionally) the bison. The district abounds in rugged mountain-chains unsurpassed in the United States for sublimity and

grandeur. The fact that our Transatlantic cousins should take pains to prevent the extinction of even the grizzly bear, is a circumstance which should, I think, have some influence in checking the too indiscriminate slaughter which prevails in our own country. Epping Forest and Wimbledon Common are districts on a very diminutive scale somewhat analogous to Yellowstone Park, as in each of them all the wild denizens are carefully protected.

Besides the interest that is now felt in natural history, popular knowledge on the subject has, thanks in a great measure to our admirable periodical literature, vastly increased. It would, I imagine, be difficult now to find anyone whose knowledge resembles that of an old Scotch judge, who had to try a case which turned on the escape of a squirrel. "Did ye clip its wings?" he asked of the prosecutor. "My lord," said the astonished witness, "it is a quadruped." "Quadruped here, quadruped there," said the judge, "if ye had a' clippit its wings it couldna' ha' flaun away. I maun decide agin ye."

Before proceeding to deal with British quadrupeds existing at the present day, I may perhaps be permitted to allude very briefly to those animals which, once common, have become extinct within historic times. A most interesting paper on this subject was read before this Society in 1879, by Mr. J. E. Harting, and it is from that paper and from a book subsequently published by him (being in fact an extension of the paper) that my information on the subject is derived. I am indebted to our President for my knowledge of Mr. Harting's work. The animals which he enumerates as having formerly abounded in this country and as having become extinct within historic times are:—The bear, the beaver, the reindeer, the wild boar, the wolf, and the wild white cattle.

Mr. Harting gives a most graphic account of the appearance of the country in ancient times, when vast portions were covered by dense forests, affording cover and shelter for animals of every description,—when the traveller was in danger from bears and packs of wolves ever ready to attack the unwary or the solitary, if passing near their strongholds. The time when the bear and reindeer became extinct is not known, but it must have been at a very early period. The beaver, as might naturally be supposed, lingered much longer, and there are places both in Wales and Scotland which to this day commemorate the fact that it once flourished in the locality. The wild boar appears to have become extinct about the time of Charles the Second. Wolves lingered long in Ireland and Scotland, and the last of which any account exists appears to have been killed in the former country about the year 1770. The wild white cattle have long been extinct in an absolutely wild state, but, as is well known, still exist in several parks, retaining their special characteristics. The most celebrated are those at Chillingham in Northumberland, the seat of the Earl of Tankerville. A splendid stuffed specimen of a Chillingham bull is to be seen in the Natural History Museum at South Kensington.

The term "terrestrial" is employed to exclude the bats, whose chief element is the air, and marine quadrupeds like the seals, whose chief element is the water. Terrestrial British quadrupeds existing in a wild state at the present day, coming under the above definition, are primarily divided by Professor Bell into four orders, which are again subdivided into numerous families, genera, and species. These orders are:—the Insectivora, comprising five species; the Carnivora, which contains eight or nine species; the Rodentia, containing twelve species; and the Ruminantia, containing three. There are, therefore, of actually wild, strictly terrestrial, quadrupeds in this country at the present day, about 30 species. I purpose to make a few remarks on each order and on some of the animals comprised in them.

The order of the Insectivora comprises the hedgehog, the mole, and the shrews, the most familiar of these being the hedgehog and the mole. As the name of the order implies, the members of it feed largely on insects.

The Hedgehog (*Erinaceus europæus*) possesses a wonderful power of defence in virtue of its tough prickly skin, which renders it a formidable antagonist to dogs, and only very plucky ones will kill it. It is easily tamed, and tolerably fearless. Like the rest of the order, hedgehogs live mostly on worms and insects. They hibernate and are not often seen in the daytime. Their fondness for milk has no doubt given rise to the fable that they are in the habit of sucking cows, and it seems probable that they may frequent places where cows are kept in the hope of finding drops of milk spilt about.

The Mole (*Talpa europæa*) is in many respects a very interesting animal, possessing immense strength, undaunted courage, and indefatigable perseverance. The engineering skill evinced in the construction of its subterraneous abode is very remarkable. It feeds principally on earthworms and the larvæ of beetles and other insects. Many animals avail themselves of their neighbours' labours, and the runs of the mole are used by field-mice and shrews. In one that I examined lately I found little stores of grain at intervals evidently garnered by mice. In the Transactions of the Society for 1883, Dr. Brett records the finding of 30 moles of a white or cream colour in about half an acre of a field of oats. They are very plentiful in this neighbourhood, but one rarely shows itself above ground voluntarily. Albino moles, caught in a hedgerow at Ley Farm on the St. Albans Road, have been kindly lent to me for exhibition by Mr. Slinn.

The Shrews, except an occasional dead one in the paths, are not very often seen. The generic name is *Sorex*. There are three species, the common shrew, the lesser shrew, and the water-shrew. The long snout of the shrews is their most characteristic feature, distinguishing them from the mice. The water-shrew swims and dives with great agility, and is a very pretty object when seen hunting in a small brook or ditch. I have very rarely seen one myself. I believe I saw two in a small brook near Croxley Mills.

I watched them for a long time and have little doubt the animals belonged to this species, but an objectionable wooden fence prevented my getting near enough to be certain. Of the water-shrews at South Kensington several are labelled as having come from Tring.

The order of the Carnivora, or flesh-eating animals, comprises the badger, otter, weasel, stoat, polecat, marten, wild cat, and fox.

I will begin with the Badger (*Meles taxus*). One from Cassiobury has been kindly lent to me by Mr. Capell. It was shot at Long Spring in 1878, and the occurrence was noted at the time by Dr. Brett in the Society's proceedings. Since the extinction of the bear, the badger has been our sole representative of the ursine or bear family. The length of the badger (including the tail) is about three feet, the colour grey, varying in tints in different parts, the head elongated, the legs formed for burrowing and immensely powerful. It is one of our most ancient inhabitants, fossil remains proving his race to have been co-existent with that of the mammoths and rhinoceroses, which once wandered over our Islands. Much misapprehension, it seems to me, exists in reference to the badger. Mr. St. John, in his 'Wild Sports of the Highlands' (published nearly 40 years ago), writes of him as an inhabitant of our wilder districts, likely to be soon extirpated, and as being nearly extinct as one of the *feræ naturæ* of England. The author of Murray's 'Handbook for Hampshire' (I quote from the 1858 edition) writes of him as rapidly disappearing from the New Forest, and soon to become as completely extinct there as in other parts of England; and Professor Bell, in his 'British Quadrupeds,' mentions comparatively few places (mainly in Oxfordshire and Gloucestershire) as haunts of the animal. Now I have always been in the habit of making enquiries as to the wild animals to be found in any district I chanced to be visiting, and the conclusion I have come to, which is fortified by the opinion of my friends Mr. Schreiber and Mr. Cowley, who are authorities on the subject, is that there are not many localities at all suited to their habits where they are *not* to be found. It would be tedious to enumerate the places where badgers are known to exist. Mr. Schreiber has furnished me with a long list of counties and places where to his knowledge they are to be met with in greater or less numbers. In the proceedings of the Society for 1877 Dr. Brett enumerates localities where they have been found in Hertfordshire. In 1883 he records the capture of one at Odsey, and in 1886 he gives particulars of their occurrence in this immediate neighbourhood. They appear to be not uncommon in the county. I think that the chance of badgers becoming extinct is very remote, even in cultivated and populous districts. They have much in their favour. Their "holts" are often in old chalk-pits, in thick woods, in steep banks, and in similar places where it would be next to impossible to dig them out. They are comparatively harmless, and some persons nowadays are rather pleased to have them on their estates, and give them protection. I have no doubt Professor Bell is right

when he describes their numbers as tending to increase. The badger, moreover, is an animal that has the bump of caution largely developed, and is very difficult indeed to trap, especially if it has once been in peril. It is omnivorous in its diet, and very fond of wasp's nests, digging them out and devouring the larvæ. It is a remarkably clean animal, according to Mr. St. John never allowing any dirt in its abode.

The Otter (*Lutra vulgaris*), which is comprised in the family of the Mustelidæ, is of a rich brown colour, and has a long and thick tail, eminently adapted to assist him in swimming. One has been kindly lent to me by Mr. Schreiber. It has been admirably mounted and gives an excellent idea of the animal. The length of the otter, including the tail, is from $3\frac{1}{2}$ to 4 feet. This is another animal which is far more common than is, I think, generally supposed. In Wales and in the western counties (and of course in the north and in Scotland) otters are very plentiful, but they are also found in most rivers where there happens to be adequate cover. Dr. Brett has recorded the capture of one at Munden, of exceptional size, in 1875, (it is now in Mr. Holland-Hibbert's museum,) and he also mentions that two were seen near Cassiobury in 1883. Mr. Holland-Hibbert tells me that the traces of one were seen at Munden in 1880, but that none have been seen since. I have myself seen four or five otters bolted by terriers in the course of an hour in one piece of marsh-land in Wales, where there were a good many drains. Three of these were killed by the hounds. My experience of otter-hunting is very limited; I have a strong objection to standing for hours together sometimes in very cold water to prevent the animal escaping up or down stream, which followers of the hunt are expected to do. Apart from this, the sight of a pack of otter hounds on a fine autumn morning hunting in a river in some lovely spot in Devon or Wales is one of the prettiest and most interesting sights I have ever witnessed. The dogs used are generally fox-hounds or stag-hounds with an admixture of otter-hounds, and the sight of them swimming backwards and forwards across stream examining every root and hole, and every bank of flags or rushes, the bright uniform of the hunt members, the frantic excitement of the terriers, and the scenery combined, make up a picture not easily forgotten. The actual run is (in my small experience at all events) not unfrequently disappointing. The master sometimes finds it hopeless to keep his field in order, and the otter is too often mobbed. The strength and fighting powers of the animal are truly marvellous. The otter is often seen in the very middle of the pack with half a dozen dogs all tearing at it, and the next moment it has escaped, as if by miracle, perhaps to be caught again, perhaps not. Like the badger, the otter is nocturnal, and rarely shows itself voluntarily by daylight. There may be plenty on a river which you may fish constantly, and you would be lucky if you ever saw one. I had the pleasure of seeing one this autumn in the Exe, near Dulverton. I watched it for some time. Its action reminded me strongly of

the seals in the Zoological Gardens, being a sort of undulating motion with a constant raising of the head to look around. Like all the Mustelidæ, otters vary much in size. Some frequent the sea-coast, particularly in parts of Scotland and Ireland, living in caves, and these are often so large that they have been thought by some to form a distinct species. This does not, however, seem to be the case. Size in animals depends very much on food and environment.

The marten, polecat, stoat, and weasel form a group of the Carnivora having a strong family likeness. Like the rest of the order they are chiefly nocturnal in their habits, and are not often seen by the casual observer. Now and again one notices a stoat or weasel running across a road or playing about a heap of stones, but not very often. Most of the stoats I have myself seen have been on the banks of rivers, hunting among the roots of trees or among stones, and more than once I have seen one swimming across a broad stream.

The Marten (*Martes foina*) is the largest and perhaps the most interesting of the group. This beautiful animal is about 27 inches long, including the tail, and is of a brownish colour with a white throat. According to some naturalists there are two species, the common or stone-marten, and the pine-marten (*Martes abietum*). This distinction is denied by others, who maintain that both varieties (if varieties they be) belong to the same species. The marten is remarkable for its agility, climbing trees like a squirrel, and is a most determined antagonist when attacked by man or dog. It is very destructive to game, and being very easily trapped has become extremely rare. It is found in the North of England, Scotland, Wales, and Ireland. It is said not to be quite extinct even in the South of England. The author of 'On Surrey Hills' says he has good reason to believe that it could be found in a district in that county which he very wisely does not indicate too clearly. There is no doubt that the marten is much more given to ranging than its congener the wild cat. One was shot in this county in 1872 within twenty miles of London, as reported in the 'Zoologist' for 1879. In Wales, Mr. Dumville Lees, a sportsman and naturalist whose property lies in Shropshire, on the Welsh border, tells me it is chiefly found in the district extending from Dolgelly northwards by Barmouth and Pensarn, and particularly on Lord Harlech's property near the latter locality.

The Polecat (*Mustela putorius*), the next in size, is, like the marten, very easily trapped, and, being also very destructive, meets with no mercy in game-preserving localities. In all such places it is practically extinct. A year or two ago I saw six dead ones in the shop of a fishmonger at Dolgelly. He told me that he had collected the skins for thirty years, and that 60 were brought to him in the first year, the number decreasing every year. They were caught, he said, in the traps set for rabbits. The animal is found more commonly, I believe, than is generally supposed, in places near the sea-shore, and in other localities where there

happens to be no preserving, and I am told on excellent authority that it is not uncommon in the Aylesbury district. In Wales and the North of England it is generally met with in those parts where the fields are enclosed by walls built of large loose stones. These afford a very safe retreat for the animal. The polecat, like the stoat and weasel, has the unpleasant faculty of producing a most atrocious odour when attacked. One of its names, foumart or foulmart, was meant to distinguish it in this respect from the marten or sweet mart. I was much interested in a specimen shown to me by Mr. Cowley, which he has had for four years, and has rendered perfectly tame, although quite an adult when caught. He also gave me the 'Zoologist' for August last, which contains a most interesting paper by Mr. Harting on the animal. The stuffed specimen exhibited, procured for me by Dr. Brett, was killed in this immediate neighbourhood about 25 years ago.

Stoats and weasels are to be found in most localities, but naturally most plentifully in wild, out-of-the-way places, where game preservation does not go on. The Stoat (*Mustela erminea*) is the larger animal. Both species vary in size, and some people consider that there are two species of weasel, or at any rate varieties, one very small which feeds almost entirely on field-mice, and which is known in some districts as the Cain. Professor Bell ridicules this idea, and says that the small specimens are nothing more than exceptionally small females. The courage of the Weasel (*Mustela vulgaris*) is extraordinary. It has often been known to attack men, sometimes in packs, when it becomes a very grave affair, and sometimes singly; even then it is not to be despised, as the little animal is marvellously quick, and makes straight for the throat. Like the otter, and many (may we not say most) animals, the weasel shows great affection for its young, and Mr. St. John writes that no one can tell the pain he felt at allowing his dog to kill one which could have escaped had it not been hampered by something it was carrying, and which turned out to be its young one. He says that nothing would have induced him to take its life had he guessed that the poor little creature was trying to save its offspring. The colour of stoats and weasels is a reddish brown above and white beneath, the tail of the weasel being of the same colour as the body. This mainly distinguishes it from the stoat, which has the end of the tail black. In winter, in the north, stoats often turn white. Dr. Brett in 1882, and Mr. Campbell in 1890, record instances of white stoats being found in Hertfordshire, which must be regarded as an unusual occurrence.

The Wild Cat (*Felis eatus*) is a most formidable creature. It is an animal that varies very much in size. The usual length appears to be, body about 2 feet, tail about ten inches, but it sometimes attains a much larger size. The colour is a yellowish grey, with a dark stripe along the back, and numerous stripes on the sides. The strength, ferocity, and vitality of the wild cat have often been pointed out, and are dwelt on by Mr. St. John, who occasionally,

but rarely, came across one. Richard the First granted a charter to the Abbot and Convent of Peterborough to hunt the wild cat in Northamptonshire, where it seems to have lingered as long as anywhere in England, except in the extreme north. There was no representative of the wild cat in the Zoological Gardens when I was last there. The animal is quite untameable and soon breaks its heart in confinement; at any rate when the confinement is solitary. The last I remember, a good many years ago, was provided with a Persian wife, and had lived very much longer than his predecessors. He had had several families and looked a degree less unhappy than those I remember before. I was horrified to learn from my friend Mr. Stradling that the true wild cat is strongly suspected to be extinct in this country. I have been making some enquiries and I hope they show that there is a chance at any rate that this is not quite the case. Mr. Duncan McLaren, a gamekeeper near Fort William, writes to me that there is no doubt of its existence at the present time in the forests under his charge. I am indebted to the Rev. Dr. Joass, of Golspie, for some extremely interesting particulars of recent occurrences in Sutherland, partly from his own experience, but principally obtained from Mr. Inglis, the Duke of Sutherland's keeper, at Dunrobin. The last wild cat killed in the immediate vicinity of Golspie was in 1885, but others were killed or tracked in the county in 1889 and 1890. Dr. Joass has very kindly given me the position and distances of the various localities where these cases occurred, and a description of their natural features. In each case the habitat appears to be a hill or steep mountain-side covered with trees,—ash, birch, or alder,—particularly where there are crevices or loose rocks. In the 'Zoologist' for 1881, Mr. Harvie Brown states that the wild cat was then to be found in suitable localities over a large extent of the West and North of Scotland, finding its chief sanctuary in the deer-forests. I venture to hope therefore that it is not quite extinct.

The Fox (*Vulpes vulgaris*) was so graphically described for us by Mr. Rooper in his recent lecture on "Bats and some other Beasts," and he gave us such an interesting account of its habits and characteristics, that I need say nothing more on the subject.

A few words may be said as to the food of the Carnivora. Like the bear in Hudibras they are not "nice," in the sense of being particular in their dietary. They take what they can get. The otter of course feeds mainly on fish, having a special predilection for eels, and all the Mustelidæ appear to be fond of a fish diet. The polecat constantly catches eels in ditches on marsh-lands and such like places. It is also very fond of the spawn of frogs. Rats, mice, frogs, toads, and slugs are eaten by foxes, badgers, polecats, etc.; and the marten, according to Mr. St. John, is fond of fruit. All kinds of feathered game and poultry, eggs, hares, and rabbits, fall a prey to the Carnivora in more or less plenty. In short, nothing seems to come amiss. A fox kept by Mr. Holland-Hibbert in his garden, was, he tells me, extremely partial to fruit. I sus-

pect that all depends on circumstances and environment, and that all would at a pinch eat vegetable food if they could get nothing better.

The Rodents, or "gnawers," as I suppose they might be termed, comprise the squirrel, the dormouse, the rats, the mice, the voles, the hare, and the rabbit.

The Squirrel (*Sciurus vulgaris*) is a great ornament of our woods, and if caught young is easily tamed. I was paying a call some time since at a house where one was loose in a room. The little wretch quickly found out that I was clothed in a rough suit, into which his claws would easily stiek. So he began running all over me. I did not dare to take hold of him and put him into his cage, as squirrels' teeth are marvellously sharp and they have a very pretty notion indeed of using them, so I was obliged to wait until his mistress came and relieved me of his attentions.

The Dormouse (*Myoxus avellanarius*) is a very pretty little creature, celebrated for its capacities for sleeping. When awake it is active enough, and climbs with great agility among the shrubs and bushes which it frequents. Its colour is tawny red. Scientifically it occupies a position intermediate between the squirrel and the mice, having many of the characteristics of the former.

Of Rats we have two distinct species, the black (*Mus rattus*), and the brown (*Mus decumanus*). The latter is only too well known; the black rat is becoming very rare indeed, and is supposed to owe its extermination to its more enterprising rival. The ears of the black rat are large and its hair is long and silky. They used to be very numerous in Whitbread's Brewery, but I am told by Mr. Edgar Lubbock that none are now seen there. Among the specimens at South Kensington several are labelled as having come from Portsmouth, and I am told that they are found on Lundy Island. A specimen has been lent to me by Dr. Brett. Against the brown rat every man's hand is raised, and, were it not for their extraordinary fecundity, the animals would soon be extinct. They find their way everywhere, especially on board ships, and are thus frequently introduced into places where none previously existed—not always to the advantage of the inhabitants. They have in this way been imported into Puffin Island, and have exterminated the puffins. On shipboard, and often in other localities, want of water is felt by the rats, and to acquire this they will gnaw through thick pipes, and adopt numerous other devices, such as climbing the rigging, to lick the raindrops off the cordage. In former days many men gained a livelihood by catching rats in the London sewers, and selling them at 3s. a dozen to the sporting public-houses, where supplies were always kept (and duly advertised in 'Bell's Life') for matches with dogs. This entertainment has been prohibited by recent legislation.

Of the Voles, the one most commonly seen is the water-vole, or water-rat, as it is often called (*Arvicola amphibius*), which we meet with so frequently on the banks of our streams and ditches. The

voles are distinguished from rats and mice by their shorter tails and obtuse heads. There is a black variety of the water-vole which is widely distributed, but I am not aware whether it has occurred in this county. The common form is very plentiful along the banks of the Grand Junction Canal and the River Colne. They swim with great ease, and are very interesting animals to watch if you can get near them. The great art in approaching all wild animals is to do so very quietly.

The bank or red vole (*Arvicola glareolus*) is less common than the next species, and is prettier, the back being a rich reddish chestnut. It is found in this county.

The common field-vole (*Arvicola agrestis*), or short-tailed field-mouse, is a remarkably prolific little animal, and were it not that almost all the Carnivora, especially the weasel, destroy immense numbers, and in this are ably assisted by the kestrel and the owls, we should be overrun with them. The colour is greyish brown above, and pale grey beneath. This species appears to vary very much in size; the largest individuals are about six inches in length, excluding the tail.

There are three species of Mice—the common house-mouse, the long-tailed field-mouse, and the harvest-mouse. Of these the most interesting is perhaps the harvest mouse (*Mus minutus*). It was first described as indigenous to this country by Gilbert White of Selborne. It is a very pretty little creature, light orange brown above, and white beneath. With the exception of one of the shrews it is the smallest of British quadrupeds, six going to make up an ounce. It is very easily tamed if caught young. The nest of the harvest-mouse, a compact ball of grass about the size of a cricket-ball, with no apparent opening, and so firm that it could be rolled along a table, greatly puzzled the Selborne naturalist. The nest he describes had eight naked little mice inside, quite filling it, and how the mother could properly bestow her maternal attentions on each of these little creatures, was a mystery.

The long-tailed field-mouse (*Mus sylvaticus*) is reddish brown above, whitish beneath. It is a great pest in gardens.

Of Hares we have two species, the common hare (*Lepus timidus*), and the mountain hare (*Lepus variabilis*) found in Scotland and in Ireland. In Scotland this is known as the "Blue Hare." It is of a greyish colour, turning white in winter. In spite of Mr. Rooper's "*bête noire*," the "Ground Game Act," the common hare is too well known to need description any more than the Rabbit (*Lepus cuniculus*).

The last group, the Ruminantia (or cud-chewing mammals), comprises the Deer, of which we have three species, the red deer, the fallow deer, and the roe deer.

The Red Deer (*Cervus elaphus*) is the noblest example of our indigenous wild animals. It is only now found (I believe) in a wild state in Scotland, and in the moorlands of Devonshire and Somersetshire. The male is termed a stag, the female a hind. A fine stag stands four feet or more at the shoulder, and is a splendid

creature to look at. In Scotland the deer are generally shot; deerstalking being one of the most aristocratic, as it is one of the most laborious of field-sports. In Devon and Somerset they are hunted. It is an exciting scene to witness a meet of the stag-hounds on one of the breezy heights of Exmoor; the magnificent scenery, combined with the glorious air, and the throng of sportsmen and sportswomen, make up a picture worth going far to see. The last time I went to a meet was this autumn, not far from Dulverton, and we had the rare good fortune to see in the distance a stag in his lair. He was lying between two bushes on the steep side of a depression known as the "Devil's Punch Bowl," the sides of which were covered with heather, bracken, and shrubs. The tufters (as the dogs are termed which find the deer before the pack is put on the trail), were at the bottom of the valley, and it was most interesting from the heights above to watch them gradually work out the scent, and make their way by slow degrees up to the stag. He did not move until they were close to him. The pack was then sent for and put on his trail. He eventually escaped. Once I came upon a hind in a thicket bordering a river in which I was fishing. She was then lying down, and rose as I and my companion approached. We were close to her, and for a few seconds she gazed at us with her beautiful eyes, and then bounded away. I think I never saw a more graceful or beautiful creature. A deer at the end of a run generally takes to the water, and stands at bay. It is then despatched by the joint aid of the dogs and the huntsmen. There are those who have not much relish for the concluding ceremonies. The hounds used in Devonshire are exactly like the ordinary fox-hounds, only rather larger.

The Rev. W. Bingley, in his well-known work on 'British Quadrupeds,' published about the beginning of the present century, says that Fallow Deer (*Cervus dama*) are not found anywhere in Great Britain or Ireland in a perfect state of nature, and Professor Bell only alludes to them as half-domesticated inhabitants of parks, chases, and preserved forests. At the beginning of the century vast herds of fallow deer roamed the New Forest, and other woods in Hampshire, while in Epping and Hainault Forests they were extremely abundant. It is curious and interesting to know that they have never absolutely died out in Epping. In 1860 but very few specimens remained, but measures were taken at that time to prevent their extinction, and the numbers have since considerably increased. The breed there is quite different from those we see in noblemen's and gentlemen's parks. They are all of an uniform dark brown, which appears to be black except when one is in very close proximity. I cannot myself understand why these Epping Forest deer should be looked upon as other than absolutely wild. They have been there from time immemorial. The male of the fallow deer is known as a buck, the female as a doe, and the young as a fawn.

The Roe Deer (*Capreolus capræa*), a beautiful animal, smaller than the fallow deer, is found plentifully in Scotland, and in some

of the woods in the North of England. I believe it has been recently introduced into Epping Forest.

As regards the question of how far any of our wild quadrupeds are in danger of extermination, my own view is that unless our social conditions vary greatly (as they very possibly may do) there is not at present much danger. Should hunting cease, and deer-forests be prohibited, the fox and the red deer would, I fancy, soon come to an end; and probably the wild cat if still existing, and the marten, which find their most congenial home in the districts kept undisturbed for the deer, would quickly follow. But, as regards any other animals, I should doubt their great decrease in numbers, until the day arrives, which a friend of mine hopes to see, when England shall be one vast market-garden. Personally I have no longing for that consummation, and I console myself with the reflection that when it does come I am not at all likely to be here to see it.

IV.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1891.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., President.

Read at Watford, 18th March, 1892.

THE number of our rainfall observers in the year 1891 shows a considerable increase upon that of any previous year, and this increase necessitates a re-arrangement of our principal table. For some years the number of stations for which the records have been inserted in this table has been 30: the number to be inserted now is 36; the number of gauges is 38; and the number of daily records received is 25, an increase of one upon that for the previous year.

The records for Nash Mills and Gorhambury now take their former place in the principal table, from which they had to be omitted in last year's report; the record for Bedford Road, Hitchin, now first appears in it; that for a station from which the returns have lately been intermittent—Bushey Heath—is again included; and there are two stations added from which returns have not before been received—Aldenham House, Elstree, and Hamels Park, Buntingford.

These alterations increase the number of returns for the river-districts of the Hiz, the Gade, the Lower Colne, and the Rib from two to three, and for the river-district of the Ver from three to four, and add to our table a new district, the Upper Colne, thus reducing the number of districts without observers from five to four: namely the Upper Ivel in the north, the Chess in the south-west, the Brent in the south, and the Stort in the east. Of these the Chess and the Stort are the districts in which it is most important that we should have observers.

The only other alteration is that Mr. Marlborough Pryor's gauge, formerly at Weston Manor, has been moved to Weston Park, a distance of about half a mile.

Particulars of the 36 rainfall stations, and the monthly and total rainfall and number of days on which at least 0·01 inch of rain fell, are given in Tables I and II, pp. 55-57.

A supplementary table (Table III, p. 58) gives ten other records of the total rainfall in the year. Two of these are the records of the additional gauges at Rothamsted which make up our number to 38, and eight are taken from 'British Rainfall, 1891.'

The symbols in the last column of Table I, as in previous reports, show the method by which the height of each gauge has been determined, $\bar{\Delta}$ signifying that a series of levels has been taken to the gauge from the nearest bench-mark, T that the height has been ascertained approximately from the same source, L that levels have been taken to the gauge from some datum other than Ordnance mean sea-level, and B that the height has been taken by means of the barometer.

The mean rainfall in the county in the year 1891 was 29·62 inches. This is 2·88 inches above the mean for the 10 years

1880–89, and 3·19 inches above that for the half-century 1840–89.* The year was therefore a decidedly wet one.

February was unprecedently dry, no rain whatever being recorded at six stations, and at several others the amount recorded was the result of condensed fog: the average at all stations, it will be seen from the table, was one twenty-fifth of an inch. October, on the other hand, was excessively wet, having had considerably more than double the average rainfall of the fifty Octobers in 1840–89. The rainfall of the last six months of the year was more than double that of the first six months, being 19·95 inches. This is 5·16 inches, or 35 per cent., above the mean (14·79 ins.) for the corresponding six months of the half-century 1840–89, and is greater than in any year since 1880; indeed, with the exception of the fall in that year, it is the heaviest in the corresponding period that has been recorded since I commenced, in 1876, to give annual reports on the rainfall in Hertfordshire, and probably since the very wet year 1852.

Distribution of Rainfall throughout the Year.—Of the total rainfall $20\frac{1}{2}\%$ fell during the winter months (Jan., Feb., and Dec.), $20\frac{1}{2}\%$ during the spring (March to May), 26% during the summer (June to Aug.), and 33% during the autumn (Sept. to Nov.). The fall during each quarter and each season, and the deviation from the mean for the half-century 1840–89, was as follows:—

	Fall.	Diff.		Fall.	Diff.
1st quarter.....	3·77 in.	−1·86 in.	Winter	6·01 in.	+0·01 in.
2nd ,,	5·80	−0·21	Spring	6·02	+0·50
3rd ,,	7·62	+0·30	Summer.....	7·84	+0·86
4th ,,	12·43	+4·96	Autumn	9·75	+1·82

February was, as already stated, unprecedently dry, and April, June, and September were dry months; October was excessively wet, and May, August, and December were wet months. The difference in each month from the mean for the half-century was:—

	in.		in.		in.		in.
Jan.	−0·25	April....	−0·71	July	−0·05	Oct.	+3·30
Feb.	−1·68	May.....	+1·15	Aug.....	+1·56	Nov.....	−0·28
Mar.	+0·06	June....	−0·65	Sept....	−1·20	Dec.	+1·93

Thus the fall up to the end of July was more than two inches below the mean for the period, but for the last five months in the year more than five inches above it, an average excess of nearly an inch per month.

The absolute maximum fall in any one day in each month, and the station recording it, was:—

	ins.		ins.
Jan. 29—Moor Park.....	0·60	July 3—Apsley Mills	0·79
Feb. 2—Red House, Ware....	0·10	Aug. 20—Therfield	1·75
Mar. 9—Bushey Heath	0·66	Sept. 8—Fauhams Hall, Ware†	0·50
April 6—Great Gaddesden	0·74	Oct. 6—Fairhill, Berkhamsted	1·47
May 24—Cheshunt College	1·88	Nov. 10—Kensworth	1·02
June 25—St. Albans.....	1·04	Dec. 1—Tring	1·36

* See 'Trans. Herts. Nat. Hist. Soc.,' Vol. VI, p. 84.

† Also at New Barnet on the 3rd.

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1891.

District.	STATION.	OBSERVER.	Diameter of Gauge.	Height of Gauge above	
				Ground.	Sea-level.
			ins.	ft. ins.	ft. +
1.	*Royston	Hale Wortham	8	0 6	269 $\overline{\uparrow}$
3.	*Hitchin—The Firs	William Lucas	5	2 1	238 $\overline{\uparrow}$
„	* „ Bedford Road ..	Francis Ransom	5	0 10	220
„	* „ High Down	Joseph Pollard	5	1 1	422 $\overline{\uparrow}$
4.	*Tring Vicarage	Rev. W. Quennell ...	5	1 0	442 T
6.	*Cowroast	Hubert Thomas	10	4 2	345 L
„	*Berkhamsted—Rosebank ..	Edward Mawley	8	1 0	401 $\overline{\uparrow}$
„	* „ Fairhill	W. Bonner Hopkins..	5	1 0	550
7.	*Great Gaddesden Vicarage...	Rev. W. T. Drake ..	8	1 0	427 T
„	*H. Hempsted—Apsley Mills	J. Dickinson & Co. ...	24	0 9	260
„	„ Nash Mills..	„	12	3 9	237 $\overline{\uparrow}$
8.	*Kensworth—The Grove ...	Miss S. Grace Jones	5	1 0	630 B
„	*Harpenden—Rothamsted ...	Lawes and Gilbert ...	5	0 9	420 T
„	St. Albans—Gorhambury ...	The Earl of Verulam...	6 sqr.	3 0	425
„	* „ The Grange ...	John Hopkinson	5	1 0	380 $\overline{\uparrow}$
9.	*Elstree—Aldenham House..	Edwin Beckett	10 sqr.	4 9	
10.	*Watford—Oaklands	Edward Harrison	5	5 6	273 T
„	Rickmansworth—Moor Park	Lord Ebury	5	2 0	340 $\overline{\uparrow}$
„	Bushey Heath.....	Forrester Scott	5	0 10	480
12.	*Welwyn Rectory	Rev. Canon Wingfield	5	0 4	228 T
„	Datchworth Rectory	Rev. J. Wardale ...	5	1 0	386 T
13.	Stevenage—Weston Park ...	M. R. Pryor	5	0 8	470 T
„	*Bennington Lodge	Rev. Dr. Parker	5	1 0	408 $\overline{\uparrow}$
14.	*Therfield Rectory	Rev. J. G. Hale	5	4 3	500
„	*Throcking Rectory.....	Rev. C. W. Harvey...	5	1 0	484 T
„	*Buntingford—Hamels Park	E. Wallis	5	1 0	400
15.	*Mnch Hadham	T. Woodham Mott ...	5	1 0	222 B
17.	Hatfield—Brocket Hall.....	Thomas Landon	8	1 0	250 ?
„	Hertford—Bayfordbury....	W. Clinton Baker ..	8	1 2	250
„	Ware—Red House	Joseph Francis	12	3 0	114 T
„	* „ Fanhams Hall.....	Miss Joyce Croft	8	1 0	253 T
18.	*Broxbourne—Stafford House	G. J. Newbery	5	1 0	118 T
„	*Cheshunt—Old Nurseries ...	Paul and Son	5	1 0	92
„	„ College... ..	Rev. Dr. Reynolds ...	5	1 0	94
„	*New Barnet—Gas Works ...	T. H. Martin	8	0 9	212
„	Southgate—The Lawns.....	George A. Church ...	5	0 6	240 T

* Daily fall received for these stations. † For explanation of these symbols see p. 53.

TABLE II.—RAINFALL IN HERTFORDSHIRE IN 1891.

RIVER DISTRICT.		STATION.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.	DAYS.	
			ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.		
OUSE	CAM	1. Rhee	Royston.....	1'57	'02	1'63	'57	3'01	2'17	2'32	3'54	1'20	5'05	1'75	3'11	25'94	170
		3. Hiz	Hitchin—The Firs	1'59	'01	1'48	'84	3'18	1'73	2'23	3'40	'87	6'28	2'09	3'56	27'26	192
			" Bedford Road	1'61	'04	1'65	'98	3'15	1'80	2'52	3'42	'94	6'25	2'19	3'67	28'29	225
		" High Down.....	1'52	'03	1'40	'97	3'44	1'70	2'94	3'66	'77	6'33	2'27	3'91	28'94	196	
	THAME	4. Up. Thame	Tring Vicarage.....	2'25	'00	1'62	1'23	2'87	1'21	1'95	5'03	1'23	8'41	2'59	4'65	33'04	189
	BULBOURNE	6. Bulbourne	Cowroast	2'16	'05	1'42	1'38	3'10	1'07	1'94	4'60	1'14	8'18	2'45	4'53	32'02	
		Berkhamsted—Rosebank	2'19	'04	1'48	1'59	2'86	1'03	2'29	4'25	1'13	8'04	2'42	4'20	31'52	196	
		" Fairhill	2'21	'02	1'45	1'96	2'90	1'12	2'45	4'37	1'54	8'37	2'58	4'31	33'28	204	
	GADE	7. Gade	Great Gaddesden Vicarage	2'04	'05	1'47	1'96	3'04	1'33	2'11	3'85	1'07	8'32	2'24	4'41	31'89	187
		Hemel Hempsted—Apsley Mills	2'38	'03	1'31	1'00	3'38	1'29	3'14	4'71	1'40	6'91	2'18	4'02	31'75	186	
		" Nash Mills	1'93	'01	1'25	1'00	3'58	1'38	3'13	4'17	1'24	7'46	2'33	4'17	31'65	194	
	COLNE	8. Ver	Kensworth—The Grove	2'14	'03	1'48	1'67	3'24	1'87	2'06	4'42	1'05	8'31	2'54	4'80	33'61	187
		Harpenden—Rothamsted	2'12	'03	1'69	1'44	3'34	1'80	2'28	3'94	1'30	6'66	2'17	4'06	30'83	182	
		St. Albans—Gorhambury	2'35	'00	1'60	'91	3'55	1'88	2'95	3'45	'97	8'20	2'87	4'59	33'32		
		" The Grange.....	2'23	'05	1'60	'87	3'57	2'07	2'92	4'29	1'02	6'35	2'13	4'03	31'13	201	
	9. Up. Colne	Elstree—Aldenham House	2'14	'10	1'14	'84	2'46	'78	2'02	3'68	1'28	6'28	2'34	3'98	27'04	184	
	LO. COLNE	10. Lo. Colne	Watford—Oaklands.....	2'22	'02	1'80	1'14	3'81	1'28	3'02	4'70	1'61	6'35	2'46	4'28	32'69	203
		Rickmansworth—Moor Park	2'62	'06	1'71	'99	3'50	1'63	3'90	5'10	1'68	6'93	2'67	4'91	35'70	198	
		Bushey Heath	2'34	'00	1'99	'92	2'98	1'02	2'93	3'75	1'45	6'34	2'35	3'73	29'80	185	
	MIMRAM	12. Mimram	Welwyn Rectory	2'55	'01	2'29	1'64	4'05	1'35	1'80	3'53	1'46	5'81	2'20	3'76	30'45	169
		Datchworth Rectory	1'88	'05	1'43	1'49	3'42	1'53	2'05	3'10	1'24	5'03	2'14	3'57	26'93	176	
	BEANE	13. Beane	Stevenage—Weston Park	1'99	'14	2'09	'86	3'17	'83	1'27	3'72	1'51	6'00	3'22	3'59	28'39	
		Bennington Lodge	2'10	'07	1'87	'94	3'40	1'05	1'95	3'42	1'12	5'31	2'34	3'66	27'23	205	
	RIB	14. Rib	Therfield Rectory.....	1'70	'02	1'87	'91	3'53	2'13	3'23	4'47	1'64	5'49	2'23	3'38	30'60	197
		Throcking Rectory	1'69	'01	1'80	'86	2'92	1'35	2'42	3'56	1'11	5'17	2'12	3'63	26'64	212	
		Buntingford—Hamels Park	2'11	'02	2'05	'90	2'76	1'40	2'48	3'58	1'18	5'04	2'36	3'46	27'34	175	
	LEA	15. Ash	Much Hadham	2'10	'06	1'84	1'31	2'78	1'30	3'05	4'29	1'12	5'13	2'40	3'82	29'20	177
	UPPER LEA	17. Upper Lea	Hatfield—Brocket Hall	2'02	'03	1'71	1'12	3'83	1'70	1'63	3'34	1'35	5'94	2'17	3'80	28'64	169
		Hertford—Bayfordbury	2'07	'03	1'90	'68	3'52	1'91	1'99	3'86	1'01	5'34	2'02	3'87	28'20	194	
		Ware—Red House	1'93	'14	1'45	'80	2'84	1'34	2'36	3'90	'76	4'99	1'98	3'97	26'46	168	
		" Fanhams Hall	1'84	'08	1'70	'81	2'84	1'22	2'30	4'08	1'82	4'38	2'05	3'09	26'21	181	
	LOWER LEA	18. Lower Lea	Broxbourne—Stafford House	2'07	'06	1'96	'81	3'16	1'62	2'73	4'07	1'05	4'97	2'08	3'60	28'18	210
		Cheshunt—Old Nurseries	2'27	'00	1'91	'82	3'96	1'41	2'48	3'63	'86	5'24	2'00	3'79	28'37	169	
		" College	2'16	'00	1'63	'81	4'12	1'86	1'53	2'92	1'41	5'07	2'03	3'51	27'05	153	
		New Barnet—Gas Works	1'96	'00	1'45	'76	3'25	'62	2'81	3'50	1'50	5'45	2'04	3'76	27'10	141	
		Southgate—The Lawns	2'05	'05	1'97	'89	3'53	1'32	3'19	4'47	1'20	5'40	2'09	3'43	29'59	205	
Mean for the County			2'06	'04	1'67	1'07	3'28	1'45	2'45	3'94	1'23	6'24	2'28	3'91	29'62	187	

TABLE III.—SUPPLEMENTARY TO TABLES I AND II.

District.	Station.	Authority.	Gauge.		Rain-fall.	Days.
			Dia-meter.	Height above Sea.		
3.	Hitchin—The Maples ...	W. Hill.....	8	220	28·11	191
„	„ Bancroft	L. W. Gatward...	5	215	29·10	196
4.	Tring—Pendley Manor...	Rev. W. Quennell			31·71	
8.	Harpenden—Rothamsted	Lawes and Gilbert	8	420	30·49	173
„	„ „	„	72×87	420	31·86	200
10.	Watford—Kytes	Mrs. Horsman ...	5	239	28·87	181
12.	Welwyn—Danesbury ...	A. M. Blake.....	5	405	29·82	181
„	Tewin—Marden Hill ...	R. L. Hoare.....	5	251	27·34	150
14.	Buntingford—Hyde Hall	A. E. Morse.....		430	25·67	179
18.	Hoddesdon—Feilde's Weir	Major L. Flower	8		25·13	

The wettest day in each month at 35 stations was:—

January 20th at 1 station; 22nd at 1; 23rd at 1; 24th at 2; 29th at 9; 30th at 20; 23rd and 30th equal at 1.

February 2nd at 1 (0·10 in.); 11th at 1 (0·06 in.); 21st at 1 (0·04 in.). No other fall exceeding 0·03 ins., and no fall at 6 stations.

March 7th at 27; 9th at 6; 10th at 1; 15th at 1.

April 4th at 26; 5th at 2; 6th at 6; 21st at 1.

May 17th at 20; 18th at 1; 23rd at 1; 24th at 13.

June 2nd at 2; 4th at 9; 20th at 1; 22nd at 4; 24th at 3; 25th at 16.

July 1st at 1; 3rd at 4; 6th at 3; 7th at 2; 8th at 9; 19th at 1; 26th at 1; 27th at 1; 29th at 11; 31st at 1; 3rd and 26th equal at 1.

August 20th at 34; 27th at 1.

September 1st at 1; 3rd at 1; 8th at 1; 12th at 1; 14th at 15; 19th at 6; 21st at 2; 22nd at 2; 30th at 4; 3rd and 19th equal at 1; 15th and 30th equal at 1.

October 5th at 1; 6th at 17; 13th at 1; 14th at 2; 15th at 2; 19th at 1; 21st at 4; 22nd at 6; 2nd and 21st equal at 1.

November 10th at 28; 11th at 2; 15th at 4; 16th at 1.

December 1st at 25; 13th at 7; 14th at 1; 27th at 1; 1st and 13th equal at 1.

The day in each month on which a heavy fall of rain was most general over the county was therefore:—

Jan. 30th.	April 26th.	July 29th.	Oct. 6th.
Feb. (none)	May 17th.	Aug. 20th.	Nov. 10th.
March 7th.	June 25th.	Sept. 14th.	Dec. 1st.

The number of wet days in the year (average of 33 gauges) was 187, being 19 above the mean for the twenty years 1870-89. Of the total number there were 36 (or 19%) in the winter months, 46 (or 24%) in the spring, 51 (or 28%) in the summer, and 54 (or 29%) in the autumn.

The number of wet days in each month, and the deviation from the mean for the 20 years 1870-89, was as follows:—

Jan. 14 — 1	April 11 — 2	July 18 + 4	Oct. 22 + 7
Feb. 2 — 12	May 18 + 5	Aug. 22 + 9	Nov. 18 + 2
Mar. 17 + 4	June 11 — 2	Sept. 14 + 1	Dec. 20 + 4

Distribution of Rainfall throughout the County.—The mean rainfall in the catchment-basin of the Ouse was 27·61 ins., and in that of the THAMES 29·87 ins. The following table (Table IV) gives the mean fall for each month and for the year in each of the five river-districts represented, and in the county for comparison, and also the difference in the year from the mean for the decade 1880–89.

TABLE IV.—RAINFALL IN THE RIVER DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	COUNTY.
	ins.	ins.	ins.	ins.	ins.	ins.
January	1·57	1·60	2·25	2·22	2·02	2·06
February	·02	·03	·00	·03	·05	·04
March	1·63	1·51	1·62	1·53	1·82	1·67
April	·57	·93	1·23	1·26	·97	1·07
May	3·01	3·25	2·87	3·23	3·36	3·28
June	2·17	1·75	1·21	1·40	1·41	1·45
July	2·32	2·56	1·95	2·65	2·31	2·45
August	3·54	3·49	5·03	4·23	3·73	3·94
September	1·20	·86	1·23	1·28	1·25	1·23
October	5·05	6·28	8·41	7·34	5·28	6·24
November	1·75	2·19	2·59	2·41	2·20	2·28
December	3·11	3·71	4·65	4·29	3·63	3·91
Year	25·94	28·16	33·04	31·87	28·03	29·62
Diff. from 1880-89	+3·43	+2·90	[+2·61*]	+3·06	+2·37	+2·88

The mean rainfall in each of the minor river-basins or sub-districts, was as follows:—

CAM	Rhee	25·94	THAME.....	Upper Thame..	33·04
IVEL.....	Hiz	28·16		Mimram	28·69
	Bulbourne	32·27		Beane	27·81
	Gade	31·76	LEA.....	Rib	28·16
COLNE	Ver	32·22		Ash	29·20
	Upper Colne	27·04		Upper Lea.....	27·38
	Lower Colne	32·73		Lower Lea.....	28·06

The total yearly fall ranged from 25·94 ins. at Royston to 35·70 ins. at Moor Park, Rickmansworth; and the total monthly fall from no rain at six stations in February to 8·41 ins. at Tring Vicarage in October. The greatest fall in any one day was 1·88 in. at Cheshunt College on the 24th of May.

Distribution of Rainfall in each Month.—The nomenclature used in the following account of the chief falls of rain is the same as in my previous reports, falls of at least $\frac{1}{2}$ inch being styled *considerable*, $\frac{3}{4}$ inch *very considerable*, 1 inch *great*, $1\frac{1}{4}$ inch *very great*, $1\frac{1}{2}$ inch *heavy*, $1\frac{3}{4}$ inch *very heavy*, and of 2 inches and upwards *excessive*. This analysis only applies to the 25 stations from which I have returns of the daily rainfall.

* Rainfall for three years of this period computed.

JANUARY.—Rainfall a little below the average; nearly all after the 19th; up to that date mostly in the form of snow. On 24th the fall was *considerable* at two stations, and on 30th at three.

FEBRUARY.—Unprecedentedly dry, no rain whatever falling at six stations, and at several others the recorded fall, or most of it, really being dew. Thus the 0·05 in. given for my own station consisted of 0·02 in. of rain on 6th, and 0·01 in. of dew on 21st, 22nd, and 24th. The heaviest fall in any one day at any of the 25 stations for which I have the daily record was 0·04 in. at Much Hadham on the 21st. There is no previous record of a month without rain at any one station, the least monthly fall recorded (and our records extend over more than half a century) being 0·08 in. at Cassiobury in April, 1870.

MARCH.—Rainfall small, but about the average, this being usually a dry month. On 7th the fall was *considerable* at twelve stations. Snow fell on several days. The great blizzard which caused much damage in the west of England was at its height in Herts on the night of the 9th. On this night, the observers at Rothamsted say, “there was a very drifting snowstorm, and on the 10th and 11th there were also drifting snow-showers, and there is no doubt that much was blown out of the gauges. From measurements in various fields it was concluded that there were upon the whole about five inches of snow, = 0·417 inch rain, which amount is accordingly entered.” The snow not having been measured at Gorhambury, $\frac{1}{2}$ inch has been added to the record for that station.

APRIL.—A dry month; most of the rain fell between 3rd and 9th; and scarcely any after 16th. On 4th the fall was *considerable* at two stations, on 5th at one, on 6th at five, and on 21st at one.

MAY.—Very wet, especially during the latter half of the month. On 17th the fall was *great* at High Down, Hitchin (1·09 in.), *very considerable* at sixteen stations, and *considerable* at eight; on 24th it was *heavy* at Cheshunt College (1·88 in.) and at the Old Nurseries, Cheshunt (1·63 in.), *very great* at Welwyn (1·30 in.), *very considerable* at six stations, and *considerable* at six.

JUNE.—Rather dry, with rain on one day only (15th) between 5th and 22nd, except at a few stations at which 0·01 in. fell on some one day. On 4th the fall was *considerable* at one station, and on 25th it was *great* at The Grange, St. Albans (1·04 in.), *very considerable* at one station, and *considerable* at seven stations.

JULY.—Rainfall about the average; nearly all fell during the first eight and the last twelve days. On 3rd the fall was *very considerable* at one station and *considerable* at one; on 6th it was *considerable* at one, on 8th at one, and on 29th at one.

AUGUST.—Very wet, especially during the latter part of the month, rain falling every day at nearly all the stations for the last fifteen days. On 2nd the fall was *considerable* at two stations. On 20th the fall was *very heavy* at Therfield (1·75 in.), *very great* at Royston (1·47 in.), The Firs, Hitchin (1·40 in.), High Down, Hitchin (1·40 in.), Bedford Road, Hitchin (1·39 in.), Tring (1·35 in.), The Grange, St. Albans (1·35 in.), Oaklands, Watford (1·33 in.),

Cowroast (1·27 in.), and Kensworth (1·27 in.), *great* at the Old Nurseries, Cheshunt (1·24 in.), Rosebank, Berkhamsted (1·22 in.), Elstree (1·20 in.), Welwyn (1·20 in.), Fairhill, Berkhamsted (1·17 in.), Broxbourne (1·15 in.), Rothamsted (1·14 in.), Hamels Park (1·13 in.), Fanhams Hall, Ware (1·10 in.), New Barnet (1·07 in.), Apsley Mills (1·05 in.), Much Hadham (1·04 in.), and Throcking (1·02 in.), and *very considerable* at two stations, Great Gaddesden and Bennington. On 27th the fall was *considerable* at fourteen stations, on 28th *very considerable* at one station, and on 31st *considerable* at one. At Rosebank, Berkhamsted, on the 10th, 0·05 in. fell in one minute, being at the rate of three inches per hour.

SEPTEMBER.—Very dry, but without any long period quite devoid of rain. The only *considerable* fall was on 3rd, at New Barnet.

OCTOBER.—Excessively wet, having about three times the average fall of rain; at most stations rain fell every day from 5th to 22nd (18 days), and at several from 4th to 26th (23 days). On 6th the fall was *very great* at Fairhill, Berkhamsted (1·47 in.), Cowroast (1·42 in.), Tring (1·38 in.), Rosebank, Berkhamsted (1·33 in.), Great Gaddesden (1·32 in.), and Kensworth (1·26 in.), *great* at Rothamsted (1·15 in.), The Grange, St. Albans (1·13 in.), Apsley Mills (1·12 in.), Bedford Road, Hitchin (1·09 in.), The Firs, Hitchin (1·08 in.), and High Down, Hitchin (1·00 in.), *very considerable* at four stations, and *considerable* at seven. On 7th the fall was *considerable* at five stations, on 13th at seven, on 14th at one, on 15th at two, on 16th at one, on 18th at four, on 19th at two, and on 20th at three. On 21st the fall was *very great* at Great Gaddesden (1·25 in.), *great* at High Down, Hitchin (1·20 in.), Fairhill, Berkhamsted (1·17 in.), Cowroast (1·10 in.), and Rosebank, Berkhamsted (1·04 in.), *very considerable* at six stations, and *considerable* at fourteen; and on 22nd it was *very great* at Tring (1·30 in.), *great* at Cowroast (1·24 in.), Fairhill, Berkhamsted (1·19 in.), Bedford Road, Hitchin (1·12 in.), Rosebank, Berkhamsted (1·11 in.), Kensworth (1·10 in.), Apsley Mills (1·06 in.), Great Gaddesden (1·05 in.), The Firs, Hitchin (1·04 in.), and High Down, Hitchin (1·04 in.), *very considerable* at five stations, and *considerable* at nine.

NOVEMBER.—Rainfall a little below the average. On 10th the fall was *great* at Kensworth (1·02 in.), and Cowroast (1·00 in.), *very considerable* at four stations, and *considerable* at ten; on 11th *considerable* at one, and on 15th at three.

DECEMBER.—Very wet; rain fell nearly every day at all stations for the first fifteen and last seven days. On 1st the fall was *very great* at Tring (1·36 in.), *great* at Cowroast (1·16 in.), Fairhill, Berkhamsted (1·15 in.), Rosebank, Berkhamsted (1·11 in.), Kensworth (1·11 in.), and Great Gaddesden (1·06 in.), *very considerable* at thirteen stations, and *considerable* at six; on 12th it was *considerable* at two stations; on 13th *great* at Bennington (1·00 in.), *very considerable* at eight stations, and *considerable* at eleven; and on 27th it was *great* at Apsley Mills (1·20 in.).

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE
DURING THE YEAR 1891.

By HENRY LEWIS.

Read at Watford, 18th March, 1892.

I HAVE no addition to make to our record of Hertfordshire birds, but that is not to be wondered at if we consider the number which have already been recorded, namely 202 species, there having been no increase in the number since our President added one to the list (the sand grouse) in his Notes on Birds observed during the year 1888. Mr. Rooper, in his last report, gave an interesting account of the rare birds observed during the severe weather of the winter of 1890-91, thus considerably lightening my labours, but some of these I will again refer to. Many of the records for last year are from the Tring Reservoirs, and for all these I am indebted to the Honourable Walter Rothschild.

THE GREEN WOODPECKER (*Geococcyx viridis*).—Mr. Rooper reports having seen a green woodpecker in Cassiobury Park. I am sorry to add that Mr. Spary has had several of these birds to mount during the year. It is a great pity that this useful species, with its loud laughing call, which is to be heard in the spring, should be destroyed. Mr. Buller also reported having received a green woodpecker and a greater spotted woodpecker (*Dendrocopos major*).

THE KINGFISHER (*Alcedo Ispida*).—It is always a pleasure to me to have the kingfisher reported. A bird of such lovely plumage is so persecuted that it is surprising we have any left in the country. Probably if it were not for the protection afforded it during incubation by some kind persons it would become extinct, at least in some localities. Mr. George Worby, of St. Albans, assures me that he has seen this bird using its feet in a very industrious manner for the purpose of scooping the earth out of a hole or tunnel it had been excavating in the bank with its bill; so Mr. Rooper is no doubt correct when he states: "Its eggs are beautifully white and transparent (he might have added 'and round or nearly so'), laid upon a nest formed of the east-up bones of its prey, in a hole scooped out of the bank by the bird for that purpose. It is commonly but erroneously believed that an old rat-hole is appropriated for the purpose."

THE COMMON BUZZARD (*Buteo vulgaris*).—Mr. Arthur Spary, one of our local taxidermists, informs me that "a specimen of the common buzzard was shot at Cole Green, close to the station, by Mr. Digby in the last week of the old year" (1891).

The buzzards are very nearly allied to the eagles, forming a connecting-link between them and the harriers and hawks. Dixon met with the buzzard in the North of Scotland, and writes: "Far in the deepest solitudes of the deer-forests, the buzzard oftentimes builds its nest. Its cradle is usually placed in some dense

hoary pine-tree, the patriarch of the forest, and the one most difficult of access. It is here, but sometimes also just on the borderland of the forests, that the buzzard finds the solitude of his choice, the seclusion which he loves. Nothing breaks the silence here save the occasional cry of a blackcock or the light tread of the mountain-hare as it hurries off at your approach. The scenery around is grand, befitting surroundings to such an abode. The distant mountains come out in bold outline against the clear morning sky; and the sunlight glistens brightly on the red bark of the pines around you. The nest is situated on a flat branch, some 60 feet from the ground." The cry of the buzzard is supposed to foretell rain. Clare writes, in the 'Village Minstrel':

" Slow o'er the wood the puttock sails,
And mournful as the storms arise,
His feeble note of sorrow wails
To the un pitying frowning skies." *

Dresser says: "This is now a rare bird in Great Britain . . . It is stated to be more numerous in North Devon than in other counties . . . It is as a rule a peaceable and quiet bird, but fights desperately during the breeding season." Benzon says that a friend of his saw a tough battle between two buzzards, which, after fighting for some time in the air, came to the ground in close combat and still continued to fight with such ferocity that he was able to walk up and kill them with his riding-whip. This was in Denmark. Nilsson states that in South Sweden "numbers are caught and used for food on their passage south through Skåne."

THE ROUGH-LEGGED BUZZARD (*Buteo lagopus*).—At our last meeting, held on the 19th of February, Lord Ebury exhibited a beautiful specimen of the rough-legged buzzard which was captured in a trap in Bishop's Wood, Rickmansworth, on the Moor Park estate. The legs and toes of the common buzzard are yellow and bare of feathers, whereas the rough-legged buzzard is feathered as low down as the origin of the toes, the feathers on the legs, as Mr. Stradling pointed out, taking the place of scales. Two of these rare birds were obtained in November last at the Tring Reservoirs.

Dresser states: "In summer this bird inhabits Northern Europe and Asia, migrating in winter into Central and Southern Asia and Europe . . . It is a rare straggler to Great Britain, and almost always in immature plumage. It has been killed in almost every county, and has been known even to breed with us." Stevenson, in his 'Birds of Norfolk,' states that their numbers vary in different seasons, very scarce some years, great quantities in others. In the winter of 1839-40 (November, December, and January) not less than 47 specimens were taken near Thetford, and many others elsewhere; few were seen afterwards till 1858, when they were again numerous.

THE COMMON HERON (*Ardea cinerea*).—Mr. Buller writes: "On the 4th of April one of the finest old male herons which I have

* Puttock is the buzzard's name in the Eastern and Midland Counties.

ever seen was killed in the neighbourhood of Welwyn. I know of one water-keeper in this county who has killed no less than 28 in eight years, and he only has about three miles of water to look after. By the time that our grandchildren become recorders the heron will be like the bittern, rarely seen."

THE TUFTED DUCK (*Anas fuligula*).—Mr. Rooper mentioned that a tufted duck had been killed in that "beautiful domain of Munden." Mr. Buller has also reported that a tufted duck, male, was killed at Kimpton Hoo, near Welwyn, on the 7th of January; and that a pair of tufted ducks were shot at Oughton Head Common, Hitchin, on the 13th of January.

Lord Lilford informs us that "this duck is an autumnal or winter visitor, and breeds in a good many of our English counties as well as in certain localities in Scotland and Ireland. Although frequently met with on the coast, the tufted duck decidedly prefers fresh to salt water. The bird thrives and breeds in captivity."

A singular hybrid between the pochard (*Fuligula ferina*) and tufted duck (*Anas fuligula*) was taken in November last at the Tring Reservoirs. Yarrell informs us that "there is in the Belfast Museum a bird shot near Downpatrick, which is apparently a hybrid between the tufted duck and the pochard." Tufted ducks as well as pochards have been known to breed in captivity. Yarrell states: "Tufted ducks bred in confinement in the ponds at the Gardens of the Zoological Society during the summers of 1839, 40, and 41." Selater says that "in 1849 a tufted duck crossed with a ferruginous duck (*Fuligula nyroca*) and the hybrids thus produced continued to breed either *inter se*, or with one of the parents, till 1861."

THE WATER-RAIL (*Rallus aquaticus*).—Mr. Rooper has informed me that Mr. Longman, of Shendish, wrote to him that "his bailiff had caught a curious bird in the yard and had sent it to be stuffed." He (Mr. Rooper) went to see it and found that it was a water-rail. As Yarrell states: "This bird certainly appears to be less abundant than it really is, the habits of the bird, and the nature of the localities which it frequents, increasing the difficulties of observation."

THE SMEW (*Mergus albellus*).—A female smew was killed near Welwyn early in the year and has been preserved in a very creditable manner by Mr. G. J. Buller, of Hitchin, late of Welwyn. Mr. Littleboy has reported the smew on two previous occasions. He says that "a female smew was shot [at Munden] on the 26th of December, 1846, by Mr. Nathaniel Hibbert," and also that "in 1885 a flight of nine visited the Marsworth Reservoir about the middle of February."

THE GREY PHALAROPE (*Phalaropus fulicarius*).—Four of these pretty and rare visitors were procured in October at the Tring Reservoirs; and one, I am informed by Mr. F. Cane, of Luton, was brought to him in November to be preserved, having been shot by Mr. Piggott by the side of a small pond at Chiltern Green.

In this bird there is a striking difference between the winter and the summer plumage. Yarrell says: "The females of this species appear to assume more perfect colours in the breeding-season and to retain them longer than the males . . . The front and sides of the neck, the breast, and all the under surface of the body are a uniform reddish chestnut or bay. . . The females are the largest." Mr. H. Seebohm says that the bird "breeds in Iceland, Spitzbergen, and in the Taimyr peninsula," and that "at their breeding-grounds they are described as being very tame." They show the same confidence and fearlessness when with us. But Hume, who met with them in their winter quarters on the coast of Scind, found them to be "very wary, rising *en masse*, and skimming along the surface of the water for a couple of hundred yards or so, as soon as the boat approached within a hundred yards of them." Kumlien says that on the Labrador coast they follow the whales, approaching them when they blow, to catch the small marine animals which are disturbed, and that from this they are known amongst the whalers as the "whale bird" and "bow-head bird."

THE COMMON REDSHANK (*Totanus calidris*).—Mr. Arthur Spary informs me that "a redshank was picked up on the Midland Railway between St. Albans and Radlett in the month of June and brought to him to preserve." This bird has been reported on two previous occasions, one having been shot in the Colne meadows and two on the Tring Reservoirs.

Mr. T. Vaughan Roberts, in a letter dated the 30th of March, writes: "While on the little island at Russell Farm, between the back-water and the Canal, I saw first a kingfisher. I often see them here. Next one of my dogs flushed a water-rail which flew into a bush close to me and I had a splendid inspection. The red bill and the exquisite brown plumage were seen in the sun to the best advantage. The bird never moved until I did. We then started a wild duck. I had seen a badger caught the previous day in Cassiobury Park, so it was 'a red-letter day' for a naturalist."

I will now make a few observations on some of our more familiar birds, as it is equally interesting to study their song, habits, and many charming ways, as it is to report a *rara avis* which is generally shot or done to death as soon as it reaches us.

THE REDBREAST (*Erithacus rubecula*).—This bird can greatly vary its song. It has occurred to me when listening to it that at times the bird is a mimic, simulating the song of other birds. I have noticed its song in summer sometimes to differ from its well-known autumn strain which it commences some time in August. In July the robin, Mr. Seebohm states, is never heard to sing. This bird is one of the first to "salute the happy morn," as well as one of the latest to retire to rest. Besides its call-note it sometimes, with others, utters a singularly plaintive note (as if in trouble), with which the birds occasionally answer each other. Mr. Ashwell informs me that in the summer a robin's nest was

found in his ivy containing 12 eggs, and another close by containing 4 eggs.

THE NIGHTINGALE (*Daulias luseinia*).—This bird was first heard on the 11th of April near Welwyn by that enthusiastic observer, Mr. Buller, who writes: "I took a walk of eleven miles on purpose to try and hear him." The late Mr. Frank Buckland wrote: "The earliest place for nightingales is Welwyn in Hertfordshire, where they arrive as early as the 10th of April." I have read that the nightingale usually arrives in this country as early as the first week in April. Mr. Arthur Lewis heard the bird on the 18th, and this is about the usual date for it to be heard at St. Albans. Should the weather prove favourable, the first month or six weeks after their arrival is a very good time to hear their unrivalled melody. Game-preserving doubtless favours many of our warblers by the protection it affords them during incubation, but Mr. Richard Jefferies states that a naturalist has recorded that in a district he visited, the nightingales were always shot by the keepers and their eggs smashed because the singing of these birds at night disturbed the repose of the pheasants. It is interesting to note that although, owing to the late spring, the buds in the hedges had hardly burst, affording little or no protection from the bitter cold wind, the nightingale should still keep his appointed time.

THE MARTIN (*Chelidon urbica*).—This is a most agreeable and sociable bird. It appears to take a deep interest in its neighbours' welfare. It will visit its neighbours' nests and they will return the compliment. The old ones as well as the young will frequently toy and play in front of their nest. The bird is fond of singing in its nest; although not a loud songster it has a very agreeable soothing sound as if it were rehearsing its song in secret. It seldom passes or flies up to the nest without saying "tweet," which we may translate into "sweet." The bird is equally polite on leaving its nest. The martin is a harmless, innocent, and useful little bird, and ought always to receive the protection it so richly deserves; for the number of insects destroyed by this species alone in a single summer must be enormous.

One of the chief features of interest in the bird-life of the year which calls for remark is the protracted stay of the swallow (*Hirundo rustica*), martin (*Chelidon urbica*), and swift (*Cypselus apus*), reports on which have reached the office of the 'Field' newspaper from numerous parts of the country. The paper states: "As to the cause of the protracted stay of these birds beyond the usual time of their departure, there is abundant room for speculation. Without knowing more of the conditions under which the birds . . . were observed, that is to say, the state of the weather, temperature, and direction of the wind, it is perhaps hardly wise to express any decided opinion on the subject, but we may hazard the conjecture that their movements were to a great extent controlled by the mildness of the late autumn, the unusual moistness of the air, and the prolonged existence of insect life, affording a continuous supply

of food." The paper also says: "Several observers have remarked upon the re-appearance of swallows and martins after they were believed to have departed for the winter. This re-appearance of the birds some time after they were supposed to have migrated admits of various explanations. (1) They may be individuals of late broods, which were not strong enough to accompany the majority at the usual period of their departure. (2) They may be birds which, reared at some distance further north, are gradually making their way southwards. (3) They may be birds which have already attempted to leave our shores, but being driven back by adverse winds or unfavourable weather, have returned to their summer quarters." It is probable that a few of the swallows and perhaps house-martins remain in some parts of Great Britain during the winter months. In what state they exist, and how they subsist, it is difficult at present to say.

THE ROOK (*Corvus frugilegus*).—Mr. Arthur Dickenson informs me that he has found Guinea fowls' eggs, as well as the China ones placed in the nests, carried into the field and left there. He credits the rooks with this piece of mischief. We can account for the birds dropping the China eggs, finding them to be too indigestible a morsel, and, as doubt exercises a powerful influence on the mind, they might think that there was something "uncanny" about eggs in general after their experience with the baulkers, and wisely determine to discard them for the future altogether from their bill of fare. He also informs me that he has been in the field and noticed the rooks circling around a turkey's nest, and he concludes that they were waiting to steal the egg as soon as the bird laid it and he should depart. I must confess that I am somewhat incredulous about this.

THE SWIFT (*Cypselus Apus*).—I once noticed a swift struggling on the road, unable to rise. I was going to the bird's assistance, when a carter passing by kindly picked the bird up and threw it in the air. Gilbert White remarks: "They never settle on the ground but through accident, and when down can hardly rise on account of the shortness of their legs and the length of their wings." Their prolonged stay was one of the notable events of bird-life last year. Mr. Rooper writes to me: "The actual departure of the swifts is so rarely witnessed that I think it worth your noting that a friend of mine, Sir T. Martin, on the 4th of August at 10 a.m., saw a large body, perhaps one hundred, after circling around, fly off westward. This occurred in Derbyshire."

Albinism.—Mr. Cain writes: "I stuffed a white thrush with almost red eyes for Mr. C. Dickenson, Harpenden Road. The bird was caught on his grounds by his cat last summer." From his description of the bird I have no doubt but that it was a song-thrush and a true albino. Mr. Cain also showed me, a short time since, a perfectly white swallow. It had been shot by Mr. King at Langford in August. Although the bird was not actually killed in Hertfordshire, it is so interesting an event that it ought to be recorded.

The following observations of the arrival, etc., of our summer migrants and other visitants have been made.

SUMMER MIGRANTS.

SPECIES.	LOCALITY.	DATE.	OBSERVER.
WHEATEAR (<i>Saricola œnanthe</i>)	Near St. Albans..	April 3.....	A. Dickenson.
REDSTART..... (<i>Ruticilla phœnicurus</i>)	Welwyn	„ 28.....	G. J. Buller.
NIGHTINGALE (<i>Daulias luscinia</i>)	Near Welwyn	„ 11.....	„
	St. Albans	„ 18.....	A. Lewis.
WHITETHROAT..... (<i>Sylvia cinerea</i>)	St. Albans	May 12.....	H. Lewis.
BLACKCAP..... (<i>Sylvia atricapilla</i>)	St. Albans	„ 17.....	„
CHIFF-CHAFF..... (<i>Phylloscopus rufus</i>)	St. Albans	April 5.....	„
WILLOW-WREN..... (<i>Phylloscopus trochilus</i>)	St. Albans	„ 19.....	„
SEDGE-WARBLER..... (<i>Acrocephalus phragmitis</i>)	Welwyn	„ 28.....	G. J. Buller.
	St. Albans	May 14.....	H. Lewis.
YELLOW WAGTAIL..... (<i>Motacilla Raii</i>)	Welwyn	April 18.....	G. J. Buller.
TREE-PIPIPIT..... (<i>Anthus trivialis</i>)	St. Albans	„ 20.....	H. Lewis.
SWALLOW..... (<i>Hirundo rustica</i>)	Ware.....	„ 16.....	J. W. Mason.
	St. Albans	„ 19.....	H. Lewis.
	Welwyn	„ 19.....	G. J. Buller.
	(Last seen) Rickmansworth ..	Oct. 9.....	T. Hope.
	„ St. Albans	„ 15.....	H. Lewis.
	„ Watford	„ 20.....	F. Rooper.
	„ St. Albans	Nov. 18.....	F. Hibbert.
MARTIN..... (<i>Chelidon urbica</i>)	St. Albans	April 20.....	H. Lewis.
	Welwyn	„ 22.....	G. J. Buller.
	(Last seen) St. Albans	Nov. 12.....	H. & J. Lewis.
SWIFT..... (<i>Cypselus Apus</i>) (Last seen).	St. Albans	April 30.....	H. Lewis.
	St. Albans	Sept. 5.....	J. Lewis.
WRYNECK..... (<i>Ijnx Torquilla</i>)	Welwyn	April 12.....	G. J. Buller.
	St. Albans	„ 16.....	A. Lewis.
CUCKOO..... (<i>Cuculus canorus</i>)	Welwyn	„ 13.....	G. J. Buller.
	St. Albans	„ 20.....	H. Lewis.
TURTLE DOVE..... (<i>Turtur communis</i>)	St. Albans	„ 27.....	A. Dickenson.

AUTUMN AND WINTER VISITANTS.

REDWING..... (Last seen)	St. Albans	April 28.....	A. Dickenson.
(<i>Turdus iliacus</i>) (First seen)	St. Albans	Sept. 14.....	„
FIELDFARE..... „	St. Albans	„ 15.....	„
(<i>Turdus pilaris</i>)			

I may add that the swallow was seen as late as the 12th of December at Findhorn Bay, N.B., by Mr. H. B. Brooke; the martin on the 3rd of December at Norwich by Mr. R. J. Colman; and the swift on the 13th of November at Northampton by Mr. C. Law.

I wish in conclusion to thank my correspondents most heartily for their efficient help.

VI.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE,
ST. ALBANS, DURING THE YEAR 1891.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., President.

Read at Watford, 6th May, 1892.

LONGITUDE of Station, $0^{\circ} 20' 7''$ W.; Latitude, $51^{\circ} 45' 9''$ N.
Cistern of barometer 388 feet, ground-level at thermometer-screen
380 feet, and at rain-gauge 379 feet, above Ordnance Datum.
Thermometers (in Stevenson screen) 4 feet, and top of rain-gauge
1 foot, above the ground. Observations taken at 9 a.m.

The accompanying tables (pp. 70, 71) give the monthly means,
etc., of the daily observations in 1891, and the following is the
usual summary for the seasons.

MEANS FOR THE SEASONS FROM DEC. 1890 TO NOV. 1891.

Seasons, 1890-91.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0-10.
		Mean.	Daily Range.			Total.	Days.	
	ins.	°	°	in.	%	ins.		
Winter	30·226	33·4	12·0	·165	89	2·94	38	7·4
Spring	29·911	44·1	14·5	·231	80	6·04	50	7·4
Summer	29·937	58·3	14·8	·394	80	9·28	52	7·2
Autumn	29·888	49·6	13·4	·328	90	9·50	55	6·7

In the next table the chief results, monthly and annual, are
compared with the means for the ten years 1877-86 at Watford.

DIFFERENCE IN 1891 FROM MEANS OF 1877-86 AT WATFORD.

Months.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0-10.
		Mean.	Daily Range.			Total.	Days.	
	in.	°	°	in.	%	ins.		
January	+·135	-3·4	+2·2	-·022	+ 2	-0·36	+ 3	+0·4
February	+·530	-1·6	+5·3	-·025	=	-2·54	-13	-1·0
March	-·140	-1·8	-3·3	-·018	- 2	-0·06	+ 7	+0·8
April	+·119	-2·6	-0·5	-·022	+ 3	-1·51	- 3	+1·2
May	-·162	-2·1	-2·1	-·012	+ 7	+1·16	+ 4	+0·9
June	+·075	+0·2	-1·2	+·027	+ 7	-0·79	- 3	+1·1
July	-·010	-2·7	-2·2	-·016	+ 4	+0·39	+ 4	+0·5
August	-·106	-3·5	-3·8	-·023	+ 6	+1·67	+ 8	+0·2
September	+·056	+1·3	-0·2	+·030	+ 2	-1·59	+ 2	-0·6
October	-·151	+1·2	-0·7	+·032	+ 4	+3·29	+ 5	-0·5
November	-·052	-0·3	-0·8	+·010	+ 5	-0·89	=	+1·9
December	+·015	+2·3	+3·5	+·014	=	+1·40	+ 3	-1·7
Year	+·026	-1·1	-0·3	-·002	+ 3	+0·17	+17	+0·3

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, IN 1891.

MONTHS.	PRESSURE OF THE ATMOSPHERE.	TEMPERATURE OF THE AIR.										HUMIDITY OF THE AIR.		
		9 a.m.	Means of		Mean.	Mean Daily Range.	Absolute Min. and Max.				Absolute Range.	Dryness.	Tension of Vapour.	Relative Humidity.
			Min.	Max.			Min.	Date.	Max.	Date.				
January	ins. 30·164	° 32·6	° 27·7	° 39·3	° 33·2	° 11·6	° 14·7	° 11th	° 50·3	° 31st	° 35·6	° 1·9	in. ·172	% 92
February	30·488	° 36·3	° 31·4	° 47·0	° 38·2	° 15·6	° 21·9	° 24th	° 65·3	° 28th	° 43·4	° 3·0	·190	89
March	29·836	° 39·0	° 34·2	° 45·7	° 39·6	° 11·5	° 22·3	° 12th	° 58·4	° 2nd	° 36·1	° 5·5	·192	81
April	29·995	° 43·3	° 35·4	° 51·3	° 43·3	° 15·9	° 29·0	° 1st	° 61·9	° 30th	° 32·9	° 6·2	·221	79
May	29·803	° 49·6	° 41·4	° 57·4	° 49·5	° 16·0	° 30·3	° 17th	° 74·9	° 12th	° 44·6	° 6·4	·279	79
June	30·044	° 58·6	° 50·3	° 67·2	° 58·7	° 16·9	° 42·6	° 11 & 12	° 74·0	° 19th	° 31·4	° 6·2	·394	80
July	29·942	° 59·1	° 50·7	° 65·7	° 58·5	° 15·0	° 44·5	° 28th	° 77·9	° 17th	° 33·4	° 7·0	·391	78
August	29·825	° 57·6	° 51·2	° 63·7	° 57·5	° 12·5	° 42·4	° 30th	° 71·7	° 14th	° 29·3	° 5·1	·396	83
September	30·027	° 58·1	° 49·5	° 65·6	° 57·7	° 16·1	° 42·2	° 24th	° 79·6	° 11th	° 37·4	° 4·6	·410	85
October	29·777	° 49·6	° 43·1	° 55·9	° 49·5	° 12·8	° 30·7	° 31st	° 62·4	° 1st	° 31·7	° 2·3	·327	91
November	29·860	° 41·3	° 36·3	° 47·5	° 41·7	° 11·2	° 27·2	° 8th	° 55·0	° 19th	° 27·8	° 1·6	·244	94
December	29·981	° 38·9	° 33·2	° 46·8	° 39·6	° 13·6	° 11·8	° 24th	° 54·6	° 5 & 31	° 42·8	° 2·8	·213	90
Year	29·978	° 47·0	° 40·4	° 54·4	° 47·3	° 14·0	° 11·8	° Dec.	° 79·6	° Sept.	° 67·8	° 4·4	·286	85

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, IN 1891—(continued).

TAKEN AT ST. ALBANS IN 1891.

71

MONTHS.	RAINFALL.				CLOUD.		WIND.											
	Total Fall. Ins.	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.	Date.	Rain or Snow.	Snow only.		Clear Sky.	Overcast.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
January	2.23	.45	29th	20	8	8.0	2	19	1.8	5	2	0	1	2	7	2	6	6
February	.05	.02	6th	4	0	6.6	8	16	1.3	4	3	2	3	3	3	4	2	4
March	1.60	.55	7th	19	11	7.1	4	13	2.8	5	4	0	1	3	3	8	7	0
April .....	.87	.37	4th	12	1	7.7	3	18	2.2	5	4	6	3	1	5	2	4	2
May	3.57	.96	24th	19	3	7.3	2	13	2.0	6	5	1	2	2	6	4	5	0
June	2.07	1.04	25th	11	0	7.4	2	10	1.9	6	7	3	1	3	5	2	3	0
July	2.92	.48	8th	19	0	7.0	1	10	2.0	3	2	0	0	3	8	7	5	3
August	4.29	1.35	20th	22	0	7.1	1	11	2.2	2	0	0	0	4	10	9	5	1
September	1.02	.20	14th	15	0	5.8	4	7	1.9	2	2	2	1	6	8	5	3	1
October	6.35	1.13	6th	22	0	6.0	9	15	1.7	3	4	0	2	6	8	3	0	5
November	2.13	.61	10th	18	0	8.4	1	20	1.4	5	3	0	4	2	7	3	2	4
December	4.03	.81	1st	20	0	5.6	10	13	2.0	0	1	2	3	3	8	7	3	4
Year	31.13	1.35	Aug.	201	23	7.0	47	165	1.9	46	37	16	21	38	78	56	45	30

The mean temperature of the year was very low, and the mean daily range of temperature was small. There were no high maxima, the extreme being $79^{\circ}6$, in September, but in December the low minimum of $11^{\circ}8$ was reached. The temperature was not nearly so variable as in the previous year, every month from January to August being cold, except June which had about a normal temperature, while each month after August was warm, except November which had about a normal temperature. The mean daily range of temperature was less than the average. The mean pressure of the atmosphere was a little above the average of the ten years 1877–86 at Watford. The lowest pressure recorded at 9 a.m. was 28.538 ins. on 11th November, and the highest was 30.338 ins. on 18th February, giving a range of 1.800 in. The rainfall was a little above the average of the ten years 1877–86, but much above the average of a long period, these years having been unusually wet ones. February was unprecedentedly dry; October, on the other hand, was excessively wet. Rain fell on an unusually large number of days. The air was very humid, and the sky was cloudy. There was a greater preponderance of N. and W. winds, and a less preponderance of easterly winds (N.E. to S.E.), than usual.

In the winter of 1890–91 (Dec. to Feb.) the mean pressure of the atmosphere was very high, the mean temperature was very low, with a considerable mean daily range, and the rainfall was very small. In the spring (March to May) the mean pressure was nearly the average, the mean temperature was low, with a small mean daily range, and the rainfall was rather small. In the summer (June to Aug.) the mean pressure was about the average, the mean temperature was low, with a small mean daily range, and the rainfall was heavy. In the autumn (Sept. to Nov.) the mean pressure was rather low, the mean temperature was rather high, and the rainfall was heavy. In each season except the winter the air was humid and rain fell on a large number of days; in the winter the air was rather dry and rain fell on very few days. In the spring, summer, and autumn the sky was cloudy.

The deviations in each season from the means of our period are as follows:—

DIFFERENCE IN 1890–91 FROM MEANS OF 1877–86 AT WATFORD.

Seasons, 1890–91.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0–10.
		Mean.	Daily Range.			Total.	Days.	
	in.	°	°	in.	%	ins.		
Winter	+ .242	−4.5	+2.0	−.038	− 1	−4.87	−14	=
Spring	−.028	−2.3	−1.9	−.017	+ 3	−0.41	+ 8	+1.0
Summer	−.014	−1.9	−2.4	−.004	+ 5	+1.27	+ 9	+0.8
Autumn	−.049	+0.7	−0.5	+ .025	+ 4	+0.81	+ 7	+0.7

NOTES ON THE MONTHS.

JANUARY.—Very cold, cloudy, with a rather humid atmosphere of high pressure, and an average rainfall (for the first three weeks almost entirely in the form of snow) on a considerable number of days. For the last thirteen days rain (or snow) fell every day, the average per day being 0·14 in. The earlier part of the month was much colder than the later part, the mean temperature from 1st to 20th being 28°·6, and from 21st to 31st 41°·2. Coldest day 18th, mean 22°·5; warmest day 29th, mean 46°·0. Min. below 32° on 21 days, below 22° on 10 (7th to 12th and 17th to 20th); max. above 42° on 10 days.

FEBRUARY.—Rather cold and bright, with an atmosphere of average humidity and exceedingly high pressure, and an unprecedentedly small rainfall, the only actual fall of rain being 0·02 in. on 6th. No snow fell. Towards the end of the month there was much fog, every day from 18th to 25th being more or less foggy, and on each of three of these days (21st, 22nd, and 24th) 0·01 in. of water collected in the rain gauge, the result of condensed fog. This, being entered as rain, brings up the total fall to 0·05 in. Coldest day 24th, mean 31°·1; warmest day 27th, mean 47°·9. Min. below 32° on 15 days, below 22° on 1 day (24th); max. above 42° on 22 days, above 52° on 4 (25th to 28th).

MARCH.—Rather cold and cloudy, with a rather dry atmosphere of low pressure, and an average rainfall (about one-third in the form of snow) on a considerable number of days. Rain (or snow) fell every day from 6th to 27th, except on 12th, 18th, and 19th. The first week was much warmer than the rest of the month, having a mean temperature of 46°·7. Coldest day 10th, mean 29°·6; warmest day 2nd, mean 51°·8. Min. below 32° on 13 days; max. above 42° on 25 days, above 52° on 6. There was a thunderstorm at about 4 p.m. on 27th, on which day snow fell. The blizzard of the 9th has been mentioned in my "Report on the Rainfall" (p. 60).

APRIL.—Cold and cloudy, with a rather humid atmosphere of rather high pressure, and a very small rainfall on a rather small number of days. Snow fell on 12th only, with hail. Coldest days 1st, mean 39°·1, and 8th, mean 39°·2; warmest day 31st, mean 53°·2. Min. below 42° every day but one (31st), below 32° on one day only (1st); max. above 52° on 12 days.

MAY.—Cold and rather cloudy, with a humid atmosphere of low pressure, and a heavy rainfall on a considerable number of days. Rain (or snow) fell every day from 15th to 30th, except on 19th and 23rd. Snow fell on 16th, 17th, and 18th, to a total depth of nearly a foot (= 0·88 in. of rain). Temperature was very changeable. Coldest day 17th, mean 39°·9; warmest day 13th, mean 63°·9. Min. below 42° on 15 days, below 32° on 2 (17th and 19th); max. above 62° on 9 days, above 72° on 2 (12th and 13th).

JUNE.—Of average temperature, rather bright, with a humid atmosphere of rather high pressure, and a rather small rainfall

on a small number of days. No rain fell from 6th to 22nd (17 days) except 0·07 in. on 15th. Coldest day 7th, mean $49^{\circ}\cdot6$; warmest days 19th, mean $64^{\circ}\cdot4$, and 25th, mean $64^{\circ}\cdot6$. Min. below 52° on 18 days; max. above 62° on 25 days, above 72° on 7.

JULY.—Cold and cloudy, with a humid atmosphere of average pressure, and a rather heavy rainfall on a considerable number of days. Rain fell every day for the first eight and last six days. On 6th 0·44 in. fell in 20 minutes, from 2.20 to 2.40 p.m., being at the rate of 1·32 in. per hour. Coldest day 29th, mean $54^{\circ}\cdot2$; warmest day 17th, mean $66^{\circ}\cdot1$. Min. below 52° on 20 days; max. above 62° on 24 days, above 72° on 3 (16th, 17th, and 25th). There were thunderstorms on several days (6th with 0·44 in. rain, 7th with 0·27 in., and 8th with 0·48 in.).

AUGUST.—Very cold and cloudy, with a humid atmosphere of rather low pressure, and a very heavy rainfall on a large number of days. Rain fell every day from 19th to 28th (10 days), the average per day being upwards of a quarter of an inch. Coldest day 30th, mean $52^{\circ}\cdot6$; warmest day 14th, mean $64^{\circ}\cdot6$. Min. below 52° on 18 days; max. above 62° on 23 days. There were thunderstorms during the first few days.

SEPTEMBER.—Rather warm, bright, with a rather humid atmosphere of rather high pressure, and a very small rainfall on about an average number of days. The six days 8th to 13th were very warm, having an average temperature of $64^{\circ}\cdot8$. Coldest day 24th, mean $52^{\circ}\cdot2$; warmest days 12th, mean $66^{\circ}\cdot2$, and 13th, mean $66^{\circ}\cdot0$. Min. below 52° on 21 days; max. above 62° on 21 days, above 72° on 5 (9th to 13th).

OCTOBER.—Rather warm and bright, with a humid atmosphere of very low pressure, and an excessive rainfall on a large number of days; in fact the wettest month since I commenced my observations at St. Albans. Rain fell every day from 5th to 22nd (18 days), the average per day being 0·31 in. Coldest day 31st, mean $38^{\circ}\cdot0$; warmest day 1st, mean $58^{\circ}\cdot0$. Min. below 42° on 13 days, below 32° on 1 day (31st); max. above 52° on 25 days, above 62° on 1 day (1st). A lunar rainbow was observed on the 17th.

NOVEMBER.—Of average temperature, very cloudy, with a very humid atmosphere of rather low pressure, and a rather small rainfall on an average number of days. Rain fell every day from 8th to 18th (11 days), the average per day being 0·15 in. The last nine days were very cold, having an average temperature of $36^{\circ}\cdot7$. Coldest day 30th, mean $35^{\circ}\cdot1$; warmest day 19th, mean $50^{\circ}\cdot3$. Min. below 42° on 24 days, below 32° on 7; max. above 52° on 6 days. There was an exceptional and very sudden depression on 11th, the pressure at 9 a.m. being 28·538 ins., about an inch lower than the pressure at 9 a.m. on 10th and at 9 a.m. on 12th, and exactly an inch lower than the mean of these. From 9 a.m. to 6 p.m. on 11th the mercury rose about half an inch, and by 11 p.m. it had risen another quarter of an inch. At the time of lowest pressure rain was falling heavily and a gale of wind was blowing.

DECEMBER.—Very mild and bright, with an atmosphere of average humidity and rather high pressure, and a heavy rainfall on a considerable number of days. Although a warm month on the whole, the week ending 25th inst. was exceedingly cold, having a mean temperature of only $23^{\circ}\cdot 0$ (9 a.m. $23^{\circ}\cdot 5$, min. $19^{\circ}\cdot 0$, max. $36^{\circ}\cdot 6$). Rain fell every day for the first ten days, averaging 0·20 in. per day. Coldest day 24th, mean $21^{\circ}\cdot 1$; warmest day 5th, mean $50^{\circ}\cdot 6$. Min. below 42° on 24 days, below 32° on 12, below 22° on 5 (20th, and 22nd to 25th), below 12° on 1 day (24th); max. above 42° on 26 days, above 52° on 8. (In December, 1890, the temperature never rose to 42° .) There was a silver thaw on Christmas Day. For nine days there had been no rain, but much fog, and a white frost every morning. Rain commenced to fall early on the 25th while the temperature was below 32° , and the roads and pavements were soon covered with a sheet of ice which only partially thawed in the afternoon and froze again at night.

VII.

A NATURALIST'S CALENDAR FOR MID-HERTFORDSHIRE.

By J. J. WILLIS.

(Communicated by the President.)

Read at Watford, 6th May, 1892.

HAVING taken Phenological Observations during the past fourteen years in accordance with a calendar of phenomena recommended for observation by the Royal Meteorological Society, and the calendar having now been reduced by Mr. E. Mawley, the Phenological Recorder to the Society, from 79 species of plants, 11 of insects, 21 of birds, and one amphibian, to 13 species of plants, 5 of insects, and 5 of birds, it seems desirable to bring together, in a condensed form, the facts already ascertained.

The observations were taken at Harpenden, in Mid-Hertfordshire, $51^{\circ} 48'$ N. Latitude, and $0^{\circ} 21'$ W. Longitude, and have extended over the fourteen years 1878 to 1891 inclusive, but as the list of phenomena to be observed was altered and extended by the Meteorological Society between 1882 and 1883, the observations of the same species do not in every case run through the fourteen years.

The record has therefore been divided into two equal periods of seven years each, which in itself will, I think, be found of value; the *earliest* and the *latest* date and year within each of these periods is also given.

The first column of figures in the table gives the total number of observations made for each species of plant, insect, and bird; the next four columns record the earliest and latest date at which each phenomenon was noted within the two periods of seven years each; the next column gives the mean dates of all the observations obtained at Harpenden; and the last column in the table shows the difference by number of days between the mean dates of most of the phenomena in Mid-Herts and in South-west Herts, the dates for that district being those given by Mr. Hopkinson for the neighbourhood of Watford, as the result of his observations extending over the twelve years 1875 to 1886 inclusive.*

Referring to the data given in the table we find that in the first seven years, 1878 to 1884, the season of 1882 was the most forward, while that of 1879 was the most backward.

In the second seven years, 1885 to 1891, there were two seasons giving very early dates, namely those of 1885 and 1890, while the most backward seasons in the same period were those of 1888 and 1891.

As a rule, in the second seven years the earliest dates of flowering of the various species of plants, and the first appearance of the insects and migratory birds, were later than during the first

* "A Naturalist's Calendar for the South-west of Hertfordshire."—'Trans. Herts. Nat. Hist. Soc.,' vol. v, p. 129 (1889).

seven years, showing pretty plainly that the second period was the colder of the two.

It is somewhat remarkable to find so great a difference in the time of blooming of our wild flowers in Mid-Herts compared with those of South-west Herts, the former being almost invariably later, although the general character of the soil and subsoil is very similar. Taking the whole of the comparable observations, the results show 49 species later in their time of blooming in Mid-Herts than in South-west Herts, while only 14 species give an earlier record.

It has long been observed that nature in her operations is so uniform that the coming forth of the insects from their winter's sleep, the return of the birds, and the periods in which certain plants and trees unfold their leaves and flowers, afford an unerring indication of the arrival of spring. It was even a pleasant fancy of Linnæus which supposed that the different hours of the daytime could be denoted and ascertained by the opening and closing of certain flowers—making thus a floral clock.

Harold Burch, in his ingenious dissertation on the "Foliation of Trees," informs us that Linnæus in the most earnest manner exhorted his countrymen to observe with all care and diligence at what time each tree expanded its buds, and unfolded its leaves and blossoms; imagining not without reason that his country would some day or other reap some new and perhaps unexpected benefit from observations of this kind made in different localities.

How far the periodical phenomena may be a guide to the forwardness or backwardness of the season, and as such an indication of the probable productiveness of our various food-crops, may be gathered from the following short summary of the early and late seasons brought to view by the results quoted in the table.

1879, a *Season of Late Records*.—January of this year was one of the coldest months ever recorded, the thermometer during the whole period having been below 32° F.; snow covered the ground, the days were nearly sunless, and the wind N. and N.E. February also was very cold, with a great excess of rain and a great deal of snow. March was first warm, then cold, and on the 21st very cold with snow; but the last few days of the month were warm. The first quarter of the year ending March 31st may be described as exceedingly cold, with much rain and snow. The next three months may be summed up in a few words, as cold, wet, and sunless; while Mr. Glaisher further informs us that for lowness of temperature, the eight months beginning with November 1878, and ending with June 1879, have only been once exceeded during the one hundred years and upwards which have elapsed since the first records were kept at Greenwich. July was cold, damp, and sunless, rain falling every day during the first half of the month, and frequently afterwards, sometimes mixed with snow.

The year was a most disastrous one for our English farmers. It was estimated that the cereal crops of the country were not more than half the average. It is also a fact worthy of notice, that in

Northamptonshire on the 1st of November was seen a field of wheat in shocks, and with a portion still remaining to be cut. Potato disease appeared in a most virulent form.

This year the daffodil was 26 days later in blooming than in the preceding year (1878), the willow 11 days, the snowdrop 16 days, the wych elm 27 days, and the ivy-leaved veronica 24 days later. In fact wild flowers were particularly shy of coming into bloom. And so bitterly cold was the beginning of May that young birds were found frozen in their nests, and the blossoms fell from the gooseberry bushes.

In order to convey some idea of the backwardness of the season, I append a table of some well-known wild plants, showing the time of flowering at Harpenden in the month of May, 1879, and the dates in the preceding year.

Species.	1879. May.	1878.	Difference in Days.
<i>Prunus spinosa</i> (Blackthorn)	1st	Feb. 27	62
<i>Anthriscus silvestris</i> (Cow-parsley)	1st	Mar. 15	47
<i>Stellaria Holostea</i> (Greater Stitchwort)	4th	Mar. 27	38
<i>Cardamine pratensis</i> (Cuckoo-flower)... ..	4th	Apl. 7	27
<i>Ranunculus acris</i> (Upright Crowfoot)	8th	Apl. 17	21
<i>Ajuga reptans</i> (Creeping Bugle)... ..	17th	May 4	13
<i>Plantago lanceolata</i> (Ribwort-plantain)	18th	Apl. 23	25
<i>Scilla nutans</i> (Blue-bell)	19th	Apl. 18	31
<i>Veronica chamædrys</i> (Germander Speedwell)	26th	Apl. 21	35
<i>Vicia sepium</i> (Bush-Vetch)	29th	Apl. 22	37
<i>Geranium Robertianum</i> (Stinking Cranesbill)	30th	May 5	25

Thus we have shown in this short list a mean difference of 33 days between the seasons of 1878 and 1879, and it may be stated that seldom within the memory of the oldest person amongst us could a season more backward be remembered.

1882, *a Season of Early Records*.—January was excessively warm and dry, vegetation was very forward, and wild flowers were particularly early; indeed from November, 1881, to the end of March, 1882, the weather may be described as having been most favourable for all out-door crops; and rooks took advantage of its unusual mildness to commence nesting several days in advance of their usual time. April was generally warm until towards the end of the month, with more than an average rainfall. May, except during one week at the commencement, was a warm and "growing" month, and the rainfall was less than the average. June was cold and unseasonable throughout, with an excess of rain which seriously damaged the luxuriant crops of hay. July was cold, wet, and ungenial, and this weather, following upon a cold and wet June, greatly interfered with the ripening of cereal crops, and caused a prevalence of potato disease. But at harvest, taking the crops

all round, the season was considered to have been a bountiful one. In fact we should have to go back more than 10 years to find one equal to it in productiveness.

1885, *a Season of Early Records*.—January exhibited the usual characteristics of the month, the first three weeks being frosty, and the closing week milder; and the mean temperature being exceedingly low, vegetation was kept healthily back. February was wet and changeable. The approach of spring was very gradual, owing to the fine days of March being robbed of their stimulating effect upon vegetation by the low night temperatures. April was mostly fair, cold, and dry. This weather being followed by a cold wet May, vegetation as a whole has seldom been more backward at the beginning of June, many wild flowers being from 10 to 14 days later in blooming than in 1884, and the migratory birds were much later in arriving than usual. Thus, owing to the changeable conditions, the early promise was not altogether realised, and the corn crops, while they were about an average in quantity, were low in quality.

1888, *a Season of Late Records*.—January was unusually dry, while February gave a continuance of severe weather, with frequent snow storms, the drifts in some places being several feet in depth. In March vegetation was reported to be particularly backward, and the sowing of all spring seeds was much delayed by the wetness of the surface-soil, especially on heavy land. April was a month of unsettled and inclement weather, with bleak and withering easterly winds, which were exceedingly trying both to animal and vegetable life. May was fairly genial, but yielded a small rainfall; the comparative absence of soil-moisture was, therefore, a great drawback to vegetation, especially to shallow-rooting plants. June was exceedingly deficient in bright sunshine and forcing heat, with a variable but low temperature; the total rainfall was excessive, owing to a severe thunder-storm on the 26th, when $3\frac{1}{4}$ inches of rain were recorded at the Rothamsted Experimental Station. The season as a whole may be pronounced as gloomy as it was chilly, and it would have been surprising if our phenological phenomena had been otherwise than very late.

1890, *a Season of Early Records*.—January was characterised for its mildness and uniformly high temperature, causing many outdoor flowers to produce bloom in great profusion, especially the primrose. Daffodils and strawberries were also reported to be in flower in adjoining districts. The hazel-nut bloom was quite a fortnight before its average time. The usual character ascribed to the second month of the year is "February fill-dyke," but that of 1890 was certainly an exception to the rule, the weather being particularly dry, and vegetation was about three weeks in advance of the usual date. March was unsettled, showery, and cold, yet a spell of fine, warm, spring-like weather prevailed towards the end of the month. So genial were some portions of March that a large white cabbage-butterfly was seen on the wing, and many of our

wild flowers, among which we may mention the wood-anemone, lesser-celandine, coltsfoot, dog's mercury, daffodil, and sweet field-violet, were generally observed in bloom, being quite a fortnight in advance of their time of flowering in the two previous years. But although the season was early, the occasional cold nights of March sufficed to prevent that inopportune and over-hasty development of vegetation which comes of a continuance of very mild weather at this period of the year.

There is an old "distich" which says :

" When the oak's before the ash
We shall have plenty of corn to thrash ;
But when the ash buds before the oak,
Then we're sure to have a soak."

In 1890 the oaks in this neighbourhood were nearly in full leaf before the ash-buds had barely begun to show, nevertheless June was unsettled, showery, and cold, with a less than average amount of bright sunshine, and July gave a considerable excess of rain, which greatly "lodged" and damaged the cereal crops, while the hay crops were very variable in quantity, and by no means secured in good condition.

1891, *a Season of Late Records*.—Our migratory feathered friends revealed to us pretty plainly that the spring of 1891 was a backward one. The ploughing of land was delayed, and spring-work was crowded into a brief and hurried space. The inclemency of the weather also considerably retarded vegetation, and gave a low yield of hay, generally in poor condition. Yet at the beginning of July the cereal crops scarcely ever looked more promising. A change of weather, however, for the worse, after the second week of July, prevented satisfactory maturation of the grain, and the final results were below those of 1890. Less wheat, barley, oats, beans, peas, and turnips, and very considerably less hay, was reported to be available in 1891 than in the previous year. Against these reductions has to be set an increased yield of hops, mangolds, and potatoes.

NATURALIST'S CALENDAR FOR MID-HERTS. (HARPENDEN.)

PLANTS. (Dates of Flowering.)

PHENOMENA.	No. of Observations.	1st 7 years, 1878 to 1884.		2nd 7 years, 1885 to 1891.		Mean date of all observations.	Days later than South-west Herts.
		Earliest.	Latest.	Earliest.	Latest.		
FEBRUARY.							
<i>Galanthus nivalis</i> (Snowdrop)	14	Jan. 15, 1882	Feb. 20, 1880	Jan. 27, 1886	Feb. 21, 1891	Feb. 1	3
<i>Corylus Avellana</i> (Hazel)	14	Jan. 23, 1884	Feb. 20, 1880	Jan. 14, 1890	Feb. 17, 1886	Feb. 7	4
<i>Mercurialis perennis</i> (Dog's Mercury)	14	Jan. 14, 1882	Apr. 2, 1879	Mar. 14, 1890	Apr. 13, 1891	Feb. 28	5
MARCH.							
<i>Potentilla Fragariastrum</i> (Barren Strawberry)	5	Jan. 23, 1882	Apr. 11, 1879	.....	.....	Mar. 11	.....
<i>Veronica hederifolia</i> (Ivy-leaved Veronica)	5	Feb. 22, 1882	Mar. 29, 1879	.....	.....	Mar. 13	.....
<i>Tussilago Farfara</i> (Coltsfoot)	14	Feb. 17, 1882	Apr. 7, 1879	Mar. 14, 1885	Apr. 5, 1888	Mar. 14	10
<i>Ficaria verna</i> (Pilewort or Lesser Celandine)	14	Feb. 25, 1882	Apr. 7, 1879	Mar. 13, 1885	Apr. 6, 1888	Mar. 17	7 earlier
<i>Salix Caprea</i> (Great Sallow)	14	Mar. 3, 1882	Mar. 23, 1881	Feb. 20, 1890	Apr. 4, 1886	Mar. 17	6
<i>Viola odorata</i> (Sweet Violet)	7	.....	.....	Mar. 12, 1887	Mar. 28, 1888	Mar. 20	11
<i>Narcissus Psaulo-narcissus</i> (Daffodil)	14	Mar. 3, 1878	Mar. 30, 1879	Mar. 15, 1885	Apr. 4, 1887	May 21	8
<i>Anemone nemorosa</i> (Wood Anemone)	14	Mar. 1, 1884	Apr. 10, 1879	Mar. 16, 1890	Apr. 14, 1888	Mar. 23	8 earlier
<i>Ulmus montana</i> (Wych Elm)	12	Feb. 14, 1884	Apr. 31, 1879	Feb. 14, 1890	Apr. 1, 1888	Mar. 24	.....
<i>Draba verna</i> (Whitlow Grass)	14	Feb. 15, 1883	Apr. 19, 1879	Mar. 15, 1888	May 10, 1891	Mar. 30	.....
APRIL.							
<i>Primula veris</i> (Cowslip)	13	Mar. 5, 1881	Apr. 1, 1883	Mar. 29, 1890	Apr. 21, 1891	Apr. 2	1
<i>Anthriscus silvestris</i> (Cow-parsley)	5	Feb. 22, 1882	May 1, 1879	.....	.....	Apr. 3	.....
<i>Nepeta Glechoma</i> (Ground Ivy)	14	Mar. 15, 1878	Apr. 18, 1879	Apr. 2, 1890	May 3, 1888	Apr. 5	5

PHENOMENA.	No. of Observations.	1st 7 years, 1878 to 1884.		2nd 7 years, 1885 to 1891.		Mean date of all observations.	Days later than South-west Herts.
		Earliest.	Latest.	Earliest.	Latest.		
APRIL (continued).							
<i>Cardamine hirsuta</i> (Hairy Bittercress)	9	Mar. 4, 1882	Apr. 21, 1879	.....	.....	Apr. 11	.....
<i>Prunus spinosa</i> (Sloe or Black-thorn)	14	Mar. 15, 1882	May 1, 1879	.....	May 4, 1891	Apr. 12	7
<i>Caltha palustris</i> (Marsh Marigold)	14	Mar. 15, 1883	Apr. 26, 1879	.....	May 7, 1891	Apr. 13	10
<i>Stellaria Holostea</i> (Greater Stitchwort)	14	Mar. 13, 1882	May 4, 1879	.....	May 6, 1891	Apr. 15	6
<i>Scilla nutans</i> (Blue-bell)	14	Mar. 27, 1884	May 19, 1879	.....	May 8, 1888	Apr. 20	0
<i>Cardamine pratensis</i> (Cuckoo Flower)	9	Mar. 27, 1882	May 4, 1879	.....	May 8, 1888	Apr. 24	19
<i>Gateopsis Tetralix</i> (Hemp Nettle)	6	Mar. 27, 1878	Apr. 31, 1880	.....	.....	Apr. 25	.....
<i>Ranunculus acris</i> (Upright Crowfoot)	14	Mar. 27, 1882	May 10, 1881	.....	May 14, 1887	Apr. 28	3 earlier
MAY.							
<i>Alliaria officinalis</i> (Garlic Mustard)	9	.....	.....	.....	.....	May 4	19
<i>Feronica chamaedrys</i> (Germander Speedwell)	14	Mar. 13, 1882	May 26, 1879	.....	May 11, 1888	May 5	10
<i>Ficaria verna</i> (Bush Vetch)	14	Mar. 12, 1882	May 29, 1879	.....	May 19, 1888	May 7	7
<i>Geranium Robertianum</i> (Herb Robert or Cranesbill)	14	Apr. 19, 1884	May 30, 1879	.....	June 8, 1891	May 11	12
<i>Ajuga reptans</i> (Creeping Bugle)	14	Apr. 18, 1882	May 17, 1879	.....	May 23, 1890	May 11	4
<i>Acer Pseudo-platanus</i> (Sycamore)	6	.....	.....	.....	May 27, 1888	May 12	.....
<i>Syringa vulgaris</i> (Lilac)	9	.....	.....	.....	May 19, 1891	May 16	.....
<i>Æsculus Hippocastanum</i> (Horse Chestnut)	9	.....	.....	.....	June 18, 1891	May 18	.....
<i>Potentilla anserina</i> (Silver-weed)	13	May 15, 1881	June 3, 1883	.....	May 25, 1891	May 23	1 earlier
<i>Cytisus Laburnum</i> (Laburnum)	9	.....	.....	.....	June 8, 1891	May 24	12
<i>Leucanthemum vulgare</i> (Ox-eye)	14	May 5, 1882	June 13, 1879	.....	June 6, 1891	May 25	2
<i>Crataegus Oxyacantha</i> (Hawthorn)	9	.....	.....	.....	June 10, 1891	May 25	10
<i>Sorbus Aucuparia</i> (Mountain Ash, or Rowan)	8	.....	.....	.....	June 2, 1887	May 26	.....
<i>Trifolium repens</i> (White or Dutch Clover)	13	Apr. 27, 1882	June 8, 1879	.....	June 1, 1821	May 27	4
<i>Galium aparine</i> (Cleavers)	14	May 7, 1882	June 13, 1879	.....	June 9, 1891	May 27	8
<i>Hieracium Pilosella</i> (Mouse-ear Hawk-weed)	13	Apr. 29, 1882	June 9, 1879	.....	June 16, 1887	May 28	11
<i>Orchis maculata</i> (Spotted Orchis)	13	Apr. 10, 1882	June 24, 1879	.....	June 6, 1889	May 29	9 earlier

JUNE.

<i>Lotus corniculatus</i> (Bird's-foot Trefoil).....	14	May 4, 1878	June 9, 1879	May 30, 1890	June 16, 1891	June 1	3
<i>Lycchnis Flos-cuculi</i> (Ragged Robin).....	14	May 18, 1884	June 20, 1879	May 30, 1885	June 14, 1891	June 3	4
<i>Erionymus europaeus</i> (Spindle-tree).....	4	.....	.....	June 3, 1885	July 9, 1886	June 3	.....
<i>Papaver Rhoeas</i> (Red Poppy).....	14	May 19, 1884	June 13, 1879	May 28, 1888	June 19, 1891	June 4	.....
<i>Rosa canina</i> (Dog Rose).....	14	May 18, 1882	June 28, 1879	June 3, 1890	June 20, 1891	June 7	0
<i>Malva silvestris</i> . (Common Mallow).....	9	May 6, 1878	July 2, 1879	June 14, 1885	July 11, 1887	June 8	4 earlier
<i>Lathyrus pratensis</i> (Meadow Vetchling).....	13	June 4, 1884	July 1, 1879	June 6, 1889	June 18, 1891	June 12	3
<i>Epilobium montanum</i> (Broad Willow-herb).....	13	June 7, 1878	June 27, 1879	June 13, 1889	June 30, 1887	June 12	5 earlier
<i>Stachys sylvatica</i> (Hedge Woundwort).....	12	May 31, 1882	June 30, 1879	June 8, 1890	June 20, 1887	June 12	0
<i>Iris Pseud-acorus</i> (Yellow Iris).....	10	May 30, 1882	June 17, 1878	June 9, 1889	June 30, 1888	June 12	6
<i>Polygonum vulgare</i> (Milkwort).....	11	June 1, 1878	July 6, 1882	May 31, 1886	June 18, 1885	June 13	24
<i>Carduus lanceolatus</i> (Spear Thistle).....	9	May 26, 1880	June 30, 1879	June 27, 1885	July 5, 1887	June 19	.....
<i>Cornus sanguinea</i> (Dog-wood).....	7	.....	.....	June 19, 1889	July 2, 1887	June 23	.....
<i>Spiraea Ulnaria</i> (Meadow-sweet).....	10	June 5, 1882	July 23, 1879	June 27, 1885	July 7, 1887	June 25	5
<i>Centaurea nigra</i> (Black Knap-weed).....	12	May 25, 1884	July 9, 1879	June 12, 1889	July 2, 1888	June 25	6
<i>Vicia cracca</i> (Tufted Vetch).....	10	June 24, 1884	July 13, 1880	June 18, 1888	July 2, 1886	June 27	1 earlier
<i>Ligustrum vulgare</i> (Privet).....	7	.....	.....	June 22, 1886	June 28, 1888	June 27	.....
<i>Gaium verum</i> (Yellow Bedstraw).....	12	June 29, 1878	July 15, 1879	June 8, 1885	July 7, 1888	June 30	6 earlier
<i>Achillea millefolium</i> (Milfoil or Yarrow).....	12	June 14, 1882	July 14, 1879	June 21, 1886	June 24, 1889	June 30	4
JULY.							
<i>Prunella vulgaris</i> (Self-heal).....	11	June 16, 1881	July 8, 1879	June 15, 1889	June 30, 1888	July 1	11
<i>Thymus Scryphium</i> (Wild Thyme).....	11	June 13, 1884	July 19, 1882	June 18, 1885	July 8, 1887	July 3	.....
<i>Carduus arvensis</i> (Field Thistle).....	12	June 19, 1881	July 23, 1879	June 28, 1885	July 7, 1886	July 4	16
<i>Campanula rotundifolia</i> (Hair-bell).....	12	June 21, 1880	July 22, 1879	June 20, 1886	July 15, 1885	July 4	4 earlier
<i>Hypericum pulchrum</i> (Upright St. John's Wort).....	11	June 15, 1878	July 14, 1881	June 24, 1885	July 17, 1887	July 5	7
<i>Scabiosa succisa</i> (Devil's-bit).....	3	June 29, 1881	July 10, 1880	.....	.....	July 5	12
<i>Senecio Jacobaea</i> (Ragwort).....	9	June 20, 1883	Aug. 4, 1879	June 9, 1886	July 15, 1887	July 6	6
<i>Sonchus arvensis</i> (Corn Sow-thistle).....	11	July 2, 1878	July 30, 1879	June 9, 1888	July 11, 1887	July 10	5 earlier
<i>Epilobium hirsutum</i> (Great Hairy Willow-herb).....	10	June 19, 1884	Aug. 6, 1879	June 11, 1885	July 18, 1888	July 12	3
<i>Hypericum tetrapetrum</i> (Square St. John's Wort).....	4	.....	.....	July 11, 1885	July 16, 1887	July 14	.....
<i>Convolvulus sepium</i> (Greater Bindweed).....	12	July 9, 1879	Sep. 3, 1879	July 9, 1886	Aug. 4, 1888	July 24	12

INSECTS, BIRDS, &c. (First appearance or arrival; Song; Nesting.)

PHENOMENA.	No. of Observations.	1st 7 years, 1878 to 1884.		2nd 7 years, 1885 to 1891.		Mean date of all observations.	Days later than South-west Herts.
		Earliest.	Latest.	Earliest.	Latest.		
		<i>Turdus muscivorus</i> (Song-thrush)—singing	14	Jan. 1, 1883	Feb. 10, 1879			Jan. 7, 1886	Feb. 9, 1891	Jan. 20	3
<i>Alauda arvensis</i> (Skylark)—singing	14	Jan. 6, 1883	Apr. 26, 1878	Jan. 8, 1888	Feb. 5, 1891	Jan. 25	2 earlier
<i>Apis mellifica</i> (Honey-bee)—working	8	.....	.....	Feb. 5, 1887	May 8, 1888	Feb. 20	5
<i>Corvus frugilegus</i> (Rook)—nesting	14	Feb. 24, 1882	Mar. 6, 1881	Feb. 27, 1885	Mar. 12, 1886	Mar. 3	6
<i>Strix Aluco</i> (Brown Owl)—heard	5	.....	.....	Jan. 31, 1887	Apr. 18, 1886	Mar. 20	.....
<i>Rana temporaria</i> (Common Frog)—spawning	12	Mar. 4, 1878	Apr. 1, 1882	Mar. 21, 1890	Mar. 30, 1888	Mar. 20	.....
<i>Timarcha levigata</i> (Bloody-nosed Beetle)—seen	7	.....	.....	Feb. 1, 1889	Apr. 17, 1888	Mar. 30	.....
<i>Pieris Brassicae</i> (Large White Butterfly)—seen	13	Mar. 5, 1883	Apr. 30, 1880	Mar. 28, 1886	Apr. 23, 1891	Apr. 7	11 earlier
<i>Vespa vulgaris</i> (Common Wasp)—seen	9	Mar. 20, 1884	Apr. 19, 1878	Feb. 12, 1885	Apr. 18, 1887	Apr. 7	.....
<i>Hirundo rustica</i> (Swallow)—seen	14	.....	.....	Mar. 31, 1885	Apr. 26, 1889	Apr. 15	.....
<i>Pieris Rapee</i> (Small White Butterfly)—seen	9	.....	.....	Apr. 5, 1890	May 5, 1889	Apr. 18	2
<i>Cucullus canorus</i> (Cuckoo)—calling	14	Apr. 12, 1882	Apr. 25, 1879	Apr. 12, 1890	Apr. 26, 1889	Apr. 20	10
<i>Dauhaus Luscinia</i> (Nightingale)—singing	14	Apr. 15, 1882	Apr. 23, 1879	Apr. 17, 1885	Apr. 28, 1890	Apr. 21	1
<i>Hirundo urbica</i> (House Martin)—seen	9	.....	.....	Apr. 21, 1885	May 11, 1880	Apr. 26	5
<i>Cyrex pratensis</i> (Cormorant)—heard	7	.....	.....	Apr. 16, 1887	May 14, 1888	May 3	.....
<i>Cypselus Apis</i> (Swift)—seen	8	.....	.....	May 3, 1887	May 19, 1891	May 8	.....
<i>Epinephile Janira</i> (Meadow-brown Butterfly)—seen	9	.....	.....	Apr. 15, 1891	June 7, 1885	May 9	1
<i>Anthocharis Cardamines</i> (Orange-tip Butterfly)—seen	8	.....	.....	Mar. 31, 1887	June 1, 1888	May 15	.....
<i>Melolontha vulgaris</i> (Cockchafer)—seen	5	.....	.....	May 28, 1886	June 6, 1887	May 29	.....
<i>Lampyrus noctiluea</i> (Glowworm)—seen	5	.....	.....	June 22, 1887	July 8, 1888	June 27	.....
<i>Bibio Marci</i> (St. Mark's Fly)—seen	4	.....	.....	June 11, 1887	July 28, 1889	June 28	.....

VIII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1891.

By EDWARD MAWLEY, F.R.Met.Soc., F.R.H.S.,
Phenological Recorder to the Royal Meteorological Society.

Read at Watford, 6th May, 1892.

THE present Report is not nearly so interesting or valuable as it would have been had the number of phenological observers been greater. It is therefore to be hoped that when it becomes generally known how easy the system of observation has recently been made, the staff of observers may be considerably increased. The localities where new observing stations are most required are the neighbourhood of Barnet and Watford in the south, and of Bishop Stortford, Buntingford, Baldock, and Royston in the north of the county. The work of observation is now rendered so simple that no member of this Society having any knowledge at all of our familiar wild-flowers, birds, and insects, need be afraid of undertaking it.

Returns were received last year from the following phenological stations:—

STATION.	Height above Sea-level.	OBSERVER.
St. Albans (The Grange)	380 feet.	Mrs. J. Hopkinson.
St. Albans (Malvern House)	300 ,,	Miss E. F. Smith.
St. Albans (St. Peter's Street)....	380 ,,	Henry Lewis.
Great Berkhamsted	400 ,,	Mrs. E. Mawley.
Harpenden	370 ,,	J. J. Willis.
Hertford	140 ,,	W. Graveson.
Hitchin	230 ,,	J. E. Little, M.A.

The plants on the list (see Table I, p. 87) flowered as a rule at the different stations in the following order:—1, Hertford; 2, Hitchin; 3, St. Albans; 4, Harpenden; and 5, Berkhamsted; or in the order of the heights of these localities above sea level—those growing at the lowest level being the earliest to come into flower and those at the highest level the latest.

THE WINTER OF 1890-91.

The weather continued very mild until the last week in November, when a severe frost all at once set in. This memorable frost did not break up until the third week in January. Consequently throughout these eight weeks all vegetable growths remained entirely at a standstill. On the farms scarcely a sound turnip or swede was anywhere to be found. In the gardens many half-hardy shrubs, as well as all the winter vegetables, were severely injured. It also proved a very trying time for birds, many of which succumbed to the cold and the want of suitable food. The remainder of the winter proved on the whole rather mild, while the duration of bright sunshine was much in excess of

the average. The first plant on the list, the hazel, was from 6 to 22 days late in coming into flower. The song-thrush commenced singing from 19 to 28 days later than the average date. The honey-bee was also from 21 to 32 days late in visiting flowers.

Mr. Hopkinson, writing from St. Albans during February, remarks: "The effect of trees in conveying moisture to the ground was at times very marked, quite a shower falling from them, and water running off the roads into the side ditches, while the dust was blowing on other parts of the road." As showing the lateness of the early spring flowers, the observer at Hitchin states that on February 28th "vegetation in the woods was very backward—no primroses, no violets, no celandine."

THE SPRING.

So few and brief were the spells of anything like unseasonably warm weather, that this season may be regarded as having been a cold one throughout. As might naturally be expected under such unfavourable conditions, all the spring wild flowers were extremely backward in making their appearance. The date of the first flowering of the coltsfoot was from 9 days earlier to 36 days later than the average, the wood anemone from 5 to 13 days late, the blackthorn from 19 to 34 days late, the garlic hedge-mustard from 4 to 19 days late, the horse chestnut from 7 to 21 days late, and the hawthorn from 3 to 19 days late. As regards our spring migrants, the swallow was from 2 days early to 13 days late in making its appearance, the cuckoo from 1 to 14 days late, and the nightingale from 4 days early to 13 days late. The wasp was from 50 days early to 12 days late. The small white butterfly was from 9 to 25 days late, the orange-tip butterfly 38 days late, and the meadow-brown butterfly 34 days early.

The above particulars are those derived from the observations sent in by the observers. As regards the coltsfoot, this is no doubt the most difficult plant on the list to observe correctly, owing to the small choice of plants observers often have. Considerable differences must therefore almost every year be expected in the dates given for it. Another year's observation will, however, show whether these differences are fairly consistent from year to year, and this after all is more important than the observer being able to select the particular group of plants which best represents the climate of his locality. The fruit-trees blossomed abundantly, and but for an unseasonably sharp frost at Whitsuntide the blossom would for once have escaped all injury from cold. During this spring quarter the farmers experienced much difficulty in providing sufficient keep for their cattle and sheep. On the other hand seldom if ever has the land, owing to the frost and continued dry weather, been at this season in such a splendid condition for working. At Berkhamsted frog spawn was first observed on March 1st. Mr. Lewis stated that at St. Albans nightingales were unusually abundant last year, and that they were still in song on the 19th of June.

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1891, WITH THE MEAN DATE FOR 1876-90.

SPECIES.	ST. ALBANS.		BERK- HAMSTED.	HAR- PENDEN.	HERT- FORD.	HITCHIN.	MEAN, 1876-90.
	The Grange.	Malvern House.					
Hazel	Feb. 9	.....	Feb. 17	Feb. 9	Feb. 1	Feb. 12	Jan. 26
Coltsfoot .....	.....	.....	Apl. 1	Mar. 28	Feb. 15	Mar. 1	Feb. 24
Wood Anemone....	.....	Mar. 28	.....	Mar. 30	Mar. 22	Mar. 30	Mar. 17
Blackthorn.....	.....	.....	May 4	May 4	Apl. 19	Apl. 28	Mar. 31
G. Hedge Mustard	May 7	.....	May 8	May 3	Apl. 23	Apl. 28	Apl. 19
Horse Chestnut....	May 23	May 31	May 30	May 25	May 17	May 23	May 10
Hawthorn	May 27	May 28	June 2	May 26	May 17	May 19	May 14
White Ox Eye .....	.....	June 4	.....	June 10	June 6	.....	May 19
Dog Rose	June 19	June 22	June 16	June 20	June 21	.....	June 4
Black Knapweed	June 27	June 22	.....	.....	June 21	.....	June 20
Harebell.....	.....	July 10	.....	.....	July 4	.....	July 5
Greater Bindweed	.....	Aug. 11	July 21	.....	July 23	.....	July 7
Ivy .....	.....	.....	Oct. 29	.....	Oct. 4	.....	Sept. 25

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1891, WITH THE MEAN DATE FOR 1876-90.

SPECIES.	ST. ALBANS.		BERK- HAMSTED.	HAR- PENDEN.	HITCHIN.	MEAN, 1876-90.	
	Malvern House.	St. Peter's Street.					
BIRDS.							
Song Thrush .....	.....	.....	Jan. 31	Feb. 9	.....	Jan. 12
Swallow	Apl. 25	Apl. 19	Apl. 10	Apl. 18	Apl. 17	Apl. 12	
Cuckoo	Apl. 26	Apl. 20	Apl. 22	Apl. 19	Apl. 13	Apl. 12	
Nightingale .....	.....	Apl. 19	Apl. 28	Apl. 21	Apl. 11	Apl. 15
Flycatcher .....	.....	.....	.....	.....	.....	.....
Swallow (last seen).....	.....	Oct. 15	Oct. 3	.....	.....	.....
INSECTS							
Honey Bee	Feb. 16	The Grange.	Malvern House.	Feb. 18	Feb. 27	Jan. 26
Wasp	Apl. 19	Apl. 9	Mar. 16	Feb. 16	Apl. 7
Small White Butterfly	Apl. 10	Apl. 26	Apl. 1
Orange-Tip Butterfly	June 14	May 7
Meadow-Brown Butterfly....	Apl. 15	May 19

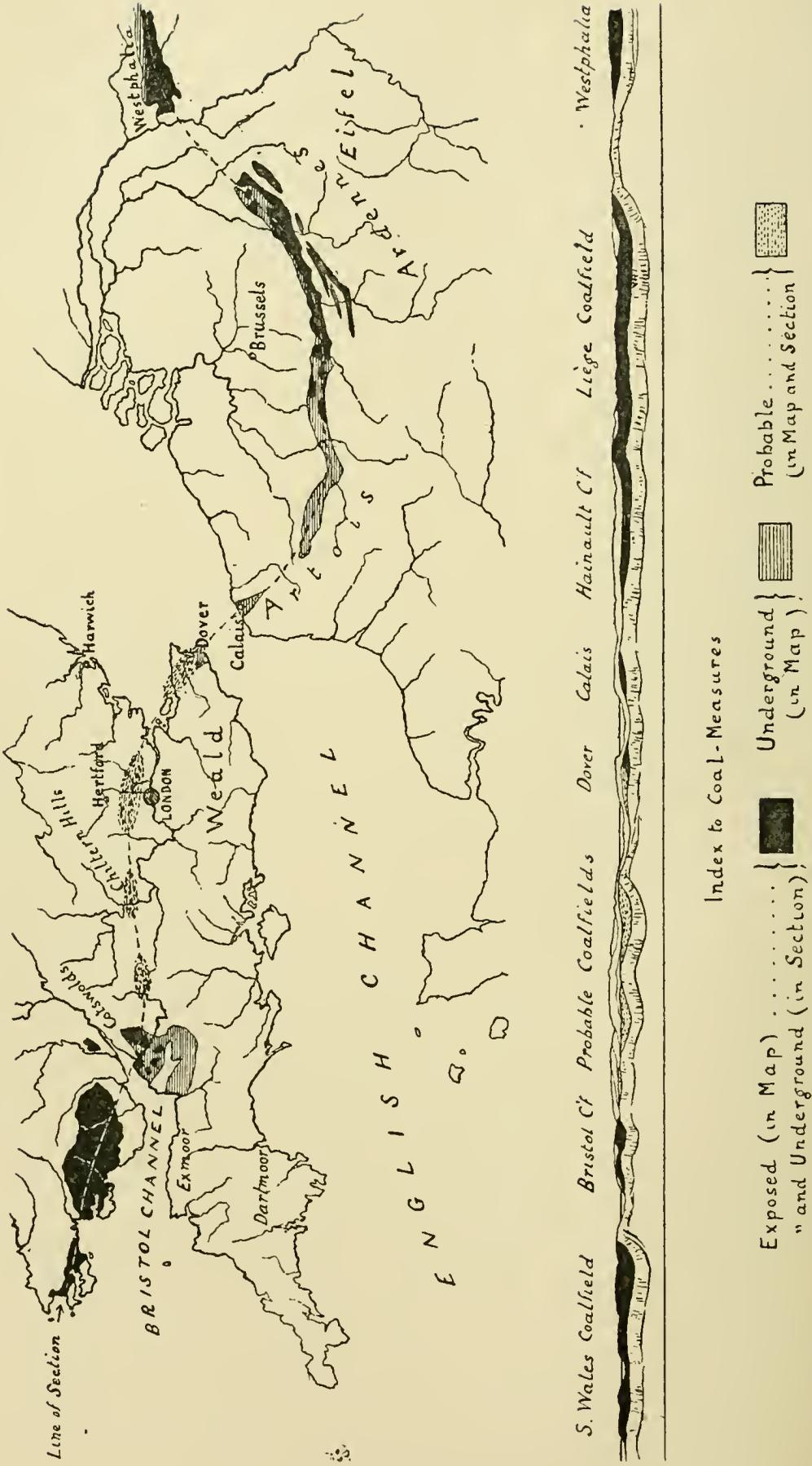
THE SUMMER.

June proved on the whole a rather genial month, but during the rest of the summer there occurred very few warm days. The fall of rain was light in June, and moderate in July, but August was an extremely wet month. Taking the whole season there was a great deficiency of sunshine. The only time when vegetation made anything like rapid progress was during the last fortnight in June. The effect of this growing weather on the flowering of plants will be at once seen on reference to Table I, by noticing the departures from the average both before and after this warm period. The white ox-eye was from 16 to 22 days late in coming into flower, the dog rose 12 to 18 days late, the black knapweed 1 to 7 days late, the harebell from 1 day early to 5 days late, and the greater bindweed 14 to 35 days late. The crop of hay was a very light one, and owing to the frequent rains in July was harvested in many places in indifferent condition.

THE AUTUMN.

This was a moderately warm season. Throughout the first half of September the weather remained fine, and for a few days it was warmer than at any time during the summer months. In October, however, there occurred scarcely a single fine day, while the falls of rain were often singularly heavy. The ivy was from 9 to 34 days late in flowering. The last swallows were seen at Berkhamsted on October 3rd, but a few were noticed at St. Albans as late as October 15th. The corn harvest was a very late one, and the weather extremely unpropitious for its ingathering. The yield appears to have been about the average.

MAP AND SECTION SHOWING THE KNOWN AND PROBABLE COAL-MEASURES IN SOUTH WALES, THE SOUTH OF ENGLAND, THE NORTH OF FRANCE, AND BELGIUM.



IX.

COAL: ITS NATURE, ORIGIN, POSITION, AND EXTENT; AND ITS RANGE UNDER THE SOUTH OF ENGLAND.

By PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.

A Lecture delivered at Watford, 18th November, 1892.

PLATES I AND II.

CONTENTS:—1. The Aspect of a Piece of Coal. 2. The Splitting of Coal. 3. The Constituents of Coal. 4. The Varieties of Coal. 5. The Origin of Coal and the Area of its Formation. 6. The Materials of the Coal-measures. 7. The Extent and Position of the Coal. 8. Coal under the South of England. 9. Conclusion.

1. *Aspect of a Piece of Coal.*—There are two or three common things which may be noticed about a piece of coal which are perhaps not very generally known. Have any of you ever tried to take up a piece of coal without dirtying your hands? It is quite possible to do so. The next time you take the trouble to look into the coalbox, take up a piece of coal that has no loose coal-dust on it, and you will find that some parts are bright and clean, and that other parts are black and dirty; but it is dirt in the right place.

2. *The Splitting of Coal.*—All parts of the coal are not the same because it has been formed by the accumulation of vegetable material under different conditions. When looking at a piece of coal in the fire, we observe that it splits, or shows an inclination to split, in two directions, either along and parallel with the lines that are black and dirty, or at right angles to them. When it splits along those black lines, the rent follows the bedding of the coal, that is to say, the coal splits along those planes which were once the surface, and on which other layers were successively formed, so that they have always remained somewhat distinct. When it splits in the other direction, it is along lines of cracks caused by contraction.

3. *The Constituents of Coal.*—So much for the common aspect of household coal; but the subject leads us into several lines of thought, only some of which can be taken up. Firstly, what is coal in a chemical point of view? Of what is it composed compared with other things in the world? For instance, we know that a very large proportion of it is carbon, and we know that it consists not merely of carbon, but also of gaseous matter, namely, hydrogen; hence we know that coal is hydro-carbon. But there is a great variety of coals. Of what do the variations consist?

In coal there is much extraneous matter which does not belong to it as coal, but is due to the method of its formation, namely, mud and sand. Sometimes the coal-merchant will send us what is termed “brassy” coal. There is no brass in it, but something that looks like brass—a compound of iron and sulphur (iron-pyrites); and this causes much bursting and sparkling of the coal in the fire, and makes the smoke sulphurous. Again, you have possibly observed white flakes on some faces of the coal; this is sulphate of

lime. Then again there are flakes and slabs of stone, which is commonly called "slate," but is not slate; it is hard mud-stone or shale, either in the coal itself, or from the strata close to it. Coal that has much mud in it is sometimes passed off as smokeless coal. Of course there is not so much smoke, because there is not so much coal in it to give off smoke. There are, however, other real smokeless coals.

When coal is burned, ashes remain—not merely cinders, which, like coke, are mostly the carbon of partially consumed coal; and if the ash, whether white or red, be examined under the microscope, some of it shows the siliceous tissue of plants, and the other part consists of atoms of mud and sand.

Very much of the substance of some coal-beds consists of minute spores that have been traced to the great Lycopods, *Lepidodendron* and *Sigillaria*, which are allied to the Club-mosses, *Isoetes* and *Selaginella*, and these spores were probably shed periodically in enormous quantities.

Great advances have been made by Dr. W. C. Williamson in the knowledge of the Lycopodiaceous trees of the coal, which he shows to have partaken of the Exogenous structure of modern trees. The well-known ribbed and jointed *Calamites* of the coal, represented in the living world by the lowly *Equisetum*, supplied their stems, leaves, and spore-cases to the material of the coal.

Sir William Dawson thinks that the tuberin of cork, of epidermis in general, and of spore-cases in particular, is a substance so rich in carbon that it is very near to coal, and so indestructible and impermeable to water that it has contributed more largely than anything else to the mineral. Prof. Prestwich refers to these, and especially to gums and resins, as main constituents of the coal; and argues that, at the time of its formation, the climate was warm and moist, with a larger percentage of carbonic acid than exists at the present day, and a more rapid plant-growth.*

In the accumulated deposits of sandstones, shales, and clays interstratified with the coal-seams, the fossils are such as the local conditions would account for. Large Coniferous trees (like the well-known examples found in Cragleith and other quarries) must have been floated down by the rivers from the high grounds of the neighbouring regions. The numerous fronds of Ferns in the shales were flooded off from lower heights and flats near by, together with trunks and fragments of the Lycopodiaceous trees. Some of this *débris* sank, waterlogged, in the lagoons and shallow land-locked sea-water; and the resulting black, stinking, carbonaceous mud was the burial place of Molluscs, such as *Anthracosia* and *Anthraeomya*, of numerous Fishes, often of large size, as *Megaliehthys* and *Rhizodus*, and Batrachian or Salamandroid animals, as *Anthraeosaurus* and *Loxomma*, with Annelids, Insects, Scorpions, Water-spiders, King-crabs, etc., often enveloped in special nodules, and other animals (*Pupa*, *Dendrepeton*, etc.) entrapped in hollow trunks of trees.

* 'Geology,' vol. ii, 1888, pp. 117-120.

As will subsequently appear, successive jungles grew and died in their place, accumulating dead wood, leaves, and fruitage (cones and spores), under different conditions of chemical change, until beds of coals, each several feet in thickness, remained in evidence of past centuries upon centuries.*

A Batrachian, something like a newt, has been found in the hollow trunks of fossil trees in Nova Scotia, for, in some of the coal beds, stumps, rotted down to a certain level, are still standing, having survived the changes of the forest, and the shale having been formed round them. There are also some marine animals found in the coal-measures here and there; and these show that sea-water came in to a certain extent.

Of course these great forests depended for their life upon the sun; and therein is the poetry of the matter; for it shows that the sun gave light and heat the same as now. Light, heat, fragrance, and colour, all come from coal; what more could the sun himself do for us? We have the solar rays absorbed by the jungles of the past preserved to us in our coal-fields, and in very many ways we use their heat, light, and colour again.

4. *The Varieties of Coal.*—Tables have been prepared of the fossil fuels that have carbon in them in greater or less proportion, mostly combined with hydrogen and oxygen. Pure carbon is found in the diamond, in graphite (commonly called black lead), and in anthracite. Then comes steam-coal. And there are the following kinds of so-called “bituminous” coal:—caking coal, coking coal, cherry coal, splint coal, and cannel coal.

Cannel coal, or Parrot coal, has much hydrogen in it, and will go off into gas when burned; it is therefore very valuable for making household gas. Boghead coal is of the same kind.

The following is a general classification of the coals:—

Highly Bitu- minous	} Gas coals	{ Torbanite, cannel-coal, parrot-coal	} Vegetable matter much altered.
Common Bitu- minous	} Household coals	{ Caking and coking coal, cherry coal, splint coal, and other coals.	} Laminæ of charcoal (mother - coal) and hydrocarbon.
Semi-bitumi- nous .....				{ Free - burning steam coals	{ 1. Charcoal deposited abundantly at first. 2. Hydrocarbon partially lost by change.
Anthracitic ..	{ Nearly smoke- less steam coal	} Hydrocarbon nearly all lost by change.	
Anthracite	Smokeless coal		All the hydrocarbon lost by heat under pressure.
Coke	{ 1. Natural	} Hydrocarbon lost by heat without pressure.	
	{ 2. Artificial		

Jet is fossilized wood which has undergone certain changes and become a hydro-carbon, instead of remaining in that peculiar combination of carbon, hydrogen, and oxygen of which wood is composed. Peat also is decomposed woody material, and under

* Prof. Jones here explained how these seams were formed, and showed diagrams of various animals and plants which occurred in them.

some conditions it becomes much like coal. So also lignite, though retaining wood-structure, has lost much of its nitrogen and hydrogen, and, like peat, often contains a considerable proportion of muddy material.

5. *The Origin of Coal and the Area of its Formation.*—Let us think about the way in which coal was made. Everyone knows now, from mere school-teaching, that coal resulted from the accumulation of vegetable matter; but it is rather difficult to form a correct notion of how and where that came about. First of all the learner must be more or less geological, and must forget his “geography” altogether. The old topographical conditions have little or nothing to do with the present. Long before the materials which form the present surface of our earth were accumulated and arranged, there were different lands and different waters. Some of these were wide seas bordered by low sloping lands covered with marshes, jungles, and forests; and the sea for the most part was shallow.

Knowing the trend and extent of the area on which coal was formed in this part of the world, we have good indications where it is now to be found, however deep it may have been let down below the surface, and however much it may have been bent, folded, and broken by the crushings due to the contractions of the Earth’s crust.

The map (exhibited) was prepared by the late Mr. R. A. C. Godwin-Austen to show the geography of the West-European region at the time when the old coal was being formed (Carboniferous period). It indicates a great bay or gulf in the western part of that sea where Western Europe is now, and the borders of which, reaching along through what is now the South of England, were covered with vegetation which formed coal.

The word jungle seems to express the condition of things which then existed, where trees grew very closely together as in tropical forests. From time to time they were thrown down by whirlwinds and their own overgrowth, forming great masses of intermixed plants of all sorts and sizes. These densely wooded and root-entangled jungles were interrupted here and there with bogs and marshes, sea-creeks and lagoons, sluggish streams and rushing rivers, each and all affecting either the soil, the vegetable growths, or the ruins of the forests; whilst successive oscillations of the land, sometimes slow and regular, sometimes sudden and overwhelming, brought in the sea to dominate for awhile until sand and mud accumulated to form new areas for maritime jungle-growths and inland forests.

The climate was warm and damp. Vegetation grew rapidly; the leaves, branches, and stems, also the fruits and seeds, or rather cones and spores, fell so thickly season after season that the material, layer upon layer, soon underwent decomposition, and for the most part chemical recomposition. Sometimes, probably according to seasons, the fallen wood lost its hydrogen and oxygen whilst exposed to the air, and became merely black touch-wood or natural charcoal. At other times the *débris* of the forests

accumulated so fast, or was so drowned in water, that the hydrogen and oxygen could not all escape from the carbon, and hydrocarbons were formed by recombinations. Hence the presence of the alternate planes (and edgewise of streaks) of bright and dull black materials in common coal. (*Dawson.*)

Under favourable conditions, tropical and subtropical forests (such as those of Central Africa, Brazil, and elsewhere), and coast-swamps (Florida, Guiana, India), would supply good and sufficient material. So also would the swamps of the "Sunk Country" of Arkansas and Louisiana, as well as the "Great Dismal Swamp" in Virginia, for one set of conditions, and the mangrove jungles in the West Indies and elsewhere for another.

6. *The Materials of the Coal-measures.*—Different varieties of the old coal are due to the fact that some coal contains more charcoal, some more hydro-carbon, and some more mud than others. Hence certain localities have given characteristics to the local coal.

In some collieries the miners are able to work at the coal under a hard roof of shale, which is muddy material that was deposited in the water, having been brought down from the higher ground, and forming layers, sometimes many yards thick. This shale contains a great many remains of plants, and sometimes of shells.

After this accumulation of shale, generally large quantities of sand were deposited; and this formed sandstone, very useful for building and paving. A layer of pure clay was often formed on these sand-beds; and this is used for making fire-bricks.

Fireclay, underclay, undercliff, underbed, seat-earth, seat-stone, bottom-stone, spavin, chunch, fake, or pouncin, is usually a dense clay, but sometimes sandy. It varies in colour, and is from six inches to ten feet or more in thickness. It is penetrated in all directions by the Stigmarian roots and rootlets of the trees (*Sigillaria* and *Lepidodendron*) that grew on it when it was the soil of the coal-forest, having been slowly deposited by the quiet, shallow, muddy waters that succeeded the deposition of shale or sandstone by waters with stronger currents; these last terminating one of the periodical disturbances to which the many stages of gradual subsidence gave rise. Fragments of Scorpions and Eurypterids occur plentifully in some of the "old soils" (fireclays). The former, being land-animals, and probably adapted to a hot (or, at least, warm) climate, are among the most interesting of the coal-fossils.

All of the above mentioned beds, layers, or strata were repeated thousands of times.

In Nova Scotia there are about 80 coal-seams in 14,570 feet of shales, clays, and sandstones. In the coal-field of South Wales there are 12,000 feet of coal-seams, shales, sand, etc., and nearly 100 seams of coal worth working.

The order and thickness of the strata belonging to the coal-field of South Wales, as given by Sir Archibald Geikie,* are (for Glamorganshire):—

* 'Textbook of Geology,' 2nd edit., 1885, p. 742.

Upper Series : sandstones, shales, etc., with 26 coal-seams, more than	.....	.....	.....	.....	.....	3400 feet.
Pennant-grit : hard, thick-bedded sandstones, and 15 coal-seams	.....	.....	.....	.....	.....	3246 ,,
Lower Series : shales, ironstones, and 34 coal-seams	.....	.....	.....	.....	.....	450 to 850 ,,
Millstone-grit.						

The Coal-measures are thus estimated at 7496 feet, or nearly $1\frac{1}{2}$ mile in thickness, besides the Millstone-grit, and the Carboniferous or Mountain Limestone occupying a still lower position.

It may be mentioned that in the British Islands the coal may possibly last, for public use, about 600 or 700 years, according to the latest calculations.*

7. *Extent and Position of the Coal*.—All the formations I have enumerated are more or less continuous throughout wide regions ; not only in Western Europe, but also elsewhere over the world. Many tracts of “coal-growths” have been of enormous extent, but have been divided in after times by earth-movements, throwing them into ridges and basins by anticlines, synclines, and faults, with intervening spaces. The coal-fields of South and North Wales, the English coal-fields of Somersetshire, Staffordshire, Warwickshire, Leicestershire, Lancashire, Yorkshire, Denbighshire, Northumberland, Durham, etc., the Scotch coal-fields of Edinburgh and Glasgow, and the small Irish coal-fields in Tyrone, Leitrim, Kilkenny, Tipperary, and Cork, are more or less disunited parts of a great whole. So also there are detached coal-fields of Carboniferous age in France, Spain, Germany, and Russia, and wide areas in America, China, Australia, etc.

All the great geological formations contain some deposits of vegetable matter, often in the form of useful coal ; but none equal to that of the palæozoic Carboniferous series, since which have been slowly deposited the Permian, Triassic, Rhaetic, Jurassic, Cretaceous, and Tertiary formations.

8. *Coal under the South of England*.—The earth-movements, giving rise gradually to mountain-ranges in some districts, and here and there exposing some of the lowest stratified rocks, have lowered others to great depths beneath the later formations, whither they can yet be followed by the scientific research of geologists. Thus, some of the old coal-measures of Western Europe lie deep in the ground, as in Westphalia ; and some come up quite near to the surface, as in Belgium and in the British area. In fact, a great subterranean ridge of crumpled strata reaches from east to west between those two districts, and the folds of those contorted rocks enclose some of the old coal-bearing beds.

To realize the whole of the conditions belonging to this subject we must (1) revert to the original formation of the coal ; and then (2) consider how it has been distributed and re-arranged.

(1) For our knowledge of what ruled the local occurrence of coal, we owe a great debt to Mr. R. A. C. Godwin-Austen, who had studied the geology of the South-western Counties with Sir

* Hull, in ‘Trans. Geol. Soc. Edinburgh,’ vol. vi, 1890, p. 79.

Henry De la Beche. To him we are indebted for the approximate demarcation of the bounds and margins of the Carboniferous formations, particularly for the probable land-limits and outward extension of the Coal-measures. In his valuable memoir "On the possible Extension of the Coal-measures,"* he explained the reasons for his indicating on the map then communicated to the Geological Society, the physical configuration of North-western Europe at the close of the Palæozoic Period, and the outline of the surfaces which supported the coal-vegetation. He concluded to define the place and range of this old coal-growth in what is now Western Europe as "an internal sea, around and occasionally over large parts of which the peculiar vegetation of the time was developed and entombed as the area rose and sank. A region with a central depressed area, such as Australia is supposed to present, and going down, by means of a long series of oscillations, would ultimately present just such an assemblage of deposits as our own Carboniferous group."

A further reference to this kind of level or hollow region is as follows:—"The large level tracts which lie west of the Blue Mountains in Australia, into which the Lachlan, the Darling, the Murrumbidgee, and the Darling discharge." (Godwin-Austen's Lecture, Royal Institution of Great Britain, April 16, 1858.)

Such an area had also been indicated in 1846 by Sir H. De la Beche in his memoir "On the Formation of the Rocks of South Wales and South-western England,"† where he refers to "the great area extending from the country drained by the Volga, eastward through eighty degrees of longitude into China, and from which the waters find no course outwards to the main ocean or to the seas connected with it." With a gradual depression—with the detritus swept in by the rivers—and with a suitable flora and climate, there might here be both extensive accumulations of vegetable matter grown in place, as well as limited deposits of drifted plants; under different conditions. De la Beche, moreover, referred to the long flat coast of the eastern seaboard of South America, with its great rivers and abundant flora, as being analogous to some parts, at least, of the areas on which the coal-seams were formed.

The area of coal-growth in this North-western European region is represented on Mr. R. A. C. Godwin-Austen's map‡ as a littoral belt (varying in width as now exposed at the surface), reaching, in an approximately semicircular or bay-like shape, from the Elbe near Magdeburg, and north of the Hartz, westward to the valley of the Ruhr, including a southern extension to Marburg; and, taken up again, passing from the Ruhr to Aix-la-Chapelle, and to Namur and Charleroi; thence by the Franco-Belgian coal-field to

* 'Quart. Journ. Geol. Soc.,' vol. xii, 1856, pp. 38-73; see also 'Coal Commission Report,' 1871, pp. 424 and 511, with plates; and 'Rep. Brit. Assoc.' for 1879, p. 227, plate xiv.

† 'Mem. Geol. Survey Gt. Brit. etc.,' vol. i., p. 296.

‡ 'Quart. Journ. Geol. Soc.,' vol. xii, 1856, plate i.

Calais, and beneath the valley of the Thames to Bristol, the Forest of Dean, and South Wales, south of the Old Red area, towards Ireland. On the eastern side of Hereford, and along the eastern border of the old rocks of Wales, the range of the coal-growth is shown by the coals appearing here and there along the Severn and the Dee; and doubtless it widened out considerably eastward across what is now England. Continuing northward, it occupied Northumbria, and stretched westward locally between the old Cumbrian land and the Southern Islands; passing around the east end of the latter, it was strong across what is now Central Scotland, with indications in North Ireland. Thus the coal-growth invested the southern and western edges of Godwin-Austen's "internal sea" abovementioned, and extended westward by two outlets: one at its south-west corner, by South Wales, and the other on the north-west, by Central Scotland, each extending into the Irish area, and thus roughly surrounding the several older Palaeozoic lands of Wales, Ireland, Cumbria, and South Scotland.

In Professor Ramsay's account of the denuded remnants of the Welsh coal-fields,* the stretch of coal-growth along the border of the old Cambrian land is clearly indicated in his statement, that—"One denuded edge of these accumulations now forms part of the counties of Pembroke, Caermarthen, Glamorgan, and Monmouth, and is elsewhere exhibited in the Forest of Dean, the narrow strips of coal-measures north of May Hill in Gloucestershire, the Clee Hills (outliers of the Forest of Wyre and Coalbrookdale), the coal-fields south and west of Shrewsbury, and that of Oswestry, Wrexham, and Mold. All these are but fragments of one great original coal-field, once mantling round North Wales and the older rocks west of the Severn and north of the Bristol Channel."

Both north and south, however, of the old Cumbrian area are a few seemingly isolated patches of coal; but the Whitehaven field is really the western portion of the North-of-England coal-growth; the coal of Anglesea belongs to the westward extension of the Laneashire coal-field; and that of Ingleton is a remnant of the northern part of the latter towards the margin of the old Cumbrian land.

(2) Sir Henry De la Beche, in 1846,† noted that a great sheet of palaeozoic rocks, including the Coal-measures, extending from Belgium to Central England, had been rolled about, undulated, crumpled, and then partially worn away before the New Red Sandstone and other Mesozoic strata were laid down upon them; and that these, in their turn, had been denuded so as to expose here and there portions of the underlying Coal-measures, though near-by a ridge of profitless Mountain Limestone or other older rock might come to the surface.

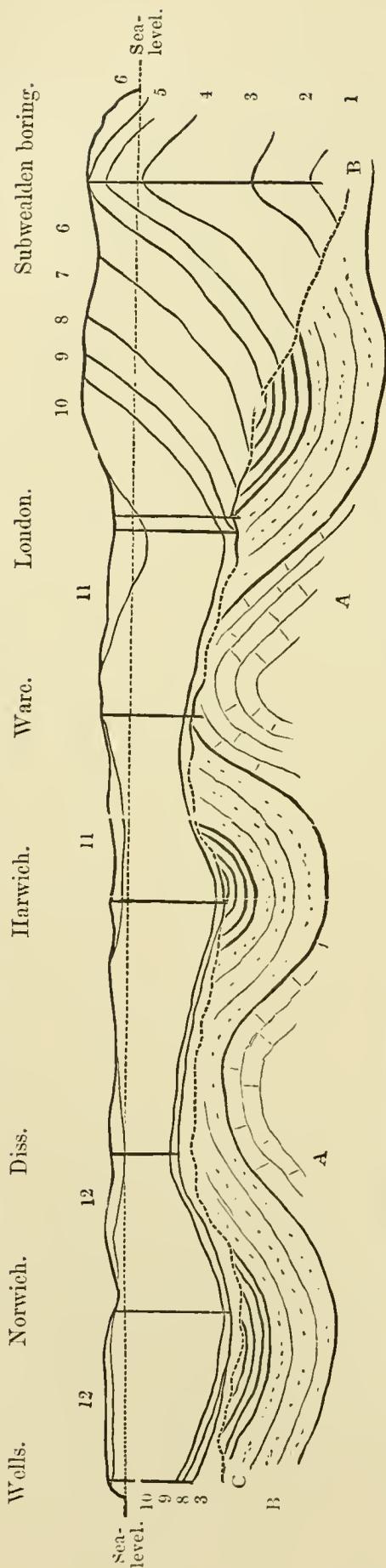
In 1856, Mr. Godwin-Austen, following up his reasoning about the areas of coal-growth (see above, page 95), explained that the

* 'Mem. Geol. Surv.,' vol. i, 1846, p. 314.

† *Ib.*, pp. 213-214.

DIAGRAM TO SHOW THE POSSIBLE OCCURRENCE OF COAL-MEASURES IN THE EASTERN COUNTIES.

(From H. B. Woodward's 'Geology of England and Wales,' 2nd Ed., 1887.)



Longitudinal Scale—25 miles to 1 inch.

Vertical Scale—2000 feet to 1 inch.

- 12. Glacial and Pliocene.
- 11. Eocene.
- 10. Chalk.
- 9. Upper Greensand and Gault.
- 8. Lower Greensand.
- 7. Weald Clay.

- 6. Hastings Beds.
- 5. Purbeck Beds.
- 4. Portland Beds.
- 3. Kimmeridge Clay.
- 2. Corallian Beds?
- 1. Oxford Clay.

- C. Carboniferous rocks (shown in basins with thick lines).
- B. Devonian and Old Red Sandstone.
- A. Silurian.

N.B.—The vertical lines indicate borings and wells.

movements of disturbance which they have undergone had tended to preserve the great Franco-Belgian coal-band, and had rendered it available; and he proceeded to state that the course of that band of Coal-measures may be traceable westward, and probably coincided with, and may some day be reached along the line of, the Valley of the Thames.

Professor Prestwich in 1871 extended this inquiry;* and, having carefully compared the coal-beds of Somerset and Belgium, described the characters and relations of the strata in detail, and showed that the coal might be met with at a workable distance from the surface along a narrow, but interrupted, curved area from Westphalia, through Belgium and France, to England; then along the north-eastern part of Kent (Isle of Thanet, etc.), and through Herts, Bucks, Oxfordshire, and Gloucestershire, to the Bristol coal-field, and on to South Wales. The coincident axis of disturbance is south of the River Thames, in his opinion throwing off the coal-beds on its northern flank. (Plate I., illustrating, by a map and section, the views of Mr. Godwin-Austen and Prof. Prestwich, has been prepared by the Editor from published data.)

In the second edition (1887) of his 'Geology of England and Wales,' Mr. Horace B. Woodward has given, at pages 200-203, a useful *résumé* of what is known on this subject. (Mr. Woodward's illustrative section is reproduced by his permission on Plate II.) A full account of the history of the question of the underground range of the older rocks in the South-east of England, especially as to the possible occurrence of the Coal-measures, is published in the 'Memoirs of the Geological Survey: The Geology of London and of Part of the Thames Valley,' vol. i, 1889, pp. 13-28, by Mr. W. Whitaker, F.R.S., who, having given close attention to this subject, has suggested the following localities as likely sites at which to search for coal in the South-east of England: St. Margaret's, Chartham, Chatham, and Shoreham (all in Kent); Bushey (Herts), Loughton (Essex), and Coombs, near Stowmarket (Suffolk).†

An interesting fact relative to this matter is that in February, 1890, the engineer of a boring at the foot of Shakespeare's Cliff, Dover, announced that at 1,204 feet below the surface there a thin seam of coal was met with, and, at several yards lower down, coal eight feet thick was pierced, associated with clays, grits, and blackish shales. (Newspapers of the time.) Dr. Blanford, in his Anniversary Address to the Geological Society on February 21, 1890, stated that Professor Boyd Dawkins, in a letter received the day before, had informed him that a coal-seam had really "been reached at a depth of 1,180 feet, and that this seam is proved to be of Carboniferous age by the plant-fossils in the associated clays. . . The discovery is solely the result of scientific induction, and arrived at by following the line of research first indicated, I believe, by

* 'Report Royal Commission on Coal-Supply,' 1871; 'Anniv. Address Geol. Soc.,' 1872; 'Popular Science Review,' July, 1872; and 'Proc. Inst. Civil Engineers,' vol. xxxvii, 1874, p. 110, etc., plates viii and ix.

† 'Geol. Mag.,' November, 1890, pp. 514-516.

the late Mr. Godwin-Austen and subsequently by Professor Prestwich." The boring was undertaken with the advice of Professor W. Boyd Dawkins; and we learn, from his Reports,* that the Coal-measures were reached at 1,113 feet below high-water mark, and were penetrated to 1,500 feet; also that in the 387 feet of Coal-measures six seams were met with, giving an aggregate of 10 feet of coal. The distance of the Coal-measures below high-water mark is a near approximation to Professor Prestwich's computation of the probable depth at which coal might be found in that part of Kent, namely, 1,000 to 1,100 feet.† The account of the coal-plants or other fossils from these beds has not yet been published.

On January 29th, 1892, Professor W. Boyd Dawkins communicated to the Geological Society of Manchester‡ some further notes on the Dover boring, with remarks on the probable results of this successful search for coal. A still later account of work done in the boring is given in the pamphlet:—

'Dover Coal-Boring; Observations on the correlation of the Franco-Belgian, Dover, and Somerset Coal-fields.' By Francis Brady. June, 1892, 8vo, 14 pages, with a map and section. And a *résumé* of this is published, under the title of '*Le Sondage de Douvres*,' par M. E. Lorieux, in the '*Annales des Mines*,' ser. 9, vol. ii, 1892, pp. 227-232.

The particulars as to the successive formations recognised, to June 30th, 1892, are—

Chalk-marl	174
Upper Greensand	8
Gault	121
Lower Greensand, Wealden, and Hastings beds	241
Oolite (upper, middle, and lower) and Lias	613
Coal-measures, with 8 <i>workable</i> coal-seams, comprising about } 16 feet of bright bituminous coal	773
Total depth.....	
1930	

The detailed list of strata show that the coal seams occur at—

1. 1136' 6" seam 3' 6" §	6. 1433' seam 1'
2. 1199' 6" ,, 6"	7. 1456' || ,, 2' 6"
3. 1229' ,, 2'	8. 1570' ,, 2' 3"
4. 1277' ,, 2'	9. 1763' 9" ,, 2' 9"
5. 1311' 9" ,, 1' 3"	10. 1831' ,, 1' 8"

Along the indicated tract beneath South-eastern England, deep borings have touched here and there either strata lying just above the coal, or below it; and, as we have just seen, in one place

* 'Report of Proceed. General Meeting South Eastern Railway,' 23 July, 1891, p. 10; 'Financial News,' 24 July, 1891. See also the 'Contemporary Review,' April, 1890; and his 'Lecture to the Royal Institution,' June 6, 1890.

† 'Trans. Manchester Geol. Soc.,' April, 1892.

‡ 'Proc. Inst. Civil Engineers,' vol. xxxvii, 1874, pp. 16 and 26 of the separate paper.

§ Divided in the middle by 1 foot of sandstone.

|| At 1549 ft. a film of coal.

(Dover), the Coal-measures have been found at a depth of 1,113 feet, and ten seams, varying from 12 to 33 inches in thickness, were pierced in the 817 feet further down (that is, to 1,930 feet), in the summer of this year. Further boring is expected to prove other and thicker coals—either such as are known to occur in France, Belgium, and Westphalia, or like the 55 seams of the Somerset coalfield, giving 98 feet of workable coal in 8,400 feet of shales and sandstones, etc.

Of course the quantity (that is, extent in any direction) of productive measures preserved in the folds of the old ridge now struck beneath Dover cannot be known without further boring and real mining by shafts and galleries; and the direction of its dip or slope, whether favourable or not for working it there, has to be ascertained before the true value of the experiment is proved.

Perhaps other trials will be made along the east-and-west folds of the old ridge at or near the spots pointed out by Mr. Whitaker, as likely for the purpose, in Kent, Herts, Bucks, Oxfordshire, and Gloucestershire.

If coal be ultimately mined successfully in the South of England, doubtless wealth may be given to many; but as your President* and others have remarked, the beauty of the country will be ruined.

9. *Conclusion.*—The formation and subsequent arrangement of coal and the Coal-measures have been so ordered that the blessings of civilisation have been largely enjoyed wherever the fossil fuel at man's feet has been industriously worked by his hands, and carefully applied to the improvement of his social position. These labours of careful perseverance, and arts of skilful manipulation, have given special characters to those whose energies have been directed to coal-mining and various manufacturing enterprises; and all conditions of society have been influenced thereby.

So also the geologist, chemist, and botanist, seeking out the composition of the various coals, their local position and extent, their special natural history, the mode of passage from dead plants to first-rate fuel—in fact aiming at a complete mastery over all the intricate events and complicated results of the coal formation—not only find a useful exercise of their cultivated intelligence and accumulated knowledge, benefiting all by the practical results, but they widen the mental culture of others, and show how the study of nature is an indispensable element in good education, and necessarily productive of lasting benefit to society at large.

The subject of coal and the Coal-measures is abundantly treated of in the scientific literature of this century in nearly all parts of the world. Besides having had the advantage of the labours of the many eminent foreign geologists who have advanced our knowledge of the subject in one or other of its various aspects, both by original research and by condensing published results in treatises and manuals for students, we have

* In the 'Counties Constitutional Magazine,' December, 1889.

had some of the most enthusiastic students of the natural history of the Carboniferous strata and fossils in our own country and within our own times.

Nevertheless a great deal has yet to be learned about the Natural History of the Coal-measures, the order and extent of the special kinds of their animals and plants, the time occupied in their formation, and the geographical and hydrographical conditions. At all events we know that all their strata have been arranged in order, have been buried under circumstances favourable to the production of the various coaly fuels, and then turned up in orderly disorder, ready to the hand of man, and well adapted for his use in this passage-stage of his civilization and development, helping him, when intelligent, active, careful, and persevering, to higher ends. For we cannot doubt that all things here are arranged for his better being, his progress towards more and more useful arts, wider ranges of science, and fitter aptitudes of life, of which as yet we have but little conception. We are still the early settlers in a beautiful world, whose capabilities, imperfectly known as yet, wait until the higher developments of Man can understand them fully, and apply the results to the general good.

NOTE.—My Address to the Geological Section of the British Association, at Cardiff, 1891, 'Report Brit. Assoc.,' 1892, pages 614–632, published also in the 'Geological Magazine' for November and December, 1891, treated of Coal in general, and that of South Wales in particular; and some portions of it have been freely used in this Lecture.

X.

ANNIVERSARY ADDRESS.

CHARLES DARWIN.

By the President, JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S.,
F.R.Met.Soc.

Delivered at the Annual Meeting, 21st February, 1893, at Watford.

LADIES AND GENTLEMEN,—

The history of science is a history of warfare,—of contests between reason and prejudice. From the earliest times of which we have any authentic record every new scientific idea has been opposed by some pre-conceived notion, and although reason has ever been victorious, prejudice is not yet completely vanquished. Science, however, is not aggressive and does not marshal her forces for direct attack; she conquers by convincing her adversaries of the justice of her cause and taking them into her own ranks, rather than by storming their position and driving them from the field of battle. The greatest of these contests in which science has been engaged in recent years is that with which the name of Charles Darwin will be for ever associated,—the contest between the essentially scientific idea of progressive development by the action of natural laws, and the absolutely unscientific notion of distinct acts of creation by supernatural decree.

Science has been defined as “the discernment, discrimination, and classification of facts, and the discovery of their relations or sequence.” It is not a knowledge of things, but of causes and of natural laws. We much more often perceive things and infer causes, than we gain a knowledge of things by inference or of causes by perception. If, for instance, we knew nothing of the world on which we dwell, we might look around us on an open plain or on the sea and conclude that the horizon bounding our view was its limit. Changing our position laterally, we should find that it was more extensive than we first thought it to be; but we might still think that it was flat and had an abrupt edge, a view which was at one time held. By travelling round it, however, we should find it to be a globe. If we merely changed our position

vertically, we might come to the same conclusion, for we should find that the higher we were, the further would the horizon recede. This inference could not be formed without some knowledge of geometry, or at least without bringing our reasoning powers into use. It would therefore be a scientific inference, and we should find it much more difficult to convince others of the correctness of our conclusion than we should have done if we had travelled round the earth in different directions, measuring our course, and so had perceived that its form was globular or nearly so. But we should only have attained a knowledge of the thing,—the knowledge that the earth is a sphere or spheroid. To complete our investigation we must arrive at a knowledge of the cause of its sphericity, and of the reason why it is not perfectly spherical, which can only be done by exercising our reasoning and imaginative faculties, and in such ways we build up science.

As the cause of any natural phenomenon can very seldom be directly perceived, our first attempt to ascertain it, after having fully investigated, by observation or experiment, all the facts connected with it, is usually by forming an hypothesis; and if our hypothesis accounts for most of the facts, and does not appear to be at variance with any, it becomes a theory; if no other explanation seems to be possible, it may become a scientific doctrine.

To discover a law, the exercise of our reasoning and imaginative faculties is still more imperative, for we can never perceive a law of nature. We may, however, as in the case of gravitation, discover a law without knowing the cause.

That the earth is a globe was inferred by astronomers long before it was circumnavigated. This was therefore a scientific inference. It gave rise to the first recorded battle between reason and prejudice, being opposed and derided on Scriptural grounds, and so dogmatically that most of the Fathers of the Church denied the possibility of salvation to those who believed it, and thought that the earth might be inhabited on opposite sides.

The theory of Copernicus that the earth and planets revolve around the sun, was ridiculed on the same grounds. It was a scientific conception opposed to the direct evidence of our senses, and to the literal interpretation of certain passages in Scripture. Copernicus died on the very day that his great work on the 'Revolution of the Heavenly Bodies' was published, and so escaped persecution. The same theory was afterwards proclaimed by Giordano Bruno, before the world was prepared to receive it, and for this and other heresies he was imprisoned for six years and then burned alive. The belief that the great astronomical truths

which Galileo revealed were hostile to religion, might have brought on him a similar fate, had he not, after imprisonment and under threat of torture, in his seventieth year, publicly recanted before the Inquisition, abjuring "the error and the heresy of the movement of the earth," though convinced that it did move. Kepler then disproved the Aristotelian doctrine of the movement of the heavenly bodies in perfect circles, and gave to the world the three astronomical laws which bear his name, for which he too was persecuted and imprisoned. And yet he was so much impressed with the sublimity of the laws which he discovered, that he exclaimed: "I do think the thoughts of God."

Now all this is changed. Our earth is universally acknowledged to be but one of several planets revolving in ellipses around one of many suns. Newton, by showing that every particle of matter attracts every other particle directly as the mass and inversely as the square of the distance, proved the general accuracy of the propositions of Copernicus and corrected errors in his application of them, and also assigned a physical cause to Kepler's empirical laws.

And yet not entirely changed. The battle between reason and prejudice still continues, but it is fought on another field; it is fought over the grandest scientific conception of modern times,—the conception of progressive development.

It is not many years since the belief was almost universal that the whole visible universe was created in its present state out of nothing in a brief period of time; that every species of animal and plant was independently created in its existing form; and that everything extraneous to our globe was created expressly for its benefit, and everything on our globe expressly for the benefit of man. These ideas must have been formed at a very early age, when the earth was believed to be the centre of the universe, immovable, and inhabited only "on the top," and when the planets were thought to be guided in their seemingly erratic course by angels. They accord with a literal interpretation of the biblical account of the creation; and they appear to pay a flattering tribute to the dignity of man. They are deeply-rooted and prejudiced ideas with which science finds it hard to contend. The persistence of the belief in the immutability of species is also due in part to the fact that it is apparently borne out by our experience. To those who have not made a special study of any department of botany, zoology, or palæontology, every species seems to be distinct, one never appearing to pass imperceptibly into another; nor can we detect progressive change in any living thing in its natural or wild state, although we have modified to a considerable extent, and still

continue to modify, certain species, once wild, which we have brought under our culture or control—our cultivated plants and domesticated animals.

When, therefore, towards the close of the last century, the nebular hypothesis was propounded by Kant and elaborated by Laplace, and the theory of the origin of species by evolution was successively advocated by Buffon, Erasmus Darwin, Geoffroy St. Hilaire, Goethe, Lamarek, and other men of less note, but little credence was given to their views, the general belief in the permanency and distinctiveness of species scarcely even being shaken, for, said Prejudice in the garb of Authority, were we not told that the sun was created to give light to the earth which was at first in darkness, and that man was made out of the dust of the ground? How then could the earth have been evolved from the sun, or both have been formed at the same time out of a revolving and condensing nebula; how then could man be a modified descendant of some lower animal? Surely such ideas were absurd; those who held them, heretics!

When Lord Rosse's telescope was directed to the nebulae, and many of those hitherto believed to be gaseous were resolved, one after another, into clusters of stars, the nebular hypothesis seemed to be shaken to its foundations, for the inference was natural that with sufficient telescopic power all the nebulae could be resolved. But the doctrine of evolution received only a temporary repulse, for, upon the discovery of spectrum analysis, it became possible to distinguish a glowing gas from an incandescient solid, and many of the nebulae were proved to be really nebulous. The nebular hypothesis, and with it the more general doctrine of evolution, revived, and it is now generally accepted. Although it is still an hypothesis, it rests upon a solid superstructure of well-ascertained facts. The theory of natural selection bears the same relation to organic evolution as the nebular hypothesis bears to cosmic evolution, and together they show us how the present material universe, and the various forms of life on our globe and perhaps on others, may have been developed by gradual metamorphosis.

Creation is not now to us, as it was to our forefathers, a series of independent acts, but a continuous process of development, and we are irresistibly led, as Goethe was, to look upon "formation, transformation," as "the Eternal Mind's eternal recreation," this formation and transformation proceeding in accordance with natural laws. Thus may we form an infinitely more exalted idea of the Supreme Lawgiver than has ever before been possible. For this grand conception of creation and its general reception in the present

day, we are indebted to Charles Robert Darwin infinitely more than to any other man. Many before him had advocated the theory of the origin of species by evolution; some had even arrived at the conclusion that variations are perpetuated and accumulated into specific differences by natural selection; but Darwin has brought forward a mass of evidence so overwhelming, that however prejudiced against his theory anyone of at least ordinary intelligence may be, after a thorough study of it the conviction cannot be resisted that species are genetically allied, or have been more or less gradually evolved one from another and not separately created, the fittest only having survived and reproduced their kind in the struggle for existence in which all living things are perpetually engaged.

Darwin has revolutionised modern thought. Owing to him, Evolution, by the survival of the fittest in the struggle for existence, is no longer an hypothesis but an established scientific doctrine which has affected every science and has brought several sciences or departments of science into existence. Essentially biological, its influence has been felt in every one of the natural sciences, and that the fittest only will survive has become an axiom in philology, sociology, and all the relations of human existence. The life of Darwin ought therefore to possess an interest to all, and although it has no special local interest to us, there is a link between Darwin and this Society besides fellowship in our labours in the investigation of Nature: he was one of our Honorary Members.

Charles Robert Darwin was born on the 12th of February, 1809, at The Mount, Shrewsbury. He was the second son of Dr. Robert Waring Darwin, who for many years was the leading physician in Shrewsbury, owing his success chiefly to his acuteness in the diagnosis of disease, and his wonderful insight into the thoughts and feelings of his patients.

Both Charles Darwin's grandfathers were talented men, for Dr. Darwin was the son of Erasmus Darwin, the well-known poet and philosopher, and one of the earliest advocates of the doctrine of evolution, and he married the daughter of Josiah Wedgwood, the even better-known potter and philanthropist, inventor of the fine earthenware which bears his name, and founder of the village and pottery-works of Etruria. Six children resulted from this marriage, two boys and four girls, and Charles was the fifth child.

The Wedgwoods were Unitarians, and Charles Darwin, as a little boy, went with his mother to the Unitarian Chapel in Shrewsbury, but he was christened at St. Chad's, and brought up as a member of the Church of England, usually attending church

after his early boyhood. His mother died in July, 1817, when he was but little over eight years of age, and his school days had but just commenced, for it was in the spring of this year that he first went to a day-school, kept by the Rev. G. Case, minister of the Unitarian Chapel he attended. From this time his life may be divided into four well-marked periods:—(1) at school and college, 1817–31; (2) at sea in his voyage round the world, 1832–36; (3) in London, 1836–42; and (4) at Down in Kent, 1842–82.

In the 'Life and Letters of Charles Darwin,' a work in three volumes, edited by his son Francis, is an Autobiography, written near the close of his life for the perusal of his wife and children, without any thought that it would ever be published. In the following brief account of Darwin's career, free use has been made of this Autobiography.

A naturalist from his earliest school days, Charles Darwin, like many a schoolboy, has a strong passion for collecting,—an innate taste, he is convinced, as neither his brother nor any of his sisters ever had it. He collects with avidity "all sorts of things," but he has more consideration for the feelings of animals than most schoolboys have, taking only a single egg out of a bird's nest, and for long never killing an insect, being content to collect only dead ones. A keen sportsman very early in life, one thing only interferes with his full enjoyment of sport—his tenderness of heart. In angling with worms, he takes care to kill them with salt and water before putting them on the hook, at the want of some success. But he modestly attributes his humanity to the instruction and example of his sisters, and doubts whether humanity is an innate quality. Passionately fond of dogs, they soon find it out, so that he is "an adept in robbing their love from their masters." Long and solitary walks have a great attraction for him, and he often became absorbed in thought, once, when thus absorbed, falling off the foot-path on the old fortifications which surround Shrewsbury.

He attends Mr. Case's school only for a year, and in 1818 goes as a boarder to the Shrewsbury Grammar School, where he is under the tuition of Dr. Samuel Butler, afterwards Bishop of Lichfield. This school being strictly classical, he believes that nothing could have been worse for the education of his mind, for during his whole life he was "singularly incapable of mastering any language." During his school days the only qualities which promise well for the future are his strong and diversified tastes, great zeal for whatever interests him, and keen pleasure in understanding any complex subject. The clear geometrical proofs of

Euclid, which he was taught by a private tutor, give him intense satisfaction, and with great delight he receives from his uncle, the father of Francis Galton, an explanation of the vernier of a barometer. He reads various books with avidity, and is especially fond of poetry, all pleasure in which he lost, with great regret, later in life. He works with his brother at chemistry, and reads several books on the subject, but, although he considers this to have been the best part of his education at school, in showing him "practically the meaning of experimental science," he was nicknamed "Gas" by his fellow schoolboys, and publicly rebuked by Dr. Butler for "wasting his time on such useless subjects."

In 1825, as he was thought to be doing no good at school, his father sent him to Edinburgh University to commence the study of medicine; but he cannot bring himself to practice dissection, and, attending some bad operations at the Edinburgh hospital, he rushes away before they are completed, and cannot be induced ever to attend again. Although too tender-hearted for surgical cases, when at home he visits poor people in Shrewsbury, and makes up medicines for them under the advice of his father, who declares that he will make a successful physician, maintaining that "the chief element of success was exciting confidence," and that his patients would have confidence in him.

At Edinburgh appears the earliest indication of Darwin's future abilities, and especially of his keen observing faculties. When scarcely 17 years of age, he discovers that the so-called ova of *Flustra* have the power of independent movement by means of cilia, and are in fact larvæ, and also that the little globular bodies which had been supposed to be the young of *Fucus loreus* are the egg-cases of the worm-like *Pontobdella muricata*; and, early in the year 1826, he reads before the Plinian Society two short papers on these discoveries. At Edinburgh, also, he first becomes aware that his father will leave him "property enough to subsist on with some comfort," which he says "was sufficient to check any strenuous effort to learn medicine."

After he has spent two sessions at Edinburgh University, his father finds that he does not like the idea of being a physician, and proposes that he shall become a clergyman. The idea is congenial to him, but he has at first some religious scruples. However, after reading Pearson's 'Exposition of the Creed,' and other books on divinity, he came to the conclusion that he could fully accept the creed of our Church. He never formally gave up his intention to be a clergyman of the Church of England, but, as he says, it died a natural death during his voyage on the "Beagle."

To study for the Church he spends three years at Cambridge, but, "so far as the academical studies were concerned," his time is wasted almost as much as it was during the years he spent at Edinburgh and at school, the only part of the course of instruction of the least use to him in the education of his mind being the careful study of Paley's 'Evidences of Christianity,' and his 'Moral Philosophy;' the logic of the 'Evidences,' and of Paley's 'Natural Theology,' giving him as much pleasure as did Euclid. In January, 1831, he takes his degree of B.A. of Cambridge University, passing his examination, tenth on the list, "by answering well the examination questions in Paley, by doing Euclid well, and by not failing miserably in Classics."

But these three years at Cambridge are very pleasant ones, "the most joyful in my happy life," he says. In "excellent health, and almost always in high spirits," he eagerly collects beetles; hires the chorister boys to sing in his rooms, for he was passionately fond of music, though strangely had no ear for it, scarcely knowing one tune from another; reads with profound interest Humboldt's 'Personal Narrative of Travels to the Equinoxial Regions of the New Continent,' and Herschell's 'Introduction to the Study of Natural Philosophy,' books which, he says, influenced him more than any others he ever read; attends Professor Henslow's lectures on botany and his delightful botanical excursions; associates with men of science much older than himself, such as Dr. Whewell and the Rev. Leonard Jenyns (now Blomefield); and finally commences the study of geology, accompanying Professor Sedgwick, on leaving Cambridge, in a geological expedition through North Wales. To show his zeal for collecting beetles, he relates that one day, on tearing off some old bark, he saw two rare beetles and seized one in each hand; then he saw a third which he could not bear to lose, so he popped one into his mouth; but alas! it ejected some intensely acrid fluid which burnt his tongue so that he was forced to spit it out. Evidently entomology was his "first love."

His intercourse with Professor Henslow begets a warm and lifelong friendship. He had for him the highest admiration, and he speaks of his knowledge being great in botany, entomology, chemistry, mineralogy, and geology; of his being deeply religious, strictly orthodox, free from every tinge of vanity; and having the highest moral qualities, an imperturbably good temper, the most winning and courteous manners, and unbounded benevolence.

On returning home from his geological tour in North Wales, Charles Darwin finds a letter from Henslow informing him that "Captain Fitz-Roy was willing to give up part of his own cabin to

any young man who would volunteer to go with him without pay as Naturalist to the Voyage of the 'Beagle.'" Having read in Humboldt's 'Travels' of the glories of Teneriffe, he had been wishing to go to sea, and is "instantly eager to accept the offer." His father at first objects, fearing that the voyage will unsettle him for the Church, but gives way to the persuasion of his uncle, Josiah Wedgwood, son of the famous potter, and after an interview with Fitz-Roy all is soon arranged. The chief incidents and general results of the voyage are very pleasantly and graphically told in the earliest and most popular of Darwin's works, 'A Naturalist's Voyage round the World,' first published in 1839 (when he was 30 years of age) under the title of 'Journal of Researches into the Geology and Natural History of the various countries visited by H.M.S. Beagle, under the command of Captain Fitz-Roy, R.N., from 1832 to 1836.'

This voyage, he says, was the most important event in his life, determining his whole career. During his five years on the "Beagle" he acquired a habit "of energetic industry and of concentrated attention" to whatever he was engaged in. His love for science "gradually preponderated over every other taste," and he discovered that "the pleasure of observing and reasoning was a much higher one than that of skill and sport." Three things seem to have made a great impression upon his mind—the beauty of tropical vegetation, the sight of a savage in his native land, and the horrors of slavery. One thing only interfered with his enjoyment—frequent sea-sickness. This he never got over, and it seems to have made him dyspeptic for the rest of his life.

He thus gives the impression which the scenery of Bahia in Brazil made upon him. "When walking quietly along the shady pathways, and admiring each successive view, I wished to find language to express my ideas. Epithet after epithet was found too weak to convey to those who have not visited the intertropical regions, the sensation of delight which the mind experiences. . . . The land is one great wild, untidy, luxuriant hothouse, made by Nature for herself, but taken possession of by man, who has studded it with gay houses and formal gardens. How great would be the desire in every admirer of nature to behold, if such were possible, the scenery of another planet! Yet, to every person in Europe, it may be truly said that at the distance of only a few degrees from his native soil, the glories of another world are opened to him. In my last walk I stopped again and again to gaze on these beauties, and endeavoured to fix in my mind for ever, an impression which at the time I knew sooner or later must

fail. The form of the orange-tree, the cocoa-nut, the palm, the mango, the fern-tree, the banana, will remain clear and separate; but the thousand beauties which unite these into one perfect scene must fade away; yet they will leave, like a tale heard in childhood, a picture full of indistinct, but most beautiful figures."

Again, in his retrospect of the voyage, he says: "Among the scenes which are deeply impressed on my mind, none exceed in sublimity the primeval forests undefaced by the hand of man; whether those of Brazil, where the powers of Life are predominant, or those of Tierra del Fuego, where Death and Decay prevail. Both are temples filled with the varied productions of the God of Nature;—no one can stand in these solitudes unmoved, and not feel that there is more in man than the mere breath of his body."

Then, turning to man in his aboriginal state, he says: "Of individual objects, perhaps nothing is more certain to create astonishment than the first sight of a savage in his native haunt,—of a barbarian,—of man in his lowest and most savage state. One's mind hurries back over past centuries, and then asks, Could our progenitors have been men like these?—men whose very signs and expressions are less intelligible to us than those of the domesticated animals; men who do not possess the instinct of those animals, nor yet appear to boast of human reason, or at least of arts consequent on that reason. I do not believe it is possible to describe or paint the difference between savage and civilised man. It is the difference between a wild and a tame animal; and part of the interest in beholding a savage, is the same which would lead every one to desire to see the lion in his desert, the tiger tearing his prey in the jungle, or the rhinoceros wandering over the wild plains of Africa."

He gives many instances of cruelty to slaves, and concludes with the following words:—"Those who look tenderly at the slave-owner, and with a cold heart at the slave, never seem to put themselves into the position of the latter;—what a cheerless prospect, with not even a hope of change! Picture to yourself the chance, ever hanging over you, of your wife and your little children—those objects which Nature urges even the slave to call his own—being torn from you and sold like beasts to the first bidder! And these deeds are done and palliated by men who profess to love their neighbours as themselves, who believe in God and pray that his Will be done on earth! It makes one's blood boil, yet heart tremble, to think that we Englishmen and our American descendants, with their boastful cry of liberty, have been and are so guilty: but it is a consolation to reflect that we at least have

made a greater sacrifice, than ever made by any nation, to expiate our sin."

Besides his 'Journal of Researches,' the voyage of the "Beagle" gave rise to several geological papers by him; to three volumes on the 'Geology of the Voyage of the Beagle,' published separately under the titles of 'The Structure and Distribution of Coral Reefs,' 'Geological Observations on the Volcanic Islands visited . . .,' and 'Geological Observations on South America,' all by himself; and to five volumes on the 'Zoology of the Voyage of the Beagle,' by different naturalists, with notes by him on the habits and range of the species described. The Invertebrata and the plants were described by specialists in scientific publications.

The most important result of this voyage has yet to be told. We see in Darwin's 'Journal' the dawn of a great discovery, for surely the recognition that few only survive in the struggle for existence, is a necessary prelude to the conviction that the fittest survive. "We do not always bear in mind," he says, "how profoundly ignorant we are of the conditions of existence of every animal; nor do we always remember that some check is constantly preventing the too rapid increase of every organised being left in a state of nature. The supply of food, on the average, remains constant; yet the tendency in every animal to increase by propagation is geometrical. . . . Every animal in a state of nature regularly breeds; yet, in a species long established, any great increase in numbers is obviously impossible, and must be checked by some means." Again, there is no more cogent argument in favour of evolution than is furnished by the fact that the living and extinct species of the same continent are much more closely related than are the living species of one continent to the extinct species of another. "The relationship," he says, "though distant, between the *Toxodon* and the *Capybara*,—the closer relationship between the many extinct Edentata, and the living sloths, ant-eaters, and armadillos, now so eminently characteristic of South American zoology,—and the still closer relationship between the fossil and living species of *Ctenomys* and *Hydrochaerus*, are most interesting facts. . . . This wonderful relationship in the same continent between the dead and the living, will, I doubt not, hereafter throw more light on the appearance of organic beings on our earth, and their disappearance from it, than any other class of facts."

On the 2nd of October, 1836, Darwin is again in England, and, after spending a few months at Cambridge and elsewhere, and taking his degree of M.A., he settles in London early in 1837,

and for three years (1838–41) acts as one of the Secretaries of the Geological Society. In January, 1839, he marries his cousin, Emma Wedgwood, grand-daughter of the founder of Etruria, and in the same year he is elected a Fellow of the Royal Society.

The bustle and stir of London life are not congenial to him, and suit his health so badly that in 1842 he resolves to live in the country. In September of this year he buys a house at Down in Kent, with eighteen acres of land, and there he resided for the rest of his life,—a life henceforth entirely devoted to scientific work. In 1846 he writes to Captain Fitz-Roy: "My life goes on like clockwork, and I am fixed to the spot where I shall end it."

From 1837 to 1846 he is almost entirely occupied in writing the works above mentioned relating to the voyage of the "Beagle," part of the year 1845 being devoted to the preparation of a new edition of his 'Journal.' During these ten years he is also engaged upon his greatest work, 'The Origin of Species by Means of Natural Selection,' having opened his first note-book on the subject in July, 1837. But he had not then conceived the idea that specific differences arise by the advantage a favourable variation possesses in the general struggle for existence, for he says: "In October, 1838, that is fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus 'On Population,' and being well prepared to appreciate the struggle for existence which everywhere goes on, from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. . . . But at that time I overlooked one problem of great importance. . . . This problem is the tendency in organic beings descended from the same stock to diverge in character as they become modified. . . . The solution, as I believe, is that the modified offspring of all dominant and increasing forms tend to become adapted to many and highly-diversified places in the economy of nature." Here are expressed the three leading principles of his theory of the origin of species—the struggle for existence, the survival of the fittest, and the adaptability of modified forms to their environment.

In 1846 he begins to work on the Cirripedia (barnacles), and in eight years he completes a monograph of the recent species, published by the Ray Society, and another of the fossil species, published by the Palæontographical Society.

From 1854 to 1859 he devotes nearly all his attention to

the 'Origin of Species,' and in 1856 he begins to write out his views on a scale three or four times as extensive as that which he afterwards followed. "But," he says, "my plans were overthrown, for, early in the summer of 1858, Mr Wallace, who was then in the Malay Archipelago, sent me an essay 'On the Tendency of Varieties to depart indefinitely from the Original Type'; and this essay contained exactly the same theory as mine." With some men such a circumstance as this might have led to a life-long jealousy, but not with men of such noble characters as Darwin and Wallace; with them it led to a life-long friendship. Darwin consults his two greatest scientific friends near at hand, Sir Charles Lyell and Sir Joseph Hooker, and they urge him to send to the Linnean Society, with Wallace's essay, an extract from his own MS. of his projected work on the 'Origin of Species,' written twenty years before. He is at first very unwilling to consent, thinking that Wallace might consider his action unjustifiable, for, he says, "I did not then know how generous and noble he was." Wallace's essay and Darwin's extract were published together in the 'Journal of the Linnean Society,' and attracted but little attention at the time.

With "thirteen months and ten days' hard labour," Darwin then makes an abstract of his MS., and on the same reduced scale completes the 'Origin of Species;' and in November, 1859, his greatest work appeared. "Though considerably added to and corrected in later editions," he says in his Autobiography, "it has remained substantially the same book."

The 'Origin of Species' is not an easy book to read. It requires close attention and much thought. Although crowded with facts tending to support the argument, the presence of the thought that some persons may not be convinced by them is too evident. With excessive honesty Darwin brings prominently forward every conceivable objection to his theory, and although he refutes each one, the impression left on the mind of most readers must be less clear than if the work had been written on the assumption that it must necessarily carry conviction of the truth of the theory to every mind. In place of a brilliant impression, however, the work gives a deep conviction, and the more the facts and arguments are thought over, the more certain does it appear that species are not stable, but are modified descendants of other species, owing their differences to slight variations which have been perpetuated, with further modifications, by advantages thus accruing over unmodified forms in the perpetual struggle for existence. Although this work can never be so popular as the 'Journal of Researches,' which any

intelligent schoolboy may read with interest and pleasure, it has been translated into every European language, and its sale in England alone has reached nearly fifty thousand copies. It is a work which scarcely admits of criticism, for Darwin has in it criticised his own conclusions more rigorously than any other man could do. This he was enabled to do by having during many years made a note of every "published fact, new observation, or thought" opposed to his general results.

Nevertheless his views were at first accepted by a few advanced thinkers only,—by such men as Sir Joseph Hooker, Sir Charles Lyell, Professor Huxley, Herbert Spencer, and Darwin's own true knight, Alfred Russel Wallace. The necessary revolution in scientific thought required time for its development, and until nine years had elapsed since the publication of the 'Origin of Species,' it could not have been asserted, as it then was by Sir Joseph Hooker, in his presidential address to the British Association, that Natural Selection "is an accepted doctrine with almost every philosophical naturalist." Fourteen years later, the views promulgated in the 'Origin of Species' had gained so many converts, that, at a meeting of the Biological Society of Washington held as a memorial of Darwin about a month after his death, Dr. Theodore Gill spoke of his views as being "universally accepted" and "taken as the recognised platform of biologists;" and Dr. J. W. Powell said that he had demonstrated the laws of biologic evolution "in a manner so masterly that there lives not in the world a working biologist, a scientific man engaged in this field of research, who has not, directly or indirectly, accepted his great conclusions."

During the last few months of 1859, Darwin is fully occupied in preparing a new edition of the 'Origin,' and with an enormous correspondence. In January, 1860, he begins to arrange his notes for his work on the 'Variation of Animals and Plants under Domestication,' published in 1868 (second edition, 1875). In July, 1861, he commences his work on the 'Fertilisation of Orchids,' published in 1862 (second edition, 1877), but he had begun to study the "cross-fertilisation of flowers by the aid of insects" in 1839. In 1868 he begins to write his 'Descent of Man, and Selection in Relation to Sex,' published in 1871 (second edition, 1874), but he had begun to collect notes on the subject in 1837 or 1838, as soon as he had become "convinced that species were mutable productions." On the birth of his first child, in December, 1839, he commences to make notes on the first dawn of expressions, continuing to study the subject for more than

thirty years, the result being the publication, in the autumn of 1872, of his book on the 'Expression of the Emotions in Men and Animals.' In the summer of 1860 he first notices that the leaves of the sundew (*Drosera*) entrap insects, and for fifteen years, whenever he has leisure, he pursues his experiments, completing his book on 'Insectivorous Plants' in 1875. In 1865 he commences to make experiments on cross- and self-fertilisation, publishing his book on the 'Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom' in 1876. In the same year his work on 'The Different Forms of Flowers on Plants of the Same Species' appears (second edition, 1880), this being a re-publication, with additions and corrections, of several papers originally published in the 'Journal of the Linnean Society.' In 1880 he completes, with the assistance of his son Francis, a book on 'The Power of Movement in Plants,' which he speaks of as "a tough piece of work." And, finally, in 1881, he works up a short paper, read before the Geological Society more than forty years before, into a book on 'The Formation of Vegetable Mould through the Action of Worms.' Any one of these works would have made the scientific reputation of any other man.

During all this time Darwin is contributing papers to various scientific societies and to scientific journals, and during all this time,—at least during the last forty years of his life,—he never knew one day of the health of ordinary men, his life being one long struggle against the weariness and strain of sickness.

On the 13th of December, 1881, not many days after the publication of his last book, he is seized with an attack at the heart; towards the end of February in the following year such attacks become frequent and more severe; and on the 19th of April he passed away, in the 74th year of his age, having worked up to the last, for, only two days before his death, he recorded the progress of an experiment in which his son Francis was engaged.

It was the wish of his family that he should be buried at Down, but they gave way to the wish of the nation, expressed in a letter to the Dean of Westminster signed by twenty members of Parliament, and the funeral took place on the 26th of April in Westminster Abbey.

The grave of Charles Darwin, the Newton of Biology, is a few feet from that of the Newton of Astronomy, and the tablet bears the following simple inscription:—

CHARLES ROBERT DARWIN.
Born 12 February, 1809.
Died 19 April, 1882.

A greater and more enduring monument has been raised by Darwin to himself in his writings than any that could be raised to him by others. "He thought," said 'The Times' on the day of his funeral, "and his thoughts have passed into the substance of facts of the universe. . . . The Abbey has its orators and ministers who have convinced senates and swayed nations. Not one of them all has wielded a power over men and their intelligence more complete than that which for the last twenty-three years has emanated from a simple country house in Kent. . . . Darwin, as he searched, imagined. Every microscopic fact his patient eyes unearthed, his fancy caught up and set in its proper niche in a fabric as stately and grand as ever the creative company of Poets' Corner wove from sunbeams and rainbows."

But interment in Westminster Abbey was not destined to be the only public honour paid to Darwin's memory. A movement for a national memorial of him was set on foot, and over £4000 were raised by subscription. About half the amount was expended on a statue, executed by Sir Edgar Boehm, R.A., and erected in the great hall of the British (Natural History) Museum at South Kensington, where it was unveiled by the Prince of Wales on the 9th of June, 1885; and the balance was entrusted to the Royal Society to be invested for the promotion of biological research.

Charles Darwin left a widow, five sons, and two daughters. His eldest son, William Erasmus, is a banker in Southampton; the second, George, is Plumian Professor of Astronomy at Cambridge University, and a Fellow of the Royal Society; the third, Francis, has done valuable botanical work, and is also a Fellow of the Royal Society; the fourth, Leonard, is an officer in the Royal Engineers, and has done good work in astronomy; and the fifth, Horace, is a mechanician, and his talents have been successfully devoted to the development of the Cambridge Scientific Instrument Company.

Every book which Darwin wrote is the result of keen observation, industrious collection of facts, and deeply thoughtful deduction, while most of his conclusions have only been arrived at after reflecting and experimenting for many years. His life shows what may be accomplished by indefatigable industry and dogged perseverance, without any remarkable original genius, unless the power to observe accurately and take infinite pains be genius. He was not a fluent writer, expressing his thoughts with difficulty, and he had neither a quick apprehension nor a retentive memory. But he rightly gives himself credit for "some power

of reasoning," "a fair share of invention and of common sense or judgment," superiority "to the common run of men in noticing things which easily escape attention, and in observing them carefully," industry "in the observation and collection of facts," a "steady and ardent love of natural science," and "patience to reflect or ponder for any number of years over any unexplained problem." Even with these qualities it is truly wonderful that he has accomplished so much without being able "to remember for more than a few days a single date or a line of poetry." He much regretted his want of mathematical knowledge, saying that men endowed with it "seem to have an extra sense."

Although the name of Darwin will always be chiefly associated with the theory of the origin of species by means of natural selection, few men have done so much as he did to advance the sciences of geology, botany, and zoology, irrespective of the light thrown upon them by his theory.

His earliest geological researches were made during his voyage round the world, and the principal results were published in the three volumes of the 'Geology of the Voyage of the Beagle.' Of the first of these volumes, 'The Structure and Distribution of Coral Reefs,' Sir Archibald Geikie says: "This well-known treatise, the most original of all its author's works, has become one of the classics of geological literature. . . . No more admirable example of scientific method was ever given to the world, and even if he had written nothing else, this treatise alone would have placed Darwin in the very front of investigators of nature." The last work which issued from his pen, 'The Formation of Vegetable Mould through the Action of Worms,' has doubtless had quite as powerful an influence upon geological thought, in showing the great results which are brought about by small causes long continued. But the chapter in the 'Origin of Species,' on the "Imperfection of the Geological Record," threw quite a new light upon the "Record of the Rocks." It is perhaps not too much to say that Darwin, in this single chapter, revolutionised the science of geology as completely as Lyell had done in the greatest geological work which has ever been written—'The Principles of Geology.' Lyell taught that we must interpret the past from our knowledge of the present, while Darwin showed how extremely fragmentary our record of the past must necessarily be, letting a flood of light upon some of the most perplexing problems with which geologists and palæontologists have to deal in applying existing agencies to the elucidation of past changes in the history of our earth.

What Darwin has done for geology, irrespective of his direct contributions to the science, cannot be better expressed than in the words of Sir Archibald Geikie. "No man of his time," he says, "has exercised upon the science of geology a profounder influence than has Charles Darwin. . . . When he began to direct his attention to geological inquiry, the sway of the Cataclysmal school of geology was still paramount. But already the Uniformitarians were gathering strength, and, before many years were past, had ranged themselves under the banner of their great champion, Lyell. Darwin, who always recognised his indebtedness to Lyell's teaching, gave a powerful impulse to its general reception by the way in which he gathered from all parts of the world facts in its support. He continually sought in the phenomena of the present time, the explanation of those of the past. Yet he was all the while laying the foundation on which the later or Evolutional school of geology has been built up. . . . That the Present must be taken as a guide to the Past, has been more fearlessly asserted than ever. And yet it has been recognised that the present differs widely from the past, that there has been a progress everywhere, that Evolution and not Uniformitarianism has been the law by which geological history has been governed. For the impetus with which these views have been advanced in every civilised country, we look up with reverence to the loved and immortal name of Charles Darwin."

The great progress of our knowledge of physiological and morphological botany in recent years is almost entirely attributable to the researches of Darwin. In showing that "the crossing of forms only slightly differentiated favours the vigour and fertility of their offspring," he opened up the most interesting of all botanical investigations, the relation of insects to flowers. His works on this subject are 'The Fertilisation of Orchids by the Agency of Insects,' and 'The Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom.' His works on 'Insectivorous Plants,' on 'The Different Forms of Flowers on Plants of the Same Species,' and on 'The Power of Movement in Plants,' in the last of which he was assisted by his son Francis, were each of them revelations to botanists. It is wonderful that he should have been the first, if not actually to see, at least to realise the importance of so many phenomena in the life of plants. In the botanical portion of his work on 'The Variation of Animals and Plants under Domestication,' he shows that horticulturists have been unconsciously making experiments which tend to prove the truth of his theory ever since they first began to cultivate plants.

Darwin was not a systematic botanist, and does not appear to have described a single new species of plant. He "looked upon plants as *living things*. He did not study their forms so much as their *actions*. He interrogated them to learn what they were *doing*. The central truth, towards which his botanical investigations constantly tended, was that of the universal *activity* of the vegetable kingdom—that all plants *move* and *act*. He has, so to speak, *animated* the vegetable world. He has shown that which-ever kingdom of organic nature we contemplate, to *live* is to *move*." (*L. F. Ward*.) "He made the dry bones live," said Dr. Masters; "he invested plants with a history, a biography, a genealogy, which at once conferred an interest and a dignity on them. Before, they were as the stuffed skin of a beast in the glass case of a museum; now they are living beings, each in their degree affected by the same circumstances that affect ourselves, and swayed, *mutatis mutandis*, by like feelings and like passions." Yet he evinced in a very practical manner his interest in systematic botany and his conviction of the importance of an exhaustive synonymic list of the plants of the world, by arranging, a few months before his death, to provide funds for the preparation and publication of a new edition of Steudel's '*Nomenclator*.' His original idea has been somewhat modified, and, under Sir Joseph Hooker's supervision, Mr. Daydon Jackson, who edited, for our Society, Pryor's '*Flora of Hertfordshire*,' is now carrying out the colossal task of constructing, on the plan of Bentham and Hooker's '*Genera Plantarum*,' a list of all known genera and species of plants, with references.

The principal purely zoological work of Darwin is his '*Monograph of the Cirripedia*,' published by the Ray Society, in two volumes of over 1000 pages and 40 plates, in 1851 and 1854. No other group of organisms has had so much light thrown upon it by any one author as the Cirripedia have had in this profound work. The most curious of the many discoveries which Darwin made in examining these animals is that of very minute parasites which he determined to be "complemental males," the name denoting that they do not pair with a female, but with a bisexual individual. He was much struck with the number of diverse beings comprised in some of the species, and by the great diversity in the sexual relations in others.

In the '*Origin of Species*,' the '*Variation of Animals and Plants under Domestication*,' and the '*Descent of Man*,' are many zoological observations of much importance, irrespective of their bearing on the theory of natural selection; and our

chief knowledge of the habits of earthworms is derived from Darwin's work on 'The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits.'

But these contributions to zoology sink into the shade under the brilliant light thrown upon the science by the great truth which Darwin revealed. Mr. Romanes says: "The influence which our great naturalist has exerted upon zoology is unquestionably greater than that which has been exerted by any other individual. . . . No labourer in the field of science has ever plodded more patiently through masses of small detail; no master-mind on the highest elevation of philosophy has ever grasped more world-transforming truth. . . . Of very few men in the history of our race can it be said that they not only enlarged science, but changed it,—not only added facts to the growing structure of natural knowledge, but profoundly modified the basal conception upon which the whole structure rested; and of no one can this be said with more truth than it can be said of Darwin."

Anthropology and Psychology are scarcely within the province of our Society, and it will therefore suffice to say that Darwin has so completely transformed our conception of both these sciences, the former by his 'Descent of Man,' and the latter by his 'Expression of the Emotions,' that all who write upon these subjects after the publication of his works must perforce treat them in a totally different manner from that in which they had ever been treated before.

Beyond the limits of the scientific world, nine persons, perhaps, out of every ten, only think of Darwin as the originator of the notion that man has been developed from the anthropoid apes, the evolution of man, as well as of the lower animals, being due to the development of organs by use and the atrophy of organs by disuse. This is the view which Lamarck expounded half a century before Darwin published his views on evolution. So far from its being due to, or even entertained by Darwin, he nowhere states that he believes man to be a modified ape, but that man and the ape have had a common ancestor, a view, moreover, which does not appear in the 'Origin of Species,' but only in his more recent work on the 'Descent of Man,' and which may still be left out of consideration in judging of his theory of natural selection. Whether, also, modifications arise from the use and disuse of organs, is a question which may be disputed without affecting the validity of his theory. It is but one of many ways by which may be brought about deviations capable of transmission by inheritance.

Others again, but let us hope very few, look upon Darwin as a man who has done his best to subvert the Christian religion and destroy our belief in God. Nothing could have been further from his intention; no such imputation more repugnant to his feelings. Never by a single word has he attacked our faith, and although doubts arose in his own mind as to the probability of supernatural interference with the laws of nature, and of divine revelation to man, he never expressed them in any of his published books or papers, nor can the inference be justly drawn from them that he held unorthodox views. He believed that he had discovered a great truth, and he honestly gave expression to his convictions, without any other motive than that of advancing our knowledge of nature and enabling us to penetrate some of her secrets. His religion did not consist in "faith in things unseen," or blind belief in the miraculous, but it was that "pure religion and undefiled" which leads a man "to visit the fatherless and widows in their affliction and to keep himself unspotted from the world." While undoubtedly the greatest naturalist, if not the greatest scientist who ever lived, he was one of the most humble, kind-hearted, and lovable of men. His affection for his friends was "of the warmest possible kind," and he had, "to an unusual degree, the power of attaching his friends to him." At Down he was most courteous to all the village people, and took an interest in everything relating to their welfare. He helped to found a Friendly Club, and served as treasurer for thirty years; and for the last thirty-six years of his life he was on the most friendly and indeed affectionate terms with the Vicar of Down, the Rev. Brodie Innes, who speaks of him as an active assistant in all parish matters, and ever ready with liberal contributions. Owing to the retired life which his ill-health necessitated, his friends were not numerous, but all who knew him seem to have been even more impressed with the beauty of his character than with the greatness of his attainments, vast as they were.

Professor Huxley says that "the more one knew of him, the more he seemed the incorporated ideal of a man of science. Acute as were his reasoning powers, vast as was his knowledge, marvellous as was his tenacious industry, under physical difficulties which would have converted nine men out of ten into aimless invalids; it was not these qualities, great as they were, which impressed those who were admitted to his intimacy with involuntary veneration, but a certain intense and almost passionate honesty by which all his thoughts and actions were irradiated, as by a central fire. . . . He found a great truth trodden under foot, reviled by bigots, and

ridiculed by all the world; he lived long enough to see it, chiefly by his own efforts, irrefragably established in science, inseparably incorporated with the common thoughts of men. . . .”

Mr. Romanes says that “while we recognise in him perhaps the greatest genius and the most fertile thinker, certainly the most important generaliser and one of the few most successful observers in the whole history of biological science, we feel that no less great, or even greater than the wonderful intellect, was the character of the man. . . . The genuine delight that he took in helping everyone in their work—often at the cost of much personal trouble to himself—in throwing out numberless suggestions for others to profit by, and in kindling the enthusiasm of the humblest tyro in science; this was the outcome of a great and generous heart, quite as much as it was due to a desire for the advancement of science. . . . On the whole, Darwin’s character was chiefly marked by a certain grand and cheerful simplicity, strangely and beautifully united with a deep and thoughtful wisdom, which, together with his illimitable kindness to others and complete forgetfulness of himself, made a combination as lovable as it was venerable.”

But however beautiful the character and however admirable the life of Darwin may have been; however greatly he may have added to our knowledge of all the sciences which are concerned with the phenomena of life and mind, past and present, with many, perhaps with most of us, his reputation is inseparably interwoven with the theory to which his name has been given. This theory has transformed Evolution from an hypothesis into a doctrine. For Evolution and Darwinism are not synonymous. Descent with modification might be imagined to take place without a struggle for existence in which the fittest survive by the destruction of the less fit, but without this the raising of the type would be inexplicable. If the type were not raised, it might still be quite true that “in the intellectual, as in the material world,”—

“All changes, nought is lost; the forms are changed,
And that which has been is not what it was,
Yet that which has been is;—”

And we could dispense with the theory of natural selection. But while the forms change, the type *is* raised, and we cannot conceive it to be thus raised by any other process than that of natural selection. The evidences of descent with modification may therefore be considered quite apart from the evidences of the survival of the fittest, although without such survival we cannot account for the evolution of the present from the past.

That the present has been evolved from the past may be shown and illustrated in various ways. The whole of living nature may be likened to a tree. The root is as yet unknown, but it is probably represented by some such simple form of life, if life it be, as the *Bathybius* of the ocean. The trunk soon divides into two main branches, representing the vegetable and the animal kingdoms, but, before it does so, forms are developed which are intermediate between plants and animals, or which at one period of their life are animate, and at other periods possess merely vegetative powers. Each main branch, the vegetal and the animal, then ramifies; the secondary branches, branchlets, and twigs representing the sub-kingdoms, classes, orders, families, genera, species, and varieties of our natural system of classification. This system is natural, because, and only so far as, it is founded on genetic relationship. The closer any two organisms agree in structure, the nearer are they genetically related. But each sub-kingdom is formed after a type which is followed with modifications in every one of its ramifications up to the individual. And just as certainly as each single leaf of a tree is vitally connected with the root, has each individual plant and animal been developed, by a purely generative process, in the course of incalculable ages, from some simple or undifferentiated form of living matter. In the utmost diversity there is unity. All living things, from the lowliest plant to the highest animal, have similar functions, they feed, grow, and reproduce their kind; protoplasm is in all the physical basis of life; and all forms of protoplasm are built up of the same elements—carbon, hydrogen, oxygen, and nitrogen. A single origin for life alone suffices adequately to explain this agreement.

In animals, when typical structures are no longer useful, they frequently remain, usually as rudimentary organs, the presence of which can only be accounted for by genetic relationship and descent with modification, for they are organs which have dwindled owing to changed conditions rendering them useless. For instance, in the course of adaptation of terrestrial quadrupeds to aquatic habits, the hind-limbs dwindle. Thus, in the seals, the hind-legs, although retaining all their typical bones, are almost rudimentary; and in the whales they are not apparent at all externally, and are only represented internally by very rudimentary remnants. Again, in the snakes there are no vestiges of fore-limbs, and only in the python do we find vestiges of hind-limbs, as tiny rudiments under the skin, and therefore quite useless to their possessor. These are cases of degeneration of organs from want of use, but they are

accompanied by elaboration of other organs which are useful, and they do not therefore indicate degeneration of the type.

But the gradual modification of certain organs, and their special degeneration co-existent with a general elaboration of the type, are nowhere more distinctly seen than in the pedigree of the horse, which has been traced backwards in time from the recent and the slightly dissimilar fossil *Equus* with a single toe and two lateral rudiments, the splint-bones, to an Eocene ancestor, about the size of a fox, with "four well-developed toes and a rudiment of another on the fore-feet, and three toes behind." In America, between the recent *Equus*, which had become extinct there before that continent was discovered by Europeans, and the Lower Eocene *Eohippus*, at least five closely-related equine genera have been discovered by Professor Marsh, each genus showing, in comparison with the one preceding it in time, an increase in the size of the animal, and elaboration of certain organs such as the teeth, with a gradual development of the middle toe, and suppression of the others one by one. Surely this is, as Professor Huxley says, demonstrative evidence of evolution.

It may be thought that man should be excepted from the scheme of evolution, his intellect, by giving him the power to devise and use tools, and to form a language, having enabled him to raise himself infinitely above any of the lower animals, and to make himself "lord of the creation." There can be no question, either, as to his specific distinctness, for by common consent he has a genus to himself, and this genus, *Homo*, has but a single species, though one with many varieties, some of which, were there not connecting links, might be considered species. Yet the late Sir Richard Owen, than whom few men have more reluctantly accepted the theory of descent with modification, especially as applied to man, said, in 1857, two years before the appearance of the 'Origin of Species:' "Not being able to appreciate or conceive of the distinction between the psychical phenomena of a Chimpanzee and of a Boshisman or of an Aztec with arrested brain growth, as being of a nature so essential as to preclude a comparison between them, or as being other than a difference of degree, I cannot shut my eyes to the significance of that all-pervading similitude of structure—every tooth, every bone, strictly homologous—which makes the determination of the difference between *Homo* and *Pithecus*, the anatomist's difficulty."

Professor Huxley, also, has shown that man, in the early stages of his development, is far nearer to the apes than the apes are to the dog; that in limb-proportion man differs less from the gorilla

than the gorilla differs from the other apes; that in cranial capacity men differ more from one another than they do from the apes, and no more from the apes than the apes differ from one another; that the differences between the skull of man and that of the gorilla are less than those between the skull of the gorilla and that of some other apes; and that the dentition of man differs less from that of the higher apes than the dentition of the higher apes differs from that of the lower apes. And he finally sums up the results of his comparison with this remark:—"Thus, whatever system of organs be studied, the comparison of their modifications in the ape series leads to one and the same result—that the structural differences which separate man from the gorilla and the chimpanzee are not so great as those which separate the gorilla from the lower apes."

If we had, in the rocks, a complete epitome of the history of our earth and its inhabitants, no doubt the pedigree of all our plants and animals, including that of man, might be traced as certainly as in the case of the horse, but the strata now existing, as Darwin has shown, are but fragments of the deposits which have been formed, and the fossils we find in them are but hap-hazard samples of the organisms which have been entombed. Our rocks are worn away by the action of water, and the sediment is carried into the sea, but only to form new rocks which are upraised and have no sooner become dry land than they are again worn down by rain and rivers, this process continually recurring, so that we only here and there catch a glimpse of the past in the strata which have escaped denudation, and in these strata we only here and there find a fossil, or a group of fossils, which has escaped destruction or obliteration. Nevertheless missing links are constantly being discovered,—links between mammals and amphibians, between birds and reptiles, between amphibians and fishes, and even between the Vertebrata and the Invertebrata (through the Tunicata); and also innumerable links between genera and species, so that it is getting more and more difficult to define a species, they run so imperceptibly one into another.

As Evolution is now an established doctrine, it is needless to multiply evidences of genetic relationship: but the question is yet to be considered as to how far Darwin's theory of natural selection is adequate to explain how evolution has taken place.

Most of the pre-Darwinian evolutionists considered that all living things possess an inherent faculty of progressive development, but the acceptance of such a view as an *efficient* cause of progress is almost as likely to stifle investigation as is the belief in special creation. It will be sufficient to give a brief outline of the views

of Erasmus Darwin, Lamarek, and Robert Chambers, to show what a great advance the theory of natural selection was upon the views which had previously been brought forward.

Erasmus Darwin, in 1794, very nearly anticipated the theory of his illustrious grandson, adducing changes taking place during life-time; changes introduced by cultivation; similarity of structure; acquired and inherited transformations; "the desire of the exclusive possession of the female" in order that (here giving a consequence as a cause) "the strongest and most active animal should propagate the species, which should thence become improved;" want of food resulting in improvement from the perpetual endeavour to obtain it; want of security resulting in modifications of form and structure; etc.; as grounds for imagining that "in the great length of time since the earth began to exist, . . . all warm-blooded animals have arisen from one living filament, which the Great First Cause endowed with animality, . . . possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end!"

"Organic life beneath the shoreless waves
Was born, and nurs'd in ocean's pearly caves;
First forms minute, unseen by spheric glass,
Move on the mud, or pierce the watery mass;
These, as successive generations bloom,
New powers acquire, and larger limbs assume;
Whence countless groups of vegetation spring,
And breathing realms of fin and feet and wing."

Lamarek then, in 1809, framed the theory that modifications of structure arise chiefly from the use and disuse of organs, the tendency to such use and disuse being engendered by changes in outer circumstances. He proposed to alter the definition of species from that of "every collection of individuals produced by other individuals like themselves," to that of "a collection of individuals resembling each other, and reproducing their like by generation so long as the surrounding conditions do not alter to such an extent as to cause their habits, characters, and forms to vary." In support of this definition he showed that many species, and even genera, run so imperceptibly into one another that it is often a very difficult matter to frame a definition of them; that there has been a gradual progress in past times from the lower forms of life to the higher, each geological formation in succession containing fossils of higher or more complex organisation; and that the earth is of vast antiquity, its strata having been very slowly deposited, and changes in its condition having been very gradually brought about; and he

inferred that in order to accommodate themselves to these changes, plants and animals, by not using organs no longer required, and by acquiring and developing new organs to fulfil new functions, have changed, little by little, their form, their organisation, and their faculties, difference of situation and exposure thus causing them to vary, and, under a continuance of the same difference of circumstances, such variations becoming essential and being transmitted, so that at the end of many generations these altered individuals are transformed into a new and distinct species. This theory is a decided advance upon that of Erasmus Darwin, for it substitutes variations in structure, etc., such as the suppression of some organs and the development of others, effected by the pressure of changes in external conditions, for his view that plants and animals have an inherent tendency to improve and take advantage of such changes, but it does not explain why the variations perpetuated are such as tend necessarily to raise the type.

Robert Chambers, in 1844, in his anonymous work entitled 'Vestiges of the Natural History of Creation,' brought forward much additional evidence in favour of the transmutation of species and their progressive development in time, and showed how recent discoveries in embryology and palæontology were in harmony,—the higher animals, including man, resembling, in the successive phases of their existence from an early embryonic condition, lower classes in the animal kingdom, in the order in which these classes successively appear in geological time. The object of this work, the author stated in his subsequently-published 'Explanations,' was "to show that the whole revelation of the works of God presented to our senses and reason is a system based in what we are compelled, for want of a better term, to call *law*; by which, however, is not meant a system independent or exclusive of Deity, but one which only proposes a certain mode of his working."

Goethe expressed himself so ambiguously about transformation and metamorphosis, that it has been questioned whether he really believed in evolution, or merely indulged in flights of poetical imagination. While he says of Nature: "*She is ever shaping new forms*: what is, has never yet been; what has been, comes not again;" he also says: "Incessant life, development, and movement are in her, *but she advances not*;" an expression quite at variance with the very principle of evolution. And yet he goes further than most evolutionists would do when he says:

"By fiery vapours rose this rock you're seeing.
In moisture came organic life to being."

The attempt to account for the origin of life from an aqueous solution acted on by an electric current was the greatest flaw in the work of Chambers, and he erred in many points, especially in deriving the mammals from the birds, their pedigree being from the fishes through the amphibians; yet he certainly prepared the way for the reception of Darwin's theory, as Darwin himself acknowledges, for the 'Vestiges' had a large sale and gave rise to a very extensive controversy. But, without the principle of natural selection, no theory of evolution could be satisfactory.

The fundamental principles of the origin of species by means of natural selection are thus stated by Darwin:—"As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently-recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be *naturally selected*. From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form."

These principles may perhaps be more clearly apprehended if stated in a somewhat different manner, and slightly modified and elaborated.

1. In every species many of the offspring do not attain maturity, owing to all living things being perpetually engaged in a struggle for existence.

2. Few, if any, animals or plants are exactly alike in all respects at any stage of their existence.

3. However slightly one individual may differ from another, if the variation gives one a better chance of living than the other, that one will be the most likely to survive.

4. External conditions vary from time to time, the alteration usually being gradual and progressive.

5. If in any species some of the offspring differ from the parent in any way which makes them more suited to new conditions than the offspring which more nearly resemble the parent, they will have the best chance of living.

6. Any beneficial variation in the offspring will most probably be transmitted to *their* offspring; and if the external conditions then remain the same, or if they continue to change in the same direction, this variation will be perpetuated.

7. A new variety, better adapted for new conditions than the normal form, may, and in the struggle for existence most probably will, oust the normal form, which will gradually die out.

Each of these propositions is indisputable and complete in itself. Their general result is to demonstrate how beneficial variations may be perpetuated, a modified form being thus *naturally selected*, gradually acquiring and transmitting, through many generations, characters which, by a cumulative process of variation, may ultimately make it specifically distinct from the original form, that form dying out, so that one species gives rise to another.

The destruction of life is immense. How few of the innumerable spores of fungi ever even germinate! What a small proportion of the spawn of fishes ever attains maturity! Of seedlings which spring up, how few survive! What a great destruction of insects is wrought by birds! Examples without end could be given of great loss of life. Why is it that so many more individuals of every species are generated than can possibly survive? If each species were independently created to fill the place prepared for it in the world, and if no species could improve itself in its struggle for existence, this waste of life would be wanton, suffering and early death inexplicable.

“ Are God and Nature then at strife,
That Nature lends such evil dreams?
So careful of the type she seems,
So careless of the single life.

.

‘ So careful of the type?’ but no.
From scarp’d cliff and quarried stone
She cries, ‘ A thousand types are gone:
I care for nothing, all shall go.’ ”

If the views of the special creationist were correct, Tennyson might well ask if God and Nature are at strife. Nature is careless of the single life, and careless of the type, that the type may be raised, for if the weakly survived equally well with the strong, there could be no progress. Here at least natural causation and teleology are in harmony, for, “ good will be the final goal of ill ” because each death “ subserves another’s gain.”

That this view of progress in the past is an earnest of progress in the future has been well expressed by Dr. J. W. Powell, Director of the United States Geological Survey. He says: “ Had philosophers discovered that the generations of living beings were degenerating, they would have discovered despair. Had they discovered that life moves by steps of generations in endless circles—that what has been is, and what is shall be, and there is no progress, the gift of science to man would have been worthless. The revelation of science is this: Every generation in life is a step in progress to a higher and fuller life; science has discovered *hope*.

Darwin demonstrated what others vaguely believed or dimly saw—the course and methods of biologic evolution. Darwin gave hope to philosophy. . . . By his discoveries the discoveries of all other biologists have been correlated and woven into systematic philosophy.”

But progress is not universal; lowly forms of life still exist; and some creatures are degenerate representatives of once higher forms. Living things seldom voluntarily “seek fresh woods and pastures new;” they are driven to do so because they tend to increase faster than their wants can be supplied. Either there is not room for all or there is not food for all. But if not for all, there is for some, and so long as any can continue to exist without a struggle, some will continue to exist without modification, and the longer they do so, the more stable will their forms become, their fixity of type being strengthened by inheritance. Then if external conditions become simpler, degeneration may ensue owing to the disuse of certain organs. Thus there may be two varieties of the same species of animal existing near together at the same time, one of which possesses the sense of sight and the other does not. One, for instance, may live at the mouth of a cave where the power of vision is of advantage, therefore retaining its sight; the other may live in the interior of the cave where sight is useless, therefore becoming blind through the disuse of its eyes for many generations. Again, those species which continue to live because their weaker brethren have succumbed, and those which have been driven away from their ancestral home, will become more vigorous, or will acquire more adaptability to changing circumstances, and these qualities will be strengthened by heredity. Herein we see why the rarer species are usually well differentiated, and the commoner species are usually prolific in varieties through which they insensibly run one into another. The struggle for existence being far more keen between different individuals of the same species than it is between individuals of different species, the rarer a species is, the less has it to struggle with other individuals of its own species, and the more stable does it become in character: the commoner a species is, the greater is its struggle, and the more variable and adaptive does it become.

Natural selection must, however, have variations to act upon. It does not beget them. Variability is probably as much an innate tendency in living things as is heredity. Each strives for mastery over the other, and there is no more difficulty in crediting the plastic or formative action of the one than that of the other. The difficulty really lies in our conception of the nature of life.

The simplest form of life of which we can conceive, is a particle of sarcode or protoplasm endowed with the power of movement, so that it may change its form if not its place; of assimilation, so that it may increase in bulk; and of fission, so that when it has attained a certain size it may form two particles, this process of division continuing, and thus causing the particles to increase in number in geometrical progression. In each particle, however minute, there must be two opposing forces, stability and mobility, while growth, by assimilation of extraneous matter, implies change, so that no living thing is precisely the same at any one period of its life as it is at any other.

Stability implies heredity, while mobility implies variability. Everything that lives must move and grow and multiply itself, and therefore change its form and dimensions and numbers, and if the food it assimilates be not always precisely the same, it must also change its composition or constitution. Given, therefore, a single particle of protoplasm, the two particles into which it divides will probably differ from one another, by however so little, when *they* divide.

Further, the molecules in every particle of protoplasm, vegetal or animal, are as incessantly moving as are the molecules in every particle of inert matter which is not absolutely cold, that is, not at an absolute *zero* temperature. In this incessant quivering or vibrating molecular motion, arises life in the one case and warmth in the other, and therefore in the very conception of the nature of life we cannot get rid of the idea of alteration by internal as well as external movement. Thus viewed, heredity is similarity resulting from stability, and variability is dissimilarity resulting from mobility.

Variability is thus as intelligible as is heredity, and it is certain that variations do occur and are perpetuated. In our domestic animals and cultivated plants, the individuals of any variety differ more from each other than do the individuals of any species or variety in a feral state, and therefore it would seem that domestication and cultivation induce variability. But Nature gives the variations, Man merely accumulates those which are useful to himself, by propagating only from his best plants, and only allowing his best animals to breed, or at least not allowing his worst to do so. With regard to the extent of variation, it may suffice to state that the domestic varieties of the same species differ more from each other in almost any character which man has selected and tried to perpetuate, than do the distinct species of the same genera in a feral state.

What Man has been doing for the last few thousand years Nature has been doing for untold ages. But there is this difference. Nature selects only the best individuals, or those which have some advantage in the struggle for existence, or some special adaptability to changed circumstances. Man selects those which have characters he wishes to perpetuate, not those which give their possessors any advantage in their life-struggle, in fact more often those which would place them at a disadvantage if left to themselves and allowed to revert to their feral condition ; and therefore, while a variety raised by Nature will be preserved, or further modified in the same direction, a variety raised by Man will tend to lose the characteristics which he has endeavoured to impress upon it. This is called reversion to the original type, and the fact of such reversion has by some been thought to furnish one of the chief arguments against the theory of Darwin. It rather furnishes an argument in favour of it, for reversion of domestic animals and cultivated plants allowed to run wild, to a type advantageous to them in their life-struggle, is really an example of the beneficial effects of natural selection. Moreover, characters acquired by domestication and cultivation which are not disadvantageous are seldom entirely lost, although it is evident that they are not so likely to be perpetuated as are characters acquired under natural conditions.

The struggle for existence amongst plants is chiefly against competing plants of their own or other species, the winners in the one case varying from the original type in some way by which they obtain an advantage, and transmitting that variation to their offspring, and in the other case driving out the competing species by having greater vigour or more adaptability to any changing circumstances. It is also a struggle against the depredations of animals, the winners then being those which possess the best means of defence, such as thorns or poisonous properties, or which are the most inconspicuous. But flowers which are inconspicuous will not attract insects, and therefore all such flowers depend, for the continued existence of their species, upon self-fertilisation. All flowers which require to be cross-fertilised are conspicuous, brightly coloured, or highly scented, so that insects may be attracted to them. This is especially the case with orchids, in many of which the adaptations for cross-fertilisation by the agency of insects are exceedingly complex. Thus the development of floral envelopes to the reproductive organs, and of the scent of flowers, may be traced to the visits of insects, for whenever any variation appears, if that variation increases the attraction of the flower to

insects, more seeds, or more vigorous seeds, will be perfected in that variety, and it will thus have a better chance of perpetuating itself than will the original form.

The struggle for existence amongst animals is too obvious to require illustration. Their increase is chiefly checked by one species preying upon another, by disease, and by insufficiency of food. As with plants will the healthiest best withstand the attacks of insects, so with animals which prey upon one another will the strongest or most wary gain the victory. In both, the effect of the struggle must be to perpetuate and increase beneficial modifications. In animals which have no means of defending themselves against attack, some subtle device is necessary, and that is generally some mode of concealment. The most efficient way to escape notice or attack is to resemble something else which is not subject to attack. This is the origin of mimicry, which takes several forms. Many insects escape destruction by resembling the flowers, leaves, twigs, or bark of the trees on which they feed. Certain beautiful and conspicuous butterflies have a disagreeable odour which renders them obnoxious to birds; others, belonging to a different genus, and having no offensive odour, resemble these in their habits and colour, and so escape destruction. Natural selection offers the only conceivable explanation of both these forms of mimicry, the tendency to mimicry being increased by the most mimetic individuals having the best chance of surviving and bearing offspring which inherit their peculiarities.

These are merely a few illustrations of the application of the principle of natural selection to the explanation of phenomena which without it are utterly inexplicable. But, after all, this principle merely supplies a missing link in a chain of causation still discontinuous, unless we accept an inherent tendency to vary as an efficient cause of variation. It enables us to understand how, when a beneficial variation takes place, that variation is perpetuated, but it does not show why beneficial variations occur. Natural selection is merely a term for the survival of the fittest by the destruction of the unfit. It cannot produce anything, but it is a necessary factor in evolution, for without it the less fit would be as likely to endure as the fittest, and there would be no progress. It embraces the theory of Lamarck, for by natural selection only can the modification of organs by use and disuse owing to changes in environment, be preserved and accumulated in the right direction for progress; and it accounts for living things fitting the conditions of their existence without being

designed to fit them, for those which did not fit these conditions have perished in the struggle for existence; but it nevertheless requires the aid of some pre-ordained guiding or determining principle, and that necessitates the existence of a Presiding Intelligence. Nothing happens by chance; everything must have a cause; and every cause must have a prior cause; so we are logically brought to see the necessary existence from eternity of a Great First Cause, of infinite power and wisdom, who has decreed the existence of matter and ordained the laws of force which govern it. Even if we could ascertain the mode in which life has been acquired by matter, and could see the quivering molecules in the protoplasm of organised beings striving with each other, some trying to pursue the course they have hitherto pursued, and others trying to pursue a new course, so that we could actually see Heredity and Variability striving for the mastery, we should still have to account for the origin of this strife, which must have been coeval with the origin of life, and for the determining principle by which the progress from simplicity to complexity is a progress, through intellectual man, towards his conception of the Supreme Intelligence.

Darwin, while clearly seeing that variability may arise from the movement and activity inherent in all life, vegetal and animal, recognises the necessity of a determining principle, when he says: "The birth both of the species and of the individual are equally parts of that grand sequence of events which our minds refuse to accept as the result of blind chance." Again, alluding to the view, now no longer held, that each species has been independently created, he remarks: "To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes, like those determining the birth and death of the individual. When I view all beings, not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Silurian system was deposited, they seem to me to become ennobled. . . . There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one," from which "endless forms most beautiful and most wonderful have been, and are being, evolved."

Professor Huxley, also, in treating of the place which Man occupies in Nature, says that "thoughtful men, once escaped from the blinding influences of traditional prejudice, will find

in the lowly stock whence man has sprung, the best evidence of the splendour of his capacities; and will discern in his long progress through the Past, a reasonable ground of faith in his attainment of a noble Future. . . . And, after passion and prejudice have died away, . . . our reverence for the nobility of manhood will not be lessened by the knowledge that Man is, in substance and in structure, one with the brutes; for he alone possesses the marvellous endowment of intelligible and rational speech, whereby, in the secular period of his existence, he has slowly accumulated and organised the experience which is almost wholly lost with the cessation of every individual life in other animals; so that now he stands . . . far above the level of his humble fellows, and transfigured from his grosser nature by reflecting, here and there, a ray from the infinite source of truth."

Goethe sees in Nature "the living visible garment of God," and Tennyson thus beautifully expresses this idea, together with that of the divine origin of the spiritual nature of man:—

"The sun, the moon, the stars, the seas, the hills, and the plains—
 Are not these, O Soul, the Vision of Him who reigns?
 Is not the Vision He? tho' He be not that which He seems?
 Dreams are not true while they last, and do we not live in dreams?
 Earth, these solid stars, this weight of body and limb,
 Are they not sign and symbol of thy division from Him?
 Dark is the world to thee: thyself art the reason why;
 For is He not all but thou, that hast power to feel 'I am I?'"

The doctrine of Evolution, as established by Darwin, has completely broken down our conception and definition of species, for a species is now seen to be but a variety so far removed from its nearest allies, by the dying out of intermediate forms, that we are enabled to frame a distinctive description of it. A similar view of the artificial character of genera has long been held. Now, a species exists not in Nature; we give to it a name merely for our own convenience; so that henceforth all controversies as to what is and what is not a true species, are at an end, and we have only to consider which forms are sufficiently distinctive to bear specific names. It has broken down our belief in the distinctiveness of the animal and vegetable kingdoms; it has shown us the reason why all living things, both plants and animals, are alike "in their chemical composition, their cellular structure, their laws of growth, and their liability to injurious influences;" why in plants and animals "sexual reproduction seems to be essentially similar;" why there are

organisms which botanists claim to be plants, and zoologists claim to be animals; why we need not wonder that some of these organisms at one period of their lives have the nature, movements, and even instincts of animals, and at another period lead a purely vegetative existence and reproduce themselves by spores; and why all such denizens of the debatable land are lowly in their organization. It has shown us the meaning of the terms of relationship used by Naturalists of the old school, unconscious of their real value and purport,—comparative anatomy, affinity, community of type, morphological unity, adaptive mimicry, etc.;—and it has explained the reason of the existence, utterly incomprehensible before, of rudimentary and abortive organs.

It has done much more. It has taught us that all things are working together, or striving against each other, for the general good. It has taught us how, by famine, disease, and premature death, the weakest succumb that the strongest may have room to live; how by the best of each race increasing, and multiplying, and replenishing the earth, low forms of life become high, out of unity and simplicity arising diversity and complexity, beauty and joy. And it teaches us still another lesson; it teaches us that we ought to work, each and all, for the general progress of mankind; that the more intellectual, the happier, and the more holy we are, the more intellectual, the happier, and the more holy will our descendants be; and that it is within our power, by always striving to subordinate the pleasures of sense to those of mind and soul, so to influence our offspring, unconsciously by heredity as well as consciously by example and precept, that the type of our race may be raised, and in the course of incalculable ages Man may advance, intellectually and spiritually, nearer and nearer to the image of his Maker.

And when prejudice has completely succumbed to reason, the doctrine of Evolution by Natural Selection will be taught in all our schools as a fundamental truth of natural science, and will be universally admitted to afford one of the most convincing proofs of the wisdom and beneficence of God, as showing how “thro’ the ages one increasing purpose runs,”—

“That mind and soul, according well,
May make one music as before,
But vaster.”

XI.

NOTES ON THE MYCETOZOA, WITH A LIST OF SPECIES FROM HERTFORDSHIRE AND BEDFORDSHIRE.

By JAMES SAUNDERS.

(Communicated by A. E. Gibbs, F.L.S.)

*Read at St. Albans, 15th November, 1892.**

IF there be any truth in the assumption that all creatures which inhabit the earth have descended from some few primordial forms of life, it will readily be granted that the two great kingdoms of animated nature may touch at numerous points; that here and there they coalesce or diverge, and that there may be existences which combine some of the features of both. To these we may surely relegate the Mycetozoa. They have at least three well-defined stages of existence: the distributive, in the form of minute spores, myriads of which are borne as impalpable dust by the country breezes; the creeping stage, when, for an indefinite period, it may be weeks or months, numbers of these spores, having thrown off their cell-coverings, coalesce, and creep about on decayed leaves or in dead wood; and the mature stage, in which, having ceased their wanderings, they become sessile, and produce capsules. From this it will be seen that they exhibit the curious phenomenon of alternation of generations; that is, if we may assume that the plasmodium stage is characterised by wholesale conjugation, and hence is "the analogue of the zygospore" (Sachs, 'Text-book of Botany,' p. 263). Possibly this may not be regarded by some as an instance of true alternation of generations, but it at least presents close analogies with this phenomenon.

It is the creeping stage which has the greatest fascination for an observer, as it is both curious and singular. It was only after many months of patient investigation that we were rewarded by the discovery of a Mycetzoon in this stage. The *we* covers two personalities, a juvenile enthusiast still in his teens, and the writer, the latter often finding material assistance from the sharp vision of his more youthful coadjutor. On the occasion referred to, we had just reached the edge of an opening in a damp Hertfordshire wood; lying near to us was a large trunk of an oak, which, having been felled many years ago, was not only saturated with moisture, but was thoroughly decayed. Overshadowing it were tall fronds of bracken, and straggling sprays of bramble. Running our eyes along its rugged bark, adorned here and there with mosses and fungi, we were gratified to see yellow veins of a substance unlike anything we had before seen. It covered a space over a foot in length and several inches in breadth. It was somewhat viscid,

* The Author exhibited coloured drawings of the Mycetozoa executed by the Misses Lister, and photographic slides shown by the oxy-hydrogen lantern; and a slide with living plasmodium which had thrown out pseudopodia during the preceding twenty-four hours was also shown on the screen by the lantern-microscope. This is probably the first time that plasmodium has thus been shown to a scientific society.—ED.

distributed in anastomosing veins, some minute, and others a quarter of an inch wide, and sometimes spread out into fan-shaped figures towards the margins of the mass. So slight was its adhesion to the bark, that a worm was seen to crawl between the two. We knew almost intuitively that it was what we had so long sought, namely the plasmodium of a Mycetozoon. The term plasmodium is that by which the creeping stage of these creatures is designated. After carefully examining it, looking at it from every aspect, and noting its dimensions and general appearance, we took off a portion with plenty of the underlying decayed wood, so as to observe it at home at our leisure. After crawling about the wood for four or five days, the granular contents contracted into small protuberances in the veins; and on the following day these changed into minute capsules, which eventually became greyish-white, and filled with dark spores.

Having thus once found plasmodium, we had little difficulty in finding it in other places afterwards. It is expedient, we soon became aware, to examine the under side of fallen branches, as it appears to avoid light.

A small specimen of an allied species to the one mentioned above, was attached to a piece of wood that lay in contact with a larger one, but only by a narrow strip about a quarter of an inch wide. The plasmodium used this strip as a bridge, and, by a single sinuous vein, nearly the whole of it passed over to the larger piece of wood. After having spread out on its surface and absorbed what food was available, it crept back again to its original position, and eventually formed its fruit.

On another occasion a small quantity of greenish-yellow plasmodium was found attached to the under side of a small rotten branch. This was placed under observation for several days, after which it mysteriously disappeared, its former position being marked by slimy tracks. One of us thought that it was dead, but the juvenile observer hoped that it had only crept into the wood. This was really the case, for after a few days it came out of its concealment, and formed a delicate group of fruits of a golden-yellow hue. The circumstance is noteworthy, inasmuch as it proved to be a rare species (*Badhamia inaurata*) of which the plasmodium stage had been recorded but once before.

Yet another instance of the peculiar habits of these organisms. Two small masses of plasmodium had been under observation for several weeks, and it was thought that they did not seem healthy, possibly wanting a change of diet. Accordingly a fungus, one of the polyporous group, was soaked in water, divided in halves, and a portion placed near each. Both of the plasmodia crept from their positions, and crawled over the respective portions of supposed aliment. Unfortunately it was the last journey for each of them, for either from the detrimental qualities of the fungus, or from acarites that may have infested them, both plasmodia perished, after two or three days of evident decadence.

Sensitive creatures are these plasmodia; requiring special en-

vironment to enable them to flourish. Moisture is essential, with a temperature not too low. Frost apparently drives them into hiding, whilst too much dry heat desiccates the surface of the matrix, and thus compels them to seek sustenance in the moist interior of the decayed vegetation. This may be rotten wood or decaying leaves, but in any case it must be organic. None of them contain chlorophyll, and hence they have not the power to assimilate food from the inorganic substances of the earth, or from the impalpable gases of the air. There are cases on record in which the sporangia, or fruiting heads, have been found on lead pipes and old shoes, but these do not imply that they fed on such indigestible articles, but that, having previously absorbed sufficient nutriment, it is a matter of indifference to what materials they may creep in order to form their capsules. The plasmodium stage is essentially the feeding one, and during this period the protoplasmic contents are particularly rich in formative materials. One may even suggest that there is a distant analogy between this life-period of the organism and the larval stage of the Lepidoptera.

The plasmodia, having no protective cell-covering, are peculiarly sensitive to injury by contact. They are really wall-less protoplasm, and hence the slightest touch from the incautious finger causes local death, although the other portions may remain healthy. The fact that their contents are not restricted by cell-walls may account for their excessive mobility, enabling them to insinuate themselves into the interstices of wood that may be only in an incipient stage of decay, and also into the honeycomb-like cavities of the fungus (*Irpex*) on which they often occur. Their course over this fungus is always indicated by a marked change in it; its normal hue is a creamy white, but, when plasmodium has passed over it, it changes to a dirty drab, and is apparently in a moribund condition. The discoloration of the food-plant may also be partly due to a slimy substance which is left by the Mycetozoon as it shifts its position, as though it threw off the waste material that would otherwise accumulate in its own substance. This rejection of useless contents is particularly marked in the fruiting stage.

Although so singularly sensitive to contact, the plasmodium will endure strange vicissitudes without injury. It may be dried up till it is apparently hard and tough, in which condition it may be kept for an indefinite period—weeks and even months—after which, by the application of moisture, with careful treatment, it may be resuscitated and will become as active as ever.

During the closing part of the summer of the past year we were desirous to obtain some plasmodium, but were unable to do so owing to the dryness of the season. A request for some of it was sent to an esteemed correspondent, who is a specialist in this department of science. In reply, a small portion of desiccated plasmodium attached to a fungus was forwarded in a pill-box. This had been dried artificially several weeks previously. Wishing to see if it would revive, it was placed in a shallow glazed vessel four or five inches wide. On the opposite side of the vessel a portion of

a suitable fungus was placed, and the intermediate space was filled with fragments of decayed wood. The whole was then immersed in water, or rather water was poured over it until the contents of the dish were covered. It was noticed that after two or three days the plasmodium had imbibed sufficient moisture to enable it to become partly detached from its position. In about a week it threw out a vein-like process, which traversed the intervening space over the fragments of wood, and reached the fungus on the opposite side of the vessel. In a few more days the whole creature had left its original position and had transferred itself to the fresh food which lay within its vicinity, although several inches distant. By what occult power it could direct its course in the desired direction, and that after weeks of apparent suspension of animation, is beyond my comprehension.

In addition to movements of the whole mass, or certain portions of it, in search of sustenance, which changes of position may be noted by the naked eye, or better still with a pocket-lens, there is also a circulation of the protoplasmic contents. It can, however, scarcely be called circulation in the ordinary sense of the term, as the course is not always in one direction. There is an ebb and flow in curious rythmic cadence. Two or three branching veins will have the central portion hurrying forwards, it may be towards the right of the observer, then suddenly they may be arrested in their course, and return towards the direction from which they came. As, however, this description can only apply to the small portion visible at one time in the field of a microscope, it would be presumptuous to imply that this would adequately describe the movements of the whole mass.

A brief description of the appearance of the Mycetozoa in the fruiting stage, will be helpful to those who wish to observe them in the field. In the immature condition they are often of a different colour from that of the mature. Some of them (*Comatrichia*) present the appearance of minute white beads scattered over the surface of decayed wood or bark. In this state they show in striking contrast to the hair-like black stalks on which they stand. In a day or two the heads change to a dusky brown. Others again appear as minute black beads, glistening as though covered with varnish. A slate-coloured genus (*Cribraria*), which eventually assumes a yellowish hue, may occasionally be found on fallen pine-logs. In the early spring a generally-distributed genus (*Reticularia* of a lovely pink, with sessile heads which are about the size of peas, may be observed on decayed tree-stumps, etc. These are not uncommon in Epping Forest and Wanstead Park. Less frequent than this is a genus (*Tubulina*) of a scarlet hue, which, when mature, shows as a small group of closely compacted cylindrical dark brown heads. This may be sought on fallen willow trunks, near to brooks, in moist meadows. A much more common species (*Trichia Jackii*) presents the appearance of a patch of sessile white heads, which, when ripe, become of a bright yellow colour. One of the most attractive (*Trichia fallax*), appears as

rows or scattered heads like tiny pink beads, but these quickly change to a clayey or ochreous hue. The last mentioned species was first noticed by the writer on a small island in a secluded park, where many trees had fallen and had been allowed to lie unmolested. These formed a perfect chaos of broken branches and prostrated trunks, over which the still-living trees cast a dense shade, the whole being surrounded by a damp atmosphere which just suited the needs of these moisture-loving creatures.

It should be mentioned that if specimens are collected in an immature state, it is desirable to keep them under an inverted wet glass for a few days, so that the contents of the sporangia may become fully matured, as unless these are so, it would be difficult or impossible to determine the species to which they belong. Many disappointments have been experienced by collectors from not taking these precautions.

The mature sporangia, or *peridia* of some authors, have usually well-marked and permanent colours. A whole series of them, including about one third of the known British genera, have opaque white heads, the whiteness being due to the presence of lime, which is deposited on the surface during the process of ripening. This group is hence called the Calcareæ. Most of these contain violet or dark brown spores, and it is desirable always to examine the colour of the spores, as this is an important point in classification. This is easily done, either by rubbing a sporangium between the fingers, or better still, upon a piece of white paper. It will be seen that not only those with lime-covered heads, but also many other species, have violet or brownish-violet spores. The genera with these characters comprise about one half of those found in this country.

It is desirable to see that the specimens collected really contain spores, so that one may be spared the experience of the writer, who on one occasion found what at first sight appeared to be an interesting group of heads, with the resemblance of an operculum to each. On a careful microscopic examination of the contents of the supposed sporangia, no spores could be detected, but instead, only a watery fluid. Upon a re-examination of the general appearance of the specimen it resolved itself into a group of eggs of one of the Lepidoptera! As some consolation for the disappointment, one felt that true knowledge is obtained not only by the observation of facts, but also by the rectification of error. Our national collections also are not absolutely free from similar inaccuracies.

Amongst the genera with dark-coloured spores is a small group which are like the reed-mace (*Typha*) in miniature. These may either be grouped, like a tiny forest, with separate stems and closely-compacted heads (*Stemonitis*), each head composed of an intricate network of most delicate threads; or both stems and sporangia may stand singly (*Comatrichia*).

A very abundant and generally-distributed genus (*Trichia*) has bright yellow spores and capillitium. This network or capillitium was called "wool" by some of the descriptive botanists of last

century, and when seen projecting from the ruptured capsules it certainly has a strong resemblance to a tiny tuft of woolly fibre. The Trichias may often be observed in compact groups of an inch or two in diameter on rotten tree-stumps, or scattered over the foliage of mosses and liverworts which grow in these situations. This does not imply that the Mycetozoa have fed on the living tissues, but that they have been nourished on the underlying decayed vegetation, and have crept out to the surface when ready to form their spores, so that these may be distributed by the wind.

There is yet another genus (*Arcyria*) which is by no means rare, in which both spores and capillitium vary in colour, and are either a pale yellow, or range from a delicate flesh tint to a deep crimson.

The presence of this woolly substance is always helpful in field-work in determining whether a specimen under observation is a Mycetzoon or not. But if an observer be in doubt, it is always advisable to secure an unknown form for careful examination at home, as otherwise a rare species may be cast aside as worthless. It should be borne in mind, however, that about one-fifth of the known British genera have no capillitium. But even these in some cases (*Cribraria*) have a delicate framework which lines the wall of the sporangium and gives it support. At first this external skeleton may be mistaken for a true capillitium, and hence may deceive the novice as to the true position in classification of the species under consideration. Close and extended observation will, however, soon enable the observer to distinguish between these two organs.

The contents of the sporangia form most interesting objects for the microscope. As they are so minute, it is necessary to use a moderately-high power, say $\frac{1}{4}$ or $\frac{1}{6}$ th-inch object-glass. It has been estimated that a single head of *Comatrichia typhina** contains a thousand million spores, in addition to those on the delicate network of the capillitium, which forms, as it were, an intricate framework around which the spores are clustered. There are other genera (*Reticularia*, etc.) in which a number of sporangia coalesce so as to form a community of an inch or so in diameter, in which the spores are so numerous that figures fail to represent them. In many species these spores, although so minute, have their walls ornamented. These markings are due to thickenings of the cell-wall, and may consist of dots, warts, spines, or other figures, and they may be either regularly or irregularly distributed over the surface. In other species the walls of the spores are smooth.

The hair-like threads which form the capillitium present many peculiarities of structure. These are usually so constant, that, next to the colour of the spores, they form the principal basis of classification in modern systems. But even in these there are not always hard and fast lines of demarcation, for some specimens present combinations of character which are assumed to belong to

* See 'Midland Naturalist,' 1882.

closely-allied species. These threads may be simple or branched; combined into a network, or have numerous free ends; and they may be united to the walls or to the central columella. Their ornamentation is often very beautiful and of most intricate designs. These markings may consist of spirals, spines, or cogs, and are due to external thickenings of the walls. In this respect they differ from the elaters of *Jungermannia*, which have the spirals coiled up in the interior of the cells.

Some few species show affinities with Mosses in the possession of an operculum; others approach the Fungi, through the Lycoperdons, in the presence of a capillitium, and the whole group exhibits a relationship with the animal world, by the motile amœbiform cells which precede the formation of the plasmodium.

The student of the Mycetozoa would find a peculiar fascination in the subject as the knowledge of it increases, and, as it is comparatively "An Open Field," he would find plenty of opportunity for original research. Nor need his observations be limited to any one period of the year, as they are to be found at almost all seasons; extremes of heat and cold being most detrimental to their development. The plasmodium has, however, the power of resisting frost. In December, 1892, the writer collected a specimen frozen hard, attached to a fungus. Upon moistening it and keeping it in a warm room, it soon revived and commenced to creep about. In a few days it formed a group of capsules. It was obtained on the borders of Hertfordshire, in a moist wood on a hill-top with an extensive prospect, many parts of which had been successfully investigated for these interesting creatures. The pursuit of this subject leads the student into some of Nature's quietest haunts, and furnishes him with material for wide generalization, as well as advanced microscopic investigation.

For the benefit of those who wish to study the Mycetozoa reference is made to the following literature on the subject:—

"Myxomyces of Great Britain," by Dr. M. C. Cooke. 1877.

"Mycetozoa," in 'Midland Naturalist,' 1882, 1887, 1888.

"Notes on Mycetozoa," by Mr. A. Lister, in 'Journ. Bot.,' Sept. 1891.

"An Open Field," by Mr. A. Lister, in 'Nature Notes,' Jan. 1892.

"Monograph of the Myxogastres," by Mr. G. Masee. 1892.

THE MYCETOZOA OF HERTS AND BEDS.

The following list is a compilation of the records of several esteemed correspondents, as well as those of myself and my son Edgar. All the twenty-seven forms enumerated for Heath, on the borders of Beds, were collected by Miss L. Bassett and Miss G. Lister, in the early part of 1892. The species marked C. C. were collected by Mr. C. Crouch; those initialed A. E. G. and H. E. S. by Mr. A. E. Gibbs, F.L.S., and Mr. H. E. Seebohm, respectively. Two forms from Bricket Wood, viz., *Trichia scabra* and *T. abrupta*,

were collected in 1889, by Mr. John Hopkinson and Mr. George Masee, at a Field Meeting of the Society (See 'Trans. Herts Nat. Hist. Society, Vol. V, p. xlviij). Another, viz., *Stemonitis ferruginea*, was collected there at a Field Meeting in 1891 (See 'Trans.,' Vol. VI, p. lxx.). The other records are those of myself and my son, and have been made since 1891.

As a guarantee of accuracy in naming, it need only be said that specimens of all the forms recorded, except those on the authority of Mr. Masee, have been examined by Mr. A. Lister, or by his daughter Miss G. Lister, to both of whom my grateful acknowledgments are due.

In the Hertfordshire list, the localities are given under the river-basins, as in the 'Flora of Hertfordshire' and other botanical records published by the Society in its 'Transactions.'

HERTFORDSHIRE.

- Ceratium hydroides*, A. & S. IVEL.—Hitchin; *Miss G. L.*
Physarum leucophæum, Fr.—Common.
P. nutans, Pers. (= *Tilmadoche nutans*, Rost.). IVEL.—Hitchin;
Miss G. L. and *H. E. S.* LEA.—Caddington.
P. compressum, A. & S. IVEL.—Hitchin; stalked and plasmodio-
 carp forms, from dirty white plasmodium; *H. E. S.*
P. viride, Pers. (= *Tilmadoche mutabilis*, Rost.). COLNE.—Kens-
 worth.
P. diderma, Rost. COLNE.—Redbourn.
Craterium vulgare, Ditm. IVEL.—Hitchin; *Miss G. L.*
C. leucocephalum (Pers.) Rost. COLNE.—Kensworth.
Leocarpus fragilis (Dicks) Rost. COLNE.—Kensworth.
Badhamia panicea (Fr.) Rost. IVEL.—Hitchin; *Miss G. L.*
B. hyalina (Pers.) Berk. COLNE.—Zouche's Farm, Caddington.
B. utricularis (Bull) Berk. COLNE.—Kensworth. Zouche's Farm,
 Caddington.
B. inaurata, Curr. (= *B. nitens*, Berk.). Plasmodium pale yellow.
 COLNE.—Zouche's Farm, Caddington.
Didymium squamulosum (A. & S.) Fr. IVEL.—Hitchin; *H. E. S.*
 COLNE.—Ayer's End; *A. E. G.*
Chondrioderma difforme (Pers.) Rost. IVEL.—Hitchin; *Miss G. L.*
C. radiatum (Linn.) Rost. COLNE.—Kensworth.
Stemonitis fusca, Roth. COLNE.—Beechwood, near Flamstead.
S. ferruginea, Ehrh. COLNE.—Kensworth. Bricket Wood; *Masee*,
 in 'Trans. Herts. N.H.S.,' Vol. VI, part 8, p. lxx.
Comatrichia typhina (Roth.) Rost. IVEL.—Hitchin; *H. E. S.*
 LEA.—Mangrove, near Luton.
C. Friesiana, De Bary. COLNE.—Ayer's End; *A. E. G.* Redbourn.
 LEA.—Lilley.
Lamproderma irideum (Cki.) Mass. IVEL.—Hitchin; *Miss G. L.*
Trichia fallax, Pers. COLNE.—Kensworth. Redbourn.
T. fragilis (Sow.) Rost. COLNE.—Kensworth. Ayer's End; *A.*
E. G. Bricket Wood.

- Trichia scabra*, Rost. } COLNE.—Bricket Wood; *Hopkinson* and *Massee*,
 'Trans. Herts N. H. S.,' Vol. V, part 8,
T. abrupta, Cooke } p. xlviiii.
T. varia, Pers., var. *nigripes*. LEA.—Wheathampstead.
T. affinis, De Bary. COLNE.—Kensworth. Ayer's End; *A. E. G.*
T. Jackii, Rost. COLNE.—Zouche's Farm, Caddington. Bricket
 Wood.
Hemiarcyria intorta, List. IVEL.—Hitchin; *Miss G. L.*
H. clarata (Pers.) Rost. LEA.—Wheathampstead.
Arcyria punicea, Pers.—Common.
A. incarnata, Pers. COLNE.—Kensworth. Harpenden.

BEDFORDSHIRE.

- Physarum leucophæum*, Fr.—Common.
P. nutans, Pers. (= *Tilmadoche nutans*, Rost.).—Luton Hoo. Lim-
 bury. Kitchen End.
P. viride, Pers. (= *T. mutabilis*, Rost.).—Stopsley.
P. callidris, List.—Pullox Hill; see 'Journ. Bot.,' 1891, p. 258.
P. compressum, A. & S.—Luton Hoo.
P. diderma, Rost.—Flitwick; see 'Journ. Bot.,' 1891, p. 260.
Craterium vulgare, Ditm.—Heath. Stopsley.
C. leucocephalum (Pers.) Rost.—Pepperstock. Totternhoe.
Leocarpus fragilis (Dicks.) Rost.—Amphill Heath.
Fuligo septica (Link) Gmel.—Kitchen End; *C. C.* Luton Hoo.
Badhamia panicea (Fr.) Rost.—Luton Hoo.
B. hyalina (Pers.) Berk.—Heath. Caddington.
B. utricularis (Bull) Berk.—Heath. Caddington.
B. rubiginosa (Chev.) Rost.—Heath.
B. inaurata, Curr. (= *B. nitens*, Berk.).—Caddington. Stopsley.
Didymium microcarpon (Fr.) Rost.—Kitchen End; *C. C.*
D. squamulosum (A. & S.) Fr.—Kitchen End; *C. C.* Sundon.
 Luton Hoo.
D. farinaceum, Schrad.—Heath.
D. pertusum, Berk.—Claphill.
Chondrioderma difforme (Pers.) Rost.—Heath. Luton.
C. testaceum (Schrad.) Rost.—First British Record, Stopsley; *E. S.*,
 July, 1892.
C. radiatum (Linn.) Rost.—Heath. Pullox Hill; *C. C.* Flitwick.
C. Michellii (Lib.) Rtfski.—Totternhoe.
Lepidoderma tigrinum (Schrad.) Rost.—Heath.
Spumaria alba (Bull) DC.—Pullox Hill; *C. C.* Totternhoe.
Stemonitis fusca, Roth.—Heath. Luton Hoo. Sundon.
S. ferruginea, Ehrh.—Chalton. Pepperstock. Kitchen End.
Comatrichia typhina (Roth.) Rost.—Heath. Luton Hoo. Stopsley.
C. Friesiana, De Bary.—Common.
Lamproderma physaroides (A. & S.) Rost.—Heath.
L. irideum (Cki.) Mass.—Ridgmount; *C. C.* Luton.
Enerthenema papillata (Pers.) Rost.—Caddington. Luton Hoo.
Brefeldia maxima (Fr.) Rtfski.—Sewell.

- Tubulina cylindrica* (Bull) DC.—Kitchen End; *C. C.*
Clathroptychium rugulosum (Wallr.) Rost.—Kitchen End; *C. C.*
Dictydium cernuum (Pers.) Nees.—Luton Hoo. Chalton.
Cribraria aurantiaca, Schrad.—Heath. Luton Hoo.
C. argillacea, Pers.—Heath. Luton Hoo.
Reticularia lycoperdon, Bull.—Luton Hoo.
R. Rozeana, Rost.—Heath; see 'Journ. Bot.,' 1891, p. 263.
Trichia fallax, Pers.—Heath. Sundon. Luton Hoo.
T. fragilis (Sow.) Rost.—Heath. Luton Hoo. Caddington.
T. scabra, Rost.—Sewell.
T. varia, Pers.—Common
T. contorta (Dit) Rost.—Caddington, with var. *inconspicua*.
T. affinis, De Bary—Heath. Sundon.
T. Jackii, Rost.—Heath. Caddington, Streatley, etc., frequent.
Prototrichia flagellifer (B. & Br.) Rost.—Heath.
Hemiarcyria rubiformis (Pers.) Rost.—Kitchen End; *C. C.* Barton
 Springs, with var. *Neesiana*.
H. clavata (Pers.) Rost.—Luton Hoo.
Arcyria punicea, Pers.—Common.
A. cinerea (Bull) Schum.—Luton Hoo. Stopsley.
A. incarnata, Pers.—Heath. Barton Springs.
A. nutans (Bull) Grev.—Caddington. Luton Hoo.
A. ferruginea, Sauter.—Heath.
Lycogala epidendrum (Buxb.) Fr.—Kitchen End; *C. C.* Luton
 Hoo.
Perichæna vermicularis (Schw.) Rost.—Kitchen End; *C. C.*; see
 'Journ. Bot.,' 1891, p. 265.
P. depressa, Lib.—Streatley.
-

XII.

ICE AND ITS WORK.

By JOHN MORISON, M.D., F.G.S.

Read at Watford, 16th December, 1892.

Abridged.

WATER, as we all know, is by far the most potent geological agent in modifying the surface of the earth, and the work done by ice, which is solid water, is scarcely less important than that which is accomplished by water in the liquid state. I will here treat of the work of ice, and the traces or tool-marks which it has left behind it in many parts of the world, especially in our own country and our own county.

The sun's heat is continually drawing up vapour in vast quantities from all the expanses of water on the earth's surface; and the water-surface of our globe is equal to about $\frac{3}{4}$ ths of its entire area. The hotter the weather is, the more watery vapour is drawn into the air, but there is always a certain amount of evaporation, however cold the weather may be. Our atmosphere thus always contains a greater or smaller amount of vapour of water. When the air is cooled down below a certain point, called the dew-point, this vapour condenses on the minute particles of dust of which the air is full, and forms mist or cloud. These fine watery particles either remain suspended in the air, or, uniting together, fall to the surface as rain, hail, or snow. In those parts of the world where the mean annual temperature is below the freezing-point, the condensed moisture falls chiefly as snow. This is the case in the Polar Regions, and also on mountain summits which are elevated sufficiently into the upper and colder regions of the atmosphere. In these places the snow covers the ground and remains more or less unmelted throughout the year. A line called the snow-line, varying in altitude in different parts of the earth's surface, may be drawn, above which the snow remains unmelted in summer. This line is close to the sea-level in the polar regions, and rises gradually as we approach the equator to a height of 18,000 or 19,000 feet. In our country it would be about 5,000 feet. When a current of warm air laden with moisture passes over cold mountain tops, it becomes chilled, and the vapour is condensed as I have described, and may fall down as rain or snow. There is much greater precipitation of moisture on mountains than on plains on account of their greater coldness, and on the loftier summits above the snow-line this precipitation takes the form of snow which remains in great part unmelted throughout the year.

Two things are necessary to produce an accumulation of perpetual snow—(1) a certain degree of elevation above the sea-level—varying in different latitudes, and (2) the presence of currents of air more or less warm and laden with moisture. The snow which falls on cold mountain tops cannot flow down as rain would.

Remaining unmelted, and more and more snow continuing to fall, there would be a constantly-increasing accumulation were it not for the existence of glaciers or rivers of ice which drain the snow-fields in the manner which I am about to describe. As the snow increases in depth, the particles underneath are pressed down by the weight of the mass above, the separate crystals become agglutinated together, and the air is squeezed out. This process continues as the pressure becomes greater and greater, till at length the heap of snow becomes a mass of blue compact crystalline ice. As more and more snow falls, the pressure from above continues to increase, and, as ice though solid is to a certain extent plastic, the effect of this pressure is to squeeze it out round the edges of the snowcap, where by the force of gravitation it is directed down into the valleys, where it forms glaciers or rivers of ice.

These glaciers, under the influence of gravitation, move slowly down the valleys. The rate of motion is very slow, not more than one or two feet in twenty-four hours, and it varies according to the slope of the valley down which the flow takes place. A glacier often extends for some considerable distance below the line of perpetual snow before it melts, and this distance varies with the size of the glacier, for the larger the mass of ice the greater is the temperature required to melt it. A glacier may extend thousands of feet below the snow-line.

The glacier throughout its course is crossed by frequent fissures called crevasses. These crevasses begin as cracks in the ice, where, from the nature of its bed, it is exposed to any strain or tension. These cracks gradually widen till they may become wide yawning chasms extending to the very bottom of the ice. The extremity or foot of a glacier varies in position according to the snowfall and the temperature of the air—a greater snowfall or a lower temperature sending the ice lower down the valley. The rocks and precipices which surround a glacier are always splitting up under the influence of frost, and quantities of rocky fragments and *débris* are continually rolling down and accumulating on the surface of the ice. This moraine stuff, as it is called, forms long mounds or bands of *débris* fringing the sides of the glacier, in which fragments of rock of all sizes, from mere sand and grit up to blocks many tons in weight, are found confusedly mixed together. A considerable part of this moraine matter slips down into the crevasses, and may descend to the very bottom of the ice and move with it along the rocky floor. These fragments of rock get fixed and frozen into the icy mass, and are pressed against the underlying rocks with all the weight of the ice above. Pushed along with irresistible force, these stones tear from the rocks over which they pass other fragments which also in like manner become frozen into the ice. All these rock-fragments, being firmly held in the grasp of the ice, grind and scratch the rocky pavement over which they are driven, while the grit and sand which result from this grinding process smooth and polish the bed over which the glacier passes. This accumulation of mud, sand, and stones, which a glacier pushes

underneath it over its rocky bed, is called the *moraine profonde*, or bottom moraine. From the foot or melting extremity of a glacier a turbid milky stream issues: the sand or mud employed by the ice in polishing its bed being carried out and suspended in the water which flows out from underneath it. The stones employed in grinding and scoring the rocks are themselves ground, smoothed, and scored, and, being pushed out at the foot of the glacier, become mingled with the great masses of *débris* brought down upon its surface and discharged at its melting extremity.

The pile of loose materials formed in this manner at the end of the glacier is called the terminal moraine, and may be of very considerable size.

We can often verify by observation the fact of the smoothing and scoring of the rocks over which a glacier passes. When it shrinks away from the side of its valley, as happens in summer from the partial melting of the ice, it is often possible to get below the ice and creep underneath it for some little distance, when we find the rocks smoothed and polished, and showing long grooves and ruts running parallel with the course followed by the glacier. Every projecting mass of rock is rounded and smoothed on the side which looks up the valley, while the other side retains its original roughness. Smaller projections are rounded and polished all over, and every dimple and hollow is smoothed and dressed in a similar manner.

As the foot of a glacier is higher up the valley in summer than in winter, in the former season we can see, on the sides and floor of the valley below the glacier-foot, distinct and recent evidence of the action of ice, the rocks being rounded and smoothed, scored and striated, as I have just described.

Another very important thing to notice about glaciers is that when a glacier diminishes in size from any cause, and shrinks away from its bed, it may drop the blocks from the moraine upon its surface on the sides of the valley, sometimes perched in the most extraordinary manner, and looking as if the slightest push would send the mover. Such stranded stones are known as perched blocks. These blocks are often of a different material from the rocks around them, and may have been carried a long way from their original source.

Glaciers may be well studied in Switzerland, and on a grander scale in Norway, where in the far north they actually reach the sea-level.

Let us now consider the condition of Greenland in the present day, where we find a country almost entirely covered by a mantle of perpetual ice and snow, or what in other words we may describe as an enormous confluent glacier. Greenland is 750,000 square miles in area, and nearly the whole of it is a frozen and lifeless desert. The coasts are deeply indented by bays and fiords, which when traced inland are found to terminate against glaciers. The whole interior of the country appears to be buried under a great depth of ice and snow, which fills up the valleys and covers over

the hills, so that its surface, which no doubt originally was very mountainous and rugged, forms a great plateau of ice gently sloping up towards the centre. Those daring explorers who have penetrated into the interior of the country describe the scene as desolate in the extreme. As far as the eye can reach nothing is visible save a dreary expanse of snow. Not a single animal or plant can be seen; over everything broods the silence of death, a silence only broken by the dismal howling of the icy wind, which sweeps before it clouds of blinding snow.

Yet even here Nature is ceaselessly at work. As the snow deepens it is pressed into ice by the weight of the snow above, and that ice creeps outward to the coast, pressed onward by the accumulating weight of snow, and thus, from the frozen mass in the interior, innumerable glaciers flow down every valley and fiord to the sea. Some of the glaciers attain an enormous size. The great Humboldt glacier is said to be no less than 60 miles wide, and its seaward face rises above the water to a height of 300 feet. Instead of the fiords being filled by water, in many cases they are filled entirely by ice, which may even be pushed out some distance into the open sea.

When a glacier enters the sea, as ice is lighter than water, the dense sea-water underneath the ice buoys it up, and as the glacier is pressed out into deeper and deeper water, at last the cohesion of the ice is overcome, and large fragments float away as icebergs. From its origin in the central desolation of Greenland to its termination in the sea, the glacier clings pertinaciously to its bed, but when once the water gets underneath it and buoys it up, the pressure in course of time becomes so great that enormous fragments are broken off and float away. These icebergs are carried to the south for an immense distance by ocean-currents, surrounded by an atmosphere of wintry fog and frost, until they finally melt. Some of these icebergs are of vast size. One Dr. Hayes estimated to contain 27,000 millions of cubic feet, and to weigh no less than 2,000 millions of tons.

The glaciers of Greenland are crossed by crevasses in the same way as those in the Alps; it is only, however, when we approach the sea that much in the shape of moraine matter appears upon their surface. This is due to the fact that the whole interior of the country is so buried beneath snow and ice that there are left above the surface, exposed to the action of frost, no bare rocky crags from which fragments might become detached. The inland valleys are all filled up and levelled to the tops of the hills. It is not until the glaciers descend to near the sea-shore, where the cliffs and mountains are more naked and exposed to the action of the weather, that they begin to show anything like moraines on their surface, and it is on the sea-coast that the greatest apparent waste of rock takes place. When we remember, however, that nearly the whole country is covered by an enormously thick sheet of ice, which is constantly in motion, being pressed continually onwards with resistless force towards the sea, we can hardly over-

estimate the tremendous wear and tear to which the surface must be subjected. All the valleys are continually being deepened; all the rocks are being smoothed, rounded, and striated; and glacial rubbish—sand, stones, and mud—must exist in great quantity underneath the ice; and are constantly being pushed out under the ice into the shallow seas, where they form a sedimentary layer on the sea-bottom, becoming mixed more or less with sea-shells of an Arctic type.

All around Greenland the sea during winter is covered by a coating of ice from 10 to 20 feet thick. In the early summer, when the ice breaks up, a narrow shelf or platform of ice adheres to the coast. This is called the ice-foot. It breaks up and is carried out to sea towards the end of the summer. During the summer vast piles of rock and rubbish, derived from the waste of the cliffs above, accumulate on the surface of the ice-foot, so that when it finally breaks up, the quantity of rock *débris* borne out to sea must be very great. Icebergs, also, often carry out to sea large quantities of rock-fragments, and, as they melt slowly and have been found as far south as the Azores, the Arctic *débris* from Greenland must be scattered far and wide over the floor of the North Atlantic. Could we suddenly strip Greenland of her mantle of ice and snow, we should find all the hills and mountains rounded, smoothed, polished, and scored up to their very summits, and all the valleys and sheltered places would be covered by a dense clay, full of stones like our boulder-clay.

Dr. Nansen, who travelled across Greenland in the summer of 1888, says that it is so thickly covered by the ice-accumulation of ages, that no part of the interior is ever laid bare. He compares the configuration of the inland ice to a shield curving upwards to a sort of plateau reaching in places at least 10,000 feet above the sea-level. He maintains that the configuration of the ground underneath must be similar to that of Norway and Scotland, with the same rugged mountain masses, high ridges, valleys, and fiords. The immense accumulation of snow has levelled up everything; in places the ice must be 6,000 feet deep, and even the mountain tops must be covered by hundreds of feet of glacier. He does not think that the quantity of snow can vary much from year to year. The enormous pressure of this vast mass of ice and snow pushes out glaciers into the sea, and causes them to send off icebergs. Even in winter Dr. Nansen maintains that there are running streams of water underneath the ice, due to this pressure, which help to prevent the growth of the mass.

But it is in the Antarctic regions that we meet with the mightiest accumulation of ice and snow. When Captain Ross undertook his celebrated voyage towards the South Pole, he found his progress southwards barred by a precipitous wall of ice, which rose out of the water for 180 feet.

For 450 miles Captain Ross sailed in front of this great ice-cliff, and found it unbroken for all that distance by a single gap or inlet. Only at one point was the ice-wall low enough to allow

its upper surface to be seen from the mast-head. This upper surface Ross describes as a smooth plain, shining like frosted silver, and stretching away as far as eye could reach into the illimitable distance. This ice-cliff is doubtless the terminal front of the immense Antarctic ice-cap which covers the South Polar Continent, and is pushed northwards over the sea-bottom in the same manner as we have seen are the glaciers of Greenland, until it reaches depths where the pressure of the water underneath it becomes powerful enough to break off large segments from its extremity, and so stop its further progress. These great segments float away as icebergs, which in the Antarctic seas attain gigantic proportions. Some of the Antarctic icebergs are no less than 2,000 feet in depth, and attain a length of several miles. The South Polar land seems to be completely buried under an enormous thickness of ice, the depth of which, within the Antarctic circle, has been estimated to be at least two miles.

There is very strong evidence to show that all our mountain-valleys in England, Wales, Scotland, and Ireland, were filled at a date geologically-speaking comparatively recent, by great glaciers similar in all particulars to those which exist at the present day in Switzerland and Norway. Geologists also generally believe that at a date generally estimated at from 100,000 to 200,000 years ago, the whole country north of about the latitude of London was covered for a lengthened period by an enormous ice-cap comparable to that which we find in Greenland, or even to that mighty accumulation of ice which buries deep the whole Antarctic Continent.

Let us consider the evidence for the former existence of glaciers in this country. We find moraines in all our mountain-valleys,—mounds of rubbish running across the valleys in a more or less perfect condition, containing scratched stones. In every long mountain-valley we find several moraines, or their remains, marking the terminal limits of the glacier at various stages of its existence. We also find morainic matter on the sides of the valleys,—the remains of the lateral moraines. On the sides of the hills enclosing the valleys we also find abundance of true perched blocks which have evidently been deposited there by ice; and we find the rocks in various places scored and striated, as well as rounded and polished. The projecting bosses of rock are smoothed and rounded on the side which looks up the valley, while the other side may retain its original roughness. The floors of the valleys are covered by a layer of tenacious clay filled with stones, which is a remnant of the *moraine profonde* of the old glacier.

We find also other appearances which ice filling up the valleys is insufficient to account for. The tops of the mountains are more or less rounded and smoothed, and we have glacial markings and striae at great heights. This is universal in the mountains of Scotland, Wales, the North of England, and Ireland. We conclude, therefore, that all these districts were once covered by one great ice-cap or more, which levelled up the valleys and covered the mountain-tops in the same manner as the great ice-sheet of

Greenland does at the present day. We might suppose that there were several such ice-caps; one for the Highlands of Scotland, one for Northern England, one for Wales, and so on. But there is other evidence to be found in the low country which proves that one single great ice-sheet covered the whole country from the Pentland Firth in the extreme north of Scotland, to at least as far south as the neighbourhood of London, and as far west as the western coast of Ireland. One proof of this is the occurrence all over the lowlands of Scotland, Ireland, and the greater part of England, of detached blocks of stone or erratic boulders which can only have been brought where we now find them by the agency of ice. So strange sometimes are the positions in which they lie, and so markedly do they often differ in character from the surrounding rocks, that they have been from the earliest ages a source of wonder and amazement. Where did they come from? There is often no other vestige of naked rock within sight, so they cannot have fallen from any cliff. They cannot have been transported by rivers, as they often stand on the summits of hills. They have not been washed up by the sea or by floods, for some of them are of enormous size, and they often consist of rocks foreign to the neighbourhood, the nearest similar rocks perhaps being fifty or sixty miles away. No conceivable agency but ice, either in the form of a moving ice-sheet, or of icebergs, could have placed them where we now find them.

Many of these erratic boulders, as they are called, have been found in Hertfordshire, especially in the northern part of the county, but no doubt the greater number of those which once existed have been broken up for road-metal long ago. A very interesting paper on this subject was read before the Society some years ago by Mr. H. G. Fordham, in which he describes nearly 200 boulders found in various parts of North Herts, near Ashwell, Hitchin, Royston, Buntingford, and various other places. These boulders are mostly sandstone and limestone of Carboniferous or Jurassic age, but a few consist of granite, dolerite, or other igneous rocks, and two or three of mica schist and gneiss. Mr. Vincent Elsdon, in a paper on the microscopical structure of Hertfordshire boulders, gives his opinion that the igneous boulders, which are mostly basic and intermediate, most likely came from the south of Scotland, and that the granitic and gneissose rocks probably had their origin in the Grampians. Mr. R. T. Andrews, of Hertford, has presented to the British Association Committee for recording erratic blocks a list of 37 so-called boulders. Eighteen of these, however, are of Hertfordshire conglomerate, and therefore have a local origin; the others, with the exception of one of Carboniferous Limestone found at Ware, are all described as sandstone or grit.

There is a large block of sandstone standing by the side of the road in Upper Dagnall Street, St. Albans, about $2\frac{1}{2}$ feet in length by 2 feet in breadth, and a foot to 18 inches in thickness, and having externally a rounded concretionary appearance. Mr. Whitaker considers this identical in character with the Sarsen stones of Wilt-

shire. If this be the case the stone probably comes from no great distance, and must be looked upon as the remnant of an Eocene bed, which formerly covered this part of the country, and not as a true erratic boulder. A boulder of about the same size, but much more angular in form, may be seen just inside the wall of St. Stephen's churchyard, close to St. Albans. This boulder consists of a rather coarse sandstone probably of Carboniferous age. There are also many masses of conglomerate scattered about the country, some of them of very considerable size, but they must be considered as remnants of a disintegrated local bed, and not as boulders in the true sense of the word.

Another proof of the former existence of a glacial period is found in the Boulder-clay or Till which covers wide areas in Scotland and the greater part of England and Ireland. This is generally a tough, tenacious clay, occasionally, however, more or less sandy, and full of stones varying in size from mere grit or pebbles to blocks several feet, or, it may be, yards in diameter, which are scattered irregularly through it. Sometimes the stones are so numerous that hardly any clay is visible, and sometimes they are comparatively few in number, so that the clay can be used for brick-making. These stones are of a peculiar shape, somewhat angular in form, but the sharp corners and edges are generally more or less smoothed away, so as to render them sub-angular. Many of them are perfectly smoothed and polished, and covered with scratches or striae of varying degrees of fineness. These striae are better seen in the hard limestones or igneous rocks than in those of sandstone or other comparatively soft material. The majority of the stones seem to be fragments of rocks in the immediate neighbourhood. In Chalk districts such as this the boulder-clay is often full of lumps of chalk; in the neighbourhood of the Coal Measures of pieces of coal. Mixed, however, with these local stones are boulders of rock foreign to the neighbourhood, which must have travelled considerable distances. In some places marine shells, more or less fragmentary, of a northern or Arctic type, are found in the boulder-clay. In other places bones of the mammoth, the reindeer, and other animals are found.

Boulder-clay is not a continuous deposit, but often contains irregular patches and layers of sand and gravel, and in some places thin beds of peat, trunks of trees, and other remains of land-vegetation. If a layer of boulder-clay be removed from the underlying rock, the latter is often seen to be smoothed, polished, and striated, or if the rock be of a soft material it may be much broken up and disintegrated. Boulder-clay covers a great part of the Lowlands of Scotland and Ireland, and also extensive areas in England, particularly in the north and east. It extends over the greater part of the eastern division of Hertfordshire.

In this neighbourhood we find a mass of boulder-clay at Bricket Wood, where, containing comparatively few stones, it is used for brick-making. Here the clay is of a somewhat mottled appearance, being very light-coloured in places owing to the large quantity of

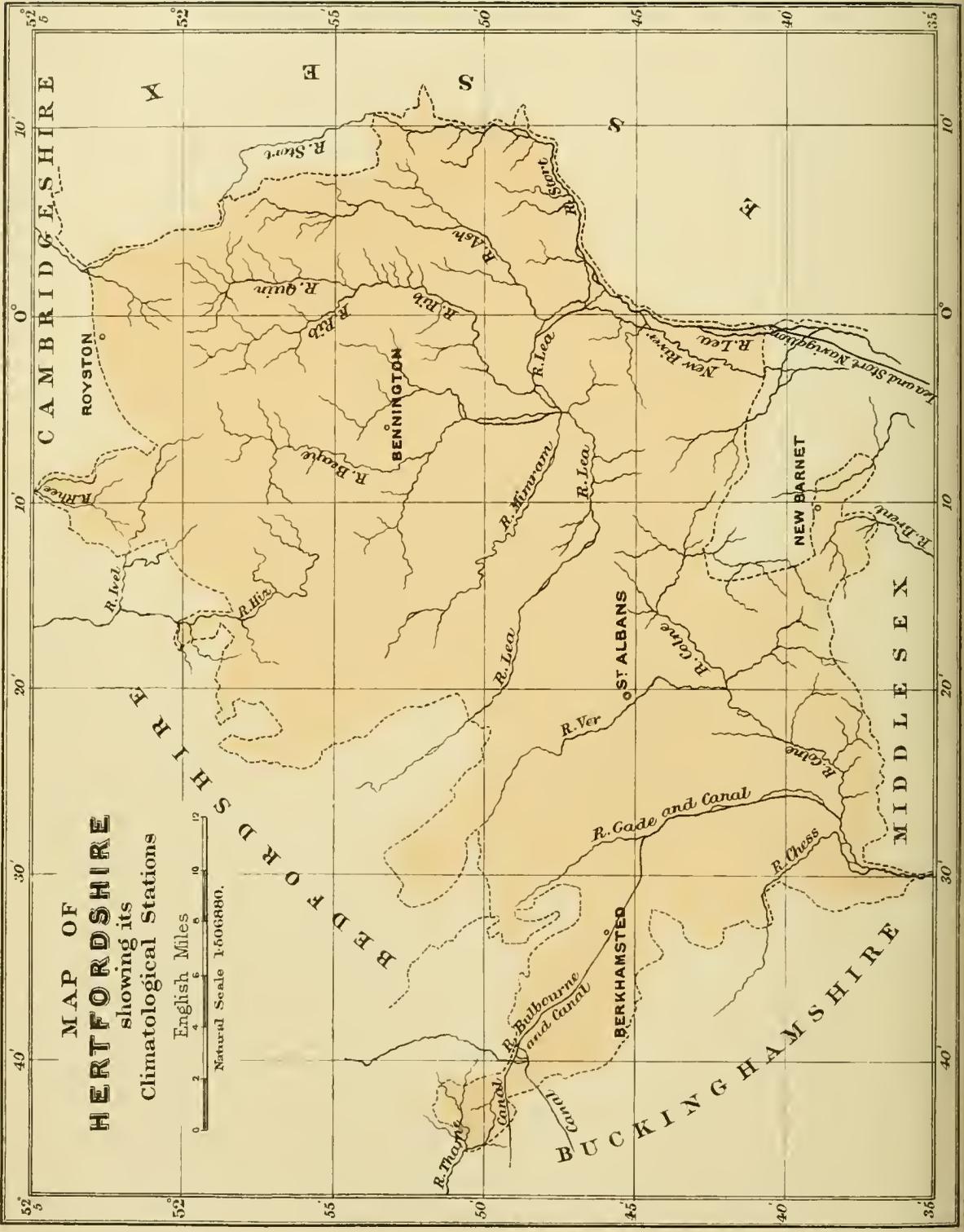
chalk which it contains. We find in it ice-scratched flints, flint-pebbles, boulders of chalk, some large unworn flints, quartzites, sandstones, and grits, and various derived Jurassic fossils. A mammoth's tooth was found here some years ago, and other mammalian remains have been discovered. A mass of boulder-clay occurs to the east of St. Albans between Beaumont's Farm and London Colney. From a well which was lately sunk near Tyttenhanger in this area through the clay, I obtained lumps of chalk with glacial striæ and also derived Jurassic fossils. Mr. Arthur Smith, of Hill End Farm, Smallford, has obtained from this bed various Jurassic fossils and also a vertebra of a fish. Boulder-clay in Hertfordshire is made up of chalk to a great extent, containing lumps of chalk and chalk-flints as well as fragments of Jurassic rocks and Jurassic fossils. We also find in smaller quantity portions of Carboniferous rocks, slates, and fragments of quartz, quartzite, and granite.

Besides the Boulder-clay we have another glacial deposit in various parts of the country known as Drift. This consists mainly of gravel and sand mixed up together in varying proportions, but it may contain seams of clay or brick-earth, as is well seen in the pits in Miskin's brickyard near St. Albans. The drift may be well studied in this neighbourhood in almost any gravel-pit. Drift gravel is made up of pebbles, rolled or sub-angular, the majority of them derived from local rocks, but containing a considerable number composed of rocks foreign to the neighbourhood. In Hertfordshire it consists mostly of flint-pebbles, but also contains sub-angular and unworn flints, sometimes of considerable size. It also contains large masses of conglomerate, the well-known Hertfordshire pudding-stone, which are often finely polished, especially on their fractured surfaces. Fragments of chalk are also to be found in it. The stones which it contains derived from rocks foreign to the locality are mostly quartz, quartzite, sandstone, and igneous rocks. Boulders of quartzite and sandstone of considerable size sometimes occur in it. In some localities, as in the gravel-pit near Welwyn Station, we find rolled Jurassic fossils—*Gryphaea* and *Belemnites*. Fragments of Arctic shells are also found in this pit. In the neighbourhood of St. Albans, and also in other parts of the county, fossils derived from the Chalk are not uncommon. In Bricket Wood and in other parts of Hertfordshire the drift may be traced underneath the boulder-clay, showing that in this case it is of earlier age. I may mention, however, that there are other boulder-clays not represented in this county which are lower than the Middle Glacial Drift, as the drift which occurs in this neighbourhood has been called.

The boulder-clay was probably the *moraine profonde* of an enormous ice-cap which covered the greater part of our country and was pushed out into the shallow seas, where Arctic shells were mixed with it, so we may suppose that the localities where the clay contains those shells were under water at the time when it was deposited. When the drift on the other hand

was laid down, the greater part of our island was doubtless submerged.

The fact that boulder-clay is found over such wide expanses of country shows us that at one time the cold was so intense that not only did glaciers fill our mountain-valleys, but that a great ice-cap was formed which enveloped the whole country except the extreme south of England. The presence of Arctic shells in the boulder-clay in some situations shows us that the ice was pushed out for some distance from the land into the shallow seas surrounding our island. The presence and universality of glacial drift show us that our country, except the highest mountain-summits, was submerged beneath the waters of an icy sea, in which icebergs and ice-rafts carried and scattered rocky *débris* far and wide.



**MAP OF
HERTFORDSHIRE**
showing its
Climatological Stations

English Miles
Natural Scale 1:606880.

XIII.

CLIMATOLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE
IN THE YEAR 1891.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 21st March, 1893.

PLATE III.

OBSERVATIONS have been made in the year 1891 at the five stations for which the reports for the four previous years were drawn up, and therefore I give the same series of tables as before.

The mean temperature of Hertfordshire in 1891, deduced from observations at these five stations, was $0^{\circ}\cdot 1$ above that of the four previous years, and $1^{\circ}\cdot 3$ below the mean of 1882-86. The mean daily range was $0^{\circ}\cdot 4$ more than in 1887-90, and $0^{\circ}\cdot 4$ less than in 1882-86. The extreme range was rather greater than in 1889, and rather less than in 1890. The relative humidity was a little greater than in the four previous years, the amount of cloud a little less, and the rainfall considerably greater, and on a much larger number of days. On the whole, the year 1891 may be said to have been cold and wet, with about an average range of temperature. February was unprecedentedly dry, and October excessively wet.

The observations are made at 9 a.m. at all the stations, the maximum temperature and rainfall being entered to the previous day.

ROYSTON.

(London Road.)

Latitude: $52^{\circ} 2' 34''$ N. Longitude: $0^{\circ} 1' 8''$ W. Altitude:
301 feet.Observer: *Hale Wortham, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	32·8	27·4	38·1	10·7	11·6	49·7	84	5·3	1·57	16
Feb.	39·6	32·2	47·0	14·8	21·0	63·4	85	4·4	·02	2
March	40·8	33·3	48·4	15·1	21·1	63·2	73	5·3	1·63	21
April.....	43·5	34·0	52·9	18·9	27·1	65·9	79	6·0	·57	12
May	51·1	40·9	61·3	20·4	29·0	77·8	80	6·5	3·01	16
June.....	60·2	49·9	70·6	20·7	40·6	80·7	86	6·4	2·17	11
July	61·1	51·3	70·9	19·6	43·7	83·4	85	6·6	2·32	16
August....	59·9	51·0	68·7	17·7	42·7	77·9	81	7·2	3·54	20
Sept.	59·7	50·4	69·0	18·6	40·1	81·1	81	4·6	1·20	11
Oct.	50·5	43·5	57·6	14·1	27·8	66·2	89	5·7	5·05	22
Nov.	42·0	36·6	47·4	10·8	24·9	55·9	86	7·4	1·75	20
Dec.	39·7	32·9	46·4	13·5	13·8	56·1	90	5·6	3·11	19
Year	48·4	40·3	56·5	16·2	11·6	83·4	83	5·9	25·94	186

BERKHAMSTED.

(Rose Bank.)

Latitude: $51^{\circ} 45' 40''$ N. Longitude: $0^{\circ} 33' 30''$ W. Altitude: 400 feet.Observer: *Edward Mawley, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	33·0	27·1	38·8	11·7	11·9	50·3	93	6·3	2·19	19
Feb.	38·9	30·4	47·4	17·0	22·3	64·1	93	7·3	·04	2
March	39·6	33·3	46·0	12·7	18·4	58·1	85	7·6	1·48	17
April.....	42·9	34·7	51·0	16·3	24·8	62·4	78	7·3	1·59	14
May.....	48·8	40·6	57·0	16·4	29·0	76·3	76	7·2	2·86	17
June.....	58·5	49·2	67·8	18·6	39·5	74·0	75	7·0	1·03	12
July.....	58·4	49·7	67·2	17·5	42·1	78·5	74	8·0	2·29	18
August....	57·8	50·4	65·1	14·7	40·4	73·3	79	7·4	4·25	23
Sept.....	57·1	48·1	66·1	18·0	40·5	81·2	81	5·9	1·13	15
Oct.	49·4	42·7	56·2	13·5	27·3	64·3	89	6·1	8·04	22
Nov.....	41·9	36·6	47·2	10·6	24·5	56·2	93	9·2	2·42	17
Dec.....	39·7	33·5	45·8	12·3	12·3	55·2	90	6·8	4·20	20
Year	47·2	39·7	54·6	14·9	11·9	81·2	84	7·2	31·52	196

ST. ALBANS.

(The Grange.)

Latitude: $51^{\circ} 45' 9''$ N. Longitude: $0^{\circ} 20' 7''$ W. Altitude: 380 feet.Observer: *John Hopkinson, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	33·5	27·7	39·3	11·6	14·7	50·3	92	8·0	2·23	20
Feb.	39·2	31·4	47·0	15·6	21·9	65·3	89	6·6	·05	4
March	40·0	34·2	45·7	11·5	22·3	58·4	81	7·1	1·60	19
April	43·3	35·4	51·3	15·9	29·0	61·9	79	7·7	·87	12
May.....	49·4	41·4	57·4	16·0	30·3	74·9	79	7·3	3·57	19
June.....	58·8	50·3	67·2	16·9	42·6	74·0	80	7·4	2·07	11
July.....	58·2	50·7	65·7	15·0	44·5	77·9	78	7·0	2·92	19
August....	57·4	51·2	63·7	12·5	42·4	71·7	83	7·1	4·29	22
Sept.....	57·6	49·5	65·6	16·1	42·2	79·6	85	5·8	1·02	15
Oct.	49·5	43·1	55·9	12·8	30·7	62·4	91	6·0	6·35	22
Nov.....	41·9	36·3	47·5	11·2	27·2	55·0	94	8·4	2·13	18
Dec.....	40·0	33·2	46·8	13·6	11·8	54·6	90	5·6	4·03	20
Year	47·4	40·4	54·4	14·0	11·8	79·6	85	7·0	31·13	201

BENNINGTON.

(Bennington Lodge.)

Latitude: $51^{\circ} 53' 45''$ N. Longitude: $0^{\circ} 5' 20''$ W. Altitude: 407 feet.Observer: *Rev. J. D. Parker, LL.D., F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	33·1	27·8	38·4	10·6	15·2	49·7	91	6·5	2·10	16
Feb.	39·3	31·5	47·0	15·5	20·6	64·2	89	6·6	·07	6
March	39·3	33·0	45·6	12·6	20·0	56·6	81	8·4	1·87	19
April.....	42·8	34·8	50·9	16·1	30·1	62·3	75	7·5	·94	11
May.....	48·7	40·4	57·0	16·6	29·4	76·8	76	7·5	3·40	21
June.....	58·6	49·5	67·7	18·2	40·4	77·7	77	7·9	1·05	10
July.....	59·0	50·5	67·4	16·9	42·6	78·6	74	8·3	1·95	19
August....	57·9	50·4	65·5	15·1	41·6	73·8	76	7·5	3·42	21
Sept.....	58·0	49·2	66·8	17·6	42·9	81·4	77	5·4	1·12	15
Oct.	49·7	42·9	56·5	13·6	32·0	63·8	87	6·5	5·31	25
Nov.	41·4	36·4	46·4	10·0	24·8	55·1	93	8·5	2·34	22
Dec.	40·0	33·8	46·1	12·3	17·7	55·8	90	6·3	3·66	20
Year	47·3	40·0	54·6	14·6	15·2	81·4	82	7·2	27·23	205

NEW BARNET.

(Gas Works.)

Latitude: $51^{\circ} 39' 5''$ N. Longitude: $0^{\circ} 10' 15''$ W. Altitude: 212 feet.Observer: *T. H. Martin, C.E.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	32·8	26·2	39·3	13·1	7·5	53·0	90	5·9	1·96	9
Feb.	38·3	28·5	48·1	19·6	16·5	63·6	90	4·2	·00	0
March	40·2	32·7	47·8	15·1	17·0	60·5	88	7·1	1·45	10
April.....	42·6	32·4	52·7	20·3	21·5	65·0	86	6·8	·76	8
May.....	49·7	39·7	59·7	20·0	28·0	78·1	81	6·3	3·25	17
June.....	59·3	48·5	70·1	21·6	34·0	78·8	84	5·8	·62	7
July.....	59·6	48·7	70·5	21·8	39·5	82·8	83	6·7	2·81	15
August....	58·5	48·9	68·1	19·2	35·0	76·0	80	7·3	3·50	19
Sept.....	57·7	46·8	68·7	21·9	37·0	80·0	83	5·2	1·50	13
Oct.	49·4	40·3	58·4	18·1	23·0	66·2	88	5·6	5·45	20
Nov.	41·9	35·2	48·7	13·5	22·0	58·0	86	6·9	2·04	16
Dec.	37·8	31·0	44·6	13·6	10·0	57·5	85	6·6	3·76	16
Year	47·3	38·2	56·4	18·2	7·5	82·8	85	6·2	27·10	152

HERTFORDSHIRE.

Means of Climatological Observations (with extremes of temperature) in 1891, at Royston, Berkhamsted, St. Albans, Bennington, and New Barnet.

Months	Temperature of the Air						Humidity	Cloud, 1-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	33·0	27·2	38·8	11·6	7·5	53·0	90	6·4	2·01	16
Feb.	39·1	30·8	47·3	16·5	16·5	65·3	89	5·8	·03	3
March	40·0	33·3	46·7	13·4	17·0	63·2	82	7·1	1·61	17
April	43·0	34·3	51·8	17·5	21·5	65·9	79	7·1	·94	11
May	49·5	40·6	58·5	17·9	28·0	78·1	78	7·0	3·22	18
June	59·1	49·5	68·7	19·2	34·0	80·7	80	6·9	1·39	10
July	59·3	50·2	68·4	18·2	39·5	83·4	79	7·3	2·46	17
August	58·3	50·4	66·2	15·8	35·0	77·9	80	7·3	3·80	21
Sept.	58·0	48·8	67·2	18·4	37·0	81·4	81	5·4	1·19	14
Oct.	47·9	42·5	56·9	14·4	23·0	66·2	89	6·0	6·04	22
Nov.	41·8	36·2	47·4	11·2	22·0	58·0	90	8·1	2·14	19
Dec.	39·4	32·9	45·9	13·0	10·0	57·5	89	6·2	3·75	19
Year	47·5	39·7	55·3	15·6	7·5	83·4	84	6·7	28·58	187

RESULTS OF CLIMATOLOGICAL OBSERVATIONS, 1887-90.

Stations.	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Royston	48·1	40·3	55·9	15·6	4·3	89·4	84	6·4	20·64	156
Berkhamsted	47·0	39·7	54·4	14·7	11·1	85·0	83	7·3	24·13	180
St. Albans	47·5	40·5	54·5	14·0	12·7	86·0	83	7·0	25·21	183
Bennington	47·1	40·2	54·1	13·9	14·4	85·1	83	7·5	23·85	192
New Barnet	47·3	38·4	56·1	17·7	8·0	88·5	84	6·3	23·06	144
County	47·4	39·8	55·0	15·2	4·3	89·4	83	6·9	23·38	171

XIV.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING
THE YEAR 1892.

By HENRY LEWIS.

Read at Watford, 21st March, 1893.

LAST year I was unable to make any addition to our record of Hertfordshire birds. On this occasion, however, I am more fortunate, having, I believe, three birds to add to our list, thus augmenting the number which have been observed in Hertfordshire from 202 to 205 species.

We are again indebted to the Honourable Walter Rothschild for all the interesting reports from the neighbourhood of Tring, which include two of the additions to our list, namely, the long-tailed duck (*Harelda glacialis*) and the pintail duck (*Dafila acuta*). In a letter dated 18th November, 1892, he says: "It may be of interest to the readers of our Transactions if you mention the fact that this year for the first time we have succeeded in hatching and rearing young emus, although we have had them in Tring Park since 1877, and they have laid regularly every year. We now have seventeen emus in the Park." As all are well aware, the emu (*Dromæus nova-hollandiæ*) is a native of Australia. There are two species of the genus. This one nearly equals the ostrich (*Struthio camelus*) in size, its height being between five and six feet. In its manners the emu bears a close resemblance to that bird. It runs with great swiftness, and we are told that its voice has a low booming sound. The eggs are six or seven in number, of a dark green colour, and are much esteemed by the natives as food. In the same letter Mr. Rothschild says: "In addition to the male and female rough-legged buzzards killed last autumn, the keepers caught a third alive, which I still have. He is in splendid plumage, and a little time back killed and ate a fine female *albino* common buzzard in the same aviary." He further states: "We have on our ground near Wigginton, in a covey of partridges, two sandy yellow birds, but as yet I have not secured either of them."

I will now proceed to notice the three birds which, it appears to me, we may add to our list.

1. THE CAROLINA, AMERICAN WOOD, or SUMMER DUCK (*Aix sponsa*).—Mr. Charles Martin, a taxidermist, living in St. Albans, early last year asked me if I would call and identify a singular duck which was shot near Moor Mill by a Mr. Allen, in December, 1891. After some little trouble I found that it was the American wood or summer duck.

Mr. Seebohm, in his 'History of British Birds' (vol. iii, p. 563), states that this bird has been included in the British list; "but," he adds, "as it is frequently kept on ornamental waters, there is no reason to suppose that it has ever occurred on our islands in a wild state." Mr. W. S. M. Durban and the Rev. M. A. Mathew,

however, in their work on 'The Birds of Devon' (p. 221), take a different view. They state: "This pretty American species is frequently kept on ponds and ornamental waters, and as it breeds freely (my specimen I take to be a bird of the year) and roams about the country at will, it appears to us that it is as much entitled to a place in the British list as other introduced and naturalized species, such as the Egyptian goose, mute swan, and pheasant. All these would soon be exterminated did they not receive protection, and they are not really *feræ naturæ*." Audubon, in his 'Birds of America,' says: "The summer duck confines itself entirely to fresh water, preferring at all times the secluded retreats of the ponds, bayous, or creeks which occur so profusely in our woods. The flight of this species," he adds, "is remarkable for its speed, and for the ease and elegance with which it is performed." It "passes through the woods, and even among the branches of trees, with as much facility as the passenger pigeon." He further states: "I never knew one of these birds to form a nest on the ground, or on the branches of a tree; they always seem to prefer the hollow broken portion of some large marsh, the hole of our large woodpecker (*Picus principalis*), or the deserted retreat of the fox-squirrel; and I have frequently been surprised to see them go in and out of a hole of any one of these, when their bodies, while on the wing, seemed to be nearly half as large again as the aperture within which they had deposited their eggs."

2. THE PINTAIL DUCK (*Dafila acuta*).—A male bird of this species was procured at Tring, on the 14th of February, 1892, and a female pintail at Marsworth Reservoir, on the 3rd of October.

As I can find no mention in our 'Transactions' of this bird having been obtained in Hertfordshire, I regard it as a species new to this county, and have accordingly added it to our list. I am rather surprised that I can find no mention of this slender and handsome duck in any of the late Mr. Littleboy's notes on birds, for, referring to the last edition of Yarrell's 'British Birds' (vol. iv, pp. 380, 381), I find it stated that "it is a regular visitor to this country, and is one of the first among those species which are taken when the decoys begin to be worked in October. It remains here through the winter till spring, and is obtained by wild-fowl shooters on the coast, as well as by fenmen on the rivers and lakes of the interior. It does not appear to linger long in the northern portions of our islands, and cannot in fact be called abundant there; but along our southern shores and estuaries it is not uncommon." "The flight of this species," he also says, "is extremely rapid." Montague says: "The notes of the pintail are extremely soft and inward; the courting note is always attended with a jerk of the head; the other greatly resembles that of a young kitten."

3. THE LONG-TAILED DUCK (*Harelda glacialis*).—A young long-tailed duck was procured at Marsworth Reservoir on the 28th of October, 1892.

I can find no mention of this duck having been recorded on any previous occasion in our 'Transactions,' so that I have great pleasure

in adding it to our list. It is an autumnal and winter visitor to our shores. Yarrell (*ib.*, vol. iv, p. 446) says that the great diversity in the appearance of its plumage depending on sex, age, or the season of the year, calls for remark, also the loud musical note of the male. For a description of the habits of this bird, I cannot do better than quote from Grey's 'Birds of the West of Scotland,' (pp. 389, 390), extracts from letters to Mr. Grey from Mr. Graham, who was residing in Iona in the year 1851. He says: "The cry of this bird is very remarkable, and has obtained for it the Gaelic name of *Lach Bhinn*, or the musical duck, which is most appropriate, for when the voices of a number are heard in concert, rising and falling, borne along upon the breeze between the rollings of the surf, the effect is musical, wild, and startling. The united cry of a large flock sounds very like bagpipes at a distance, but the note of a single bird when heard very near is certainly not so agreeable. . . . They are of a very lively and restless disposition, continually rising on the wing, flying round and round in circles, chasing one another, hurrying along the surface, half-flying, half-swimming, and accompanying all these gambols with their curious cries. When the storms are at their loudest, and the waves running mountains high, then their glee seems to reach its highest pitch, and they appear thoroughly to enjoy the confusion." When watching them on one of these occasions, he adds: "I had to take shelter under a rock from a dreadful blast, accompanied by very heavy snow, which in a moment blotted out the whole landscape; everything was enveloped in a shroud of mist and driving sleet; but from the midst of the intense gloom there arose the triumphant song of these wild creatures rising above the uproar of the elements; and when the mist lifted, I beheld the whole flock careering about the bay as if mad with delight."

MISCELLANEOUS NOTES.

THE BLACKBIRD (*Turdus merula*).—Mr. Bolter, of Cuckman's Farm, caught a blackbird with curiously-coloured wings in a weasel-trap early last year. On my expressing a desire to see the bird, he brought me the wings, which, lacking the black colouring matter in some of the feathers, have a singular appearance.

THE GRASSHOPPER-WARBLER (*Locustella naevia*).—Our late President, Mr. Hopkinson, reports having heard the grasshopper-warbler on the 26th of April. It is seldom we obtain a close inspection of this extremely shy bird, but last spring my son, as well as myself, were both favoured with an interview. It was early one lovely spring morning that we heard the bird singing its reeling song, both while it was creeping mouse-like through the hedge, as well as when perched on the top of some spray, pouring out a volume of sound; we were within a few yards of the bird, but it appeared to be in too excited a state to care much for our presence. Its song may be heard in summer, especially during the evenings, but I have never then seen the bird. Its nest is most difficult to find.

THE SPOTTED FLYCATCHER (*Muscicapa grisola*).—Last summer my attention was directed by Mrs. Charles Dickinson to a nest built by a spotted flycatcher on the side of a clover rick. The eggs were hatched and the young reared, although from the inclination of the nest I was surprised that the bird did not displace the eggs when leaving the nest, or that the young did not tumble out.

THE PIED FLYCATCHER (*Muscicapa atricapilla*).—In a communication I received from Mr. A. C. G. Cameron, of Bedford, he enclosed an inventory of Hertfordshire quadrupeds, birds, and insects, preserved by a Mrs. Young, of Bennington. In the list I find mention of a pied flycatcher. Although uncommon in Hertfordshire, this bird is a regular summer migrant, arriving in England in April and leaving us in September. Mr. J. E. Harting informs us that he has known several instances of the bird nesting as near London as at Hampstead, Highgate, and Harrow. I feel persuaded I once observed a bird of this species near St. Albans, but as I was not quite sure and did not obtain a second view, I never recorded the fact.

THE SWALLOW (*Hirundo rustica*).—The following incident relating to the nesting habits of this beautiful bird of the air, the swallow, is well worth recording in our 'Transactions.' Through the kindness of Mr. Seymour, a taxidermist of Hertford, I was shown an old straw hat on which a pair of swallows had built their nests. The hat was hung on a nail in an old hut which stood in a field on the estate of Mr. E. S. Hanbury. It is probable that the birds, building a little on one side of the hat, caused it to become top-heavy, or tilt on one side, for they fastened the hat to the hut by means of a dab of mud (like mortar), evidently, I think, to steady it or keep it in its place, thus showing considerable intelligence on the part of these little mason builders. They then built another nest on the hat which, when found, contained four eggs.

THE BULLFINCH (*Pyrrhula europæa*).—Mr. Arthur Dickinson, of New Farm, St. Albans, states that bullfinches have been unusually abundant in this locality during this autumn and winter, a statement I can fully corroborate. This winter I observed bullfinches pecking and possibly feeding on the poisonous berries of *Solanum dulcamara*. They are fond of ripe privet berries. In confinement the female of this species will often sing or pipe as well as the male bird.

THE YELLOW-HAMMER (*Emberiza citrinella*), like the robin and song thrush, and many other birds, I believe to be a "partial migrant" in this locality. Probably some of our members may have noticed that they appear to be much more numerous in this neighbourhood in summer than in winter.

THE NIGHTJAR (*Caprimulgus europæus*).—On the 13th of July Mr. Charles Dickinson informed me that he had a pair of nightjars nesting in his wood. Some weeks afterwards I visited the spot only to find that the young had flown. The bird makes no nest whatever, but sits on two beautifully-marked eggs on the bare ground. It rests lengthwise on a branch (or fore and aft as a

sailor would say), not crosswise as other birds do. Mr. Cane, of Luton, writes to me: "I had a nightjar from your county with four wing-spots, a circumstance I have never seen recorded. Although I have received numbers of these birds in my time, I have never seen one like it; it is a very unusual occurrence."

THE CUCKOO (*Cuculus canorus*) has been reported to me as having been heard, and in one instance seen, at an unusually early date. Mr. J. E. Harting, in 'Our Summer Migrants' (page 219), states: "In no instance, so far as I am aware, has the cuckoo been heard or seen before the 6th of April." The cuckoo was reported in the 'Field' (April 23, 1892, p. 586) to have been heard at Hatfield on the 2nd of April, 1892. Miss Lewis assures me that both she and a friend heard it in Hatfield Park on that day; and Mr. Ernest Gibbs informs me that the bird was heard at Harpenden on the same day. Sergeant McKay states that it was heard at Boxmoor on the 4th of April. Mr. Day, one of our postmen, reports having heard the bird at St. Albans on the 5th of April, and both Mr. Charles and Mr. Arthur Dickinson heard it at Beech Bottom on the same day. Mr. Rooper reports having seen a cuckoo in his garden at Watford on the 6th of April.

THE PEREGRINE FALCON (*Falco peregrinus*).—In my last paper a common buzzard (*Buteo vulgaris*) was reported, second-hand, by Mr. Arthur Sparry, as having been "shot at Cole Green . . . by Mr. Digby." Mr. Sparry, after having seen the bird, states that he was misinformed, for it proved to be a female peregrine falcon. I have also seen the bird, and can confirm this determination. I must confess I am sorry to report the death of so noble a bird, with its "Tradition of Ages;" why it should be so ruthlessly persecuted I fail to see.

Lord Lilford remarks*: "The peregrine can and does take grouse and partridges when she gets a fair chance and is hungry, but it must be remembered that as a rule she captures her 'quarry' in the air, and that our common game-birds just mentioned are of terrestrial habits and certainly by no means willing to take wing when a falcon is in sight, but do their utmost to squat close and conceal themselves, so that they are by no means the habitual, or even (in my opinion) a particularly favourite prey of the peregrine." He is convinced that pigeons, the smaller species of the Duck family, especially teal, and wading-birds of all kinds, are the most usual and most natural food of the falcon, and he adds, "I do not think that the most ardent lover of the gun should grudge her a due share of these. Several specimens of this falcon have at different times been obtained in this county. One, a male bird I have in my possession, was, tradition affirms, captured years since in clap-nets by a bird-catcher named George Farr, when pouncing down on his brace bird. Mr. Sparry informs me of several. One, killed near Sandridge, came into the possession of a Mr. Franklin, of that village; another was killed at Marshall's Wick by a keeper

* 'Coloured Figures of the Birds of the British Islands,' part xii.

named Pangbourn; and two at least were obtained by the late Mr. Thrale of No Man's Land, besides those which Mr. Littleboy has reported.

THE QUAIL (*Coturnix communis*).—Mr. Seymour informs me that a quail was shot just before Christmas at Hertingfordbury, by Mr. Topham of that place. From the numerous accounts in the 'Field' newspaper of this bird having been obtained in several different counties in England during last year, it appears to have been unusually abundant. Although a summer visitor to this country, a few appear to remain with us during the winter months.

The following notes on birds, culled from letters I have received from my friend Mr. Cane, of Luton, may prove of interest, although the birds may not all have been obtained in Hertfordshire. In a letter dated the 25th of January, 1892, he states: "I had a land-rail brought to me on Saturday, taken at Toddington; there was a slight injury to one wing, which may account for its prolonged stay with us, the bird being a summer visitor to our shores." He further states in the same letter: "I also had brought to me a beautiful blackbird with an almost white head." In another letter, dated the 26th of January, he states that a bird-catcher in the previous week caught a pure white or *Albino* linnet, and that mountain finches were abundant in his neighbourhood.

Mr. Arthur Dickinson reports having seen, in November last, large flights of wood pigeons (*Columba palumbus*) and nine wild geese passing over the New Farm, Harpenden.

The arrival of our summer "Migrants" in this country must always prove an unusually interesting event to a true lover of Nature; especially must this be the case to an ornithologist. That a feeling of surprise not unmingled with wonder should take possession of our minds is not unnatural on finding ourselves early one fine spring morning literally surrounded with nightingales, in an ecstasy of song, in the old spot, where the evening before not one was to be heard or seen, our little wandering minstrels presenting themselves to our view, supremely happy, and, with the rivalry of love, already answering each other in an echo of song. The males of this species arrive several days in advance of the females; this is the case with the grasshopper-warbler, and the greater white-throat; in fact the males arrive in most instances among our Warblers before the females, but in the case of the swallow, Charles Dixon, in 'Idle Hours with Nature,' says: "The old birds are paired for life, and fly the whole distance in company. . . . Right across the mighty continent of Africa our little party of swallows travel, lingering here and there in their northern flight" (p. 21). Dixon also says that the common sandpiper and the spotted flycatcher pair before they migrate, and that the common sandpiper "pairs for life, and returns season after season to its old breeding haunts; but the young birds pair before leaving their winter quarters" (p. 61). It is marvellous how a bird so small as the willow-wren and its congeners can sustain the protracted flights necessary to bring them from their winter to their summer quarters.

Its winter quarters are "Northern Africa and Palestine," but specimens have been obtained from Natal and South-west Africa.* We shall be able to show that, in some instances at least, some of our little friends obtain a kindly lift on their toilsome way. In his 'Sylvan Folk,' John Watson says: "Dr. Sennep seriously asserts that numbers of small birds annually find their way into Palestine, being borne by cranes over mountains and seas, which, without their aid, it would be difficult to cross. Mr. J. E. Harting quotes this statement, and adds that in the autumn flocks of cranes are seen coming from the north with the first cold blast from that quarter, flying low, and uttering peculiar cries as they circle over the cultivated plains. Little birds of different species may be seen flying up to them; while the twittering of those already comfortably settled upon their backs is distinctly heard. . . . Professor Claypole, although extremely incredulous at first, had ocular demonstration that small birds are sometimes carried by a flock of cranes, for he saw the former rise from among them at the discharge of a flint-lock. The same gentleman is satisfied, too, that wagtails and other small migrants cross over from Europe on their southward migration in a similar manner." Watson also says that Hedenburg, the Swedish traveller, "was staying at Rhodes in autumn, and at that season the storks came in flocks over the sea. Whilst watching these he often heard the notes of small birds; and on one occasion he saw several come off the storks' backs." And, as another instance, that "Dr. Rae, the Arctic traveller, had the assertion of the Cree Indians that a small passerine bird regularly availed itself of the migration of the Canada goose to get a lift on its long journey, and that these little wanderers are frequently seen to fly off the backs of the geese, when the latter are shot, or a gun is fired."

SUMMER MIGRANTS.

SPECIES.	LOCALITY.	DATE.	OBSERVER.
NIGHTINGALE	Hitchin	April 4.....	J. E. Little.
(<i>Daulias luscinia</i>)	St. Albans	„ 10.....	H. L. & J. L. †
	St. Albans	„ 17.....	{ Rev. W. Urwick & H. L. ‡
	Harpenden	„ 22.....	J. J. Willis.
WHITETHROAT.....	St. Albans	May 1.....	H. L.
(<i>Sylvia cinerea</i>)			
BLACKCAP.....	St. Albans	April 24.....	H. L.
(<i>Sylvia atricapilla</i>)			
CHIFF-CHAFF	St. Albans	Mar. 30.....	H. L. & J. L.
(<i>Phylloscopus rufus</i>)			
WILLOW-WARBLER	Oaklands, St.		
(<i>Phylloscopus trochilus</i>)	Albans	April 6.....	H. L.
SEDGE-WARBLER	St. Albans	May 1.....	H. L.
(<i>Acrocephalus phragmitis</i>)			
GRASSHOPPER-WARBLER	Harpenden	April 25.....	G. Cartmel.
(<i>Locustella naevia</i>)	St. Albans	„ 26.....	J. Hopkinson.

* See 'Our Summer Migrants,' by J. E. Harting, pp. 26 and 27.

† Heard the curr several times, but did not see the bird or hear it sing.

‡ Bird in song.

SPECIES.	LOCALITY.	DATE.	OBSERVER.
TREE-PIBIT	St. Albans	April 10.....	H. L.
(<i>Anthus trivialis</i>)	St. Albans	,, 21.....	A. Lewis.
	Harpenden	,, 25.....	J. J. Willis.
	Hitchin.....	,, 25.....	J. E. Little.
	Berkhamsted	Mar. 29.....	Mrs. E. Mawley.
SPOTTED FLYCATCHER	Berkhamsted	June 17	Mrs. E. Mawley.
(<i>Muscicapa grisola</i>)			
SWALLOW	Berkhamsted	Oct. 27.....	Mrs. E. Mawley.
(<i>Hirundo rustica</i>) (last seen)..	St. Albans	Nov. 6.....	H. L.
	Rickmansworth ..	Oct. 26.....	T. Hope.
HOUSE-MARTIN	St. Albans	April 11.....	F. Hibbert.
(<i>Chelidon urbica</i>)			
SWIFT	St. Albans	May 9.....	H. L.
(<i>Cypselus Apus</i>)	Watford	,, 9.....	J. L.
WRYNECK	Oaklands, St.		
(<i>Iynx torquilla</i>)	Albans	April 6.....	H. L.
CUCKOO.....	Hatfield	,, 2.....	Miss Lewis & G. French.
(<i>Cuculus canorus</i>)			
	Harpenden	,, 2.....	A. E. Gibbs.
	Boxmoor	,, 4.....	Sergt. McKay.
	St. Albans	,, 5.....	C. & A. Dickinson.
	Watford.....	,, 6.....	G. Rooper.
LANDRAIL.....	Oaklands, St.		
(<i>Crex pratensis</i>)	Albans	May 10.....	H. L.

XV.

NOTES ON SOME HERTFORDSHIRE MAMMALIA.

By T. VAUGHAN ROBERTS.

Read at Watford, 21st March, 1893.

MY notes on the Mammalia of Hertfordshire consist of nothing more than short references to species in the county, and more particularly in this immediate neighbourhood, which have come under my own observation. None (with the exception of the black variety of *Mus decumanus*) can be considered as rare, but possibly it may be of interest, in one or two cases, to learn the fact of their occurrence. I have not attempted to give a list of all the Mammalia which have been recorded. The 'Transactions' of the Society furnish particulars of the most interesting occurrences which have been noticed in former years, and no doubt some day a naturalist will arise who will be able to give us something like a complete list. The county does not afford a promising field, it is far too near London, far too densely populated, and too much cultivated to make it probable that any of our rarer quadrupeds (with possible exceptions among the bats) would be likely to be met with.

All my specimens, the skins of which will be exhibited, are of animals obtained in this locality, and those which are mounted on cloth have been prepared for me by Mr. Bowers, of Watford, and I think reflect great credit on his skill as a taxidermist.*

The first in order of the Mammalia are the bats. The one I exhibit was knocked down by my son in his bedroom at Verulam House. It is the long-eared bat (*Plecotus auritus*), a common species, and one of the three which, as mentioned by Mr. Rooper in his paper on 'Bats and some other Beasts,' would be likely to be noticed. I have no doubt from enquiries I have made that the great bat or noctule (*Scotophilus noctula*), another of the species mentioned, is found about Watford, but I have not succeeded in obtaining a specimen. The remaining species, the common bat or pipistrelle (*Scotophilus pipistrellus*), referred to by him, occurs everywhere. As stated by Mr. Rooper, the order of the Chiroptera is an extremely interesting one, but it is a very difficult one to study. It is by no means easy to identify the various species, and exceedingly difficult (at least I find it so) to obtain specimens. I have tried in various quarters but have so far met with no success. I should be grateful for any bats that appear to belong to any other species than the common one, and would endeavour to get them properly identified. I may observe that the long-eared bat is, as was remarked by Mr. Rooper, one of the most interesting of the family. It appears to be very easily tamed, becoming familiar with those who feed and fondle it, almost from the first. Professor Bell

* These remarks, and others of a similar nature, refer to specimens exhibited by the author at the meeting, during the reading of his paper.—Ed.

describes one that used to flit about a room and would take a fly from its mistress's lips in the gentlest manner, alighting on her cheek. These bats are playful in confinement, and their somewhat uncouth gambols are very amusing. They are very clean, and spend much time in combing their hair with their claws. When asleep the large ears are folded down so that there is no sign of them. The species is often found in the roofs of houses, nesting between tiles.

The hedgehog (*Erinaceus europæus*) appears to be partial to gardens in Watford. In my friend Mrs. Bishop's grounds I was shown two nests formed for hibernating, one in a hedge partially protected by the roots of the trees, and the other under a heap of branches and sticks lying against an outhouse. Each nest was formed in the same manner, the interior full of dry leaves, and the whole encased with grass, just like the outside of some birds' nests. A slight hollow or depression in the ground was made in each case as the foundation. The nest in the hedge had been disturbed, and the occupant had left it, but we found a hedgehog in the other one, which we took out and afterwards put back. Hedgehogs specially affect haystacks and outhouses, where straw, turnips, and other things are kept, and they have often made their nests inside an outhouse in Mrs. Bishop's grounds. In the 'Zoologist' for September, 1887, an account appears of hedgehogs eating swedes. This may account for their taking up their quarters in Mrs. Bishop's outhouse where mangolds or swedes were stored. In 1891 a female with young was found in Mr. Sumner Knyvett's walled garden under a pile of wood formed of sawn trees. It must have entered from the Clarendon Road.

I have seen a few specimens of the common shrew (*Sorex vulgaris*) dead on paths, but not many. I have also seen the water-shrew (*Crossopus fodiens*) in a small brook on Mr. Stone's farm near Cassio Bridge. They are interesting little creatures to watch when one gets the chance. They swim under water with great facility. My friend Mr. Fry tells me that he has noticed water-shrews in the Gade in Cassiobury Park.

As mentioned in my paper on 'Terrestrial British Quadrupeds,' badgers (*Meles taxus*) are not uncommon in Hertfordshire. In December, 1891, I paid a visit to the celebrated badger earths at Ashlyns. I was taken to see them by Mr. Holliday, of Haresfoot. He told me that his father, who had lived all his life in the locality, died some years ago at the age of 93, so that he could carry his recollection and knowledge of the earths back for a period of about 100 years from the present time; and he knew that badgers had inhabited the spot as far back as memories and traditions went. The place in question is a large depression or wide pit in the chalk, with beech trees growing in and around it. It may be natural, or the ground may have been dug out at some distant period. The entrances to the main earths are situated at one side where the ground rises. The holes run in various directions, but all terminate (it is said) in a large chamber some distance off, excavated under the

beech trees growing on the high ground which forms that side of the depression. Some three or four years ago a determined attempt was made to exterminate the badgers in order to get rid of the mange in the foxes that used the earths. Great excavations were made and vast quantities of chalk removed, but the attempt had to be abandoned. I forget how many men were employed, but I think they were at work for twelve days. The runs were found in numerous directions and at considerable depths; one cutting made by the workmen, that I went into, must have been eight or nine feet deep, and there were runs all along the bottom. A chamber was also found supported by a pillar left in the centre. Foxes, badgers, and rabbits all use this great earth. Mr. Holliday told me that he had frequently watched both fox and badger cubs playing together outside. We went to see another very similar but smaller earth, also in a depression in a beech grove, with the holes formed on the highest side and running into the chalk under the roots of the trees. Mr. Holliday entirely confirms Mr. St. John's statement as to the extreme cleanliness of the badger in its abode. An inspection of these earths gave one an excellent idea of the resources of badgers, and of the almost impossibility of destroying them when the locality chosen for their abode happens to be one well adapted for their habits. The extent of their runs and the great depth at which they occurred rendered even this most vigorous attempt futile. I hope and believe that now they will be suffered to remain in peace, and that the prescriptive right of such ancient inhabitants to their stronghold will be respected.

Foxes (*Canis vulpes*) have, as we all know, been credited from remote antiquity with ingenuity in the art of getting out of wells. One was found at the bottom of a well in the ice-house at Ashlyns. Mr. Holliday got a ladder, went down, and brought it up under his arm. The animal appeared quite to grasp the situation, did not attempt to bite, but merely looked up at him with its wonderfully bright eyes. On reaching the surface it was of course liberated.

The extraordinary courage of the weasel (*Mustela vulgaris*) is well known. Osgood, Mr. Hucks Gibbs' keeper, tells me that when feeding his young pheasants he has actually killed with his foot one that had come close to him through the grass after the birds, and had seen others at the same time.

Both stoats and weasels seem to be commoner in this locality than might be expected. Osgood tells me that he has killed as many as fifty stoats (*Mustela erminea*) in one year, a number which strikes me as being very large in such a country as this. The exceptionally fine specimen of a stoat exhibited I obtained from him. It was shot near Aldenham. A comparison between this skin and another which may be taken to represent the normal size of a stoat will show what a singularly fine animal the Aldenham specimen was. The keeper told me that he had no recollection of ever having seen a larger one. Stoats, he tells me, often produce ten or twelve young at a litter. He has frequently killed as many.

On one occasion he killed with a stick three young ones out of a number that were on a path, and before he could fetch his gun, which was near, the dam had carried away her dead little ones.

I exhibit from this neighbourhood a squirrel (*Sciurus vulgaris*), which is I think a fine specimen. Also a dormouse (*Myoxus avelanarius*) which was taken near Aldenham. I fancy the species is not very abundant in the county. It is said in the 'Zoologist' for December, 1887, that dormice are very common in nut-rows on Buckland Common, on the borders of Buckinghamshire, adjoining Hertfordshire. At Haresfoot I was told that a nest had been found many years ago, but that none had been noticed since.

Mr. Cane, the ornithologist, of Luton, in January, 1892, informed Mr. Lewis of a black rat which had been taken near Wheathampstead, and which appeared to him to be the *Mus hibernicus* of Thompson. This is a black rat with a white chest, specimens of which have been found in Ireland, and as to which a good deal of controversy has arisen among naturalists, some considering it a distinct species and others only a variety. Mr. Cane compared this specimen most carefully with the plates and descriptions in the 'Zoologist,' and could see no difference between it and those designated *Mus hibernicus*. I paid him a visit and took a careful note of the various markings and peculiarities of the specimen which he had stuffed. I sent these particulars to Mr. Oldfield Thomas, of the British Museum (Natural History), South Kensington, who is a recognised authority on these matters. In reply he wrote: "To the best of my belief *Mus hibernicus* is nothing more than a melanoid variety of the common grey rat (*Mus decumanus*). Its spasmodic occurrence wherever the latter is found is therefore only to be expected, but the Luton [Wheathampstead] case is interesting as showing that the form does occur in England."

The water-vole (*Arvicola amphibia*) exhibited came to its end in a rather curious manner. It was started on the island lying between the backwater and the canal at Russell Farm, near Watford, the island being connected with the farmyard by a plank-bridge. The vole ran all along the bridge right into the jaws of a cat which was waiting at the other end. What induced an animal so amphibious to cross the bridge instead of jumping into the stream where it would have been safe it is hard to say. Here and there on the banks of the Colne, regular runs may be noticed leading from the water-side to trees or hedges (often at a considerable distance) where rat-holes are visible, and sometimes at the entrance to these holes grain or acorns may be noticed. I have not been able to ascertain whether these runs are made by the common grey rat or by the water-voles. To decide the question one would have to ferret the holes, and I have been unable to obtain permission to do so in the most likely places.

The difference between the bank-vole and its congener the field-vole (*Arvicola agrestis*) will be seen from the specimen. The tail of the bank-vole, it will be observed, is longer, and the head less blunt and vole-like, but the latter characteristic, although apparent

in living specimens, is not very observable in the mounted skins. As regards the field-vole or short-tailed field-mouse, as it is generally termed, I should be glad of a specimen measuring six inches from the nose to the root of the tail. They are often found of this size, but I have seen none hereabouts.

Last March, when I was away from home, a box arrived marked "Live Mice." It was brought into the drawing-room, where my wife and some other ladies were assembled at a working party. I regret to say that so far from any rational scientific interest being exhibited in the arrival, screams and entreaties that the box might not be opened, were the only welcome accorded the little strangers. They turned out to be a consignment of bank-voles (*Arvicola glareolus*) from Haresfoot Farm. They were found in a nest formed in a heap of mangolds. There were a great number of them, and the men caught in their hands those that were sent to me. I had a cage made for them in three compartments, one for sleeping, another for food, and at the end a revolving wheel, on the plan of the ordinary dormouse-cages, but on a larger scale. It was most interesting and amusing to note the first experiments the little creatures made with the wheel. They quickly discovered the hole through which they could get inside it, but at first were greatly puzzled and frightened at the motion. Very speedily, however, they discovered that they could make it revolve, and then their delight was unbounded. They never seemed to tire of working it night and day; some were always at work, and often three or four would be in at the same time. If one approached to look at them they might bolt out for a moment, but would immediately return. On July 23rd I found two young ones, evidently just born, on the platform under the wheel. They had slipped through the wires. On putting them into the sleeping-place I saw another. When the little girl who attended to them used to drive those which happened to be outside into the sleeping-place, in order to clean out the middle compartment, she occasionally heard sounds of fighting. On the 26th of July, on raising the trap-door that shuts off the sleeping-place, after the cleaning had been finished, one rushed out bleeding in the head, and was followed by the mother with a young one in her mouth. The wounded one I found dead the next morning. Our idea was that it had attacked the little ones and been bitten by the mother. On the 6th of August I opened the sleeping-compartment and found three little ones covered with hair and lively enough. The young ones soon found out the revolving wheel, but their mother apparently disapproved or considered it to be too dangerous. It was amusing to see her follow them, seize them in her mouth, and hustle them into their sleeping-nest. One young one was, however, very persistent, and kept running back, but his mother followed, and not only carried him back to the sleeping-place, but shook him and thumped him on the floor on the way, evidently as a means of correction. A second family soon appeared, when I thought it time to get rid of them. I fed them on corn, bread, apples, carrots, gooseberries, etc., with plenty of water.

They seemed in perfect health, which I attributed mainly to the wheel, as through this they got as much exercise as they liked.

The animals I have mentioned are the only ones about which I have any remarks to make. I shall be grateful to any members of the Society who will kindly send me information as to any species which either by reason of rarity or peculiarity may be thought to possess an interest, and if the animal itself can be sent so much the better. As regards the question of whether a specimen should be sent alive or dead, this I must leave to the discretion of the sender, begging only that due regard may be had to feminine susceptibilities.

XVI.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE,
ST. ALBANS, DURING THE YEAR 1892.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 18th April, 1893.

LONGITUDE of Station, 0° 20' 7" W.; Latitude, 51° 45' 9" N.
Cistern of barometer 388 feet, ground-level at thermometer-screen
380 feet, and at rain-gauge 379 feet, above Ordnance Datum.
Thermometers (in Stevenson screen) 4 feet, and top of rain-gauge
1 foot, above the ground. Observations taken at 9 a.m.

The accompanying tables (pp. 176, 177) give the monthly means,
etc., of the daily observations in 1892, and the following is the
usual summary for the seasons.

MEANS FOR THE SEASONS FROM DEC. 1891 TO NOV. 1892.

Seasons, 1891-92.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0-10.
		Mean.	Daily Range.			Total.	Days.	
	ins.	°	°	in.	%	ins.		
Winter	29·892	37·0	11·6	·192	90	6·53	56	6·3
Spring	30·034	45·4	17·6	·224	73	3·57	34	5·2
Summer	29·993	58·5	17·2	·367	74	8·55	39	6·0
Autumn	29·939	47·6	12·0	·297	89	9·71	56	7·0

In the next table the chief results, monthly and annual, are
compared with the means for the ten years 1877-86 at Watford.

DIFFERENCE IN 1892 FROM MEANS OF 1877-86 AT WATFORD.

Months.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0-10.
		Mean.	Daily Range.			Total.	Days.	
	in.	°	°	in.	%	ins.		
January	-·142	-1·8	+1·5	-·017	=	-1·60	+ 1	-1·6
February	-·150	-2·2	-0·1	-·028	=	-1·07	+ 1	-0·4
March	+·069	-4·7	-1·4	-·037	=	-0·30	+ 1	-0·2
April	+·159	-0·2	+4·5	-·035	- 8	-1·51	- 5	-2·8
May	+·056	+1·7	+0·4	-·001	- 5	-1·07	- 4	-0·6
June	+·041	-1·8	+0·2	-·028	=	-0·32	=	-0·6
July	+·072	-2·9	-1·1	-·050	=	-0·22	- 5	-0·4
August	+·014	-0·5	+0·9	-·015	- 1	+1·08	+ 1	-0·8
September	+·021	-1·1	-2·1	-·003	+ 3	+0·82	+ 1	+0·5
October	-·187	-3·8	-1·4	-·039	+ 1	+1·17	+ 7	+0·1
November	+·168	+1·2	-2·3	+·025	+ 5	-0·97	=	+1·1
December	+·050	-2·4	+0·1	-·022	=	-1·13	- 3	-1·4
Year	+·014	-1·5	-0·1	-·021	=	-5·12	- 5	-0·6

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, IN 1892.

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.			Dryness.	Tension of Vapour.	Relative Humidity.	
			Min.	Max.			Min.	Date.	Max.				Date.	Absolute Range.
January	ins. 29·887	° 34·0	° 29·6	° 40·6	° 34·8	° 10·9	° 16·3	° 12th	° 51·1	° 29th	° 34·8	in. ·177	% 90
February ...	29·808	° 36·8	° 32·9	° 43·1	° 37·6	° 10·2	° 16·8	° 17th	° 52·0	° 7th	° 35·2	° ·187	° 89
March	30·045	° 35·7	° 30·0	° 43·4	° 36·4	° 13·4	° 20·6	° 10th	° 57·9	° 31st	° 37·3	° ·173	° 83
April	30·035	° 45·5	° 35·6	° 56·5	° 45·9	° 20·9	° 27·2	° 15th	° 70·3	° 4th	° 43·1	° ·208	° 68
May	30·021	° 54·8	° 44·0	° 62·5	° 53·8	° 18·5	° 29·1	° 7th	° 79·5	° 31st	° 50·4	° ·290	° 67
June	30·010	° 57·2	° 47·3	° 65·6	° 56·7	° 18·3	° 35·2	° 15th	° 79·8	° 10th	° 44·6	° ·339	° 73
July	30·024	° 58·1	° 50·3	° 66·4	° 58·3	° 16·1	° 43·9	° 21st	° 78·6	° 3rd	° 34·7	° ·357	° 74
August	29·945	° 60·6	° 51·8	° 69·0	° 60·5	° 17·2	° 42·8	° 5&11	° 78·9	° 17th	° 34·1	° ·404	° 76
September	29·995	° 55·1	° 48·1	° 62·3	° 55·2	° 14·2	° 36·6	° 18th	° 68·7	° 13th	° 32·1	° ·358	° 82
October	29·741	° 44·4	° 38·5	° 50·6	° 44·5	° 12·1	° 26·5	° 24th	° 58·6	° 29th	° 32·1	° ·256	° 88
November	30·080	° 42·7	° 38·6	° 48·3	° 43·2	° 9·7	° 26·4	° 2nd	° 58·3	° 14th	° 31·9	° ·259	° 94
December	30·016	° 34·0	° 30·2	° 40·4	° 34·9	° 10·2	° 16·1	° 29th	° 52·4	° 15th	° 36·3	° ·177	° 90
Year	29·967	° 46·6	° 39·7	° 54·0	° 46·8	° 14·3	° 16·1	° Dec.	° 79·8	° June	° 63·7	° ·265	° 81

MONTHS.	RAINFALL.				CLOUD.		WIND.											
	Total Fall. Ins.	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.	Date.	Rain or Snow.	Show only.		Clear Sky.	Over-east.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	'99	'15	22nd	18	9	6.0	6	15	1.5	3	1	2	3	1	3	7	7	4
February	1.52	'36	20th	18	8	7.2	4	16	1.6	1	3	3	3	0	2	7	5	5
March	1.36	'38	15th	13	7	6.1	8	10	2.0	3	9	10	1	1	2	1	3	1
April	'87	'35	27th	10	5	3.7	13	5	1.6	5	8	4	0	1	2	3	2	5
May	1.34	'51	25th	11	0	5.8	6	10	1.9	3	5	2	2	3	6	5	2	3
June	2.54	'63	28th	14	0	5.7	5	8	1.7	1	1	3	2	1	5	7	5	5
July	2.31	'65	19th	10	0	6.8	3	12	2.0	5	5	5	3	1	6	3	1	2
August	3.70	1.55	27th	15	0	6.1	5	13	1.7	2	3	1	1	2	12	4	4	2
September	3.43	1.00	29th	14	0	6.9	5	16	1.8	1	2	0	1	3	11	6	4	2
October	4.23	'87	27th	24	0	6.6	8	16	1.8	7	4	1	2	2	7	1	6	1
November	2.05	'45	15th	18	0	7.6	3	18	1.2	3	4	2	7	2	6	2	1	3
December	1.50	'43	1st	14	7	5.9	8	13	1.4	6	5	1	1	1	9	3	2	3
Year	25.84	1.55	Aug.	179	36	6.2	76	152	1.7	40	50	34	26	18	71	49	42	36

The mean temperature of the year was very low. The mean daily range of temperature was about the average. There were no high maxima, the extreme being $79^{\circ}8$ in June; but in each of the three winter months there were rather low minima, the lowest being $16^{\circ}1$ in December. The temperature was below the average in every season, the summer being particularly cold, and the only months in which it was above the average were May and November. While these were comparatively much the warmest months in the year, March and October were comparatively much the coldest, March being $1^{\circ}2$ colder than February, and October being only $1^{\circ}3$ warmer than November. The mean pressure of the atmosphere was slightly above the average of that of the ten years 1877–86 at Watford. The lowest pressure recorded at 9 a.m. was 29.136 ins. on 18th February, and the highest was 30.601 ins. on 31st March, giving a range of 1.465 in. The rainfall was considerably below the average of that of the ten years 1877–86, and a little below a long-period average, but rain fell on nearly the usual number of days. August, September, and October were very wet months; January and April were very dry. The air had an average humidity, and the sky, except in autumn, was comparatively free from cloud. South-westerly winds were as usual much the most frequent, but southerly winds were less frequent than usual.

In the winter of 1891–92 (Dec. to Feb.) the mean pressure of the atmosphere was rather low, the mean temperature was low, with a considerable mean daily range, and the rainfall was about the average. In the spring (March to May) the mean pressure was rather high, the mean temperature was low, with a considerable mean daily range, the air was dry, and the rainfall was very small. In the summer (June to August) the mean pressure was a little above the average, the mean temperature was very low, with an average mean daily range, and the rainfall was about the average. In the autumn (Sept. to Nov.) the mean pressure was almost exactly the average, the mean temperature was low, with a small mean daily range, the air was moist, and the rainfall was heavy. Rain fell on many days in winter and autumn, and on but few in spring and summer.

The difference between these seasons and the means of the seasons for 1877–86 at Watford is shown in the following table.

DIFFERENCE IN 1891–92 FROM MEANS OF 1877–86 AT WATFORD.

Seasons, 1891–92.	Pressure.	Temperature.		Tension of Vapour.	Humi- dity.	Rainfall.		Cloud, 0–10.
		Mean.	Daily Range.			Total.	Days.	
	ins.	°	°	in.	%	ins.		
Winter	–.092	–1.1	+1.6	–.011	=	–0.28	+ 5	–1.1
Spring	+ .095	–1.1	+1.2	–.024	– 4	–2.88	– 8	–1.2
Summer	+ .042	–1.7	=	–.031	– 1	+0.44	– 4	–0.6
Autumn.....	+ .002	–1.3	–1.9	–.006	+ 3	+1.02	+ 8	+0.5

NOTES ON THE MONTHS.

JANUARY.—Cold and bright, with an atmosphere of average humidity and rather low pressure, and a small rainfall (about half in the form of snow) on a considerable number of days. The ten days 7th to 16th were very cold, having a mean temperature of $27^{\circ}\cdot7$ (9 a.m. $27^{\circ}\cdot2$, max. $33^{\circ}\cdot5$, min. $23^{\circ}\cdot3$). Coldest day 12th, mean $22^{\circ}\cdot8$; warmest day 30th, mean $46^{\circ}\cdot6$. Min. below 32° on 20 days, below 22° on 3 (12th, 13th, and 16th); max. above 42° on 15 days (below 32° on 14th). There was a “silver thaw” on the 17th.

FEBRUARY.—Cold and rather cloudy, with an atmosphere of average humidity and low pressure, and a rather small rainfall (mostly in the form of snow) on a considerable number of days. The four days 16th to 19th were exceedingly cold, having a mean temperature of $25^{\circ}\cdot6$ (9 a.m. $24^{\circ}\cdot4$, max. $33^{\circ}\cdot0$, min. $19^{\circ}\cdot3$). Coldest day 17th, mean $23^{\circ}\cdot2$; warmest day 7th, mean $46^{\circ}\cdot6$. Min. below 32° on 10 days, below 22° on 3 (17th, 18th, and 19th); max. above 42° on 18 days (below 32° on 19th).

MARCH.—Very cold and rather bright, with an atmosphere of normal humidity and rather high pressure, and a rather small rainfall (about two-fifths in the form of snow) on an average number of days. The first half of the month was very much colder than the last half, the mean temperature for the first fifteen days being $31^{\circ}\cdot1$ (9 a.m. $30^{\circ}\cdot7$, max. $36^{\circ}\cdot6$, min. $25^{\circ}\cdot9$), and for the last sixteen days $41^{\circ}\cdot3$ (9 a.m. $40^{\circ}\cdot5$, max. $49^{\circ}\cdot7$, min. $33^{\circ}\cdot8$). Coldest day 3rd, mean $28^{\circ}\cdot0$; warmest day 18th, mean $45^{\circ}\cdot8$. Min. below 32° on 19 days, below 22° on 2 (9th and 10th); max. above 52° on 7 days (below 32° on 2nd and 4th).

APRIL.—Of about average temperature and very bright, with a very dry atmosphere of rather high pressure, and a small rainfall (one fourth in the form of snow) on a small number of days. From 28th March to 11th April (15 days) no rain or snow fell, this being the longest drought in the year. The eight days 12th to 19th were very cold, having a mean temperature of $37^{\circ}\cdot8$ (9 a.m. $36^{\circ}\cdot8$, max. $45^{\circ}\cdot5$, min. $31^{\circ}\cdot1$). Coldest day 14th, mean $35^{\circ}\cdot3$; warmest day 5th, mean $55^{\circ}\cdot4$. Min. below 42° on 26 days, below 32° on 7; max. above 52° on 18 days, above 62° on 12.

MAY.—Rather warm and bright, with a very dry atmosphere of rather high pressure, and a rather small rainfall on a small number of days. No rain fell from 5th to 12th (8 days). The first seven days were very cold, having a mean temperature of $43^{\circ}\cdot6$ (9 a.m. $44^{\circ}\cdot7$, max. $50^{\circ}\cdot5$, min. $35^{\circ}\cdot5$), and the last eight days were very warm, their mean temperature being $63^{\circ}\cdot4$ (9 a.m. $64^{\circ}\cdot0$, max. $72^{\circ}\cdot7$, min. $53^{\circ}\cdot4$). Coldest day 6th, mean $41^{\circ}\cdot3$; warmest day 31st, mean $69^{\circ}\cdot0$. Min. below 42° on 15 days, below 32° on one day (7th); max. above 52° on 26 days, above 62° on 17, above 72° on 4 (25th, 28th, 30th, and 31st). There were thunderstorms on 25th, with 0·51 in. of rain, and 26th, with 0·31 in.

JUNE.—Cold and bright, with an atmosphere of normal humidity and pressure, and an average rainfall on the usual number of days. There were two warm periods, 6th to 10th (5 days), mean temperature $61^{\circ}9$, and 26th to 28th (3 days), mean $64^{\circ}1$. Coldest day 14th, mean $47^{\circ}3$; warmest day 10th, mean $67^{\circ}2$. Min. below 52° on 24 days, below 42° on 8; max. above 62° on 20 days, above 72° on 6. There was a white frost on the morning of the 15th, disappearing before 9 a.m., and a severe thunderstorm on the 28th, when 0.63 in. of rain fell, and a house in St. Albans, and several trees around, were struck by the lightning.

JULY.—Cold and rather bright, with an atmosphere of normal humidity and rather high pressure, and an average rainfall on a small number of days. From 20th to 30th (11 days) no rain fell. Coldest day 19th, mean $51^{\circ}5$; warmest day 3rd, mean $69^{\circ}2$. Min. below 52° on 25 days; max. above 62° on 25 days, above 72° on 4 (2nd, 3rd, 4th, and 23rd).

AUGUST.—Of nearly average temperature and rather bright, with an atmosphere of normal humidity and pressure, and a very heavy rainfall, though on about an average number of days. Coldest day 10th, mean $54^{\circ}0$; warmest day 17th, mean $67^{\circ}5$. Min. below 52° on 16 days; max. above 62° on 28 days, above 72° on 8 (12th, 14th, 15th, 17th, and 21st to 24th). There were thunderstorms on 18th, with 1.00 in. of rain; on 23rd, with 0.10 in.; and on 27th, with 1.55 in.

SEPTEMBER.—Rather cold and cloudy, with a humid atmosphere of average pressure, and a heavy rainfall on the usual number of days. The last three days were very cold, having a mean temperature of $49^{\circ}8$. Coldest day 29th, mean $48^{\circ}5$; warmest day 13th, mean $62^{\circ}7$. Min. below 42° on 4 days; max. above 62° on 16 days. There was a white frost on the morning of the 18th, disappearing before 9 a.m., and thunderstorms occurred on 19th, with 0.71 in. of rain; 20th, with 0.23 in.; and 21st, with 0.73 in.

OCTOBER.—Very cold, with a rather humid atmosphere of very low pressure, and an excessively heavy rainfall on a very large number of days. Rain fell every day from 12th to 21st (10 days), and for the last seven days in the month, the fall during this period including 0.87 in. on 27th, 0.76 in. on 28th, and 0.86 in. on 30th. The coldest period was from 18th to 26th (9 days), the mean temperature being $39^{\circ}5$. Min. below 42° on 25 days, below 32° on 2 (24th and 26th); max. above 52° on 14 days. The first frost of the winter was on 24th (min. $26^{\circ}5$). On this morning the mulberry tree in my garden was almost completely stripped of its leaves by a single gust of wind.

NOVEMBER.—Rather warm and cloudy, with a very humid atmosphere of unusually high pressure, and a rather small rainfall on a considerable number of days. Coldest day 2nd, mean $34^{\circ}6$; warmest days 5th, mean $52^{\circ}5$, 14th, mean $52^{\circ}4$, and 15th, mean $52^{\circ}6$. Min. below 42° on 23 days, below 32° on 4 (2nd, 3rd, 8th, and 21st); max. above 52° on 7 days (2nd to 5th, and 13th to 15th). There was a dense mist on 2nd and 8th.

DECEMBER.—Cold and bright, with an atmosphere of average humidity and rather high pressure, and a small rainfall (more than half in the form of snow) on about the usual number of days. No rain or snow fell from 17th to 30th (14 days). The last eight days were very cold, having a mean temperature of $26^{\circ}\cdot0$ (9 a.m. $24^{\circ}\cdot6$, max. $32^{\circ}\cdot8$, min. $20^{\circ}\cdot7$). Coldest days 28th, mean $22^{\circ}\cdot6$, 29th, mean $23^{\circ}\cdot5$, and 30th, mean $24^{\circ}\cdot6$; warmest day 15th, mean $46^{\circ}\cdot6$. Min. below 32° on 17 days, below 22° on 5; max. above 52° on one day (15th) (below 32° on 28th, 29th, and 30th).

XVII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN
HERTFORDSHIRE DURING THE YEAR 1892.

By EDWARD MAWLEY, F.R.Met.Soc., F.R.H.S.,

Phenological Recorder to the Royal Meteorological Society.

Read at Watford, 18th April, 1893.

THE localities represented in this Report are the same as in the previous one, viz. :—

STATION.	Height above Sea-level.	OBSERVER.
St. Albans (Malvern House)	300 feet.	Miss E. F. Smith.
St. Albans (St. Peter's Street).....	380 ,,	Henry Lewis.
Great Berkhamsted	400 ,,	Mrs. E. Mawley.
Harpenden	370 ,,	J. J. Willis.
Hertford	140 ,,	W. Graveson.
Hitchin	230 ,,	J. E. Little, M.A.

In answer to a recent appeal made to the members of the Society, several residing in other parts of the county have very kindly come forward and offered their services as observers. To these volunteers my best thanks are due, as well as to those members previously on our staff who have been so good as to supply me with materials for the present report. Additional observers are, however, still required if the different districts in our county are to be adequately represented. The desirability of numerous observing-stations will be seen on reference to Table I, where an unfortunate gap will be noticed in the returns from Hertford in the middle of the flowering season, and another unfortunate gap in the Hitchin returns at the beginning of it. Now both these stations being early ones, the mean records for the county for the plants affected by the missing observations must necessarily come out somewhat later than they otherwise would have done. Had we more stations, a missing observation here and there would of course be less seriously felt. This Table also shows how important it is that our present staff of observers should send in each year as complete returns as they possibly can.

The order in which the plants came into flower at the different stations varies but slightly from that given in the previous Report :—1, Hertford; 2, Hitchin; 3, Harpenden; 4, St. Albans; and 5, Berkhamsted; the only difference being that in 1892 Harpenden was slightly in advance of St. Albans instead of immediately following it. So that as a rule the higher the station above sea-level, the later have again been the dates of flowering recorded.

THE WINTER OF 1891-92.

Throughout the first half of December, 1891, the weather continued very mild, but shortly before Christmas a sharp frost lasting about ten days set in. During this frost very little rain

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1892, WITH THE MEAN DATE FOR 1876-91.

SPECIES.	ST. ALBANS.		BERK- HAMSTED.	HAR- PENDEN.	HERT- FORD.	HITCHIN.	MEAN, 1876-91.
	Malvern House.						
Hazel .....	.....		Feb. 15	Jan. 31	Jan. 21	.....	Jan. 27
Coltsfoot .....	.....		Mar. 13	Mar. 18	Feb. 9	.....	Feb. 25
Wood-Anemone.....	.....		Apl. 8	Apl. 1	Mar. 20	.....	Mar. 18
Blackthorn	Apl. 9		Apl. 20	Apl. 13	Apl. 10	.....	Apl. 2
Garlic Hedge-Mustard	Apl. 24		Apl. 25	Apl. 24	Apl. 15	.....	Apl. 20
Horse-Chestnut	May 26		May 22	May 16	.....	May 17	May 11
Hawthorn	May 17		May 25	May 22	.....	May 15	May 15
White Ox-Eye	May 19		May 28	May 25	.....	May 24	May 20
Dog-Rose	June 10		June 6	June 1	.....	June 1	June 5
Black Knapweed .....	.....		July 1	June 16	.....	July 8	June 20
Harebell	July 15		July 10	July 4	July 21	July 3	July 5
Greater Bindweed	July 15		July 1	July 8	July 15	July 20	July 8
Ivy	Sept. 24		.....	.....	Sept. 18	Sept. 30	Sept. 26

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1892, WITH THE MEAN DATE FOR 1876-91.

SPECIES.	ST. ALBANS.		BERK- HAMSTED.	HAR- PENDEN.	HITCHIN.	MEAN, 1876-91.
	Malvern House.	St. Peter's Street.				
BIRDS.						
Song-Thrush .....	.....	Feb. 5	Jan. 31	Feb. 4	Jan. 25	Jan. 14
Swallow .....	.....	Apl. 21	Mar. 29	Apl. 25	Apl. 25	Apl. 12
Cuckoo	Apl. 24	Apl. 6	Apl. 28	Apl. 20	Apl. 24	Apl. 13
Nightingale .....	.....	Apl. 17	May 1	Apl. 22	Apl. 4	Apl. 15
Spotted Flycatcher .....	.....	.....	June 17	.....	.....	.....
Swallow (last seen) .....	.....	Nov. 6	Oct. 27	.....	.....	.....
INSECTS.						
Honey-Bee	Feb. 10	.....	Jan. 28	.....	Jan. 30	Mar. 18
Wasp .....	.....	.....	Apl. 6	May 30	Apl. 22	Mar. 19
Small White Butterfly .....	.....	.....	Apl. 2	.....	Apl. 8	Apl. 2
Orange-Tip Butterfly	May 23	.....	May 9	.....	May 13	May 21
Meadow-Brown Butterfly .....	.....	.....	May 17	.....	.....	.....

fell, but in the rest of the month there was only one perfectly dry day, while the rainfall often proved very heavy. January was cold and dry, the sharpest frosts taking place about the middle of the month. In February there occurred during the end of the third week the keenest frosts of the winter—the exposed thermometer indicating at Berkhamsted on two occasions between 26° and 27° of frost. Rain and snow fell at frequent intervals, but the aggregate amount entering the rain-gauge was short of the average for the month.

The Christmas frosts came upon all vegetable growths after a long spell of unseasonably warm weather and when the soil had become saturated by constant rain, and consequently at a time when delicate plants were least prepared to resist them. Had these frosts been more severe, considerable damage must undoubtedly have been done. Fortunately after this time the ground never became sufficiently warm during the rest of the season to awake them from their winter slumbers. The usual winter farming operations were greatly interrupted, at first by the sodden state of the soil, and afterwards by frost.

Taking the mean date at the three stations sending in returns for these plants, the hazel was first in flower on February 2nd or six days later, and the coltsfoot on March 4th or eight days later than the adopted average for the county given in the last column of Table I. In my own garden at Berkhamsted the last rose-bloom of the year was destroyed by frost on December 20th, or nineteen days later than the average date of its destruction in the previous six years. In the same garden the winter aconite first came into blossom on January 25th, which is seventeen days earlier than in the previous year. The mean date when the song-thrush was first heard is eighteen days late, while the honey-bee first appeared among flowers twenty-two days later than usual.

THE SPRING.

This season was chiefly remarkable for the cold, dry, and sunny weather which prevailed during the greater part of it. March proved particularly cold for a spring month; while April was also cold, but no sooner had May been entered upon than the temperature began gradually to rise, and towards its close the weather was quite summerlike.

Notwithstanding the long continuance of bright sunshine, the ground remained singularly cold and dry until about the middle of May, when some welcome rains arrived, which started everything into rapid growth. Until this period, owing to the cold weather and the absence of rain, the growth of both field and garden crops remained almost at a complete standstill. The pastures especially presented a very bare appearance. The fruit and other flowering trees blossomed late and very irregularly, in some places being loaded with blossom while in others there was but a scanty show. As in the previous spring, farmers were sorely taxed to find sufficient green food for their cattle and sheep. On the other hand,

the land again worked splendidly, and consequently spring corn and other seeds were got in under the most favourable conditions.

The spring flowers on the list were all more or less late in making their appearance. According to the returns sent in, the mean variations from the average were as a rule as follows:—Wood-anemone twelve days late, blackthorn eleven days late, garlic hedge-mustard two days late, horse-chestnut nine days late, hawthorn five days late, and white ox-eye four days late.

The spring migrants also arrived later than usual, the swallow being five days late, the cuckoo seven, and the nightingale four days late.

The insects on the list were also behind their average dates, the wasp being seventeen days late, the small white butterfly three days, and the orange-tip butterfly ten days late.

THE SUMMER.

The weather of the first and last ten days in June was warm and at times even quite hot, but the remaining ten days were all very cold. On one night (that preceding the 15th) the exposed thermometer indicated a sharp ground-frost. This was the first month for six months in which the rainfall had been at all above the mean. July was cold, the mean temperature seldom rising above the average, while the rainfall proved unseasonably heavy. During August the days were as a rule warm, whereas the night temperatures were often singularly low for a summer month. The fall of rain was again heavy.

The June rains unfortunately came too late for the hay, which proved in most cases a very scanty crop. The corn and other farm-crops were, however, greatly benefited. The frost of June 15th proved remarkably keen for a summer month, and in most low-lying districts greatly damaged potatoes, scarlet runners, and other tender vegetables. During July and August, considering that these are generally the warmest months of the year, the progress made by vegetation was slow. Bush-fruits and strawberries were as a rule good and plentiful. During the sunny days of August, butterflies made their appearance in unusual numbers—notably peacocks, red admirals, and painted ladies. That erratic butterfly, the clouded yellow, was also frequently seen. The mean date of flowering of the dog-rose was about seasonable, but the black knapweed, harebell, and greater bindweed came into blossom respectively eight, six, and four days later than the average.

THE AUTUMN.

Notwithstanding the unseasonable coldness of many of the nights, the first autumn month was on the whole rather a warm one than otherwise, while the rainfall was only about seasonable. October may be described as having been cold and wet throughout. In fact there occurred but very few days during the course of it without some rain. During November the weather continued variable, but usually very mild, with about an average rainfall.

The early part of September proved very favourable for the ingathering of the harvest, but towards the end of the month rain began to fall heavily and at frequent intervals. The grain-crops were as a rule light—the only one of them above average being barley. Potatoes in most localities yielded well, while turnips and mangolds were also good. The fruit-crops were as a rule indifferent, and did not ripen satisfactorily owing to the coldness and dullness of the summer and autumn months. The continuous rains in October so saturated the ground that at the end of the season all seasonable farm-operations were much in arrear.

The ivy, favoured doubtless by a spell of warm sunny weather in September, came into flower two days in advance of its average date.

XVIII.

NOTES ON LEPIDOPTERA OBSERVED IN HERTFORDSHIRE.

By A. E. GIBBS, F.L.S.

Read at Watford, 18th April, 1893.

It was only on the day of the last meeting of our Society that I accepted the post of Recorder of Lepidoptera occurring in Hertfordshire. The short time which has elapsed since then has given me very little opportunity of collecting information from observers in different parts of the county, and I am therefore placed at some disadvantage in presenting my first report, which I hope may be the forerunner of an annual series.

THE CLOUDED-YELLOW BUTTERFLY (*Colias edusa*).—The year 1892 has been chiefly memorable entomologically for the extraordinary abundance of the clouded-yellow butterfly, *Colias edusa*, for not since 1877, which will long be remembered as the great *edusa* year, have we been favoured with such a profusion of this beautiful insect. The fact has long been noted that in some years particular species of insects are extremely plentiful, and then for a time seem quite to disappear until another prolific season comes round, when they may again be seen everywhere.

We have no insect in our British fauna more uncertain in its appearance than *edusa*. Sometimes for years it may be sought for in vain, and then comes a season like that of last year, when it might be taken on almost any bright day. A writer in the 'Entomologist' (1878, p. 54), referring to the appearance of the insect in 1877, gave the dates previous to that year in which it had been recorded, as follows:—"1804, 1808, 1811, 1825 (one record), 1826 (very abundant), 1831 (plentiful), 1833, 1835 (both species [*edusa* and *hyale*] common), 1836 (common), 1839 (common, many in June), 1843 (abundant), 1844 (very common), 1845 (scarce), 1847, 1848 (one record), 1851 (one record), 1852, 1855 (common), 1856 (common), 1857 (very common, recorded to November 18th), 1858 (very common, particularly so in June, also to November 7th), 1859 (very abundant), 1861 (scarce), 1862, 1865 (common), 1867 (several), 1868 (common, but *hyale* much more so), 1869 (several), 1870 (scarce), 1871 (one record), 1872 (not uncommon), 1875 (very common), 1876 (common)." I have looked through the volumes of the same magazine subsequent to that date, and find that, with the exception of the years 1890 and 1891, the appearance of *edusa* was recorded every season. In some years it was evidently scarce, only a few stray captures being reported, while in other years it was fairly common. It was most plentiful in 1879, 1883, 1884, 1885, and 1892. In the fifteen years, 1878 to 1892, there were thus five years in which, though it may not have been freely taken over a large area, it was not a rarity in the south of England, while the remaining ten years are marked by the capture of a few specimens only, and in some cases its absence from likely localities such as the New Forest is commented on.

Last season *edusa* appears to have been first seen in the New Forest on the 24th of May, whence it is inferred that our visitors landed on the coast of Hampshire, and from there spread themselves out over the country. After this date specimens were observed in many widely-scattered localities. They no doubt deposited their eggs on clover and other leguminous plants, their progeny appearing as perfect insects in August, in which month *edusa* was recorded from every English county except Northumberland, Durham, Cumberland, Westmoreland, Huntingdon, and Rutland.* In some of these counties it was probably present but unnoticed. It was far more plentiful, as might naturally be expected, in the south than in the north of the country, though several individuals are recorded as having been taken in Scotland.

Colias edusa appears to be really a native of the lower regions of the Swiss Alps, where it generally produces a single brood and hibernates, as does the brimstone butterfly with us. Thence the perfect insects are occasionally, from causes not very well understood, driven northwards, and so reach our shores, but fail, probably from climatic reasons, to establish themselves.

I cannot now attempt to investigate at any length the cause of these spasmodic appearances and disappearances, and it must suffice to say that the generally-accepted theory is that in years of unusual abundance a migration has taken place from the Continent about the month of May, and that the immigrants have laid eggs from which the numerous August brood has sprung.

Miss Ormerod, in her 'Report of Observations on Injurious Insects' for the past year (1892, p. 31) alludes to the appearance of *edusa*. Every entomologist will be pleased to hear that so competent an authority as Miss Ormerod does not rank *edusa* as an injurious insect, but she sounds a note of warning with regard to it, pointing out that the caterpillars when under supervision have been found to be voracious feeders on trefoil and white clover, and "may prove to be an infestation requiring attention."

During 1877, the year in which *edusa* was particularly abundant, I took a great many specimens both of it, and its congener, *C. hyale*, in the neighbourhood of St. Albans. Its favourite place of resort then was a piece of nursery-garden, and the steep banks of the road, now the site of Mr. Sander's orchid establishment. The pale variety of *edusa* (*helice*) was also taken at the same spot. The only other information that I have been able to find with regard to its appearance in Hertfordshire in 1877 is a note by Mr. Arthur Cottam, which was printed in our Transactions, † and which states that it then visited us in unusual numbers, the localities mentioned being St. Albans, Watford, and Bushey. In 1885, when it appears to have been more plentiful than in any other year between 1877 and 1892, I find in the 'Entomologist' the following communication from Mr. G. H. Tite, Amwell House,

* 'Entomologists' Record,' vol. iv, p. 16.

† 'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 239.

Ware:—"On August 4th I captured, in the fruit-garden here, a fine female specimen of *C. edusa*."

During the past summer I had not the same opportunities for taking advantage of the presence of *edusa* as I had in 1877, and I am therefore unable to give much information from my own observations with regard to its appearance in our county. In August I was away from England and was pleased to find it very abundant on the Continent. I remember seeing it on a sunny day flying by hundreds over the clover and potato patches at the back of the dunes, in the south-west of Belgium, between Ostend and Nieuport. It was a sight never to be forgotten. The insects with their bright golden wings looked like blossoms which had escaped from their stalks and gone a-gipsying. Only one came under my notice in St. Albans, and that was flying at a great pace across High Street. Miss Ormerod also records seeing one in her garden at Torrington House, and Mr. Arthur Lewis saw one at Sparrowswick. At Tring it was abundant. Mr. E. Hartert, curator of the Hon. Walter Rothschild's Museum, writes: "In 1892 *C. edusa* was very plentiful in August and September, but only one *helice* was seen and taken by the Honourable Charles Rothschild." Mr. Frank Latchmore reports from Hitchin: "*C. edusa* abundant all round. I saw several of the pale variety (*helice*) which were taken here." Mr. Henry Warner, of Wormley, says: "We had no great quantity of *C. edusa* here as we had some years ago, but I observed some half-dozen, and only one *hyale*. One of my sons saw an *edusa* at Hendon in June; those observed here were in August and September." Mr. W. Graveson also reports the appearance of *edusa* at Hertford in the autumn. From Ferney House, Southgate, Mr. R. Dymond writes: "My first *edusa* was a male in good condition. I put it out of some thistles on August 3rd. It flew a short distance and then settled, when it seemed to have no disposition to fly further, so I easily caught it in my hat. After that my captures were two on the 4th, one on the 5th, one on the 8th, and one on the 10th, all males, in good condition; on the 5th I caught my first female, which was very much battered and worn. After that I took other females in a better condition." About the 15th of August Mr. Dymond left home, so that his observations, so far as Hertfordshire is concerned, ceased. He did not take *C. helice* at all, but in September he saw *hyale* in splendid condition on the railway-embankment near Oakleigh Park Station, but unfortunately failed to capture it. Mr. Dymond further reports that the males of *edusa* which he took at Southgate were both smaller and lighter in colour than some which were sent to him from Sandgate. He also informs me that a great many of these insects were taken by the lads of the Boys' Farm Home at Southgate. Mr. E. R. Chambers writes to the 'Entomologist' that one example of each sex of *edusa* was taken at Harpenden on the 8th of September, and a female on the 14th. We thus have records of *C. edusa*, its pale variety *helice*, and *C. hyale*, from our county during 1892. They were all, however, seen in

the autumn, and it would be interesting to know if any of the immigrants in May and June found their way into Hertfordshire. As Mr. Warner, jun., saw one at Hendon, very near our borderline, it is not at all unlikely that we have been favoured with an unrecorded visit.* It is worth noting that in 1878, the year after the last abundant visitation, *edusa* was almost entirely absent from England. Mr. Jenner Weir, of Blackheath, Mr. G. W. Oldfield, of Guildford, and Mr. H. Kerry, of Harwich, each wrote to the 'Entomologist' † calling attention to its rarity or absence. It remains to be seen what 1893 will bring forth.

OTHER BUTTERFLIES. — The large and small white butterflies (*Pieris brassicæ* and *P. rapæ*) are reported as having been a very great pest at Hitchin last autumn. Mr. Harold Gatward, of that town, has favoured me with the loan of some artistically-executed drawings, very true to nature, of several larvæ, and they include representations of these most injurious and voracious caterpillars. As these two species are so exceedingly well-known it is only necessary to simply mention the fact of their unusual abundance.

Several butterflies of the genus *Vanessa* are recorded in the entomological papers as having been remarkably abundant during 1892, but the only local observer who reports a similar state of things in Hertfordshire is Mr. R. Dymond, of Southgate. With regard to the red admiral butterfly he says: "*Vanessa atalanta* was unusually abundant here during August and September of last year. Along one side of the Great Northern Cemetery there is a wall made with brick pillars and iron bars intervening. On these pillars, between eight and nine o'clock a.m., I have often seen about forty *atalantas* collected together, sometimes a dozen on each pillar. Curiously enough they always keep to the same part of the wall (about 100 yards). I have also seen the painted lady (*V. cardui*) settling on a certain part of the road from five p.m. till as late as eight o'clock." Both these are beautiful and abundant species, and seem to prefer the haunts of men, flying about our gardens in a fearless manner, sunning themselves and sipping nectar from the flowers. It is a curious fact that the Vanessidæ are reported as having been exceedingly numerous in the last great *edusa* year, 1877. ‡ Mr. R. Dymond also tells me that the Camberwell beauty, *V. antiopa*, was taken at sugar a few years ago at Southgate. Although very rare in England, I have seen *antiopa* sporting over the pastures very freely on the Continent.

The capture of the chalk-hill blue (*Polyommatus corydon*) on Broxbourne Common some time ago is recorded by Mr. H. Warner. He has never heard of another there before or since. This pretty

* On the appearance of a report of this paper in the County newspapers, Mr. C. F. Pilbrow, of Colney Heath, St. Albans, wrote to the 'Herts Advertiser,' stating that on June 7th, 1892, he took two female specimens of *C. edusa* near Colney Heath, one of which laid a large number of eggs on the food-plant supplied to it, which, however, did not hatch, probably owing to being unfertilized.

† 'Entomologist,' 1878, p. 269.

‡ 'Entomologist,' 1877, p. 188.

silvery blue insect is a butterfly which loves the chalk downs, and is, as Mr. Newman remarks, "generally absent where there is no chalk." Broxbourne Common is rather an unlikely locality for the species, being, as Mr. Warner informs me, three miles away from the nearest chalk, and certainly a considerable distance from any downs. This is, so far as I can ascertain, the first record for the county, though the species must, I think, occur on the hills in the north and west of Hertfordshire.

HAWK-MOTHS.—Turning now from the butterflies to the moths, and dealing first with the Sphingidæ, or hawk-moths, a group which includes some of our largest British insects, I have to record a note from Mr. F. Latchmore, in which he reports an unusual abundance of the larvæ of the eyed hawk-moth (*Smerinthus ocellatus*) and the poplar hawk-moth (*S. populi*) at Hitchin. He says that he several times found as many as twenty caterpillars feeding on a small weeping-willow. The willow stems were in many places along the hedges stripped of their leaves by them. Mr. Henry Lewis, of St. Albans, had a female eyed hawk-moth brought to him, and it laid a number of eggs which passed into the possession of Mr. Arthur Lewis, and from which many pupæ resulted. Mr. Arthur Lewis also reports *S. populi* to have been abundant on some willow plants in his garden at Sparrowswick.

Mr. F. Latchmore informs me that no convolvulus hawk-moths (*Sphinx convolvuli*) were taken at Hitchin in 1892, though this insect is frequently captured in the town in September and October. It is not a common moth at St. Albans, but in September, 1887, two specimens were taken, one on a gate at the end of Cumberland Road, and the other in a nursery-garden close by. One is in my collection, the other in that of Mr. Henry Lewis. I have never seen the caterpillar of this moth, and its habits do not appear to be very well known. Mr. Buckler tells us that the larva when full-fed measures four inches in length and has a diameter of five-eighths of an inch. Like *Colias edusa*, this insect seems to be particularly abundant in certain years, but no reason for this has, so far as I am aware, been assigned. In 1846 it abounded in England and was very generally distributed. But even in years of unusual abundance the larva is seldom found. It appears to be sluggish in its habits, and feeds principally on the wild convolvulus. The unusually long proboscis of this insect is worthy of note.

Towards the end of 1891 Mr. George Buller gave me a number of pupæ of the elephant hawk-moth (*Chærocampa elpenor*), the larvæ of which he had taken at Welwyn. These duly emerged in the following June. In 1888 there was brought to me a nearly full-fed caterpillar which was found at St. Albans feeding on fuchsia. I had no difficulty with it, as it fed freely on fuchsia, and in due course pupated. This is a very lovely moth, and well repays the trouble of rearing. In Ireland the larva is called the "murrain worm," as it is supposed to be the cause of disease in cattle. Needless to say it is quite harmless.

Mr. J. E. K. Cutts, of Watford, informs me that a friend of his

took the yellow-legged clearwing (*Sesia asiliformis*) near Sandridge. This is the first record of the occurrence of this moth in our county. Mr. H. Warner, of Wormley, says that the broad-bordered bee clearwing-moth (*S. fuciformis*) is to be taken in his neighbourhood. It seems to be very local, and is generally found in one particular swampy spot at the road-side, but it also frequents the woods where the bugle is plentiful.

THE GOAT MOTH (*Cossus ligniperda*)—A most extraordinary find of goat-moth larvæ is reported from Station Road, Hitchin, by Mr. F. Latchmore. Over 200 were taken wandering about a small walled garden in search of a place to “spin up.” Two or three young aspen trees in the garden were literally riddled with “goat-holes.” Mr. Latchmore was kind enough to send to me a large batch of these larvæ which I have kept through the winter. They have not changed to pupæ, but have hibernated in sawdust, and are just beginning to show signs of moving. The larvæ of the goat-moth are wood-feeders. The egg is laid by the parent moth in the crevices of the bark of a number of our forest and orchard trees, and the young grub, as soon as hatched, begins to eat its way into the wood of the living tree, which is often, as Mr. Latchmore says, “literally riddled with holes.” It remains in the larva state three years, during which time it can do an immense amount of damage. It then turns to a chrysalis in one of its galleries, and just before emergence forces itself to the entrance, whence the moth escapes, leaving the empty pupa-shell projecting from the tree. Several reports have been made to this Society at different times with reference to the damage done by this insect, and I believe that the first entomological observation which was read before us was a note by Mr. J. H. James in 1875, on the “Destruction of an Oak-tree by the Larvæ of the Goat Moth.”* Miss E. A. Ormerod, in her most useful ‘Manual of Injurious Insects,’ a work which every farmer and gardener should study, gives full directions for dealing with this insect should it become a pest.

THE WOOD-LEOPARD MOTH (*Zeuzera pyrina*).—The wood-leopard moth is another insect whose larvæ feed on the living wood of many different trees. In 1891 Mr. John Hopkinson sent to me a female found in his garden at St. Albans, and it laid a quantity of eggs, but I was not successful in rearing them. Mr. J. E. K. Cutts tells me that he found that a larva had attacked one of his fruit-trees, and he was fortunate in catching the moth just as it emerged from the pupa-case, which it left projecting from the hole in the tree. Mr. Latchmore says that at Hitchin this insect is very common in the perfect state, and is taken at rest in the daytime in various parts of the town.

THE SMALL EGGAR (*Eriogaster lanestris*).—In June Mr. Arthur Lewis found on a slow-bush on Harpenden Common a web of the caterpillars of the small eggar, from which he took a number

* ‘Trans. Watford Nat. Hist. Soc.,’ Vol. I, p. 64.

of larvæ which he succeeded in rearing. On the 26th I searched on the same bushes and found a few insects, some of which were nearly full fed, while others had not shed their last skin. Several of these I preserved, but the remainder unfortunately died. However the larvæ collected by Mr. Lewis changed into pupæ, some of which I am able to exhibit. The larva when full fed spins a small oval and very compact cocoon inside which it pupates, leaving breathing-holes which look like fine pin-pricks. Before the moth emerges, the cocoon becomes darker at one end, and ultimately the insect comes out through a very carefully-cut aperture. Only three of the moths appeared this spring, and, as the pupæ seem still to be alive and healthy, it is to be presumed that the others will emerge next year.

THE LACKEY MOTH (*Bombyx neustria*).—In May I found that a small plum tree in the garden at The Hollies had been attacked by the lackey moth. The web of caterpillars was cut off and I took it indoors for observation. The female lackey moth lays her eggs in the autumn in a band round the stem or branch of the food-plant, and, as soon as the small hairy dark-coloured grubs emerge, they spin a web in which they live, stripping the branches of the tree for a supply of food, and often leaving them quite bare of leaves. These caterpillars are rather conspicuous and handsome creatures. The head or first segment is of a light blue tint, and has two black eye-like spots upon it. A whitish longitudinal line runs down the centre of the back, and on either side of this are narrow stripes of black and orange-red, and a broader one of blue. The caterpillar is hairy, especially on the underpart of the body. It spins in any convenient corner a cocoon which is easily distinguished by the quantity of sulphur-coloured powder which it contains. My insects began to pupate about the second week in June, and during July the moths emerged, but I am not able to give the exact dates. The caterpillars of this moth do an immense amount of mischief, and as soon as a web of them is observed on a fruit-tree the branch should be carefully cut off, without jerking it so as to alarm the insects, and plunged into boiling water. Miss Ormerod tells us that in France *B. neustria* is such a troublesome pest in orchards, in consequence of the ravages of the caterpillars, if left unchecked, ruining the apple-leafage over an extent of miles of country, that an old law made it compulsory on landed proprietors to have the shoots with the webs on cut off and destroyed.

THE EMPEROR MOTH (*Saturnia pavonia*).—In 1889 Mr. Arthur Lewis released some larvæ of the emperor moth in his garden at Sparrowswick. Last autumn a fine full-grown caterpillar was brought to him, having been found on Bernard's Heath, which adjoins his residence, and it may not be too much to hope that this beautiful insect has established itself in the neighbourhood of St. Albans. It is not a fresh introduction to our county's fauna, for its occurrence has been previously recorded.

THE COMMON QUAKER (*Taniocampa stabilis*).—On April 6th I took

a female quaker moth "at sallow" at Bricket Wood. She seemed to be rather exhausted, and on the 9th I uncurled her proboscis with a pin, and fed her with sugar. This revived her, and in the night she deposited about 200 eggs on an oak twig. They were spherical in shape but slightly flattened, and at first of a creamy white tint; in three days they began to turn dark in the centre and on the rim. On the 13th she laid about 150 more on the same twig, on the 15th about another 50 on the lid of the box, and on the 16th about 70 more. On the 19th and 20th, for some reason or other, the moth destroyed the batch she had laid upon the box-lid, but in the night of April 20–21 she deposited another 40 to 50 on the side of the box. The total number laid, including those the mother destroyed, was thus approximately 500. In the night of April 25–26, sixteen days after the eggs were deposited, the little larvæ began to emerge, and were of a lightish green tint with black heads. After this the other eggs hatched at regular intervals, and the larvæ, which were fed on whitethorn, began to pupate in July, and by the middle of that month they had all gone into the chrysalis state, in which they remained until the spring, the first moth appearing on March 20th.

THE SATELLITE (*Scopelosoma satellitia*).—A hibernated satellite, taken at sugar on April 22nd, laid 41 eggs of a chocolate-brown tint. These hatched on May 10th, and duly fed up and pupated. The first imago appeared on September 9th. These caterpillars are terribly cannibalistic in their habits, and will devour any other larvæ which come within their reach. The entomologist who is unfortunate enough to get one of these creatures introduced into his feeding-cage will probably find the majority of his pets devoured in a very short time. *Calymnia trapezina* is another ill-mannered larva, and will offend in the same way and as badly as *satellitia*. The larva of the satellite is an evil-looking creature, almost jet black in colour. The head is brownish-black, and the second segment forms a black band with two very distinct orange stripes upon it. The velvety black of the caterpillar is varied by three indistinct longitudinal lines, and several snow-white spots appear in a line with the spiracles—one between the second and third segment, another between the third and fourth, another, sometimes extended to a line or a blotch and sometimes entirely absent, on the fifth segment, and a fourth linear white mark on the eleventh segment.

THE MERVEIL-DU-JOUR (*Agriopsis aprilina*).—In the late spring and early summer, when sugaring, the prettily-mottled caterpillars of the merveil-du-jour moth may be found crawling up the bark of the oak trees to feed. Last year we took several at Bricket Wood, but most of them died when pupating. Those who wish to rear this moth may easily find the larvæ by searching the trunks of the oak trees carefully by the light of a lantern. They hide in the crevices of the bark, and a glance at the caterpillar will at once show that its colours assimilate very nearly to those of a

lichen-covered tree-trunk, thus affording it protection from its enemies.

THE EARLY THORN (*Selenia bilunaria*).—On the 1st of May I took a female of the early thorn flying lazily on Bernard's Heath. She laid about a dozen eggs in the box in which I placed her. These hatched on the 22nd of that month, and I succeeded in rearing them. The first perfect insect emerged from the chrysalis on July 18th. This is a double-brooded moth, the first brood appearing early in the spring, and the second at the end of summer. The female I caught belonged to the spring brood, and her progeny became the second brood of the year, with the exception of one specimen which remained in the pupa state till February 1st of the present year (1893), when it emerged. This is, I think, a rather interesting fact, and I should like to know if other observers have noticed a similar thing. It shows that the generations of these double-brooded moths are not always alternate. This specimen was a male, and, as with most insects which have remained long in the chrysalis state, the markings are rather darker and richer than on those which hatched in the autumn. I preserved one of this batch of larvæ which I am able to show. I fed them on plum leaves.

OTHER MOTHS.—Mr. F. M. Campbell, F.L.S., reports that on August 21st, 1891, he found in his garden at Rose Hill, Hoddesdon, a mature larva of the alder-moth (*Acronycta alni*) on some fresh-turned mould under a lime tree. Mr. Cutts was also fortunate enough to take an imago on a fence in Nascot Wood Road, Watford, last summer. The occurrence of this rare moth is worth more than the passing note I am able to devote to it, for I believe that it has never previously been recorded from Hertfordshire.

Mr. R. Dymond reports to me the capture of the speckled footman (*Deiopeia pulchella*) at Southgate last year. So far as I am aware, this pretty moth, also, has never been taken before in our county, and it is therefore another addition to our fauna.

When at Hitchin last autumn Mr. H. Gatward showed to me a drawing of the caterpillar of the swordgrass-moth (*Calocampa exoleta*) and the imago which resulted from it. He has been good enough to send the drawing to me for exhibition. The larva was found upon lavender by Mr. F. Ransom, in his garden, and he sent it to Mr. Gatward. It continued to feed for a week, and on August 9th buried itself. The moth appeared on October 8th. The usual food-plants of this moth are the devil's-bit scabious, the catch-fly, and the rest-harrow. Mr. A. F. Griffith also reports having taken the larva of this moth on the banks of the Midland Railway, near Sandridge, feeding on *Heracleum*. To Mr. Gatward I am also indebted for a drawing (exhibited) of the larva of the broom-moth, feeding upon knapweed.

Mr. Latchmore informs me that the mullein-moth (*Cucullia verbasci*) is very common in the larva state at Hitchin. It is generally taken on fine mullein plants grown in gardens, where it

plays havoc with the foliage. Along the streams the water-betony is also infested by it. Mr. Buller in 1891 sent to me from Welwyn half a dozen pupæ of this moth enclosed in their earthen cocoons, but only one emerged. In a note on rearing these insects Mr. Latchmore writes: "On the water-betony they thrive splendidly, and attain a large size. I get a plant of betony and put it in water. This does not then require re-planting. They finish off by eating the top shoot, after they have changed their skin for the last time. When this is done they will invariably commit suicide if not removed to a box of earth. I often keep larvæ in the yard at the back of my house, and after watching them grow up let them wander away to pupate." The same observer sent to me a number of specimens of the five-spotted burnet-moth (*Zygana trifolii*), which, as usual, was abundant in a marshy common at Ippollytts, and at Oughton Head, Hitchin.

Mr. Gatward, of Hitchin, took two larvæ of the pebble-prominent (*Notodonta ziczac*) on a weeping-willow at Hitchin, and he successfully reared them. Mr. Arthur Lewis took a pale prominent (*Pterostoma palpina*) creeping about the branches of an oak tree in his grounds. He also found a caterpillar of an apple green colour, which turned out to be the large ranunculus-moth (*Polia flavocincta*), eating the leaves of the ivy covering his house. This larva seems to feed upon a variety of low-growing plants, such as chickweed and groundsel. Newman says that the full-fed caterpillar rests in an almost straight position, with its head slightly tucked in, but falls off its food-plant and forms a rather loose ring when annoyed. Mr. Lewis has secured a nice series of specimens of the moth from these caterpillars. One of the best captures made by him was that of two fine specimens of the bird-wing moth (*Dipterygia scabriuscula*) at sugar in the garden. The occurrence of this rare moth is interesting as it is new to the neighbourhood, though not to the county. I hope that during the coming summer it may occur again. Mr. Lewis also tells me that he took that pretty moth, the white-spotted pinion (*Calymnia diffinis*) at sugar at Sparrowswick, St. Albans. In 1891 I took a single specimen of this at Bricket Wood, and Mr. Lewis had previously taken it at St. Michael's, St. Albans, but it is a moth which ought to be fairly common with us, and no doubt would not prove to be scarce if sought for in the right places. It is recorded by other collectors. Among other insects in Mr. Lewis's cabinet, all of which he tells me he took at St. Michael's, are the frosted green (*Asphalia ridens*), taken while flying round a lamp, the lilac beauty (*Pericallia syringaria*), the straw underwing (*Cerigo matura*), and the double-lobed moth (*Apamea ophiogramma*), which has also been taken by Mr. J. E. K. Cutts, of Watford.

Mr. Cutts was singularly fortunate in his captures last year. Amongst other rare insects taken by him was the miller (*Acronycta leporina*), a larva of which he found on a fence in Langley Road. He made a hole in a cork for it to pupate in, and it enlarged the hole and used it. *Neuria reticulata* and *Aplecta advena* he took

at sugar in his orchard. Mr. Cutts, in the course of a most interesting letter, says: "My orchard-trees being young, and not large enough to sugar on, I tie pieces of cork bark on the stakes, and sugar on the bark. I use treacle with a little rum in it. I bred a nice series of the buff-tip moth (*Phalera bucephala*), and also of the peacock butterfly. The year before last I found the larvæ of the dot-moth (*Mamestra persicariæ*) very abundant, and bred a nice series, and in London I found the brindled beauty moth (*Biston hirtaria*) extremely abundant, and turned a few out in my garden last autumn, and, as I found a female in the garden this spring, they, of course, bred." Mr. Cutts also numbers among the moths he has taken in Hertfordshire: *Luperina cespitis*, *Teniocampa populeti*, *T. miniosa*, *Orthosia macilenta*, *Cosmia pyralina*, *Aplecta advena*, *Plusia pulchrina*, *Selenia lunaria*, and *Pelurga comitata*. Some of these have also been taken by other collectors.

SUGARING.—Sugaring during the last two seasons has yielded very good results, and the autumn of 1891 was a specially prolific time. With the exception of one evening at Radlett, and a few nights' work in the garden at home, the whole of my sugaring has been done at Bricket Wood, in company with Mr. Arthur Lewis, and we have nearly always kept to the same trees.

In 1891 the genus *Xanthia* was remarkably abundant at Bricket Wood, and I took every species of it there. *Fulvago* and *flavago* were, of course, the commonest; *fulvago* appears to come out a few days sooner than *flavago*, and to have more variety in its markings. Of *aurago* I only took one specimen during two years' work; of *citrago* one at sugar at Bricket Wood, and one at light at St. Albans; of *gilvago* one dark specimen at Bricket Wood, and two lighter ones on the street lamps in St. Albans; while *ferruginea* was fairly common. Among other autumn moths which came freely to sugar at Bricket Wood may be mentioned: *Phlogophora meticulosa*, *Anchocelis rufina*, *A. litura*, *A. pistacina*, *Asphalia diluta*, *Amphipyra pyramidea*, *Hadena protea*, *Agriopis aprilina*, *Scopelosoma satellitia*, *Orthosia lota*, *O. macilenta*, *Miselia oxyacanthæ*, and *Noctua C-nigrum*.

In 1892 we began sugaring on April 11th, but it was a bright moonlight night with a cold wind, and our venture proved a failure, only a few hybernated specimens being seen, and though we visited Bricket Wood several times, we did not do much good work until towards the end of the following month. On May 30th the first *Thyatira batis* appeared. This is a common insect at Bricket Wood, where I have seen nearly a score of specimens on one patch of sugar. Other moths taken on this date included *Cymatophora* or, *Rusina tenebrosa*, *Grammesia trigrammica*, *Odontopera bidentata*, *Boarmia consortaria*, *Xylophasia rurea*, *Numeria pulveraria*, *Noctua plecta*, and *Zanclognatha grisealis*. A very fresh specimen of *Notodonta camelina* was found at rest on an oak tree, and had evidently just emerged. During the course of the summer we took specimens of *Acronycta ligustri*, *Aplecta herbida*, *Leucania turca*, *Lithosia mesomella*, *Cleoceris viminalis*, *Dianthæcia cucubali*,

Eurymene dolobraria, and *Amphydasis betularia*, the latter at rest on a tree. Sugar at Radlett on June 8th, with a rather cold wind blowing, yielded *Thyatira batis*, *Mamestra anceps*, *Noctua festiva*, *Grammesia trigrammica* (including a good dark variety), *Acronycta psi*, *Agrotis corticea*, *Miana fasciuncula*, etc. *Thyatira derasa* came rather freely to sugar in the garden at The Hollies, and at Sparrowswick, St. Albans.

SALLOW-BEATING.—Sallow in 1892 was not very productive. Neither at Harpenden nor Bricket Wood did anything but the commonest species reward our exertions, though at the latter place we took larvæ of *Triphæna fimbria*, *Noctua brunnea*, etc., from which good specimens were bred. In past years *Teniocampa populeti*, *T. gracilis*, and *T. miniosa* have been taken at Bricket Wood.

LARVÆ-BEATING.—Larvæ-beating, by which is meant shaking the caterpillars off the trees and bushes into an umbrella or on to a newspaper spread on the ground, has in past years yielded Mr. Arthur Lewis, at Bricket Wood, such insects as the canary-shouldered thorn (*Eugonia alniaria*) and the sprawler (*Asteroscopus sphinx*), and he and I working together last year found the larvæ of the purple hairstreak butterfly (*Thecla quercus*) fairly abundant on the young oaks. The imago of this insect can be taken in most of our woodlands almost every season.

CONCLUSION.—In conclusion, permit me to sincerely thank my correspondents, who at very short notice have furnished me with the data to compile my first annual entomological report. My requests for information have been most readily responded to, and I trust that in the present year I may be favoured with notes from many observers. I shall be most happy to receive intimations of the occurrence of rare insects, or any facts about butterflies and moths that may be of interest. I shall also be glad to receive from persons who pretend to no entomological knowledge, any butterflies, moths, caterpillars, or pupæ which may strike them as being uncommon. Schoolboys who form collections of insects are often able to secure day-flying species, which those of us who work at night have very little chance of obtaining, and I shall be glad to inspect the collections of such beginners, and to help them when necessary to name their specimens.

XIX.

CLIMATOLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE
IN THE YEAR 1892.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 18th April, 1893.

OBSERVATIONS were continued during the year 1892 at the five stations for which the reports for the five previous years have been drawn up, and therefore I give the usual series of tables.

The mean temperature of Hertfordshire in 1892, deduced from observations at these five stations, was 0°·5 below that of the five previous years, and 1°·8 below the mean of 1882–86. The year was therefore a decidedly cold one. The mean daily range was 0°·8 more than in 1887–91, and 0°·1 more than in 1882–86. The extreme range was less than in 1890, and greater than in 1891. The air was a little less humid than in the five previous years, the amount of cloud was rather less, and the rainfall rather greater, but on a smaller number of days. The weather was very cold from the early part of spring late into autumn, and, while dry in spring, wet and humid in the latter part of summer and in autumn.

The observations are made at 9 a.m. at all the stations, and are entered to the day of observation, except the maximum temperature and the rainfall, which are entered to the previous day.

ROYSTON.

(London Road.)

Latitude: 52° 2' 34" N. Longitude: 0° 1' 8" W. Altitude:
301 feet.

Observer: *Hale Wortham, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·6	29·4	39·8	10·4	17·2	52·8	90	6·4	·86	12
Feb.	38·1	32·4	43·9	11·5	12·2	54·5	88	6·8	1·92	18
March	37·0	29·6	44·3	14·7	19·7	60·8	88	6·5	·99	8
April.....	46·8	34·4	59·3	24·9	24·6	74·0	76	4·0	·78	12
May	54·8	43·8	65·8	22·0	28·6	81·9	76	5·3	1·28	14
June.....	59·0	47·2	70·8	23·6	31·8	86·0	76	5·5	2·46	14
July	59·7	50·5	68·8	18·3	44·3	83·4	81	6·9	3·60	9
August....	62·0	51·7	72·3	20·6	42·9	82·0	79	6·5	3·18	14
Sept.	56·2	47·1	65·4	18·3	35·7	71·2	81	6·0	2·81	10
Oct.	45·6	38·8	52·3	13·5	25·4	59·6	88	6·1	3·84	23
Nov.	43·6	38·7	48·5	9·8	29·9	57·1	92	6·8	1·53	15
Dec.	34·7	29·4	40·1	10·7	17·1	53·0	90	6·2	1·66	12
Year	47·7	39·4	55·9	16·5	12·2	86·0	84	6·1	24·91	161

BERKHAMSTED.

(Rose Bank.)

Latitude: 51° 45' 40" N. Longitude: 0° 33' 30" W. Altitude: 400 feet.

Observer: *Edward Mawley, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·5	29·3	39·6	10·3	13·8	52·1	93	7·0	1·07	17
Feb.	37·6	32·3	42·9	10·6	13·8	52·0	89	7·7	1·56	19
March	36·5	29·3	43·7	14·4	20·0	58·7	82	7·1	1·26	10
April	45·7	33·8	57·7	23·9	25·9	70·0	67	4·7	·90	9
May	53·4	43·2	63·6	20·4	26·2	79·9	66	6·3	1·21	13
June	56·3	45·9	66·6	20·7	33·1	79·6	72	6·2	2·93	14
July	58·2	49·7	66·8	17·1	41·6	79·1	74	7·8	2·97	11
August	60·0	50·6	69·3	18·7	38·6	80·6	75	6·9	4·10	16
Sept.....	54·7	46·3	63·1	16·8	31·1	69·0	82	7·0	2·57	14
Oct.	45·1	38·2	52·0	13·8	26·1	59·7	90	7·3	3·88	23
Nov.	43·3	37·7	49·0	11·3	27·0	59·5	96	9·0	2·04	17
Dec.	35·2	29·8	40·5	10·7	13·8	52·6	93	7·8	1·44	13
Year	46·7	38·8	54·6	15·8	13·8	80·6	82	7·1	25·93	176

ST. ALBANS.

(The Grange.)

Latitude: 51° 45' 9" N. Longitude: 0° 20' 7" W. Altitude: 380 feet.

Observer: *John Hopkinson, F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	35·1	29·6	40·6	10·9	16·3	51·1	90	6·0	·99	18
Feb.	38·0	32·9	43·1	10·2	16·8	52·0	89	7·2	1·52	18
March	36·7	30·0	43·4	13·4	20·6	57·9	83	6·1	1·36	13
April	46·0	35·6	56·5	20·9	27·2	70·3	68	3·7	·87	10
May	53·3	44·0	62·5	18·5	29·1	79·5	67	5·8	1·34	11
June.....	56·5	47·3	65·6	18·3	35·2	79·8	73	5·7	2·54	14
July	58·3	50·3	66·4	16·1	43·9	78·6	74	6·8	2·31	10
August....	60·4	51·8	69·0	17·2	42·8	78·9	76	6·1	3·70	15
Sept.....	55·2	48·1	62·3	14·2	36·6	68·7	82	6·9	3·43	14
Oct.	44·5	38·5	50·6	12·1	26·5	58·6	88	6·6	4·23	24
Nov.	43·4	38·6	48·3	9·7	26·4	58·3	94	7·6	2·05	18
Dec.	35·3	30·2	40·4	10·2	16·1	52·4	90	5·9	1·50	14
Year	46·9	39·7	54·0	14·3	16·1	79·8	81	6·2	25·84	179

BENNINGTON.

(Bennington Lodge.)

Latitude: 51° 53' 45" N. Longitude: 0° 5' 20" W. Altitude: 407 feet.

Observer: *Rev. J. D. Parker, LL.D., F.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·6	29·9	39·2	9·3	16·1	52·1	89	7·2	·70	13
Feb.	37·1	32·3	42·0	9·7	15·2	53·4	90	7·9	1·63	21
March	36·4	29·5	43·3	13·8	18·9	58·8	82	7·5	1·22	14
April	46·0	35·1	56·9	21·8	26·2	70·5	67	5·1	·86	11
May	53·6	43·7	63·4	19·7	29·0	79·6	67	6·8	1·61	13
June	56·3	46·5	66·1	19·6	35·2	79·7	70	6·4	2·98	16
July	57·7	49·4	66·1	16·7	43·8	78·5	73	7·6	3·09	10
August	60·4	51·2	69·5	18·3	42·0	79·8	75	6·1	3·61	13
Sept.	55·0	46·9	63·2	16·3	36·2	69·0	79	7·1	2·41	13
Oct.	44·7	38·4	50·9	12·5	29·3	50·9	89	7·7	3·87	23
Nov.	42·8	37·8	47·9	10·1	27·0	47·9	95	8·8	1·64	18
Dec.	35·1	30·2	39·9	9·7	19·2	39·9	90	6·4	1·42	13
Year	46·6	39·2	54·0	14·8	15·2	79·8	81	7·1	25·04	178

NEW BARNET.

(Gas Works.)

Latitude: 51° 39' 5" N. Longitude: 0° 10' 15" W. Altitude: 212 feet.

Observer: *T. H. Martin, C.E.*

Months	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·9	29·0	40·9	11·9	15·0	53·0	90	6·0	·69	14
Feb.	38·1	32·0	44·3	12·3	13·0	53·2	91	7·3	1·41	17
March	36·3	27·7	44·8	17·1	15·0	60·5	87	6·2	1·14	9
April	45·4	31·8	59·0	27·2	23·0	73·9	70	4·2	·80	9
May	53·3	40·5	66·1	25·6	21·0	83·0	78	5·7	1·37	7
June	56·7	45·0	68·4	23·4	31·0	84·0	77	6·0	3·06	11
July	58·9	48·4	69·5	21·0	40·0	81·5	78	6·2	1·85	7
August	60·7	48·6	72·4	23·8	33·5	81·5	71	5·5	3·01	12
Sept.	54·9	43·5	66·3	22·8	25·8	73·7	84	5·8	2·81	10
Oct.	44·4	35·6	53·1	17·5	22·5	60·1	83	6·2	3·66	19
Nov.	43·3	36·9	49·8	12·9	24·0	59·2	90	7·0	2·11	11
Dec.	34·8	28·4	41·2	12·8	11·0	54·5	90	5·8	1·49	8
Year	46·8	37·3	56·3	19·0	11·0	84·0	82	6·0	23·40	134

HERTFORDSHIRE.

Means of Climatological Observations (with extremes of temperature) in 1892, at Royston, Berkhamsted, St. Albans, Bennington, and New Barnet.

Months	Temperature of the Air						Humidity	Cloud, 1-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·7	29·4	40·0	10·6	13·8	53·0	90	6·5	·86	15
Feb.	37·8	32·4	43·2	10·8	12·2	54·5	89	7·4	1·61	19
March	36·6	29·2	43·9	14·7	15·0	60·8	84	6·7	1·19	11
April	46·0	34·1	57·9	23·8	23·0	74·0	70	4·3	·84	10
May	53·7	43·1	64·3	21·2	21·0	83·0	71	6·0	1·36	12
June	57·0	46·4	67·5	21·1	31·0	86·0	74	6·0	2·79	14
July	58·6	49·7	67·5	17·8	40·0	83·4	76	7·1	2·77	9
August	60·7	50·8	70·5	19·7	33·5	82·0	75	6·2	3·52	14
Sept.	55·2	46·4	64·1	17·7	25·8	73·7	82	6·6	2·81	12
Oct.	44·9	37·9	51·8	13·9	22·5	60·1	88	6·8	3·90	22
Nov.	43·3	37·9	48·7	10·8	24·0	59·5	93	7·8	1·87	16
Dec.	35·0	29·6	40·4	10·8	11·0	54·5	91	6·4	1·50	12
Year	47·0	38·9	55·0	16·1	11·0	86·0	82	6·5	25·02	166

RESULTS OF CLIMATOLOGICAL OBSERVATIONS, 1887-91.

Stations.	Temperature of the Air						Humidity	Cloud, 0-10	Rain	
	Means				Extremes				Am't	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Royston	48·2	40·3	56·1	15·8	4·3	89·4	84	6·3	21·70	162
Berkhamsted	47·1	39·7	54·5	14·8	11·1	85·0	83	7·3	25·60	183
St. Albans	47·5	40·5	54·5	14·0	11·8	86·0	84	7·0	26·40	186
Bennington	47·2	40·1	54·2	14·1	14·4	85·1	82	7·5	24·52	195
New Barnet	47·3	38·4	56·2	17·8	7·5	88·5	84	6·3	23·87	145
County	47·5	39·8	55·1	15·3	4·3	89·4	83	6·9	24·42	174

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1892.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 18th April, 1893.

THERE are several alterations in the staff of our rainfall observers in the year 1892, but the number of records entered in our principal table is the same as in the previous year, namely 36. The number of daily records received and utilised in drawing up this report is 27, an increase of two upon that for the previous year.

Five stations disappear from this table, Mr. Francis Ransom having moved his gauge during the year from Bedford Road to Baneroft, Hitchin; the Rev. W. Quennell having left Tring, and the rainfall not being taken by the present vicar; the records from Aldenham House, Elstree, and Brocket Hall, Hatfield, being imperfect; and no reply to my applications having been received from the observer at Bushey Heath. On the other hand five stations are added, records having been received from Odsey; The Maples, Hitchin; Elm House, Tring; Kytes, Watford; and Marden Hill, Hertford. Odsey is one of our former stations, now reinstated owing to Mr. H. George Fordham's return to England. His gauge is actually in Cambridgeshire, but it is close to the Hertfordshire border, on the narrow neck of land which runs into our county, so that its record is more representative of the rainfall of the north of Herts than it is of that of the south of Cambs.

These alterations increase the number of stations in the river-district of the Rhee from one to two, and in that of the Mimram from two to three, remove from our table the river-district of the Upper Colne, and reduce the number of stations in that of the Upper Lea from four to three. An observer is much wanted in the neighbourhood of North Mimms or elsewhere in the district of the Upper Colne,* and also in that of the Stort.

Particulars of the 36 rainfall stations, and the monthly and total rainfall and number of days on which at least 0·01 inch of rain fell, are given in Tables I and II, pp. 205–207.

A supplementary table (Table III, p. 204) gives seven other records of the total rainfall in the year. One of these is the composite record of Mr. Ransom, two are the records of additional gauges at Rothamsted, and three are taken from 'British Rainfall, 1892.' The remaining record is that referred to in the note below.

The mean rainfall in the county in the year 1892 was 24·74 inches. This is exactly two inches below the mean for the decade 1880–89, and 1·69 inch below that for the half-century 1840–89.† While the year was therefore a rather dry one on the average

* While this paper has been passing through the press, Mr. Arthur Smith, of Smallford, St. Albans, has consented to join the staff of our rainfall observers, and has also obtained for me a record of the rainfall taken in 1892 at Brookmans Park, Hatfield. Both these localities are in the Upper Colne district.

† See 'Trans. Herts. Nat. Hist. Soc.,' Vol. VI, p. 84.

throughout Hertfordshire, the defect from the mean was greatest in the west of the county (Colne), and there was a slight excess in the north-east (Cam); the defect in the south (Thames) was much greater than in the north (Ouse).

TABLE III.—SUPPLEMENTARY TO TABLES I AND II.

District.	Station.	Observer.	Gauge.		Rain-fall.	Days.
			Dia-meter.	Height above Sea.		
3.	Hitchin	F. Ransom	5	212	23·84	216
4.	Tring—Pendley Manor....	J. G. Williams....	5	500?	24·87	200
8.	Harpenden—Rothamsted	Lawes and Gilbert	8	420	23·79	175
”	”	”	72×87	420	25·29	179
9.	Hatfield—Br’kmans Park	A. Gorrie		400?	24·75	
12.	Welwyn—Danesbury	A. M. Blake.....	5	405	23·70	154
18.	Hoddesdon—Feilde’s Weir	Major L. Flower	8	90?	22·00	

Distribution of Rainfall throughout the Year.—Of the total rainfall 16 % fell during the winter months (Jan., Feb., and Dec.), 14 % during the spring (March to May), 36 % during the summer (June to Aug.), and 34 % during the autumn (Sept. to Nov.). The fall during each quarter and each season, and the deviation from the mean for the half-century 1840–89, was as follows:—

	Fall.	Diff.		Fall.	Diff.
1st quarter.....	3·69 ins.	—1·94 in.	Winter	4·01 ins.	—1·99 in.
2nd ,,	4·98	—1·03	Spring	3·48	—2·04
3rd ,,	8·77	+1·46	Summer.....	8·85	+1·87
4th ,,	7·30	—0·18	Autumn	8·40	+0·47

January and April were very dry; August and October were very wet. The difference in each month from the mean for the half-century was:—

	in.		in.		in.		in.
Jan.	—1·43	April.....	—0·70	July	+0·18	Oct.	+0·92
Feb.	—0·12	May	—0·70	Aug.	+1·07	Nov.	—0·66
Mar.	—0·39	June.....	+0·62	Sept.	+0·21	Dec.	—0·44

Thus the fall was below the mean for the period in each of the first five months, above the mean in each of the next five months, and below the mean in the last two months; and about three inches below the mean during the first half of the year, and an inch and a half above it during the second half.

The absolute maximum fall in any one day in each month, and the station recording it was:—

	ins.		ins.
Jan. 11—Cowroast	0·60	July 16—Hamels Park	2·08
Feb. 15—Throcking Rectory..	0·62	Aug. 27—New Barnet	1·84*
Mar. 15—Cowroast	0·56	Sept. 29—Moor Park	1·62
April 27—Throcking Rectory..	0·45	Oct. 30—Bayfordbury, Hertfd	1·29
May 26—Apsley Mills	1·17	Nov. 15—New Barnet	·71
June 28—High Down, Hitchin	1·27	Dec. 1—Moor Park	·59

* 1·83 at Oaklands, Watford, and at Southgate, on the same day.

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1892.

District.	STATION.	OBSERVER.	Diameter of Gauge.	Height of Gauge above		
				Ground.	Sea-level.	
1.	*Royston	Hale Wortham	ins. 8	ft. 0	ins. 6	269 $\overline{\uparrow}$
„	Odsey	H. George Fordham	5	1	0	260 $\overline{\uparrow}$
3.	*Hitchin—The Firs	William Lucas	5	2	1	238 $\overline{\uparrow}$
„	„ The Maples	William Hill.....	8	1	1	220 $\overline{\uparrow}$
„	* „ High Down	Joseph Pollard	5	1	1	422 $\overline{\uparrow}$
4.	Tring—Elm House	E. J. Le Quesne	12	1	2	460
6.	*Cowroast	Hubert Thomas	5	4	2	345 $\overline{\uparrow}$
„	*Berkhamsted—Rosebank ..	Edward Mawley	8	1	0	401 $\overline{\uparrow}$
„	* „ Fairhill	W. Bonner Hopkins ..	5	1	0	550 $\overline{\uparrow}$
7.	*Great Gaddesden Vicarage...	Rev. W. T. Drake ..	8	1	0	427 $\overline{\uparrow}$
„	*H. Hempstead—Apsley Mills	J. Dickinson & Co. ...	24	0	9	260
„	* „ Nash Mills..	„	12	3	9	237 $\overline{\uparrow}$
8.	*Kensworth—The Grove ...	Miss S. Grace Jones	5	1	0	630 $\overline{\uparrow}$
„	Harpenden—Rothamsted ..	Lawes and Gilbert ...	5	0	9	420 $\overline{\uparrow}$
„	St. Albans—Gorhambury ...	The Earl of Verulam...	6 sqr.	3	6	425 $\overline{\uparrow}$
„	* „ The Grange ...	John Hopkinson	5	1	0	380 $\overline{\uparrow}$
10.	Watford—Kytes	Mrs. Horsman	5	1	0	239 $\overline{\uparrow}$
„	* „ Oaklands	Edward Harrison	5	5	6	273 $\overline{\uparrow}$
„	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340 $\overline{\uparrow}$
12.	*Welwyn Rectory	Rev. Canon Wingfield	5	0	4	228 $\overline{\uparrow}$
„	*Datchworth Rectory	Rev. J. Wardale ...	5	1	0	386 $\overline{\uparrow}$
„	Hertford—Marden Hill.....	R. H. Hoare	5	0	6	257 $\overline{\uparrow}$
13.	*Stevenage—Weston Park ...	M. R. Pryor	5	0	8	470 $\overline{\uparrow}$
„	*Bennington House	Rev. Dr. Parker	5	1	0	408 $\overline{\uparrow}$
14.	*Therfield Rectory	Rev. J. G. Hale	5	4	3	500
„	*Throcking Rectory ..	Rev. C. W. Harvey ...	5	1	0	484 $\overline{\uparrow}$
„	*Buntingford—Hamels Park	E. Wallis	5	1	0	400 $\overline{\uparrow}$
15.	*Much Hadham	T. Woodham Mott ...	5	1	0	222 $\overline{\uparrow}$
17.	Hertford—Bayfordbury.....	W. Clinton Baker ..	8	1	4	250
„	*Ware—Red House	Joseph Francis	12	3	0	114 $\overline{\uparrow}$
„	* „ Fanhams Hall.....	Miss Joyce Croft	8	1	0	253 $\overline{\uparrow}$
18.	*Broxbourne—Stafford House	G. J. Newbery	5	1	0	118 $\overline{\uparrow}$
„	*Cheshunt—Old Nurseries ...	Paul and Son	5	1	0	92 $\overline{\uparrow}$
„	„ College... ..	Rev. Dr. Reynolds ...	5	1	0	94
„	*New Barnet—Gas Works ...	T. H. Martin	8	0	9	212
„	*Southgate—The Lawns.....	George A. Church ...	5	0	6	240 $\overline{\uparrow}$

* Daily fall received for these stations. † For explanation of these symbols see p. 53.

TABLE II.—RAINFALL IN

RIVER DISTRICT.		STATION.	JAN.	FEB.	MAR.	
OUSE	CAM	1. Rhee {	Royston.....	·86	1·92	·99
			Odsey.....	·93	1·85	·88
	IVEL	3. Hiz {	Hitchin—The Firs	·84	1·47	1·03
			„ The Maples	·87	1·54	1·08
			„ High Down.....	·93	1·47	1·05
	THAME	4. Up.Thame	Tring—Elm House	1·28	1·68	1·11
		6. Bulbourne {	Cowroast	1·14	1·36	1·16
			Berkhamsted—Rosebank	1·07	1·56	1·26
			„ Fairhill	1·09	1·57	1·25
	COLNE	7. Gade {	Great Gaddesden Vicarage	·96	1·56	1·28
			Hemel Hempsted—Apsley Mills.....	·97	1·29	1·26
		„ Nash Mills	·77	1·08	1·24	
8. Ver {		Kensworth—The Grove	1·09	1·23	1·20	
			Harpenden—Rothamsted	·85	1·30	1·05
		St. Albans—Gorhambury	·89	1·61	1·34	
	„ The Grange.....	·99	1·52	1·36		
TILAMES	10. Lo. Colne {	Watford—Kytes	·77	1·26	1·29	
			„ Oaklands.....	·93	1·46	1·43
			Rickmansworth—Moor Park	·91	1·54	1·44
	12. Mimram {	Welwyn Rectory	1·08	1·39	1·22	
			Datchworth Rectory	·66	1·18	·96
			Hertford—Marden Hill	·75	1·79	1·39
	13. Beane {	Stevenage—Weston Park	1·30	1·60	1·64	
			Bennington House	·70	1·63	1·22
	14. Rib {	Therfield Rectory.....	1·14	2·16	1·21	
			Throcking Rectory	·89	2·12	·99
		Buntingford—Hamels Park	·64	1·83	1·43	
15. Ash	Much Hadham	·70	2·33	1·40		
17. Upper Lea {	Hertford—Bayfordbury	·71	1·62	1·30		
		Ware—Red House	·78	1·51	1·11	
		„ Fanhams Hall	·76	1·86	1·14	
18. Lower Lea {	Broxbourne—Stafford House	·73	1·77	1·35		
		Cheshunt—Old Nurseries	·62	1·48	1·27	
		„ College	·54	1·69	1·32	
		New Barnet—Gas Works	·69	1·41	1·14	
		Southgate—The Lawns	·79	1·56	1·24	
Mean for the County			·88	1·59	1·22	

HERTFORDSHIRE IN 1892.

APL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.	DAYS.
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
·78	1·28	2·46	3·60	3·18	2·81	3·84	1·53	1·66	24·91	161
·93	1·59	3·00	3·30	3·11	2·46	3·29	1·36	1·44	24·14	173
·91	1·66	2·81	2·74	2·51	2·83	3·31	1·49	1·39	22·99	164
·94	1·66	2·87	2·81	2·46	2·68	3·39	1·49	1·43	23·22	149
·69	1·49	3·23	3·09	2·60	2·93	3·46	1·51	1·48	23·93	160
·86	1·14	1·85	3·46	3·33	2·38	3·49	1·95	1·18	23·71	168
·80	1·18	2·15	3·16	3·31	2·69	3·60	2·03	1·60	24·18	
·90	1·21	2·93	2·97	4·10	2·57	3·88	2·04	1·44	25·93	176
·74	1·11	2·68	2·76	4·19	2·69	3·99	2·14	1·52	25·73	168
·77	1·23	2·68	2·75	4·07	2·55	3·51	1·99	1·48	24·83	159
·82	1·72	2·53	2·91	3·88	2·71	4·00	2·00	1·60	25·69	176
·78	1·50	2·60	2·54	3·92	2·91	4·22	2·11	1·60	25·27	164
·77	1·09	2·75	3·31	4·27	2·37	3·58	1·51	1·63	24·80	148
·73	1·32	2·49	2·90	3·62	2·37	3·87	2·00	1·59	24·09	166
·68	1·82	2·02	2·43	4·60	2·55	3·83	2·01	1·41	25·19	
·87	1·34	2·54	2·31	3·70	3·43	4·23	2·05	1·50	25·84	179
·78	1·21	2·99	1·88	3·69	2·76	3·97	1·84	1·47	23·91	156
·92	1·48	2·60	2·31	4·43	2·71	4·37	2·17	1·71	26·52	179
·99	1·40	2·53	2·49	4·49	3·17	4·82	2·55	2·10	28·43	167
·92	1·10	2·46	3·11	3·28	2·80	4·18	1·71	1·68	24·93	171
·64	1·19	2·09	2·43	3·34	2·28	3·52	1·62	1·50	21·41	164
·70	1·44	2·69	3·02	4·13	2·72	4·02	1·71	1·35	25·71	157
·87	1·94	2·80	2·81	3·07	2·85	3·41	1·71	1·35	25·35	
·86	1·61	2·98	3·09	3·61	2·41	3·87	1·64	1·42	25·04	178
1·03	1·49	3·12	3·65	3·31	3·03	4·20	1·79	1·90	28·03	173
·90	1·44	2·84	2·94	3·25	2·81	3·97	1·74	1·73	25·62	171
·88	1·37	2·73	4·02	3·40	2·62	3·90	1·75	1·73	26·30	139
·99	1·63	3·01	2·29	2·81	2·21	4·20	2·06	1·97	25·60	152
·83	1·22	2·77	2·59	3·09	2·43	4·05	1·89	1·43	23·93	168
·66	2·00	2·68	1·90	3·00	1·90	3·90	1·95	1·44	22·83	148
·67	1·31	2·95	1·55	2·99	1·85	3·89	2·00	1·33	22·30	156
·80	1·56	3·15	2·03	3·22	2·44	4·09	2·12	1·57	24·83	187
·82	1·44	2·89	1·92	3·34	2·63	3·98	2·14	1·50	24·03	149
·81	1·41	2·96	1·94	2·76	2·57	3·69	2·17	1·41	23·27	128
·80	1·37	3·07	1·85	3·00	2·81	3·66	2·11	1·49	23·40	134
1·00	1·47	3·16	1·80	3·10	3·01	3·83	2·44	1·32	24·72	186
·83	1·43	2·72	2·68	3·45	2·64	3·86	1·90	1·54	24·74	164

The wettest day in each month at 35 stations was:—

January 1st at 1 station; 4th at 1; 7th at 3; 8th at 2; 10th at 2; 11th at 2; 14th at 1; 22nd at 14; 26th at 1; 27th at 1; 30th at 4; 6th and 22nd equal at 1; 7th and 22nd equal at 1; 1st, 8th, 10th, and 30th equal at 1.

February 14th at 3; 15th at 6; 16th at 2; 20th at 21; 21st at 1; 28th at 1; 15th and 20th equal at 1.

March 1st at 1; 15th at 30; 26th at 3; 15th and 26th equal at 1.

April 27th at all stations.

May 25th at 31; 26th at 3; 25th and 26th equal at 1.

June 22nd at 2; 23rd at 4; 28th at 29.

July 5th at 2; 16th at 13; 19th at 19; 16 and 19th equal at 1.

August 18th at 6; 27th at 29.

September 21st at 8; 29th at 26; 21st and 29th equal at 1.

October 27th at 10; 30th at 25.

November 15th at 33; 16th at 2.

December 1st at all stations.

The day in each month on which a heavy fall of rain was most general over the county was therefore:—

Jan. 22nd	April 27th	July 19th	Oct 30th
Feb. 20th	May 25th	Aug. 27th	Nov. 15th
March 15th	June 28th	Sept. 29th	Dec. 1st

The number of wet days in the year (average of 33 gauges) was 164, being 4 below the mean for the twenty years 1870–89. Of the total number there were 43 (or 26 %) in the winter months, 32 (or 20 %) in the spring, 38 (or 23 %) in the summer, and 51 (or 31 %) in the autumn.

The number of wet days in each month, and the deviation from the mean for the 20 years 1870–89, was as follows:—

Jan. 14 —1	April 9 —4	July 10 —4	Oct. 22 +7
Feb. 18 +4	May 12 —1	Aug. 14 +1	Nov. 16 =
March 11 —2	June 14 +1	Sept. 13 =	Dec. 11 —5

Distribution of Rainfall throughout the County.—The next table (Table IV, p. 209) gives the mean fall for each month and for the year in each of the five river-districts represented, and in the two main hydrographical divisions of the county, the catchment-basins of the Great Ouse and the Thames, and also the difference in the year from the mean for the decade 1880-89.

The mean rainfall in each of the minor river-basins or sub-districts represented, was as follows:—

		ins.		ins.	
CAM	Rhee	24·53	LEA..... {	Minram	24·02
IVEL.....	Hiz	23·38		Beane	25·20
THAME....	Upper Thame.....	23·71		Rib	26·65
COLNE	Bulbourne	25·83		Ash	25·60
	Gade	25·26		Upper Lea.....	23·02
	Ver	24·91		Lower Lea.....	23·87
	Lower Colne	26·29			

The total yearly fall ranged from 21·41 ins. at Datchworth to 28·43 ins. at Moor Park, Rickmansworth; and the total monthly fall from 0·64 in. at Datchworth in April to 4·82 ins. at Moor Park in October. The greatest fall in any one day was 2·08 ins. at Hamels Park, Buntingford, on the 16th of July.

TABLE IV.—RAINFALL IN THE RIVER DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	·90	·88	1·28	·96	·79	·89	·88
Feb.	1·88	1·49	1·68	1·41	1·70	1·65	1·58
March	·94	1·05	1·11	1·27	1·26	1·01	1·26
April	·85	·85	·86	·82	·83	·85	·82
May	1·44	1·60	1·14	1·35	1·47	1·53	1·41
June	2·73	2·97	1·85	2·58	2·84	2·87	2·70
July	3·45	2·88	3·46	2·67	2·53	3·11	2·62
August	3·14	2·53	3·33	4·02	3·22	2·77	3·56
Sept.	2·64	2·81	2·38	2·73	2·55	2·74	2·62
October	3·56	3·39	3·49	3·99	3·90	3·46	3·93
Nov.	1·45	1·50	1·95	2·03	1·92	1·48	1·96
Dec.	1·55	1·43	1·18	1·59	1·54	1·48	1·55
Year	24·53	23·38	23·71	25·42	24·55	23·84	24·89
Diff. from 1880-89	+1·02	-1·88		-4·39	-1·82	-0·84	-2·26

Distribution of Rainfall in each Month.—The nomenclature used in the following account of the chief falls of rain is the same as in my previous reports, falls of at least $\frac{1}{2}$ inch being styled *considerable*, $\frac{3}{4}$ inch *very considerable*, 1 inch *great*, $1\frac{1}{4}$ inch *very great*, $1\frac{1}{2}$ inch *heavy*, $1\frac{3}{4}$ inch *very heavy*, and of 2 inches and upwards *excessive*. This analysis only applies to the 27 stations from which I have returns of the daily rainfall.

JANUARY.—Rainfall very small, equally distributed over the month, but for the first three weeks nearly all in the form of snow. On 11th only was a *considerable* fall recorded, and then at only one station.

FEBRUARY.—Rainfall a little below the average, distributed over the month, but the heaviest falls, all in the form of snow, occurring in the week ending 20th, and amounting to about half the total fall in the month. On 15th and 20th only were there *considerable* falls recorded, and on each occasion at only one station.

MARCH.—While the rainfall was only a little less than in February, it did not occur on nearly so many days, so that March appeared to be a rather dry month. About one-third of the amount gauged fell as snow. On 15th only was there a *considerable* fall, recorded only at four stations.

APRIL.—A dry month. No rain (or snow) fell until the 12th, from 27th March, an absolute drought of 15 days' duration. Snow, the last of the winter, then fell daily for a few days, and rain only at intervals afterwards. No *considerable* fall was recorded.

MAY.—A rather dry month, with very little rain until 25th. On that and the following day there were thunderstorms with heavy rain amounting to about half the total fall in the month. On 25th the fall was *considerable* at seven stations, and on 26th *great* at Apsley Mills (1·17 in.), and *considerable* at two stations.

JUNE.—A rather wet month, with several heavy falls of rain during the last nine days. On 22nd the fall was *very considerable* at one station and *considerable* at one; and on 23rd *very considerable* at one and *considerable* at thirteen stations. On 28th it was *very great* at High Down, Hitchin (1·27 in.), *great* at New Barnet (1·20 in.), Rosebank, Berkhamsted (1·18 in.), Fairhill, Berkhamsted (1·15 in.), Fanhams Hall, Ware (1·12 in.), and Southgate (1·08 in.), *very considerable* at six stations, and *considerable* at ten. This fall was due to a thunderstorm in the night of 28th–29th, when extraordinary and very destructive hailstones fell in the north-west of Hertfordshire. Accounts of the storm, as experienced at Berkhamsted and Kensworth, are appended to this report. Several observers record frost on the 18th, which did much damage to vegetation.

JULY.—While the rainfall was rather heavy, July was not a wet month throughout, for on the average over the county rain only fell on two days before the 12th and on one day after the 19th, but between the 12th and the 19th (eight days) about two inches fell. For the eleven days after this date no rain was recorded at any station. On 5th the fall was *very considerable* at two stations and *considerable* at thirteen; on 13th it was *considerable* at one station; on 16th it was *excessive* at Hamels Park (2·08 ins.), *heavy* at Royston (1·58 in.), *very great* at Therfield (1·28 in.), *very considerable* at eight stations, and *considerable* at six; on 17th it was *considerable* at one station; and on 19th *very considerable* at thirteen stations, and *considerable* at thirteen. The fall on the 16th was due to a thunderstorm, during which there fell, at Rosebank, Berkhamsted, 0·41 in. of rain in 9 minutes, being at the rate of 2·73 ins. per hour.

AUGUST.—An excessively wet month, but with several intervals of a few days each without rain, not quite half the days in the month being wet. On 18th the fall was *very great* at Bennington (1·49 in.), Throcking (1·41 in.), and Weston Park (1·32 in.); *great* at Hamels Park (1·22 in.), Datchworth (1·11 in.), Royston (1·09 in.), Moor Park (1·07 in.), Welwyn (1·05 in.), Oaklands, Watford (1·04 in.), and The Grange, St. Albans (1·00 in.); *very considerable* at seven stations; and *considerable* at one station. On 19th it was *considerable* at one station, and on 23rd at one. On 27th it was *very heavy* at New Barnet (1·84 in.), Oaklands, Watford (1·83 in.), Southgate (1·83 in.), and Broxbourne (1·75 in.); *heavy* at Nash Mills (1·71 in.), The Grange, St. Albans (1·55 in.), and Apsley Mills (1·50 in.); *very great* at Cowroast (1·40 in.), Welwyn (1·40 in.), Fanhams Hall, Ware (1·40 in.), Fairhill, Berkhamsted (1·39 in.), Datchworth (1·39 in.), Rosebank, Berkhamsted (1·37 in.), Red House, Ware (1·35 in.), Bennington (1·33 in.), Hamels Park (1·33 in.), Great Gaddesden (1·31 in.), and Kensworth (1·29 in.); *great* at Much Hadham (1·23 in.), Moor Park (1·21 in.), the Old Nurseries, Cheshunt (1·20 in.), Royston (1·12 in.), Therfield (1·09 in.), and Throcking (1·03 in.); and *very considerable* at three stations. On 28th there was a *very considerable* fall at one station. The fall on the 18th was due to a thunderstorm.

SEPTEMBER.—A very similar month to July, with a rather heavy rainfall but not wet throughout, in fact very little rain fell before the 19th. On that day the fall was *considerable* at one station; and on the 20th also at one. On 21st it was *great* at High Down, Hitchin (1·20 in.), The Firs, Hitchin (1·13 in.), and Royston (1·07 in.); *very considerable* at six stations; and *considerable* at seventeen. On 29th it was *heavy* at Moor Park (1·62 in.); *very great* at New Barnet (1·37 in.), and Southgate (1·26 in.); *great* at Oaklands, Watford (1·20 in.), the Old Nurseries, Cheshunt (1·12 in.), Cowroast (1·07 in.), Broxbourne (1·02 in.), and The Grange, St. Albans (1·00 in.); *very considerable* at fourteen stations; and *considerable* at five. The fall entered to the 19th was due to a thunderstorm on the morning of the 20th, commencing, at St. Albans, at about 6 a.m., and culminating at 8, when the thunder appeared to be almost simultaneous with the lightning.

OCTOBER.—Excessively wet, with a greater rainfall even than August, and, unlike that month, with but few days without rain. At most stations rain fell every day for the ten days 12th to 21st, and for the last seven days, this period being by far the wettest, having, in fact, an average month's rainfall. On 27th the fall was *great* at Moor Park (1·07 in.), Nash Mills (1·05 in.), and Fairhill, Berkhamsted (1·00 in.), *very considerable* at seven stations, and *considerable* at twelve; and on 28th it was *very considerable* at two stations, and *considerable* at nine. On 30th it was *very great* at Broxbourne (1·27 in.); *great* at the Old Nurseries, Cheshunt (1·24 in.), Much Hadham (1·16 in.), New Barnet (1·12 in.), Red House, Ware (1·10 in.), Southgate (1·10 in.), Royston (1·08 in.), Hamels Park (1·05 in.), Moor Park (1·03 in.), and Fanhams Hall (1·00 in.); *very considerable* at nine stations; and *considerable* at eight.

NOVEMBER.—Very wet during the first half of the month and very dry during the second half, the first sixteen days having four or five times as much rain as the last fourteen, this latter period determining the month to be rather dry on the whole. On 15th the fall was *considerable* at seven stations, and on 16th at one station.

DECEMBER.—Of the same character as November, but even more strongly marked, for at most stations all the rain in the month fell during the first sixteen days, partly as snow. After the 16th there was only a slight fall of snow at a few stations on 31st, there being thus a drought of fourteen days' duration at all stations, and an "absolute" drought (see p. 232) of fifteen days at nearly all, determining the month to be dry on the whole. On 1st only was a *considerable* fall recorded, and then at only three stations.

The Thunderstorm of 28th–29th June, 1892.—Of this remarkable storm, briefly referred to on p. 210, I have been favoured with interesting accounts by Mr. Edward Mawley, of Rosebank, Berkhamsted, and Miss Grace Jones, of The Grove, Kensworth.

The advantage of the possession of self-recording instruments is well shown by Mr. Mawley's account, which is as follows:—

“Throughout the whole of the evening and night preceding the 29th of June, the weather was extremely unsettled, there having been thunder at 6.45 p.m.; thunder and lightning at 7.50 p.m. (time-interval 18 seconds); a few drops of rain at 8.7 p.m.; thunder and lightning at 9 p.m.; a sharp shower at 10.45 p.m.; a very heavy shower shortly after midnight; and a singularly heavy downpour of rain between 1.24 and 1.32 a.m., followed by a fall of large hailstones lasting about three minutes. During the early part of the storm the flashes of lightning were unusually brilliant and continuous, and between 1.32 and 1.37 a.m. were quickly followed by loud peals of thunder. At 2.0 a.m. there occurred another heavy downpour of rain, when the time interval between the lightning and thunder was 7 secs. Three minutes later it amounted to 17 secs. Very heavy showers also took place at 3.30 and 4 a.m.

“The most noteworthy feature of this memorable night was, however, the severe thunderstorm which passed over here between 1.20 and 1.30 a.m. During these ten minutes all my self-recording instruments were more or less affected. The barograph curve shows a sudden rise and fall of about three-hundredths of an inch; the thermograph an equally sudden fall of several degrees of temperature. The anemograph curves were still more remarkable. The atmosphere, which during the previous hour had fallen to almost a dead calm, was all at once set moving at the rate of about ten miles an hour; while the wind-vane made a complete tour of the compass, starting at S.E. and veering rapidly through S., W., N., and E., and back to S.E., when the air again became calm. The self-recording rain-gauge had also an extremely busy time, over half an inch of rain being recorded by it during the eight minutes ending 1.32 a.m.

“Some of the hailstones which fell during this storm were spherical and about half an inch in diameter, while others were roughly triangular and about $\frac{3}{4}$ inch long by $\frac{3}{8}$ inch across. The rhubarb-leaves in my garden were completely riddled, and the foliage of roses, chrysanthemums, and other plants, was slit and otherwise much torn and bruised. One rose-bud had a gash in it $\frac{1}{4}$ inch deep. Neither of my own greenhouses was injured, but, at Frithsden Gardens, situated about a mile and a half to the north of Berkhamsted, the damage to the numerous greenhouses was very great, about every other pane of the 16 oz. glass being broken, and about one in every ten of the 21 oz. panes.”

At Kensworth the storm was even more severe than at Berkhamsted, the hailstones being much larger, and doing much more damage than at Frithsden. Miss Jones says:—

“Thunder, not very heavy, and very vivid lightning, had been almost continuous for several hours, when, at 1.40 a.m., hail suddenly commenced, lasting about nine minutes, during which time every pane of glass in greenhouses and skylights was smashed to atoms, tiles were cracked and split off, corn crops and fruit were severely damaged, and the ground was covered with leaves and twigs cut off from the trees, as it might be in October after a tremendous gale. Many of the hailstones weighed 2½ ounces. One, which I picked up immediately after the storm ceased, covered the palm of my hand, was half an inch thick, of solid ice, flat, oval in shape, and serrated all round; others were round and as large as tennis-balls, likewise with sharp edges. Not one person in this village can remember a similar fall of hail.

“I believe that we were almost in the centre of the storm, as little or no damage was done within half a mile on either side. It seems to have travelled in a straight line from Ashridge and Studham. It does not appear to have been felt at Whipsnade or Markyate Street, and it was but little felt at Dunstable. During the fall of hail, which alone was appalling, a peculiar sharp crackling sound was heard, as if we were surrounded by electricity, and there was a strong odour of sulphur. A walnut-tree within about 100 yards of my house was struck by the lightning.”

OBSERVATIONS OF TEMPERATURE AND RAINFALL TAKEN AT
THROCKING RECTORY, BUNTINGFORD, 1880-1889.

By the REV. C. WIGAN HARVEY, M.A.

Read at Watford, 18th April, 1893.

THIS paper is an attempt to place before those who take an interest in meteorological statistics, the results of observations taken daily at 9 a.m., at Throcking Rectory, near Buntingford, during the ten years 1880-89.

The altitude of the station is 483 feet above mean sea-level. The thermometers, a mercury maximum and spirit minimum, are by Negretti and Zambra, have been verified at Kew Observatory, and are enclosed in a Stevenson's screen with their bulbs 4 feet above the surface of the ground. The rain-gauge, which is of the Snowdon pattern, is of 5 inches diameter, the top being 12 inches above the surface of the ground. As the receiver is capable of containing 8 inches of rain, I have never had the mortification of recording an overflow.

The year 1884 showed the highest, and the year 1888 the lowest mean temperature, whilst the driest years were 1884 and 1887, and the wettest year was 1882. Although the actual rainfall in 1887 was slightly less than in 1884, the number of days on which rain fell in 1887 exceeded the number in 1884 by twelve.

THE YEAR. *Temperature.*—The mean for the 10 years was $47^{\circ}\cdot4$, the years 1880, 2, 3, and 4 being above, and the years 1881, 5, 6, 7, 8, and 9 being below that average. The highest mean temperature, $48^{\circ}\cdot8$, occurred in 1884, and the lowest, $46^{\circ}\cdot2$, in 1888. The absolute range of temperature was between $89^{\circ}\cdot6$ on July 15th, 1881, and $10^{\circ}\cdot7$ on January 22nd, 1881, so that practically the range for 1881 was the range for the whole decennial period. *Rainfall.*—The average annual fall was 24·52 inches, the years 1880, 1, 2, 3, 5, 6, and 9 having more, and the years 1884, 7, and 8 having less than that average. The greatest yearly fall was 27·92 inches in 1882, and the smallest was 18·26 inches in 1887; the fall in 1884 was 18·39 inches. The heaviest daily fall was 2·60 inches on July 12th, 1889, the result of a series of thunderstorms. The average number of days upon which rain fell was 167; this number was exceeded in 1881, 3, 5, and 8. The greatest number of days upon which rain fell was 193, in 1882, and the least number 138, in 1884.

WINTER (December, January, February). *Temperature.*—The mean temperature was $37^{\circ}\cdot3$, the winters of 1882, 3, 4, 5, and 7 being above, and the winters of 1880, 1, 6, 8, and 9 being below that average. The coldest winter was $34^{\circ}\cdot9$, in 1880-81, and the warmest, $39^{\circ}\cdot8$, in 1883-84. The absolute range of temperature was between $56^{\circ}\cdot6$ on January 10th, 1888, and $10^{\circ}\cdot7$ on January

22nd, 1881. *Rainfall*.—The average fall was 5·14 inches, the fall in 1881, 2, 3, 5, and 7 being greater, and the fall in 1880, 4, 6, 8, and 9 being less than that average; 7·11 inches fell in 1882, and only 2·86 inches in 1888. The average number of days upon which rain fell was 44, the years 1881, 2, 3, 4, 5, and 6 having more, and the years 1880, 7, 8, and 9 having less than this average. The greatest fall in any one day was 1·36 inch on December 17th, 1881, the only instance of a fall of at least an inch in the winter months.

SPRING (March, April, May). *Temperature*.—The mean temperature was $44^{\circ}9$; the springs of 1880, 1, 2, and 4 being above, and those of 1883, 5, 6, 7, and 8 being below that average, whilst that of 1889 was exactly the average. The warmest spring was $48^{\circ}1$, in 1882, and the coldest, $42^{\circ}2$, in 1887. The absolute range of temperature was between $79^{\circ}6$ on May 26th, 1880, and $17^{\circ}6$ on March 24th, 1883. *Rainfall*.—The average fall was 4·92 inches, which amount was exceeded in 1882, 5, 6, 8, and 9, the fall in 1880, 1, 3, 4, and 7 being less than the average; 7·61 inches fell in 1886, and only 2·29 inches in 1880. The average number of days on which rain fell was 38, the years 1886, 7, 8, and 9 having more than this average, and the years 1880, 1, 2, 3, 4, and 5 having less. The greatest fall in one day was 1·10 inch on May 24th, 1886, and May 11th, 1889.

SUMMER (June, July, August). *Temperature*.—The mean temperature was $59^{\circ}0$, the years 1882, 3, 4, and 7, being above, and the years 1880, 1, 5, 6, 8, and 9, being below this average. The warmest summer was $61^{\circ}8$, in 1887, and the coldest, $56^{\circ}9$, in 1888. The absolute range of temperature was between $89^{\circ}6$ on July 15th, 1881, and $34^{\circ}6$ on June 9th, 1881. *Rainfall*.—The average fall was 6·37 inches, the years 1880, 1, 3, 4, 8, and 9 having a fall above, and the years 1882, 5, 6, and 7, below that average; 8·57 inches fell in 1881, and only 2·48 inches in 1887. The average number of days upon which rain fell was 39, the years 1880, 1, 2, 8, and 9 having more, and the years 1883, 4, 5, 6, and 7 having less than this average. The greatest fall in any one day was 2·60 inches on July 12th, 1889.

AUTUMN (September, October, November). *Temperature*.—The mean temperature was $48^{\circ}3$, the years 1881, 3, 4, and 6 being above, and the years 1880, 2, 5, 7, 8, and 9 being below that average. The warmest autumn was $52^{\circ}3$, in 1883, and the coldest, $45^{\circ}4$, in 1887. The absolute range of temperature was between $84^{\circ}2$ on September 4th, 1880, and $20^{\circ}4$ on November 17th, 1887. *Rainfall*.—The average fall was 8·09 inches, the fall in 1880, 2, 3, and 5 being above, and in 1881, 4, 6, 8, and 9 below that average, whilst the fall of 1887 equalled the average; 11·88 inches fell in 1885, and only 4·19 inches in 1884. The average number of days on which rain fell was 46, the years 1881, 2, 3, 5, and 7 having more, and the years 1880, 4, 6, 8, and 9 having less than this average. The greatest fall in one day was 1·25 inch on September 10th, 1885.

TABLE I.—*Temperature and Rainfall in each Year, 1880-1889.*

YEAR.	TEMPERATURE.			RAINFALL.			
	Mean.	Highest.	Lowest.	Total.	Accumulation from 1880.	Greatest in 24 hours.	Days.
	°	°	°	in.	in.	in.	
1880	47·7	84·2	14·5	27·41	27·41	1·22	157
1881	46·6	89·6	10·7	27·32	54·73	1·36	186
1882	48·6	77·6	19·1	27·92	82·65	1·04	193
1883	48·5	80·0	17·6	25·95	108·60	1·20	169
1884	48·8	86·4	25·1	18·39	126·99	1·60	138
1885	46·6	84·3	20·3	26·22	153·21	1·25	169
1886	47·0	84·9	15·6	25·24	178·45	1·10	166
1887	47·2	85·7	17·3	18·26	196·71	0·79	150
1888	46·2	86·4	15·8	22·87	219·58	0·75	178
1889	46·8	81·3	15·2	25·57	245·15	2·60	165
1880-89	47·4	89·6	10·7	24·52	245·15	2·60	167

TABLE II.—*Mean and Extreme Temperature and Rainfall, 1880-1889.*

MONTH.	TEMPERATURE.			RAINFALL.			
	Mean.	Highest.	Lowest.	Average.	Since Jan. 1st.	Greatest in 24 hrs.	Days.
	°	°	°	in.	in.	in.	
January	36·1	56·6	10·7	1·38	1·38	0·70	13
February.....	38·8	56·4	15·8	1·75	3·13	0·64	14
March	39·3	66·2	17·6	1·39	4·52	0·63	11
April	44·5	72·1	23·1	1·70	6·22	1·04	15
May.....	51·0	79·6	28·7	1·83	8·05	1·10	12
June	56·5	83·7	34·6	1·65	9·70	0·99	11
July.....	61·0	89·6	40·6	2·83	12·53	2·60	15
August.....	59·6	86·4	40·9	1·89	14·42	0·94	13
September.	55·2	84·2	32·9	2·43	16·85	1·25	13
October... ..	46·7	76·9	27·3	2·99	19·84	1·16	16
November..	42·0	61·2	20·4	2·67	22·51	0·79	17
December..	37·5	54·9	19·1	2·01	24·52	1·36	17
The Year's Average.	47·4	89·6	10·7	24·52	24·52	2·60	167

JANUARY. *Temperature.*—Mean, $36^{\circ}1$. Above in 1882, 3, 4, 6, and 8; below in 1880, 1, 5, 7, and 9. Warmest, $42^{\circ}8$ in 1886; coldest, $28^{\circ}6$ in 1881. Range between $56^{\circ}6$ on January 10th, 1888, and $10^{\circ}7$ on January 22nd, 1881. *Rainfall.*—Average, 1.38 inch. Above in 1881, 3, 4, 5, and 6; below in 1880, 2, 7, 8, and 9. Greatest monthly fall, 2.49 inches in 1886; smallest, 0.26 inch in 1880. Greatest daily fall, 0.70 inch on January 18th, 1881. Average number of days on which rain fell, 13; above in 1883, 4, 5, and 6; below in 1880, 1, 2, 7, 8, and 9.

FEBRUARY. *Temperature.*—Mean, 38.8 . Above in 1880, 2, 3, 4, 5, and 7, below in 1881, 6, 8, and 9. Warmest, $48^{\circ}2$ in 1887; coldest, $33^{\circ}4$ in 1888. Range between $56^{\circ}4$ on February 12th, 1885, and $15^{\circ}8$ on February 25th, 1888. *Rainfall.*—Average, 1.75 inch. Above in 1880, 1, 2, 3, 5, and 9; below in 1884, 6, 7, and 8. Greatest monthly fall, 3.55 inches in 1883; smallest, 0.24 inch in 1886. Greatest daily fall, 0.64 inch on February 14th, 1882, and February 10th, 1883. Average number of days on which rain fell, 14. Above in 1880, 1, 3, and 5; below in 1882, 4, 6, 7, and 9; equal to average in 1888.

MARCH. *Temperature.*—Mean, $39^{\circ}3$. Above in 1880, 1, 2, 4, and 5; below in 1883, 6, 7, 8, and 9. Warmest, $45^{\circ}3$ in 1882; coldest, $34^{\circ}3$ in 1883. Range between $66^{\circ}2$ on March 16th, 1884, and $17^{\circ}6$ on March 24th, 1883. *Rainfall.*—Average, 1.39 inch. Above in 1881, 6, 8, and 9; below in 1880, 2, 3, 4, 5, and 7. Greatest monthly fall, 3.26 inches in 1888; smallest, 0.64 inch in 1883. Greatest daily fall, 0.63 inch on March 11th, 1888. Average number of days on which rain fell, 11. Above in 1886, 8, and 9; below in 1880, 3, 4, and 5; equal to average in 1881, 2, and 7.

APRIL. *Temperature.*—Mean, $44^{\circ}5$. Above in 1880, 2, 3, 5, and 6; below in 1881, 4, 7, 8, and 9. Warmest, $46^{\circ}8$ in 1882; coldest, $42^{\circ}4$ in 1888. Range between $72^{\circ}1$ on April 20th, 1885, and $23^{\circ}1$ on April 4th, 1881. *Rainfall.*—Average, 1.70 inch. Above in 1880, 2, 3, 5, and 9; below in 1881, 4, 6, 7, and 8. Greatest monthly fall, 3.16 inches in 1882; smallest, 0.81 inch in 1881. Greatest daily fall, 1.04 inch on April 25th, 1882. Average number of days on which rain fell, 15. Above in 1880, 2, 4, 5, 8, and 9; below in 1881, 3, 6, and 7.

MAY. *Temperature.*—Mean, $51^{\circ}0$. Above in 1881, 2, 4, and 9; below in 1880, 3, 5, 7, and 8; equal to average in 1886. Warmest, $54^{\circ}6$ in 1889; coldest, $47^{\circ}7$ in 1885 and 7. Range between $79^{\circ}6$ on May 26th, 1880, and $28^{\circ}7$ on May 4th, 1883. *Rainfall.*—Average, 1.83 inch. Above in 1885, 6, 7, and 9; below in 1880, 1, 2, 3, 4, and 8. Greatest monthly fall, 4.63 inches in 1886; smallest, 0.39 inch in 1884. Greatest daily fall, 1.10 inch on May 24th, 1886, and May 11th, 1889. Average number of days on which rain fell, 12. Above in 1885, 6, 7, and 9; below in 1880, 2, 3, 4, and 8; equal to average in 1881.

JUNE. *Temperature.*—Mean, $56^{\circ}5$. Above in 1882, 3, 5, 7,

and 9; below in 1880, 1, 4, 6, and 8. Warmest, $58^{\circ}\cdot 8$ in 1887; coldest, $51^{\circ}\cdot 1$ in 1886. Range between $83^{\circ}\cdot 7$ on June 15th, 1887, and $34^{\circ}\cdot 6$ on June 9th, 1881. *Rainfall*.—Average, 1·65 inch. Above in 1880, 1, 2, 3, 5, 8, and 9; below in 1884, 6, and 7. Greatest monthly fall, 2·36 inches in 1882; smallest, 0·41 inch in 1886. Greatest daily fall, 0·99 inch on June 7th, 1889. Average number of days on which rain fell, 11. Above in 1880, 1, 2, and 8; below in 1883, 4, 6, 7, and 9; equal to average in 1885.

JULY. *Temperature*.—Mean, $61^{\circ}\cdot 0$. Above in 1881, 2, 3, 6, and 7; below in 1880, 8, and 9; equal to average in 1884 and 5. Warmest, $63^{\circ}\cdot 9$ in 1887; coldest, $56^{\circ}\cdot 7$ in 1888. Range between $89^{\circ}\cdot 6$ on July 15th, 1881, and $40^{\circ}\cdot 6$ on July 11th, 1888. *Rainfall*.—Average, 2·83 inches. Above in 1880, 3, 4, 8, and 9; below in 1881, 2, 5, 6, and 7. Greatest monthly fall, 5·23 inches in 1880; smallest, 0·38 inch in 1885. Greatest daily fall, 2·60 inches on July 12th, 1889. Average number of days on which rain fell, 15. Above in 1880, 2, 8, and 9; below in 1881, 4, 5, 6, and 7; equal to average in 1883.

AUGUST. *Temperature*.—Mean, $59^{\circ}\cdot 6$. Above in 1880, 3, 4, 6, and 7; below in 1881, 2, 5, 8, and 9. Warmest, $63^{\circ}\cdot 1$ in 1884; coldest, $56^{\circ}\cdot 9$ in 1881. Range between $87^{\circ}\cdot 7$ on August 11th, 1884, and $40^{\circ}\cdot 9$ on August 16th, 1888. *Rainfall*.—Average, 1·89 inch. Above in 1881, 4, and 8; below in 1880, 2, 3, 5, 6, 7, and 9. Greatest monthly fall, 4·85 inches in 1881; smallest, 0·85 inch in 1887. Greatest daily fall, 0·94 inch on August 9th, 1884. Average number of days on which rain fell, 13. Above in 1881, 8, and 9; below in 1880, 3, 4, 5, 6, and 7; equal to average in 1882.

SEPTEMBER. *Temperature*.—Mean, $55^{\circ}\cdot 2$. Above in 1880, 3, and 4; below in 1881, 2, 5, 6, 7, 8, and 9. Warmest, $58^{\circ}\cdot 8$ in 1880; coldest, $52^{\circ}\cdot 9$ in 1887. Range between $84^{\circ}\cdot 2$ on September 4th, 1880, and $32^{\circ}\cdot 9$ on September 26th, 1885. *Rainfall*.—Average, 2·43 inches. Above in 1880, 3, 5, and 7; below in 1881, 2, 4, 6, 8, and 9. Greatest monthly fall, 4·04 inches in 1883; smallest, 1·18 inch in 1886. Greatest daily fall, 1·25 inch on September 10th, 1885. Average number of days on which rain fell, 13. Above in 1881, 3, 5, and 7; below in 1880, 2, 4, 6, and 9; equal to average in 1888.

OCTOBER. *Temperature*.—Mean, $46^{\circ}\cdot 7$. Above in 1882, 3, 4, 6, and 9; below in 1880, 1, 5, 7, and 8. Warmest, $50^{\circ}\cdot 5$ in 1883; coldest, $43^{\circ}\cdot 7$ in 1881. Range between $76^{\circ}\cdot 9$ on October 4th, 1886, and $27^{\circ}\cdot 3$ on October 31st, 1881. *Rainfall*.—Average, 2·99 inches. Above in 1880, 2, 5, 6, and 9; below in 1881, 3, 4, 7, and 8. Greatest monthly fall, 5·49 inches in 1882; smallest, 0·81 inch in 1888. Greatest daily fall, 1·16 inch on October 6th, 1880. Average number of days on which rain fell, 16. Above in 1880, 1, 2, 5, 6, and 9; below in 1883, 4, 7, and 8.

NOVEMBER. *Temperature*.—Mean, $42^{\circ}\cdot 0$. Above in 1881, 6, 8, and 9; below in 1880, 2, 3, 4, 5, and 7. Warmest, $46^{\circ}\cdot 7$ in

1881; coldest, $38^{\circ}9$ in 1887. Range between $61^{\circ}2$ on November 5th, 1881, and $20^{\circ}4$ on November 17th, 1887. *Rainfall*.—Average, 2.67 inches. Above in 1882, 3, 5, 6, 7, and 8; below in 1880, 1, 4, and 9. Greatest monthly fall, 4.03 inches in 1888; smallest, 0.97 inch in 1889. Greatest daily fall, 0.79 inch on November 3rd, 1887. Average number of days on which rain fell, 17. Above in 1881, 2, 3, 7, and 8; below in 1880, 4, 5, 6, and 9.

DECEMBER. *Temperature*.—Mean, $37^{\circ}5$. Above in 1880, 2, 3, 4, and 8; below in 1881, 5, 6, 7, and 9. Warmest, $40^{\circ}3$ in 1888; coldest, $34^{\circ}7$ in 1886. Range between $54^{\circ}9$ on December 4th, 1888, and $19^{\circ}1$ on December 11th, 1882. *Rainfall*.—Average, 2.01 inches. Above in 1880, 1, 2, 4, and 6; below in 1883, 5, 7, 8, and 9. Greatest monthly fall, 4.01 inches in 1881; smallest, 1.01 inch in 1883. Greatest daily fall, 1.36 inch on December 17th, 1881. Average number of days on which rain fell, 17. Above in 1880, 1, 2, 4, and 7; below in 1883, 5, 6, and 8; equal to average in 1889.

EXTREMES. *Temperature*.—The maximum temperature has exceeded 80° on forty-nine occasions, of which 8 occurred in June; 22 in July; 15 in August; and 4 in September. The earliest was on June 2nd, and the latest on September 17th. The minimum temperature has indicated at least 20° of frost on five occasions, all of which occurred in January, 1881; *i.e.* January 22nd, $10^{\circ}7$; 24th, $11^{\circ}2$; 25th, $11^{\circ}7$; 26th, $11^{\circ}5$; 27th, $11^{\circ}9$. *Rainfall*.—The total fall in any one day has exceeded an inch upon thirteen occasions; 1 in April; 3 in May; 3 in July; 3 in September; and 3 in October. On one of these occasions only (July 12th, 1889) did the fall exceed 2 inches.

THE CLIMATE OF WATFORD,
DEDUCED FROM METEOROLOGICAL OBSERVATIONS TAKEN
DURING THE TEN YEARS 1877-1886.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 18th April, 1893.

FROM meteorological observations extending over a period of ten years it should be possible to arrive at some idea of the climate of Watford. For all elements of climate but the rainfall it is not likely that the mean annual value deduced from any ten years' observations will differ greatly from the mean for a much longer period, nor that the extremes will be greatly exceeded. Taking, for example, the temperature, which is the most important element of climate, the mean annual temperature deduced from observations extending over any ten years probably will not differ more than half a degree from the average for half a century, or even a century. At the Royal Observatory, Greenwich, during the half-century 1841-90, there appears to have been only one decennial period when this difference was exceeded, and then but slightly. The mean annual temperature at Greenwich in our decade 1877-86 was $0^{\circ}\cdot3$ below the half-century's average, the mean for this decade being $49^{\circ}\cdot16$, and for the half-century $49^{\circ}\cdot46$.* At Watford in this decade it was $48^{\circ}\cdot3$ (or more precisely $48^{\circ}\cdot33$), and therefore the true value for the half-century would probably be about $48^{\circ}\cdot6$, or a little less than a degree lower than the Greenwich mean temperature for the same period.

Again, it is a well-founded assumption that the mean of the extremes in a long series of years gives a fairly accurate idea of the mean temperature of a place. If I had left undisturbed the minimum and maximum thermometers from the beginning of 1877 to the end of 1886, from a single reading of these thermometers the mean temperature of Watford would have been inferred to be $49^{\circ}\cdot0$, which is a little more than half a degree above its true value for the period. On the above assumption, if $48^{\circ}\cdot3$ were the true mean for a long period, a lower minimum temperature than any I have recorded would be more likely to occur, or to have occurred, during such period, than a higher maximum. This inference also follows if we assume that the mean temperature at Watford during the half-century 1841-90 was $48^{\circ}\cdot6$; and if during that period the maximum attained during 1877-86 has not been exceeded, the minimum is not likely to have fallen more than a degree lower than the minimum I have actually recorded.

After temperature the most important element of climate is rainfall, but the mean rainfall of any place cannot be directly ascertained, with any probability of accuracy, from observations extending over a shorter period of time than 40 or 50 years. It

* See 'Quart. Journ. R. Met. Soc.,' vol. xvii, p. 236, and vol. xviii, p. 239.

can be calculated approximately, however, from the observed value for such a period as ten years, if we know the mean rainfall over the surrounding district, or even the mean at a single not far-distant station, by comparing the mean for the shorter period with that for the longer one, for we may reasonably infer that the relation subsisting in (say) ten years between the rainfall at two or more adjacent stations, will be approximately maintained for forty or fifty years, should no physical change affecting climate, such as alteration of level or clearing of forests, have taken place.

After temperature and rainfall, the sequence of phenomena in relative importance, as indicating the nature of the climate of any place, is probably humidity, cloud, and wind. Atmospheric pressure can scarcely be considered an element of climate, but in determining the character of other meteorological phenomena it is of paramount importance, and it will therefore be discussed first. For a similar reason—the cause preceding the effect—humidity, cloud, and wind will be discussed before rainfall.

But before proceeding to the consideration of the general results arrived at from the observation of these phenomena, it is necessary to give some information as to the localities where the observations have been made, the instruments used, and the method of observation and reduction.

The observations were commenced at Holly Bank, Watford, on the 1st of March, 1876. At the end of September in the following year I removed to Wansford House, Watford, where they were carried on from that time until the end of the year 1886, when I removed to St. Albans. Observations have thus been taken at Wansford House for nine years and three months. Ten years is, however, a period to be preferred to nine, for, besides having the advantage of being of longer duration, it is much more convenient to work with, and moreover it is the usual period, between that for one year and for a quarter of a century, for which results of meteorological observations are published. As the localities are only about half a mile apart, the observations of as many months at one of them as of years at the other, cannot, I think, insomuch as the slight difference between the two situations is concerned, materially affect the general results of the observations at Wansford House. I have, therefore, included the records of observations for nine months at Holly Bank with those for nine years and three months at Wansford House. A description of each locality having already appeared in the annual reports of my observations contributed to the Society, with full particulars of the instruments used, etc., it will suffice to give here only a brief summary of information most of which may be found in greater detail in previous volumes of our Transactions.* At first my observatory was a "Second-order" Station of the Royal Meteorological Society (obs. taken at 9 a.m. and 9 p.m.), but for the greater portion of the time it was a Climatological Station (obs. taken at 9 a.m. only).

* 'Trans. Watford Nat. Hist. Soc.,' Vol. I, pp. 217-219; *ib.*, Vol. II, pp. 209-211; and 'Trans. Herts Nat. Hist. Soc.,' Vol. III, pp. 181, 182.

SITUATION OF STATIONS.

Holly Bank.—Latitude, $51^{\circ} 40' 5''$ N.; longitude, $0^{\circ} 24' 10''$ W. (of Greenwich). Centre of Watford about a mile S.S.E. Ground-level at thermometer-screen and rain-gauge 268 feet, and cistern of barometer 272 feet, above Ordnance Datum (mean sea-level). Ground in the immediate neighbourhood nearly level, then rising very slightly towards N., and falling slightly towards E. and S.E. to the River Colne, distant about a mile.

Wansford House.—Latitude, $51^{\circ} 35' 45''$ N.; longitude, $0^{\circ} 23' 40''$ W. Centre of Watford about half a mile S. Ground-level at thermometer-screen and rain-gauge 223 feet, and cistern of barometer 234 feet, above Ordnance Datum. Ground immediately around slightly inclined towards E., then rising slightly towards N.W., and falling rather more considerably towards E. and S.E. to the River Colne, distant about half a mile.

The subsoil is gravel on chalk, the plane of saturation in which, except where lowered by pumping, rises at a very slight gradient from the river, the surface of which is, at Watford, 180 feet above mean sea-level. To pen back the water for the Watford Mill, the banks of the river have been raised; being thus rendered very sluggish, it has gradually silted up its bed; and, just above Watford, its surface is now at least a foot above the alluvial plain through which it flows, which is consequently often flooded after heavy rain. The town of Watford is now extending over this low-lying land, which it would seem to be impossible effectually to drain. All other parts of Watford and the country around it have a very dry subsoil, the effects of heavy rain soon disappearing.

INSTRUMENTS, AND METHOD OF OBSERVATION AND REDUCTION.

Barometer, a Fortin standard with tube half an inch in internal diameter. 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, top of rim 1 foot above the ground (grass), capacity of receiver 8 inches depth of rain. Wind-vane (at Wansford House only), about 25 feet above the ground, and 105 feet distant from nearest object of equal height.

Observations taken at 9 a.m.* Readings of minimum thermometer entered to day of observation, of maximum thermometer and rain-gauge to previous day. Readings corrected for index-errors of instruments, and barometric readings corrected to 32° in accordance with the temperature shown by attached thermometer, and reduced to sea-level. No corrections made for diurnal range of pressure or temperature, the mean temperature adopted being the arithmetical mean of the minimum and maximum readings.

Reductions made in part from Guyot's 'Tables, Meteorological and Physical' (3rd Ed.), and in part from tables in the Royal Meteorological Society's 'Instructions for the Observation of Meteorological Phenomena,' by W. Mariott (2nd Ed.).

* The observations taken at first at 9 p.m. also, are not here utilised.

GENERAL RESULTS AND INFERENCES.

As all the more important elements of the climate of Watford are given in a tabular form, it is only necessary to state here some of the general results which may be arrived at from an examination of the tables, and inferences which may be drawn from their study, it being understood that the tables give the information, these remarks being merely a running commentary upon them. Occasionally a fact may be stated which is neither shown in the tables nor can be deduced from them. Except for rainfall, the values given are considered as approximately-correct elements of the climate of Watford, and are therefore usually expressed in the present tense.

In the division of the year into seasons, the months of March, April, and May are considered as Spring; June, July, and August as Summer; Sept., Oct., and Nov. as Autumn; and Dec., Jan., and Feb. as Winter.

Pressure of the Atmosphere (Tables I–III, p. 223).—The mean pressure was practically the same during each half of the period, being a little over 29·952 ins. in the first five years, and a little under this in the second five years, but the difference was less than 0·001 in. The year of lowest pressure was not the wettest, nor was the year of highest pressure the driest in the series.

Pressure was alternately above and below the mean in each two successive years. Commencing below the mean, it was below for six years and above for four. The average annual deviation from the mean was between 0·022 and 0·023 in. While the lowest and the highest mean annual pressures deviated almost equally from the mean for the whole period, the lowest pressure recorded deviated 41 per cent. more from the mean than did the highest pressure, and the mean of the lowest pressures 28 per cent. more than the mean of the highest pressures.

The extreme range of pressure was 2·596 ins., being from 28·384 ins. on 9th December, 1886, to 30·980 ins. on 1st March, 1882.

On the average pressure is low in spring and autumn, about the mean for the year in summer, and high in winter; low in November and high in January. The season with the lowest mean pressure was the winter of 1878–79, and that with the highest, the winter of 1881–82; the month with the lowest mean pressure was February, 1879, and that with the highest, January, 1880.

Temperature of the Air (Tables IV–VI, p. 225).—The second half of the period was appreciably warmer than the first half, the mean temperature during the first five years being 47°·78, or 0°·55 below the mean for the period (48°·33), and during the second five years, 48°·88, or 0°·55 above the mean, the difference therefore being 1°·1. This is entirely owing to the low temperature of the coldest year, 1879 (45°·4), and the high temperature of the warmest year, 1884 (50°·1). While the extreme annual range was thus 4°·7, no other years differ from each other in their mean temperature more than one degree,

TABLE I.—*Mean and Extreme Pressure in each Year, at 9 a.m.*

Year.	Mean.	Absolute Min.		Absolute Max.		Range.
	Ins.	Ins.	Date.	Ins.	Date.	Ins.
1877	29·906	28·635	Jan. 2	30·623	Jan. 21	1·988
78	29·934	29·005	Oct. 26	30·654	Mar. 16	1·649
79	29·960	28·949	April 7	30·819	Dec. 23	1·870
80	30·004	28·860	Nov. 16	30·694	Jan. 7	1·834
81	29·959	28·932	Dec. 20	30·658	May 8	1·726
82	29·932	28·959	Mar. 1	30·980	Jan. 18	2·021
83	29·961	28·968	Feb. 2	30·860	Feb. 23	1·892
84	29·995	28·656	Dec. 20	30·668	Oct. 5	2·012
85	29·940	28·957	Jan. 11	30·611	Dec. 23	1·654
86	29·931	28·384	Dec. 9	30·745	Feb. 8	2·361
Mean	29·952	28·830		30·731		1·901

TABLE II.—*Seasonal Pressure at 9 a.m.*

Season.	Mean.	Min. seasonal pressure.		Max. seasonal pressure.		Range.
	Ins.	Ins.	Year.	Ins.	Year.	Ins.
Spring	29·939	29·813	1877	30·040	1880	0·227
Summer	29·951	29·831	79	30·070	85	0·239
Autumn	29·937	29·845	78	30·126	79	0·281
Winter.....	29·984	29·772	78-79	30·195	81-82	0·423

TABLE III.—*Monthly and Annual Pressure at 9 a.m.*

Month.	Mean.	Min. monthly pressure.		Max. monthly pressure.		Range.
	Ins.	Ins.	Year.	Ins.	Year.	Ins.
January	30·029	29·678	1886	30·406	1880	0·728
February.....	29·959	29·545	79	30·304	78	0·759
March	29·976	29·757	77	30·126	80	0·369
April	29·876	29·715	79	30·024	83	0·309
May.....	29·965	29·792	78	30·102	80	0·310
June.....	29·969	29·824	79	30·051	84	0·127
July.....	29·952	29·802	79	30·188	85	0·386
August	29·931	29·747	78	30·034	83	0·287
September	29·971	29·839	83	30·055	86	0·216
October	29·928	29·770	78	30·147	79	0·377
November	29·912	29·663	77	30·233	79	0·570
December	29·966	29·651	82	30·324	79	0·673
Year	29·952	29·545	1879	30·406	1880	0·861

and the average annual deviation from the mean is $0^{\circ}\cdot75$, the temperature being below the mean for four years and above it for six years.

The coldest year (1879) was the wettest, had the smallest mean daily range of temperature, more than the average amount of cloud, the smallest number of days of clear sky, and the largest number of days of overcast sky; the warmest year (1884) was the driest, had the largest mean daily range of temperature, less than the average amount of cloud, nearly the largest number of days of clear sky, and the smallest number of days of overcast sky.

The extreme range of temperature was $85^{\circ}\cdot3$, the absolute minimum being $6^{\circ}\cdot4$ on 21st January, 1881, and the absolute maximum $91^{\circ}\cdot7$ on 5th July, 1881, the range thus being the same for this year as for the whole period.

The mean daily range of temperature, $14^{\circ}\cdot4$, varied from $13^{\circ}\cdot1$ in 1879 to $15^{\circ}\cdot2$ in 1884.

Autumn is warmer than spring, by $2^{\circ}\cdot6$, chiefly owing to the colder nights in spring. On the other hand the excess of the temperature of summer over that of winter, $21^{\circ}\cdot9$, is more due to the warm days in summer than to the cold nights in winter. Spring is $8^{\circ}\cdot2$ warmer than winter, and summer $13^{\circ}\cdot7$ warmer than spring; autumn is $11^{\circ}\cdot1$ colder than summer, and winter $10^{\circ}\cdot8$ colder than autumn. Thus winter passes slowly into spring, and spring quickly into summer, while summer passes into autumn, and autumn into winter, at a nearly equal rate.

The mean daily range of temperature is greatest in summer and least in winter, and greater in spring than in autumn; but the absolute range has been greatest in autumn and least in winter, and greater in spring than in summer. Although the nights are as a rule colder in spring than in autumn, a colder night has occurred in autumn than in spring. In winter the nights are not so much colder than in spring as are the days; in summer they are not so much warmer than in autumn as are the days.

January is on the average the coldest month, and July the warmest, though only $0^{\circ}\cdot1$ warmer than August. The temperature increases from January to July, and decreases from July to January as follows:—

Increase.			Decrease.		
Jan.	to Feb.	$3^{\circ}\cdot2$	July	to August	$0^{\circ}\cdot1$
Feb.	to March	$1^{\circ}\cdot4$	August	to Sept.	$4^{\circ}\cdot4$
March	to April	$4^{\circ}\cdot5$	Sept.	to Oct.	$8^{\circ}\cdot1$
April	to May	$5^{\circ}\cdot7$	Oct.	to Nov.	$6^{\circ}\cdot2$
May	to June	$6^{\circ}\cdot6$	Nov.	to Dec.	$4^{\circ}\cdot6$
June	to July	$2^{\circ}\cdot7$	Dec.	to Jan.	$0^{\circ}\cdot7$

Assuming that the mean temperature of each month occurs about the middle of the month, it would appear that the increase of temperature is most rapid during the month of May, or from the middle of April to the middle of June; and that the decrease is most rapid during the month of October, or from the middle of September to the middle of November.

TABLE IV.—*Mean and Extreme Temperature in each Year.*

Year.	Mean.	Means of		Mean daily Range.	Absolute Min. and Max.				Absolute Range.
		Min.	Max.		Min.	Day.	Max.	Day.	
1877	48·2	41·0	55·4	14·4	20·6	Mar. 1	80·9	July 31	60·3
78	48·5	41·5	55·5	14·0	8·8	Dec. 25	84·6	June 26	75·8
79	45·4	38·8	51·9	13·1	7·8	Dec. 7	76·9	July 29	69·1
80	48·8	41·6	56·0	14·4	11·2	Jan. 21	86·2	Sept. 4	75·0
81	48·0	40·7	55·3	14·6	6·4	Jan. 21	91·7	July 5	85·3
82	49·0	41·9	56·1	14·2	15·2	Dec. 11	77·9	Aug. 12	62·7
83	48·8	41·6	56·0	14·4	20·5	Mar. 24	81·5	June 29	61·0
84	50·1	42·5	57·7	15·2	23·7	Apl. 23	90·0	Aug. 11	66·3
85	48·0	40·6	55·3	14·7	22·1	Jan. 22	87·5	July 25	65·4
86	48·5	41·2	55·9	14·7	13·7	Jan. 8	87·2	Ang. 31	73·5
Mean	48·3	41·1	55·5	14·4	15·0		84·4		69·4

TABLE V.—*Mean and Extreme Seasonal Temperature.*

Season.	Mean.	Means of		Mean daily Range.	Absolute Min. and Max.				Absolute Range.
		Min.	Max.		Min.	Year.	Max.	Year.	
Spring	46·3	38·1	54·5	16·4	19·8	1886	81·0	1884	61·2
Summer	60·0	51·4	68·6	17·2	35·3	80	91·7	81	56·4
Autumn	48·9	42·0	55·9	13·9	17·9	79	86·2	80	68·3
Winter	38·1	33·1	43·1	10·0	6·4	81	59·1	82	52·7

TABLE VI.—*Mean and Extreme Monthly and Annual Temperature.*

Month.	Mean.	Means of		Mean daily Range.	Absolute Min. and Max.				Absolute Range.
		Min.	Max.		Min.	Year.	Max.	Year.	
Jan.	36·8	32·1	41·5	9·4	6·4	1881	55·5	1877	49·1
Feb.	40·0	34·9	45·2	10·3	18·4	86	58·8	78	40·4
March	41·4	34·0	48·8	14·8	19·8	86	67·8	84	48·0
April	45·9	37·7	54·1	16·4	23·7	84	71·9	85	48·2
May	51·6	42·5	60·6	18·1	28·0	86	81·0	84	53·0
June	58·2	49·1	67·2	18·1	35·3	80	84·6	78	49·3
July	60·9	52·3	69·5	17·2	39·2	81	91·7	81	51·5
Aug.	60·8	52·7	69·0	16·3	37·0	77	90·0	84	53·0
Sept.	56·4	48·2	64·5	16·3	30·8	85	86·2	80	55·4
Oct.	48·3	41·6	55·1	13·5	23·0	77	77·4	86	54·4
Nov.	42·1	36·1	48·1	12·0	17·9	79	62·1	81	44·2
Dec.	37·5	32·4	42·5	10·1	7·8	79	59·1	82	51·3
Year	48·3	41·1	55·5	14·4	6·4	1881	91·7	1881	85·3

In March the nights are colder than in February, and in July colder than in August.

The mean daily range of temperature is least in December and January, and greatest in May and June. The increase and decrease is as follows:—

Jan. to Feb.	+0.9	July to August	—0.9
Feb. to March	+4.5	August to Sept.	0.0
March to April	+1.6	Sept. to Oct.	—2.8
April to May	+1.7	Oct. to Nov.	—1.5
May to June	0.0	Nov. to Dec.	—1.9
June to July	—0.9	Dec. to Jan.	—0.7

Thus the mean daily range increases in the early part of the year (Jan. to May) twice as rapidly as it decreases in the rest of the year (May to Jan.). The greatest increase (Feb. to March) is mostly due to the cold nights of March.

Temperatures below freezing-point have occurred in every month but the three months of summer—June, July, and August; only once, however, in September. The average number of frosty nights has been as follows* :—

Jan. 15	April 4	July 0	Oct. 3
Feb. 10	May 2	August 0	Nov. 8
March 12	June 0	Sept. 0	Dec. 13

The minimum temperature of the year has occurred four times in January, three times in December, twice in March, and once in April; the maximum temperature has occurred four times in July, three times in August, twice in June, and once in September.

Temperature, Humidity, and Cloud at 9 a.m. (Tables VII–IX, p. 227).—The temperature of the air in these tables is that shown by the dry-bulb thermometer, the temperature of evaporation that shown by the wet-bulb. From these values the temperature of the dew-point, or that at which dew would be deposited, is calculated. The thermometric dryness is the difference between the temperature of the air and that of the dew-point; the relative humidity is the percentage of moisture in the air to its complete saturation, represented as 100.

The mean temperature at 9 a.m. is on the average 0°·1 higher than the mean of the minimum and maximum temperatures; in no year has the difference exceeded 0°·4.

From November to March the temperature at 9 a.m. is lower than the mean of the minimum and maximum; from April to August it is higher; and in September and October it is about the same as this mean. The mean of the 9 a.m., the minimum, and the maximum temperatures, probably gives a truer mean for the day than does the mean of the minimum and

* This of course does not include ground-frosts. The number of nights when the temperature of the surface of the ground, or of other objects cooled by radiation to a temperature below that of the air, has been below freezing, would be considerably greater. Ground-frosts have occurred in June, and frequently in September.

TABLE VII.—*Temperature, Humidity, and Cloud, in each Year, at 9 a.m.*

Year.	Temperature of			Dry-ness.	Rela-tive Humi-dity.	Short of Satu-ration.	Cloud, 0-10	Days of	
	Air.	Evap-ora-tion.	Dew-point.					Clear Sky.	Over-cast.
1877	° 48·6	° 46·0	° 43·1	° 5·5	% 82	% 18	6·4	40	132
78	48·8	42·6	43·3	5·5	82	18	6·8	53	145
79	45·7	43·5	41·0	4·7	84	16	7·2	37	176
80	48·7	46·3	43·7	5·0	83	17	7·0	51	151
81	48·2	45·3	42·1	6·1	80	20	6·1	65	146
82	49·0	46·6	44·0	5·0	84	16	6·8	50	152
83	48·7	46·0	43·0	5·7	81	19	6·8	56	140
84	50·3	47·4	44·3	6·0	80	20	6·5	62	124
85	48·0	45·2	42·1	5·9	81	19	6·6	64	152
86	48·3	45·8	43·1	5·2	83	17	7·1	49	169
Mean	48·4	45·8	43·0	5·4	82	18	6·7	53	149

TABLE VIII.—*Seasonal Temperature, Humidity, and Cloud, at 9 a.m.*

Season.	Temperature of			Dry-ness.	Rela-tive Humi-dity.	Short of Satu-ration.	Cloud, 0-10	Days of	
	Air.	Evap-ora-tion.	Dew-point.					Clear Sky.	Over-cast.
Spring	° 46·7	° 43·4	° 39·7	° 7·0	% 77	% 23	6·4	15	32
Summer ..	60·8	56·5	52·7	8·1	75	25	6·6	12	30
Autumn	48·8	46·9	44·9	3·9	86	14	6·5	15	38
Winter	37·5	36·3	34·7	2·8	90	10	7·5	11	49

TABLE IX.—*Monthly and Annual Temperature, Humidity, and Cloud, at 9 a.m.*

Month.	Temperature of			Dry-ness.	Rela-tive Humi-dity.	Short of Satu-ration.	Cloud, 0-10	Days of	
	Air.	Evap-ora-tion.	Dew-point.					Clear Sky.	Over-cast.
Jan.	° 36·2	° 35·1	° 33·4	° 2·8	% 90	% 10	7·5	4	18
Feb.	39·3	38·1	36·3	3·0	89	11	7·6	3	15
March	40·5	38·3	35·5	5·0	82	18	6·3	6	12
April	46·5	43·2	39·5	7·0	76	24	6·5	4	11
May	53·1	48·6	44·1	9·0	72	28	6·4	5	9
June	59·2	54·6	50·5	8·7	73	27	6·3	4	10
July	61·9	57·3	53·4	8·5	74	26	6·5	4	10
Aug.	61·3	57·4	54·0	7·3	77	23	6·9	4	10
Sept.	56·5	53·9	51·4	5·1	83	17	6·4	5	11
Oct.	48·1	46·4	44·5	3·6	87	13	6·5	5	13
Nov.	41·7	40·4	38·7	3·0	89	11	6·5	5	14
Dec.	37·0	35·9	34·4	2·6	90	10	7·3	4	16
Year	48·4	45·8	43·0	5·4	82	18	6·7	53	149

maximum alone. The mean diurnal temperature from November to March is therefore probably rather lower than that given in Table VI, and from April to August rather higher.

The spring and summer half of the year is much drier than the autumn and winter half, having on the average 12 per cent. less relative humidity. Summer is drier than spring, by 2 per cent.; autumn is drier than winter, by 4 per cent. Spring, summer, and autumn are about equally cloudy, and much less so than winter. Summer and winter have fewer days of clear sky than spring and autumn; spring and summer have fewer days of overcast sky than autumn, and autumn has much fewer than winter.

The air is driest in May and most humid in December and January, June and July closely following upon May in dryness, and November and February closely following upon December and January in dampness. Though the coldest months are the most humid, the warmest are not the driest, for the three summer months are more humid than May, and September is much more humid than April. March is an exception to this rule, being a cold and rather dry month.

December, January, and February are much more cloudy than any other months in the year. March has the greatest number of days of clear sky, February the least; January has the greatest number of days of overcast sky, May the least.

Force and Direction of the Wind at 9 a.m. (Tables X–XII, p. 229).—The force of the wind, like the amount of cloud, is arrived at by estimation, but while it is easy to estimate the proportion, in tenths, of cloud to clear sky, it is not easy to estimate the proportionate force of the wind, from calm, represented by 0, to a hurricane such as we never experience in this country, represented by 12. The greatest force on this scale at which I have ever estimated the wind at 9 a.m. is 7, on two occasions; the greatest estimated mean force in any month is 3.0 (in April, 1881); the least in any month is 1.0 (in February and November, 1886). The mean annual force has varied from 1.6 to 2.0. The wind is strongest in spring, lightest in summer, and rather stronger in autumn than in winter, but the mean seasonal variation is very slight. It is strongest in April and lightest in July.

With regard to direction, S.W. winds are much the most prevalent, and E. winds are the least so. The wind has been S.W. on as many as 95 days in the year, and it has been S.E. on as few as 17; both these extremes were in 1877. S.W. winds prevail most in summer, and are less prevalent in spring than in autumn or winter; N.E. winds prevail most in spring. There is no great preponderance of winds from any other quarter in any season. S.W. winds prevail most in July and August, N.E. winds most in April and May. There are very few E. winds in February, July, November, and December. Calms occur most often in December; much the least often in April and May.

TABLE X.—*Force and Direction of the Wind in each Year, at 9 a.m.*

Year.	Mean Force, 0-12.	Number of Days of								
		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
1877	2.0	33	27	21	17	39	95	60	50	23
78	1.6	37	45	24	29	32	60	43	59	36
79	1.6	42	72	36	44	27	70	23	32	19
80	1.7	49	69	25	26	28	70	35	42	22
81	2.0	36	64	32	33	40	66	37	45	12
82	2.0	25	37	24	34	43	89	47	39	27
83	1.6	36	47	30	36	32	76	42	52	14
84	1.8	33	64	23	37	26	69	24	54	35
85	1.7	36	58	28	40	37	62	39	40	25
86	1.6	26	47	33	46	29	55	50	51	28
Mean	1.8	35	53	28	34	33	71	40	47	24

TABLE XI.—*Seasonal Force and Direction of the Wind at 9 a.m.*

Season.	Mean Force, 0-12.	Number of Days of								
		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Spring ..	2.0	10.1	20.0	10.0	9.6	7.8	14.7	6.8	10.2	2.8
Summer	1.6	9.1	9.5	5.4	8.7	7.6	21.5	10.7	12.6	6.9
Autumn	1.8	9.2	12.8	6.7	7.3	7.4	17.7	9.6	13.1	7.2
Winter..	1.7	7.1	10.3	5.4	8.7	10.3	17.5	12.9	10.7	7.3

TABLE XII.—*Monthly and Annual Force and Direction of the Wind at 9 a.m.*

Month.	Mean Force, 0-12.	Number of Days of								
		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Jan.	1.7	2.0	5.0	2.7	2.8	3.2	6.1	3.1	3.7	2.4
Feb.	1.7	2.2	2.9	1.3	3.7	4.3	5.4	3.9	2.7	1.8
March...	2.0	4.6	5.3	3.4	2.0	2.3	5.2	2.5	4.1	1.6
April	2.1	2.4	7.6	4.0	4.5	3.2	3.6	1.9	2.2	.6
May	1.9	3.1	7.1	2.6	3.1	2.3	5.9	2.4	3.9	.6
June	1.6	3.7	4.2	2.2	3.7	2.4	5.5	2.7	3.6	2.0
July	1.5	2.4	2.3	1.1	2.7	3.3	7.7	4.7	4.4	2.4
Aug.	1.8	3.0	3.0	2.1	2.3	1.9	8.3	3.3	4.6	2.5
Sept.	1.7	3.5	4.0	2.2	3.4	2.0	5.7	2.8	3.9	2.5
Oct.	1.8	2.7	4.7	3.4	2.1	2.1	5.3	3.6	4.7	2.4
Nov.	1.8	3.0	4.1	1.1	1.8	3.3	6.7	3.2	4.5	2.3
Dec.	1.6	2.9	2.4	1.4	2.2	2.8	6.0	5.9	4.3	3.1
Year	1.8	35.5	52.6	27.5	34.3	33.1	71.4	40.0	46.6	24.2

Rainfall (Tables XIII–XV, p. 231).—The decade 1877–86 is a very misleading one from which to form an idea of the mean rainfall at Watford, this period having been an exceptionally wet one. We have now, from the observations commenced at Nash Mills in 1833, a record of the rainfall in Hertfordshire for 60 years, and during the whole of that period there is only one decade at all approaching in wetness that of 1877–86, and that is 1876–85, the year 1876 having been wetter than 1886. Not only is this the case, but if we extend our comparison to the whole period for which we have records of the rainfall in the British Isles, the 167 years from 1726 to 1892, it will be found that there has not been any period of ten consecutive years with a mean annual rainfall approaching within several inches that of 1876–85 or 1877–86.* In every year of our decade 1877–86 but one, 1884, the rainfall was above the average for half a century or any longer period as far back as our records extend, and in most of the years much above it; in seven years out of the ten it exceeded 30 inches, and in four of these years it exceeded 33 inches per annum.

In order, therefore, to arrive at an approximate determination of the mean annual rainfall at Watford, it is necessary to compare the fall during these ten years with that of a long period at some not far-distant station having a sufficiently long record. Nash Mills, Hemel Hempstead, is the only rainfall-station in Hertfordshire with a record of at least half a century, and, as it is only six miles from Watford and has about the same rainfall, the ratio the rainfall of these ten years bears to that of fifty years is likely to be about the same at Watford as there.

The mean annual rainfall at Nash Mills for the fifty years 1840–89, was 27·18 ins.; for the ten years 1877–86, it was 31·07 ins.; the difference, 3·89 ins., is 12·52 per cent., or, say, $12\frac{1}{2}$ per cent., or one-eighth, of 31·07 ins. The value at Watford of 30·96 ins. for the ten years 1877–86, should therefore be reduced by $12\frac{1}{2}$ per cent. to give an approximate value for the fifty years 1840–89. Or we may ascertain this by proportion, thus:—31·07 : 27·18 :: 30·96 : 27·08.

The mean annual rainfall at Watford, although 30·96 ins. in 1877–86, will therefore probably have been about 27 ins. in 1840–89. This is a sufficiently long period for our purpose, but if we wished to arrive at the probable value for the last *century*, a further reduction would have to be made.

For the half-century the approximate mean monthly and seasonal rainfall would be as follows:—

	ins.		ins.		ins.		ins.
March	1·45	June	2·50	Sept.	2·28	Dec.	2·30
April	2·08	July	2·21	Oct.	2·68	Jan.	2·27
May	2·11	Aug.	2·29	Nov.	2·64	Feb.	2·27
	<hr/>		<hr/>		<hr/>		<hr/>
Spring	5·64	Summer	7·00	Autumn	7·60	Winter	6·84

* See Symons' 'British Rainfall, 1891,' *Frontispiece*.

TABLE XIII.—*Rainfall in each Year.*

Year.	Mean.	Min. monthly fall.		Max. monthly fall.		Max. in 24 hours.		Days of	
	Ins.	In.	Month.	Ins.	Month.	In.	Year.	Rain.	Snow.
1877	31·76	·85	Sept.	4·93	Jan.	1·11	Aug. 21	203	12
78	34·27	1·19	July	4·82	June	1·99	June 30	190	26
79	35·98	·57	Nov.	5·68	June	1·20	Aug. 2	193	38
80	33·35	·37	Jan.	5·83	Oct.	1·89	Sept. 14	162	12
81	30·15	·82	April	4·94	Aug.	1·09	Dec. 17	185	24
82	33·57	1·55	Jan.	6·10	Oct.	·87	Apl. 25	199	10
83	28·27	1·00	Mar.	4·07	Feb.	·78	Sept. 29	183	13
84	22·35	·65	May	3·37	Dec.	1·10	June 6	152	8
85	30·02	·32	July	4·14	Oct.	1·58	Sept. 10	183	12
86	29·91	·82	Feb.	4·50	Dec.	1·65	Dec. 26	187	40
Mean	30·96	·81		4·84		1·33		184	20

TABLE XIV.—*Seasonal Rainfall.*

Season.	Mean.	Min. seasonal fall.		Max. seasonal fall.		Max. in 24 hours.		Days of	
	Ins.	Ins.	Year.	Ins.	Year.	In.	Year.	Rain.	Snow
Spring ..	6·45	3·95	1884	10·04	1878	1·70	1878	42	5
Summer	8·01	3·34	85	15·72	79	1·99	78	43	0
Autumn	8·69	4·48	79	13·68	80	1·89	80	48	3
Winter..	7·81	4·56	79-80	12·52	76-77	1·65	86	51	12

TABLE XV.—*Monthly and Annual Rainfall.*

Month.	Mean.	Min. monthly fall.		Max. monthly fall.		Max. in 24 hours.		Days of	
	Ins.	In.	Year.	Ins.	Year.	In.	Year.	Rain.	Snow.
Jan.	2·59	·37	1880	4·93	1877	1·08	1879	17	5
Feb.	2·59	·82	86	4·16	79	·73	81	17	3
March ..	1·66	1·00	83	2·67	77	·79	84	12	4
April	2·38	·82	81	3·95	78	1·70	78	15	1
May	2·41	46	80	4·77	78	1·04	86	15	0
June	2·86	1·26	77	5·68	79	1·99	78	14	0
July	2·53	·32	85	4·52	80	·66	77	15	0
Aug.	2·62	·50	80	5·80	79	1·20	79	14	0
Sept.	2·61	·85	77	5·30	80	1·89	80	13	0
Oct.	3·06	·78	79	6·10	82	1·23	80	17	1
Nov.	3·02	·57	79	4·29	78	·85	77	18	2
Dec.	2·63	·80	79	4·50	76	1·65	86	17	4
Year	30·96	·32	1885	6·10	1882	1·99	1878	184	20

The only year with a small rainfall (1884) was much the warmest; the year with the largest rainfall (1879) was much the coldest. (See also under "Temperature," p. 224.)

Spring is the driest season, autumn the wettest, and there is rather more rain in summer than in winter, but winter has the greatest number of wet days.

The fall of rain varies most in summer, least in spring; the wettest summer having had nearly five times as much rain as the driest, but the wettest spring not three times as much as the driest.

March is much the driest month; October is the wettest, but November is nearly as wet. While the difference between the mean rainfall of March and that of October or November is nearly an inch and a half, there is not a difference of half an inch between the mean rainfall of any of the other months.

The least fall of rain in any season was 3·34 ins. in the summer of 1885, the least in any month was 0·32 in. in July, 1885; the greatest fall of rain in any season was 15·72 ins. in the summer of 1879, the greatest in any month was 6·10 ins. in October, 1882; the greatest in any day (of 24 hours, ending 9 a.m. on following day) was 1·99 in. on 30th June, 1878.

Falls of rain exceeding one inch in 24 hours have occurred on fourteen occasions, their average being 1·37 inch.

Absolute droughts (periods of more than fourteen consecutive days without rain) have occurred on ten occasions, their average duration being seventeen days. The longest was twenty-three days, from 8th to 30th March, 1880.

Exceptional Phenomena.—Phenomena of occasional occurrence giving but little indication of climate, a few only of the most remarkable will be here enumerated, in chronological order.

In 1878 "the Eurydice squall" of 24th March was severely felt at Watford; one of the highest floods on record occurred on 11th April; our heaviest rainfall, on 30th June, caused a very destructive flood, the east of Hertfordshire suffering most severely; and a winter of exceptionally long duration commenced on 27th October. In 1879 a terrific thunderstorm occurred on 2nd August, and 1·20 in. of rain fell in three hours. In 1880, in the five days 11th to 15th September, 4·79 ins. of rain fell. In 1881 the mean temperature of January was only 29°·2; there was a very heavy snowstorm on the 18th of that month; and a very destructive gale on 14th October. In 1882 a severe gale on 29th April brought with it sea-spray, and caused great destruction to foliage. In 1884 a series of very severe thunderstorms occurred in July; and the mean temperature of August was as high as 65°·6. And in 1886 there were serious floods in May.

All these occurrences, and many others of an exceptional nature, are noticed more or less fully in our 'Transactions,' either in my annual reports or in special papers.

XXIII.

A LIST OF HERTFORDSHIRE HEPATICÆ.

By A. E. GIBBS, F.L.S.

Read at Watford, 18th April, 1893.

THE following is a short list of the Hepaticæ which are at present known to be indigenous to our county. It is compiled principally from a manuscript by the late Rev. W. H. Coleman, which is now in the possession of the Society. There are also some records by other observers. Records to which no observer's name is attached are my own, and the mark ! is used to indicate that I also have found the species growing in the locality mentioned. All the records for which references are made to our 'Transactions' are of species found at field meetings of the Society.

The usual and convenient plan of dividing the county into river-districts is adhered to.

MARCHANTIACEÆ.

Marchantia polymorpha, L. IVEL.—“Court behind my house [at Hitchin] and in the church-yard, Hitchin;” *Brown*; *Coleman*. COLNE.—Side of watercourse near the River Ver, Water-walk, St. Albans, 1887; *Hopkinson*. On wall near St. Peter's Church, St. Albans. In own garden, and at Kingsbury, St. Albans; *Hopkinson*. LEA.—Bank of canal in Panshanger Park; north side of Essendon Church, and on garden-pots at Baron Dimsdale's, Essendon; *Coleman*. Broxbourne Common; *Andrews*, 1891 ('Trans. Herts Nat. Hist. Soc.,' VI, lxxvii).

Conocephalus conicus, L. CAM.—Ashwell; *II. Fordham*; *Coleman*. IVEL.—Plantation by the side of Ippollytts brook; *Brown*; *Coleman*. LEA.—Ditch-banks near Roxford Farm; about springs and on the banks of the Maran [Mimram] at Tewin; *Coleman*; *Webb*.

Asterella hemispherica, L. LEA.—Drover's Lane, near No Man's Land; *Coleman*; *Thrale*.

Lunularia vulgaris, Mich. IVEL.—Hitchin; *Brown*; *Coleman*. LEA.—On garden-pots at Baron Dimsdale's, Essendon; *Coleman*. Wormley Bury; *Webb*.

Riccia crystallina, L. LEA.—Fields between Bengoe and Ware West Mill; Little Berkhamstead; Panshanger; Digswell Lodge Farm; near Ball's Wood; Broxbourne Wood; *Coleman*.

Ricciella fluitans, L. LEA.—Broxbourne Bury Ponds!; *Coleman*. Pond outside Wormley West Wood on the west; *Coleman*. Broxbourne Common, 1888; 'Trans. Herts Nat. Hist. Soc.,' V, xxv; *Andrews*, 1891 (*ib.* VI, lxxvii).

Ricciocarpus natans, L. IVEL.—Ditch between Baldock and Radwell; *Coleman*. LEA.—Pond at Broxbourne Bury; pond by the west fork of Brickendon Lane; pond between Bayford and Little Berkhamstead; pond in Wormley Wood; near Black Fan Wood; between Brickendon Green and How Clay-pits; *Coleman*.

JUNGERMANNIACEÆ.

Frullania dilatata, L. CAM.—Sandon Woods; *H. Fordham*; *Coleman*. IVEL.—Hitchin; *Brown*. THAME.—Tring; *Coleman*. COLNE.—On trees, Harpenden Road, St. Albans. Beaumont's Avenue, St. Albans, 1888; 'Trans. Herts Nat. Hist. Soc.,' V, xxii. Hatches Green. LEA.—Common near Hertford; *Webb*; *Coleman*.

F. tamarisci, L. COLNE.—No Man's Land; *Coleman*. LEA.—Wormley Wood; Sherrard's Park Wood; Gurstead Wood; *Coleman*.

Lejeunea serpyllifolia, Dicks. LEA.—Box Wood; Wormley Wood; Bramfield Woods; Panshanger, in a copse on the south side of the river and left of the road to Cole Green; copse south of the river opposite Watery Hall Farm, Hertingfordbury; *Coleman*.

Radula complanata, L. IVEL.—Hitchin; *Brown*; *Coleman*. THAME.—Tring; *Coleman*. COLNE.—St. Albans; *Braithwaite*, 1884 ('Trans. Herts Nat. Hist. Soc.,' III, xlvi). LEA.—Common near Hertford; *Coleman*.

Porella platyphylla, L. CAM.—Royston; *H. Fordham*; *Coleman*. IVEL.—Wellbury near Hitchin; *Brown*; *Coleman*. COLNE.—Ashridge Park; *Holmes*, 1885 ('Trans. Herts Nat. Hist. Soc.,' III, lxiv). Hedgerow, King Harry Lane, St. Albans. Hemel Hempstead; *Piffard*. Hatches Green. No Man's Land. LEA.—Frequent at Hertford; *Coleman*. In fruit in Panshanger Park; *Webb*; *Coleman*.

Lepidozia reptans, L. LEA.—Sherrard's Park Wood; Digswell; Dawley's Wood, Tewin; *Coleman*.

Odontoschisma sphagni, Dicks. COLNE.—Colney Heath; *Coleman*.

Cephalozia byssacea, Roth. COLNE.—No Man's Land; *Coleman*. LEA.—Hertford Heath; Box, Bayford, and Dawley's Woods; *Coleman*.

C. bicuspidata, L. IVEL.—Hitch Wood; *Brown*; *Coleman*. St. Albans; *Braithwaite*, 1884 ('Trans. Herts Nat. Hist. Soc.,' III, xlvi). Bricket Wood; *Hopkinson*, 1889 ('Trans. Herts Nat. Hist. Soc.,' V, xlvi). LEA.—Hertford Heath; Box Wood; Broxbourne Wood; Wormley Wood; Hatfield Woodside; Birch Green; Sherrard's Park; *Coleman*. Broxbourne Common, 1888; 'Trans. Herts Nat. Hist. Soc.,' V, xxv. Hatfield Park; *Hopkinson*, 1890 ('Trans. Herts Nat. Hist. Soc.,' VI, xxxix).

Lophocolea bidentata, L. IVEL.—Hitch Wood, in fruit; *Brown*; *Coleman*. COLNE.—St. Albans; Colney Heath; *Coleman*. Bricket Wood!; *Holmes*, 1885 ('Trans. Herts Nat. Hist. Soc.,' III, lxxii); *Hopkinson*, 1887. Pré Wood, St. Albans, 1887; *Hopkinson*. Hemel Hempstead; *Piffard*. Kensworth; *J. Saunders*. LEA.—Near Hertford; *Coleman*. Broxbourne Common.

L. heterophylla, Schrad. COLNE.—Tunnel Woods, Watford; *Holmes*, 1883 ('Trans. Herts Nat. Hist. Soc.,' II, lxiv). Ashridge Park; *Holmes*, 1885 ('Trans. Herts Nat. Hist. Soc.,' III, lxiv). LEA.—Broxbourne Bury Park pales; Bayford Wood water-course; *Coleman*.

Chiloscyphus polyanthos, L. IVEL.—On the steep bank of a watercourse in a wood at Sandon; *Brown*; *Coleman*. LEA.—Box Wood; Wormley Wood; Hoddesdon Park Wood; Bayford Wood watercourse; roadside by Callis Wood; *Coleman*. Var. β , *fluitans*. COLNE.—Colney Heath; *Coleman*. LEA.—Broxbourne Wood; *Coleman*.

Kantia trichomanis, L. IVEL.—Hitch Wood; *Brown*. LEA.—Hertford Heath; Box Wood; Wormley and other woods; Hatfield Woodside; Bell Bar; *Coleman*.

Trichocolea tomentella, Ehrh. LEA.—On the banks of the principal watercourse in Wormley Wood; *Coleman*.

Blepharozia ciliaris, Nees. LEA.—On old paling in Panshanger Park, very scarce; *Coleman*.

Scapania undulata, Dill. IVEL.—Hitch Wood; *Brown*; *Coleman*. THAME.—Tring Heath; *Coleman*. LEA.—Hertford Heath; Wormley Wood, in fruit; *Coleman*.

S. nemorosa, L. IVEL.—Hitch Wood; *Brown*; *Coleman*. COLNE.—Bricket Wood. LEA.—Hertford Heath; Box Wood; Wormley Wood; Sherrard's Park Wood; *Coleman*.

S. resupinata, Dumort. LEA.—Hertford; *Coleman*, in *Tabulae Synoptice Plantarum* (MS.).

Diplophyllum albicans, L. IVEL.—Hitch Wood; *Brown*; *Coleman*. COLNE.—Bricket Wood!; *Holmes*, 1885 ('Trans. Herts Nat. Hist. Soc.,' III, lxxii); *Hopkinson*, 1889 (*ib.*, V, xlvi). LEA.—Wormley Wood; Northaw; Sherrard's Park Wood; *Coleman*.

Plagiochila asplenoides, L. IVEL.—Hitch Wood; *Brown*; *Coleman*. COLNE.—Lane from Radlett to Boreham Wood. Hemel Hempstead; *Piffard*. LEA.—Common in woods near Hertford, but barren; *Coleman*.

Eucalyx hyalina, Lyell. IVEL.—Hitch Wood; *Brown*; *Coleman*. LEA.—Sherrard's Park Wood; lane between Harmer and Burnham Green; *Coleman*.

Jungermannia crenulata, Sm. COLNE.—Colney Heath; *Coleman*. LEA.—Hertford Heath; Birch Green; *Coleman*.

J. barbata, Schreb. LEA.—Dawley's Wood, Tewin; *Coleman*.

J. ventricosa, Dicks. LEA.—Hertford Heath, barren; *Coleman*.

J. bicrenata, Lindenb. LEA.—Hertford Heath; Ridgeway, Northaw; Bull's Green, Bramfield; between Tewin and Burnham Green; *Coleman*. Caddington; *J. Saunders*.

J. capitata, Hook. LEA.—Hertford; *Coleman*, in *Tab. Syn. Plant.* Dawley's Wood, Tewin; *Coleman* (mixed with specimens of *Campylopus flexuosus*; *teste* Boswell).

J. incisa, Schrad. COLNE.—Colney Heath?; *Coleman*. LEA.—Hertford Heath; Wormley Wood; *Coleman*.

J. turbinata, Rad. CAM.—Royston Heath; Ashwell; *Fordham*; *Coleman*. COLNE.—Ashridge Park; *Holmes*, 1885 ('Trans. Herts Nat. Hist. Soc.,' III, lxiv). LEA.—Steep chalky pasture between Chadwell and the road from Hertford to Ware; old chalk-pit in Panshanger Park, near the keeper's [house]; chalk-pit at Little Munden; *Coleman*.

Nardia scalaris, Schrad. COLNE.—Colney Heath?; *Coleman*. Hedgerow, Bernard's Heath, St. Albans. LEA.—Hertford Heath; *Coleman*.

Fossombronina pusilla, Nees. IVEL.—Hitch Wood; *Brown*; *Coleman*. Colne.—Tunnel Woods, Watford; *Holmes*, 1883 ('Trans. Herts Nat. Hist. Soc.,' II, lxviii). Bricket Wood; *Holmes*, 1885 (*Ibid.* III, lxxii). LEA.—Hertford Heath; *Coleman*. Box Wood; *Webb*; *Coleman*. Broxbourne Wood; *Coleman*.

Pellia epiphylla, L. CAM.—Ashwell; *H. Fordham*. IVEL.—Hitchin, on the banks of a pond; *Brown*; *Coleman*. LEA.—Bayford Wood; Box Wood; Hoddesdon Park; Broxbourne; Hatfield Woodside; *Webb*; *Coleman*. Sandon; *Brown*; *Coleman*.

P. calycina, Tayl. COLNE.—Tunnel Woods, Watford; *Holmes*, 1883 ('Trans. Herts Nat. Hist. Soc.,' II, lxviii). LEA.—Bank of a canal cut parallel to the Maran [Mimram] in Panshanger Park; *Coleman*.

Aneura pinguis, L. COLNE.—Tunnel Woods, Watford; *Holmes*, 1883 ('Trans. Herts Nat. Hist. Soc.,' II, lxviii). LEA.—Hertford Heath; bog at Little Berkhamstead; Box Wood; Kentish Lane bog; *Coleman*.

A. multifida, L. IVEL.—Hitchin Common; *Brown*; *Coleman*. COLNE.—Tunnel Woods, Watford; *Holmes*, 1883 ('Trans. Herts Nat. Hist. Soc.,' II, lxviii). LEA.—Bogs at Little Berkhamstead and at Hatfield Woodside; Box Wood; Wormley Wood; Kentish Lane bog; *Coleman*.

Metzgeria furcata, L. IVEL.—Hitchin; *Brown*; *Coleman*. COLNE.—Bennett's End, Hemel Hempstead; *J. Saunders*. LEA.—In fruit in Panshanger Park; *Coleman*. Broxbourne Common.

Spheroearpus terrestris, Sm. LEA.—Fields between Bengoe and Ware West Mill; field by the high road opposite Foxley's Wood; near Black Fan, Digswell; *Coleman*.

ANTHOCEROTACEÆ.

Anthoceros punctatus, L. LEA.—Field near Rickney's Farm, between Bengoe and Ware West Mill; *Coleman*.

INDEX.

A.

Abbot's Langley visited, xxviii.
Acronycta, sps., in Herts, 195-198.
 Additions to the Library in 1891, xvi;
 in 1892, xlii.
 Address, Anniversary, 1892, 1; 1893,
 101.
Adela viridella at Aldenham, xxi.
Agriopsis aprilina at Bricket Wood,
 194, 197.
Agrotis corticea at Radlett, 198.
 Air, temperature of, at Watford,
 1877-86, 222, 225, 227.
Aix sponsa near St. Albans, 161.
 Albinism in birds, 67.
Alcedo ispida in Herts, 62.
 Aldenham, Watford, visited, xxi; rain-
 fall at, in 1891, 56.
 Aldenham Church and its history, xxi.
Amphipyra pyramidea in Herts, 197.
Amphydasis betularia in Herts, 198.
Anas fuligula in Herts, 64.
Anchoealis, sps., at Bricket Wood, 197.
Ancura pinguis and *multifida* in Herts,
 236.
 Anniversary Meetings, reports of, in
 1892, xii; in 1893, xxxvii; Address,
 1892, 1; 1893, 101.
Anthoceros punctatus in Herts, 236.
Anticlea badiata at Harefield, xlvi.
Apamea ophiogramma in Herts, 196.
 Ape and Man, xxxiv.
Aplecta advena in Herts, 196, 197;
A. herbida in Herts, 197.
 Apsley Mills, Hemel Hempstead, rain-
 fall at, in 1891, 56; in 1892, 206.
Areyria cinerea at Digswell, lii.
Ardea cinerea at Welwyn, 63.
Arvicola amphibia, notes on, 49, 172;
A. agrestis, 50, 172; *A. glareolus*,
 50, 173.
Asphalia ridens at St. Albans, 196;
A. diluta at Bricket Wood, 197.
Asterella hemisphaerica in Herts, 233.
Asteroscopus sphinx at Bricket Wood,
 198.
 Atmosphere, pressure of, at Watford,
 1877-86, 222, 223.
 AUBREY, J. (quoted), on Verulam
 House, xxvi.
 Autumn visitants in 1891, 68.
 Ayot visited, xlvi, l.

B.

BACON, FRANCIS, 1; his residence at
 Gorhambury, xxv, 2; his times, 2;
 birth and parentage, 6; childhood
 and youth, 7; enters the bar, 8;
 advice to Queen Elizabeth, 8; in
 Parliament, 9; his 'Essays,' 12;
 advice to, and treatment of, the Earl
 of Essex, 13; his 'Advancement of
 Learning,' 15; advice to James
 the First, 16; rapid advancement,
 17; marriage, 17; at Peacham's
 trial, 18; created Baron Verulam,
 19; his sincerity, 19; his '*Novum
 Organum*,' 20; created Viscount St.
 Alban, 22; his fall, 22; retires to
 Gorhambury, 23; his later works,
 24; his '*Sylva Sylvarum*,' 25;
 death, 27; character, 27, 32; teach-
 ing and influence, 30; monument
 in St. Michael's Church, xxv, 33;
 extracts from his '*Commentarius
 Solutus*' relating to Gorhambury,
 34; his portraits and bust at Gor-
 hambury, xxviii.
 Badger, haunts and habits of, 44.
 Balance-sheet for 1891, xv; 1892, xli.
 Bank-vole, notes on, 50, 173.
 Barnet, New, rainfall at, in 1891, 56;
 in 1892, 206; climatological observa-
 tions at, in 1891, 159; in 1892, 201.
 Bats and some other Beasts, 37.
 Bayfordbury, Hertford, rainfall at, in
 1891, 56; in 1892, 206.
 "Beagle," voyage of, 109, 117.
 Bedfordshire Mycetozoa, list of, 145.
 Bedmont visited, xxviii.
 Beech Bottom, St. Albans, visited,
 xxiv.
 Bennington, rainfall at, in 1891, 56;
 in 1892, 206; climatological observa-
 tions at, in 1891, 159; in 1892,
 201.
 Berkhamsted, rainfall at, in 1891, 56;
 in 1892, 206; phenological observa-
 tions at, in 1891, 87; in 1892, 183;
 climatological observations at, in
 1891, 158; in 1892, 200.
 Bernard's Heath, St. Albans, visited,
 xxiv.
 Berry Grove Wood, Aldenham, visited,
 xxi.

- Birds observed in Herts in 1891, 62 ;
in 1892, 161.
- Biston hirtaria* at Watford, 197.
- Blackbird, light-coloured, 163.
- Blepharozia ciliaris* in Herts, 235.
- Boarmia consortaria* in Herts, 197.
- Bombyx neustria* at St. Albans, 193.
- Boulder-clay, 154 ; in Herts, 154.
- Boulders, 153 ; in Herts, 153.
- Bower Heath visited, xx.
- BRETT, Dr. A. T., remarks on plant-diseases, x ; on the valley of the Colne, xxxiii.
- Bricket Wood Common regulation scheme, discussions on, xviii, xix.
- British terrestrial quadrupeds, 41.
- Brocket Hall, Welwyn, rainfall at, in 1891, 56.
- Brocket Park, Welwyn, visited, xlvi.
- Brookmans Park, Hatfield, rainfall at, in 1892, 204.
- Broxbourne, rainfall at, in 1891, 56 ;
in 1892, 206.
- Broxbourne Wood visited, xxx ; fungi of, xxx.
- Bullfinch, notes on, 164.
- Buntingford, rainfall at, in 1891, 56, 58 ; in 1892, 206.
- Bushey Heath, rainfall at, in 1891, 56.
- Bushey Mill visited, xxi.
- Buteo vulgaris* at Cole Green, 62 (determined to be *Falco peregrinus*, 165) ; *B. lagopus* in Herts, 63.
- Butterflies of Symond's Hyde, xlvi.
- Butterfly, clouded-yellow, appearance of, 187 ; in Herts, 188 ; other species, 190.
- Buzzard, common, at Cole Green, 62 (determined to be the peregrine falcon, 165) ; rough-legged, in Herts, 63.
- Bye-meeting at St. Albans in 1891, ix.
- C.
- Calendar, naturalist's, for Mid-Herts, 76, 81.
- Calocampa exoleta* in Herts, 195.
- Calymnia diffinis* in Herts, 196.
- Cam district, rainfall in, in 1891, 59 ;
in 1892, 209.
- CAMPBELL, Lord (quoted), on Francis Bacon's influence in the law, 30.
- Capreolus capraea* noticed, 51.
- Caprimulgus europæus*, notes on, 164.
- Cassiobury Park, Watford, green woodpecker in, 62.
- Cat, wild, notes on, 47.
- Cephalozia bicuspidata* in Digs Well Park, lii ; in Herts, 234 ; *C. byssacea* in Herts, 234.
- Cerigo matura* in Herts, 196.
- Cervus elaphus* noticed, 50 ; *C. dama*, 51.
- Chalk at St. Albans, xxiii ; at Harefield, xlv.
- CHAMBERS, R., on evolution, 127.
- Chelidon urbica*, notes on, 66.
- Cheshunt, rainfall at, in 1891, 56 ;
in 1892, 206.
- Chiloscyphus polyanthos* in Herts, 235.
- Chiltern Green, grey phalarope at, 64.
- Chœrocampa elpenor* at Welwyn, 191.
- CHURCH, Dean (quoted), on character of Francis Bacon, 31.
- Cladonia pyxidata* at Digs Well, lii.
- Clavaria stricta* at Wormley, xxxi.
- Cleocerys viminalis* at Bricket Wood, 197.
- Climate of Watford, 219.
- Climatological observations in Herts, in 1891, 157 ; in 1892, 199.
- Cloud at Watford, 1877-86, 226, 227.
- Coal, its aspect, 89 ; splitting, 89 ; constituents, 89 ; varieties, 91 ; origin and area of formation, 92 ; associated materials, 93 ; position and extent, 94 ; range under the South of England, 94 ; discovery at Dover, 97.
- Cole Green, peregrine falcon at, 165 (reported as common buzzard, 62).
- Colias edusa*, appearance of, 187 ; in Herts, 188.
- Colne at Colney Heath, variation in flow of, xlix.
- Colne district, rainfall in, in 1891, 59 ;
in 1892, 209.
- Colney Heath visited, xlix.
- Conocephalus conicus* in Herts, 233.
- Coremia designata* at Knebworth, xlvi.
- Coronella levis* exhibited, xlv.
- Corvus frugilegus* stealing eggs, 67.
- Cosmia pyralina* in Herts, 197.
- Cossus ligniperda* at Hitchin, 192.
- Coturnix communis* at Hertingfordbury, 166.
- Council elected, 1892, xii ; 1893, xxxvii ; report of, for 1891, xiii ; for 1892, xxxviii.
- Cowroast, Tring, rainfall at, in 1891, 56 ; in 1892, 206.
- Cromer Hyde visited, xlvi.
- Cryptogamic plants, lists of, xxx, li, lii, 144, 233.
- Cuckoo, notes on, 165.
- Cucullia verbasci* in Herts, 195.
- Cuculus canorus*, early appearance of, in 1892, 165.
- CUSSANS, J. E. (quoted), on Aldenham xxii ; on Knebworth, xlvi ; on River Colne at Colney Heath, xlix.
- Cymatophora* or at Bricket Wood, 197.
- Cypselus apus*, notes on, 67.

D.

- Dafila acuta* at Tring and Marsworth Reservoir, 162.
 Danesbury, Welwyn, rainfall at, in 1891, 58; in 1892, 204.
 DARWIN, CHARLES, 101; his birth and parentage, 105; at school, 106; at Edinburgh University, 107; at Cambridge University, 108; Voyage on the "Beagle," 109; his 'Journal of Researches,' 109; in London, 111; at Down in Kent, 112; his monographs of the Cirripedia, 112; his 'Origin of Species,' 113; his later works, 114; his death, 115; industry and perseverance, 116; geological researches, 117; botanical investigations, 118; zoological work, 119; work in anthropology and psychology, 120; character, 121; influence of his theory of natural selection upon Evolution, 122; adequacy of his theory, 125; his recognition of a determining principle, 134.
 DARWIN, ERASMUS (quoted), on evolution, 126.
 Darwinism and Evolution not synonymous, 122.
 Datchworth, rainfall at, in 1891, 56; in 1892, 206.
Daulias luscinia, arrival of, 66.
 Days of rain in 1891, 58; in 1892, 208; at Watford, 1877-86, 231.
 Deer, red, fallow, and roe, notes on, 50.
Deiopeia pulchella at Southgate, 195.
 Delrow, Aldenham, visited, xxiii.
Dendrocopus major in Herts, 62.
Depressaria liturella at Rickmansworth, xlvi.
Dianthæcia cucubali at Bricket Wood, 197.
 Digswell Park, Welwyn, visited, 1; Mollusca of, 1; fungi of, li; mosses of, lii.
Diplophyllum albicans in Herts, 235.
Dipterygia scabiuscula in Herts, 196.
 Diseases of plants, ix.
 DIXON, HEPWORTH (quoted), on Francis Bacon, 2; on condition of England in 1597, 11.
 Dormouse, notes on, 49.
 Drift beds, at St. Albans, xxiii; notes on, 155; in Herts, 155.
 Duck, tufted, in Herts, 64; summer, near Moor Mill, Colney Street, 161; pintail, at Tring and Marsworth Reservoir, 162; long-tailed, at Marsworth, 162.
 Dunstable visited, xlvi.

E.

- East Hyde, Luton, visited, xx.
 Eggar moth at Harpenden, 192.
 Elstree, rainfall at, in 1891, 56.
Emberiza citrinella a partial migrant, 164.
 Emperor moth at St. Albans, 193.
 England, range of Coal-measures in the South of, 94.
Erigaster lanestris at Harpenden, 192.
Erinaceus europæus, notes on, 43.
Erithacus rubecola, notes on, 65.
Eucalyx hyalina in Herts, 235.
Eugonia alniaria at Bricket Wood, 198.
Eupthecia vulgata at Aldenham, xxiii.
Euphorbia amygdaloides at Symond's Hyde, xlvi.
Eurymene dolobraria at Bricket Wood, 198.
 Evolution and Darwinism, 122.
 Expenditure in 1891, xv; in 1892, xli.

F.

- Fairhill, Berkhamsted, rainfall at, in 1891, 56; in 1892, 206.
Falco peregrinus at Cole Green, 165.
 Fanhams Hall, Ware, rainfall at, in 1891, 56; in 1892, 206.
 Feilde's Weir, Hoddesdon, rainfall at, in 1891, 58; in 1892, 204.
Felis catus in Britain, 47.
 Field Meetings, reports of, 1892, May 7, Harpenden and East Hyde, xx; May 21, Aldenham, Watford, xxi; May 28, St. Albans, xxiii; June 25, Gorhambury, St. Albans, xxv; July 2, Abbott's Langley and Bedmont, xxviii; Oct. 8, Gorhambury, St. Albans, xxviii; Oct. 13, Broxbourne and Wormley, xxx; 1893, April 29, Rickmansworth and Harefield, xlv; May 13, Brocket Park, Welwyn, xlvi; May 27, Knebworth, xlvi; June 17, Zouche's Farm, Dunstable, xlvi; June 22, Colney Heath and Tittenhanger, St. Albans, xlix; Oct. 17, Digswell and Sherrards Park Wood, Welwyn, l.
 Field-vole, notes on, 50, 172.
 FLOWER, Sir W., elected an honorary member, xxxvii; letter from, xliv.
 Flycatcher, notes on, 164.
Fossombronia pusilla in Herts, 236.
 Fox, traits and exploits of, 38.
Frullania dilatata and *tamarisci* in Herts, 234.
 Fungi of Broxbourne and Wormley, xxx; of Digswell Park and Sherrards Park Wood, li.

G.

- Gaddesden, Great, rainfall at, in 1891, 56; in 1892, 206.
Gecinus viridis in Herts, 62.
 GEIKIE, Sir A. (quoted), on Charles Darwin, 117, 118.
 Geology of St. Albans, xxiii; of Rickmansworth and Harefield, xlv; of Dunstable, xlviii.
 GIBBS, A. E.: Notes on Lepidoptera observed in Hertfordshire, xlv, 187-198; A List of Hertfordshire Hepaticæ, xlv, 233-236.
 GIBBS, Rev. K. F., remarks on Aldenham Church, xxi.
 Glacial drift at St. Albans, xxiv.
 Glaciers, described, 148; of Greenland, 149; their former existence in Britain, 152; in Herts, 153.
 Goat-moth at Hitchin, 192.
 GOETHE (quoted), on evolution, 104, 127.
 Gorhambury, St. Albans, visited, xxv, xxviii; Francis Bacon's residence at, xxv, 2; portraits at, xxviii; rainfall at, in 1891, 56; in 1892, 206.
Grammesia trigrammica in Herts, 197, 198.
 Grasshopper-warbler at St. Albans, 163.
 Great Gaddesden, *see* Gaddesden.
 Greenland, glaciers of, 149.

H.

- Habrostola tripartita* at Rickmansworth, xlvi.
Hadena protea at Bricket Wood, 197.
 Hadham, Much, rainfall at, in 1891, 56; in 1892, 206.
 Hailstorm, destructive, 28th-29th June, 1892, 210, 212.
 Hamels Park, Buntingford, rainfall at, in 1891, 56; in 1892, 206.
 HARDY, W. J. (quoted), on Pré Mill, xxvii.
 Hare, common and mountain, notes on, 50.
 Harefield chalk-pits visited, xlv.
Harelda glacialis at Marsworth, 162.
 Harpenden visited, xx; rainfall at, in 1891, 56, 58; in 1892, 204, 206; naturalist's calendar for, 76, 81; phenological observations at, in 1891, 87; in 1892, 183.
 Harvest-mouse, notes on, 50.
 HARVEY, Rev. C. W.: Observations of Temperature and Rainfall taken at Throcking Rectory, Buntingford, 1880-1889, xlv, 213-218.
 Hatfield, rainfall at, in 1891, 56; in 1892, 204.
 Hawk-moths in Herts, 191.
 Head-quarters of the Society, removal of, xxxiv, xl.
 Hedgehog, notes on, 43.
Helleborus viridis at East Hyde, xx.
 Hemel Hempstead, rainfall at, in 1891, 56; in 1892, 206.
Hemiareyria clavata at Digswell, lii.
 Hepaticæ of Herts, 233.
Herbula cespitalis on Dunstable Downs, xlviii.
 Heron at Welwyn, 63.
 Hertford, ordinary meeting at, in 1892, xviii; rainfall at, in 1891, 56; in 1892, 206; phenological observations at, in 1891, 87; in 1892, 123.
 Hertfordshire, rainfall in, in 1891, 53; in 1892, 203; birds observed in, in 1891, 62; in 1892, 161; meteorological observations in, in 1891, 69; in 1892, 175; phenological observations in, in 1891, 85; in 1892, 182; Mycetozoa of, 144; boulders in, 153; boulder-clay of, 154; drift of, 155; climatological observations in, in 1891, 157; in 1892, 199; Mammalia of, 169; Lepidoptera observed in, 187; Hepaticæ of, 233.
 High Down, Hitchin, rainfall at, in 1891, 56; in 1892, 206.
Hirundo rustica building on a hat, 164.
 Hitchin, rainfall at, in 1891, 56, 58; in 1892, 204, 206; tufted duck shot near, 64; phenological observations at, in 1891, 87; in 1892, 183.
 Hoddesdon, rainfall at, in 1891, 58; in 1892, 204.
 HOPKINSON, J.: Anniversary Address, 1892 (Francis Bacon), xii, 1-36; 1893 (Charles Darwin), xxxvii, 101-136; Report on the Rainfall in Hertfordshire in 1891, xviii, 53-61; . . . in 1892, xlv, 203-212; Meteorological Observations taken at The Grange, St. Albans, during the year 1891, xx, 69-75; . . . during the year 1892, xlv, 175-181; Climatological Observations taken in Hertfordshire in the year 1891, xlv, 157-160; . . . in the year 1892, xlv, 199-202; The Climate of Watford, deduced from Meteorological Observations taken during the ten years 1877-1886, xlv, 219-232; A Preliminary Introduction to the Investigation of Microscopic Leaf-Fungi (title only), xlv; reception of members by, at The Grange, St. Albans, in 1891, ix; in 1892, xxiv;

- remarks on water-supply of London, x; on Bricket Wood regulation scheme, xviii; on Beech Bottom, xxv; on the geological work of ice, xxxiii; on the removal of the Society's head-quarters, xxxiv; Mollusca collected by, 1; mosses, etc., collected by, lii.
- Humidity at Watford, 1877-86, 226, 227.
- HUXLEY, T. H. (quoted), on Charles Darwin, 121; on difference between man and ape, 125.
- I.
- Ice and its work, 147.
- Income and expenditure in 1891, xv; in 1892, xli.
- Injuries to plants, ix.
- Ivel district, rainfall in, in 1891, 59; in 1892, 209.
- J.
- JONES, Prof. T. R.: Coal: its Nature, Origin, Position, and Extent; and its Range under the South of England, xxxiii, 89-100.
- Jungermannia erenulata*, *barbata*, *ventricosa*, *bicrenata*, *capitata*, *incisa*, and *turbinata*, in Herts, 235.
- K.
- Kantia trichomanis* in Herts, 235.
- Keusworth, rainfall at, in 1891, 56; in 1892, 206.
- KEPLER (quoted), on theology and science, 5.
- Kimpton Hoo, tufted duck at, 64.
- Kingfisher in Herts, 62.
- Kingsbury, St. Albans, visited, xxv.
- Knebworth visited, xlvii.
- Kytes, Watford, rainfall at, in 1891, 58; in 1892, 206.
- L.
- Lackey-moth at St. Albans, 193.
- LAMARCK (quoted), on evolution, 126.
- Langley House, Abbot's Langley, remarkable horse-chestnut at, xxviii.
- Larkin, Mr. and Mrs., reception of members by, at Delrow, Aldenham, xxiii.
- Larvæ-beating in Herts, 198.
- Lathræa squamaria* near Harpenden, xx.
- Lea district, rainfall in, in 1891, 59; in 1892, 209.
- Lejeunea serpyllifolia* in Herts, 234.
- Lepidoptera of Symond's Hyde Wood, xlvi; observed in Herts, 187.
- Lepidozia reptans* in Herts, 234.
- Lepus timidus, variabilis*, and *cuniculus*, notes on, 50.
- Leucania turca* at Bricket Wood, 197.
- LEWIS, H.: Notes on Birds observed in Hertfordshire during the year 1891, xviii, 62-68; . . . during the year 1892, xlv, 161-168.
- Library, additions to, in 1891, xvi; in 1892, xlii.
- Lithosia mesomella* at Bricket Wood, 197.
- Locustella naevia*, notes on, 163.
- London Clay at Woodcock Hill, xlvi.
- London, water-supply of, x, xiv, xxxix.
- Lophocolca bidentata* and *heterophylla* in Herts, 234.
- Lunularia vulgaris* in Herts, 233.
- Luperina cespitis* in Herts, 197.
- Lutra vulgaris*, notes on, 45.
- M.
- Mamestra persicaria* in Herts, 197;
- M. anceps* at Radlett, 198.
- Mammalia of Herts, 169.
- Man and Ape, xxxiv.
- Marchantia polymorpha* in Herts, 233.
- Marden Hill, Hertford, rainfall at, in 1891, 58; in 1892, 206.
- MARLOWE (quoted), on aspirations of an Englishman, 4.
- Marsworth Reservoir, pintail-duck and long-tailed duck at, 162.
- Marten, notes on, 46.
- Martes foina*, notes on, 46.
- Martin, notes on, 66.
- MASSEE, G., lists of fungi determined by, xxx, li.
- MASTERS, Dr. (quoted), on Charles Darwin, 119.
- MAWLEY, E.: Report on Phenological Phenomena observed in Hertfordshire during the year 1891, xx, 85-88; . . . during the year 1892, xlv, 182-186.
- Maynes, St. Albans, visited, xxvi.
- Meles taxus*, notes on, 44.
- Mergus albellus* near Welwyn, 64.
- Merveille-du-Jour* moth at Bricket Wood, 194.
- Meteorological observations taken at The Grange, St. Albans, in 1891, 69; in 1892, 175.
- Metrocampa margaritaria* at Zouches Farm, xlviii.
- Metzgeria furcata* in Herts, 236.
- Miania fasciuncula* at Radlett, 198.

Mice, notes on, 50.
 Mid-Herts naturalist's calendar, 76.
 Migrants, summer, in 1891, 68; in 1892, 167; notes on arrival of, 166.
Miselia oxyacanthæ at Bricket Wood, 197.
 Mole, notes on, 43.
 Mollusca found at Digswell, 1.
 Moor Mill, Colney Street, summer duck shot near, 161.
 Moor Park, Rickmansworth, rainfall at, in 1891, 56; in 1892, 206.
 MORISON, Dr. J.: Ice and its Work, xxxiii, 147-156.
 Mosses found in Digswell Park, lii.
 Moths of Symond's Hyde Wood, xlvii.
 Much Hadham, *see* Hadham.
 Munden Park, Watford, tufted duck killed in, 64.
Mus rattus and *decumanus*, notes on, 49; *M. minutus* and *sylvaticus*, 50.
Muscicapa grisola and *atricapilla*, notes on, 164.
Mustela putorius, notes on, 46; *M. erminea* and *vulgaris*, 47.
 Mycetozoa, xx, xxxii, lii; notes on, 137; list of Herts species, 144; list of Beds species, 145.
Myoxus avellanarius, notes on, 49.

N.

Nardia scalaris in Herts, 236.
 Nash Mills, Hemel Hempstead, rainfall at, in 1891, 56; in 1892, 206.
 Natural selection explained, 128.
 Naturalist's calendar for Mid-Herts, 76.
 NAVILLE (quoted), on Bacon and Descartes, 32.
 Nebular hypothesis, 104.
Neuria reticulata in Herts, 196.
 New Barnet, *see* Barnet.
 Nightingale, notes on, 66.
 Nightjar, notes on, 164.
Noctua, *sps.*, in Herts, 197, 198.
Notodonta ziezac at Hitchin, 196; *N. camelina* at Bricket Wood, 197.
Numeria pulveraria at Bricket Wood, 197.

O.

Oaklands, Watford, rainfall at, in 1891, 56; in 1892, 206.
 Observations, meteorological, at St. Albans, in 1891, 69; in 1892, 175; phenological, in Herts, in 1891, 85; in 1892, 182; climatological, in Herts, in 1891, 157; in 1892, 199.
Odontopera bidentata at Bricket Wood, 197.

Odontoschisma sphagni in Herts, 234.
 Odsey, rainfall at, in 1892, 206.
 Ordinary meetings, reports of, 1891, x-xi; 1892, xii, xviii-xx, xxxii-xxxiv; 1893, xxxiv-xxxvii, xlv-xlv.
 'Origin of Species,' 113.
Orthosia lota and *macilenta* in Herts, 197.
 Otter, notes on, 45.
 Oughton Head Common, Hitchin, tufted duck at, 64.
 Owen, Sir R., obituary notice of, xxxviii; (quoted) on similitude of *Homo* and *Pithecius*, 124.

P.

Papers, list of, read in 1891, xiii; in 1892, xxxix.
Parage megera at Knebworth, xlviii.
Parmelia caperata, Digswell, lii.
Pellia epiphylla and *calycina* in Herts, 236.
Pelurga comitata in Herts, 197.
 Pendley Manor, Tring, rainfall at, in 1891, 58; in 1892, 204.
 Peregrine falcon at Cole Green, 165.
Pericallia syringaria in Herts, 196.
 Phalarope, grey, in Herts, 64.
Phalaropus fulicarius in Herts, 64.
Phalera bucephala in Herts, 197.
 Phenological phenomena observed in Herts in 1891, 85; in 1892, 182.
 PHILLIPS, F. W.: An Hour with the Microscope at a Pond-side (title only), xviii.
Phlogophora meticulosa at Bricket Wood, 197.
Physarum compressum at Knebworth, xlviii; *P. leucophæum* at Digswell, lii.
Pieris brassicæ and *rapæ* abundant at Hitchin, 190.
Plagiochila asplenoides in Herts, 235.
 Plant-diseases and injuries to plants, ix.
 Plants, cryptogamic, lists of, xxx, li, lii, 144, 233.
 Plasmodium of Mycetozoa, xxxii, 138.
Plusia pulchrina in Herts, 197.
 Polecat, notes on, 46.
Polia flaviocincta at St. Albans, 196.
Polyommatus corydon on Broxbourne Common, 190.
 Pond-yards, St. Albans, visited, xxvi.
Porella platyphylla in Herts, 234.
 Pré Mill, St. Albans, site of, xxvii.
 Pré Wood, St. Albans, visited, xxv.
 President's Address, 19th Feb. 1892, 1; 21st Feb. 1893, 101.
 Pressure of the atmosphere at Watford, 1877-86, 222, 223.

Puccinea malvacearum at Cromer Hyde, xlv.

PURROTT, Mr. and Mrs., reception of members by, at Maynes, St. Albans, xxvi.

Pyrrhula europæa, notes on, 164.

Q.

Quadrupeds, British terrestrial, 41.

Quail shot at Hertingfordbury, 166.

Quaker-moth at Bricket Wood, 193.

R.

Rabbit noticed, 50.

Radula complanata in Herts, 234.

Rainfall in Herts in 1891, 53; in 1892, 203; at Throcking, 1880-89, 215; at Watford, 1877-86, 230, 231.

Rallus aquaticus at Shendish, 64.

Rat, black and brown, notes on, 49.

Reading Beds at St. Albans, xxiii; at Woodcock Hill, xlv.

Redbreast, notes on, 65.

Red House, Ware, rainfall at, in 1891, 56; in 1892, 206.

Redshank in Herts, 65.

Report of the Council for 1891, xiii; for 1892, xxxviii; on the rainfall in Herts in 1891, 53; in 1892, 203; on phenological phenomena in Herts in 1891, 85; in 1892, 182.

Reservoirs, remains of, in Pré Wood, St. Albans, xxv.

Riccia crystallina in Herts, 233.

Ricciella fluitans in Herts, 233.

Ricciocarpus natans in Herts, 233.

Rickmansworth visited, xlv; rainfall at, in 1891, 56; in 1892, 206; rough-legged buzzard at, 63.

ROBERTS, T. V.: Terrestrial British Quadrupeds existing in a Wild State at the Present Day, xi, 41-52; Notes on some Hertfordshire Mammalia, xlv, 169-174; remarks on buzzards, xviii.

ROMANES, G. J. (quoted), on Charles Darwin, 120, 122.

Rook, stealing eggs, 67.

ROOPER, G.: Bats and some other Beasts, xi, 37-40; remarks on birds, xviii.

Rothamsted, Harpenden, rainfall at, in 1891, 56, 58; in 1892, 204, 206.

Royston, rainfall at, in 1891, 56; in 1892, 206; climatological observations at, in 1891, 157; in 1892, 199.

RUDLER, F. W.: The Natural History of the Diamond (title only), xix.

Rusina tenebrosa at Bricket Wood, 197.

S.

St. Albans, bye-meeting at, in 1891, ix; ordinary meetings at, in 1892, xix, xxxii; field meetings at, in 1892, xxiii, xxv, xxviii; geology of, xxiii; rainfall at, in 1891, 56; in 1892, 206; meteorological observations at, in 1891, 69; in 1892, 175; phenological observations at, in 1891, 87; in 1892, 183; climatological observations at, in 1891, 158; in 1892, 200.

St. Michael's Church, St. Albans, visited, xxv; monument to Francis Bacon in, xxv, 33.

Sallow-beating in Herts, 198.

Satellite-moth in Herts, 194.

Saturnia pavonia at St. Albans, 193.

SAUNDERS, J.: Notes on the Mycetozoa, with a List of Species from Hertfordshire and Bedfordshire, xxxii, 137-146; Mycetozoa found by, lii.

Scapania undulata, *nemorosa*, and *resupinata* in Herts, 235.

Science defined, 101.

Sciurus vulgaris notes on, 49.

Scopelosoma satellitia in Herts, 194, 197.

Selenia bilunaria in Herts, 195; *S. lunaria* in Herts, 197.

Seligeria calcarea at Harefield, xlv.

Serge Hill, Bedmont, visited, xxviii.

Shendish, water-rail caught at, 64.

Sherrards Park Wood, Welwyn, visited, 1; fungi of, li.

Shrews, notes on, 43.

SILVESTER, F. W., on Bricket Wood regulation scheme, xix.

Smerinthus ocellatus and *populi* at Hitchin, 191.

Smew killed near Welwyn, 64.

Snakes exhibited, xi, xlv.

Snow-line, height of, 147.

SOLLY, Mr. and Mrs., reception of members by, at Serge Hill, Bedmont, xxviii.

Southgate, rainfall at, in 1891, 56; in 1892, 206.

SPEDDING, J., his biographies of Francis Bacon, 27; (quoted) on the character of Francis Bacon, 29.

Sphaerocarpus terrestris in Herts, 236.

Sphingidæ in Herts, 191.

Sphinx convolvuli at St. Albans, 191.

Squirrel, notes on, 49.

Stemonitis fusca at Knebworth, xlvi.

Stevenage, rainfall at, in 1891, 56; in 1892, 206.

Stoat, notes on, 47.

STRADLING, A.: Crocodiles and Canaries (title only), xii; Man and Ape, xxxiv-xxxvii; snakes exhibited by, xi, xlv.

Sugaring at Bricket Wood, 197.

Summer migrants in 1891, 68; in 1892, 167; notes on their arrival, 166.

Swallow, notes on, 66.

Symonds Hyde Great Wood visited, xlv; Lepidoptera of, xlv.

T.

Tæniocampa, sps., in Herts, 197, 198.

Talpa europæa, notes on, 43.

Temperature of the air at Throcking, 1880-89, 215; at Watford, 1877-86, 222, 225, 227.

TENNYSON quoted, 129, 135, 136.

Terrestrial British quadrupeds, 41.

Tertiaries at St. Albans, xxiv.

Thame district, rainfall in, in 1891, 59; in 1892, 209.

Thecla quercus at Bricket Wood, 198.

Therfield, rainfall at, in 1891, 56; in 1892, 206.

Throcking, rainfall at, in 1891, 56; in 1892, 206; temperature and rainfall at, 1880-89, 213.

Thunderstorm in June, 1892, 210, 212.

Thyatira batis and *derasa* in Herts, 197, 198.

Tittenhanger visited, xlix.

Totanus calidris in Herts, 65.

Tremellodon gelatinosum at Wormley, xxxi.

Trichia affinis at Digswell, lii.

Tricholea tomentella in Herts, 235.

Tring, rainfall at, in 1891, 56; in 1892, 206; pintail duck at, 162.

Tring Reservoirs, grey phalarope at, 64.

Triphæna fimbria at Bricket Wood, 198.

Turdus merula, light-coloured, 163.

V.

Vanessa atalanta, *cardui*, and *antiopa* at Southgate, 190.

VERULAM, Earl of, reception of members by, at Gorhambury, St. Albans, xxviii.

Verulam House, St. Albans, site of, xxvi.

Viola Riviana at East Hyde, xx.

Visitants, autumn and winter, in 1891, 68.

Voles, notes on, 49.

Voyage of the "Beagle," 109, 117.

W.

WARD, L. F. (quoted), on Charles Darwin, 119.

Ware, rainfall at, in 1891, 56; in 1892, 206.

WARNER, H., reception of members by, at Wormley, xxx.

Water-rail at Shendish, 64.

Water-supply of London, x, xiv, xxxix.

Water-vole, notes on, 49, 172.

Watford, ordinary meetings at, in 1891, x-xi; in 1892, xii, xviii-xx, xxxii-xxxiv; in 1893, xxxiv-xxxvii, xlv-xlv; rainfall at, in 1891, 56, 58; in 1892, 204, 206; climate of, 219.

Weasel, notes on, 47.

Welwyn, rainfall at, in 1891, 56, 58; in 1892, 204, 206; heron, tufted duck, and smew killed near, 64.

Weston Park, Stevenage, rainfall at, in 1891, 56; in 1892, 206.

Wettest days in 1891, 58; in 1892, 208.

WHITAKER, W., remarks on geology of St. Albans, xxiii.

WILLIS, J. J.: A Naturalist's Calendar for Mid-Hertfordshire, xx, 76-84.

Wind, force and direction of, at Watford, 1877-86, 228, 229.

Winter visitants in 1891, 68.

Woodcock Hill Kilu visited, xlv.

Wood-leopard moth in Herts, 192.

Woodpecker, green and greater spotted, in Herts, 62.

Wormley Wood visited, xxx; fungi of, xxx.

X.

Xanthia, sps., at Bricket Wood, 197.

Xanthosetia hamana at Zouches Farm, Dunstable, xlviii.

Xylophasia rurea at Bricket Wood, 197.

Y.

Yellow-hammer, a partial migrant, 164.

Z.

Zanclognatha grisealis at Bricket Wood, 197.

Zeugera pyrina in Herts, 192.

Zouches Farm, Dunstable, visited, xlviii.

LIBRARY
OF THE
HERTFORDSHIRE NATURAL HISTORY SOCIETY
AND FIELD CLUB

APPENDIX.

LIST OF MEMBERS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY
AND FIELD CLUB.

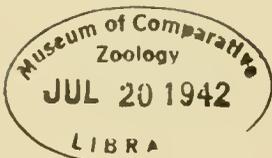
APRIL, 1894.

PAST PRESIDENTS.

- 1875-77. SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D.,
Treas.R.S., V.P.S.A.
1877-79. ALFRED T. BRETTE, M.D.
1879-81. J. GWYN JEFFREYS, LL.D., F.R.S., F.L.S., F.G.S.
1881-83. GEORGE ROOPER, F.Z.S.
1883-85. RIGHT HON. THE EARL COWPER, K.G.
1885-87. PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S.
1877-89. F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S.
1889-91. RIGHT HON. THE EARL OF CLARENDON.
1891-93. JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc.
-

TRUSTEES.

ALFRED T. BRETTE, M.D.
JOHN HOPKINSON, F.L.S., F.G.S.
W. LEPARD SMITH.



80032

HONORARY MEMBERS.

Elected

- 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.*
- 1883 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, F.R.A.S., F.R.Met.Soc., *Brantholme, Kendal, Westmoreland.*
- 1882 Cooke, M. C., M.A., LL.D., A.L.S., *Herbarium, Royal Gardens, Kew*; and *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 *14, Carlyle Square, Chelsea, London, S.W.*
- 1893 Flower, Sir William Henry, K.C.B., LL.D., F.R.S., F.R.C.S., F.L.S., F.G.S., Pres.Z.S., Director of the Natural History Department of the British Museum, *Cromwell Road, South Kensington, S.W.*; and *26, Stanhope Gardens, London, S.W.*
- 1890 Geikie, Sir Archibald, D.Sc., LL.D., F.R.S., F.R.S.E., F.G.S., Director-General of the Geological Surveys of the United Kingdom, *28, Jermyn Street, 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*; and *1, Dartmouth Place, Blackheath.*
- 1879 Harting, James Edmund, F.L.S., F.Z.S., Mem. Brit. Orn. Union, *Linnean Society, Burlington House, London, W.*
- 1877 Henslow, Rev. George, M.A., F.L.S., F.G.S., F.R.H.S., Professor of Botany, Queen's College, London, *Drayton House, Ealing.*

- 1875 Hooker, Sir Joseph Dalton, R.N., K.C.S.I., C.B., M.D., D.C.L. (Oxon.), LL.D. (Cantab.), F.R.S., F.L.S., F.G.S., etc., *The Camp, Sunningdale, Berks.*
- 1883 Huxley, Rt. Hon. Thomas Henry, P.C., D.C.L. (Oxon.), LL.D. (Edin.), M.D., Ph.D., F.R.S., F.L.S., F.G.S., F.Z.S., etc., Dean of the Royal College of Science, *South Kensington, S.W.*; and *Hodeslea, Eastbourne.*
- 1886 Jackson, Benjamin Daydon, Sec.L.S., *Clevedon, Cautley Avenue, Clapham Common, London, S.W.*
- 1883 Jones, Thomas Rupert, F.R.S., F.G.S., ex-Professor of Geology at the Royal Military College, Sandhurst, *10, Uverdale Road, King's Road, Chelsea, London, S.W.*
- 1875 Lubbock, Rt. Hon. Sir John, Bart., P.C., M.P., D.C.L., LL.D., F.R.S., F.S.A., F.L.S., F.G.S., *High Elms, Farnborough, Kent*; and *15, Lombard Street, London, E.C.*
- 1881 Ormerod, Eleanor A., F.R.Met.Soc., F.E.S., *Torrington House, St. Albans.*
- 1880 Selater, Philip Lutley, M.A., Ph.D., F.R.S., F.L.S., F.G.S., Sec. Z.S., *3, Hanover Square, London, W.*
- 1885 Seebohm, Henry, F.L.S., F.Z.S., *22, Courtfield Gardens, Cromwell Road, London, S.W.*
- 1876 Symons, George James, F.R.S., Sec.R.Met.Soc., *62, Camden Square, London, N.W.*
- 1876 Whitaker, William, B.A. (Lond.), F.R.S., F.G.S., Assoc. Inst.C.E., Geological Survey of England, *33, East Park Terrace, Southampton*; and *28, Jermyn Street, London, S.W.*

CORRESPONDING MEMBER.

- 1894 Saunders, James, *47, Rathgar Road, Luton.*

ORDINARY MEMBERS.

An asterisk before a name indicates a Life Member.

Elected

- 1890 Acworth, Mrs., *The Hook, Northaw, Potter's Bar.*
1887 André, R., *Melrose, Bushey Grove, Watford.*
1879 Andrews, R. Thornton, *Castle Street, Hertford.*
1892 Archer, Miss Janet, *St. George's Villa, Chalk Hill, Watford.*
1890 Ashdown, C. H., F.R.G.S., *Belmont, St. Albans.*
1883 *Attenborough, Mrs., *Haydon Hill, Bushey, Watford.*
1877 *Attfield, John, M.A., Ph.D., F.R.S., F.C.S., F.I.C., Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, *Ashlands, Watford*; and *17, Bloomsbury Square, London, W.C.*
1879 Austin, Vernon, *Blairgowrie, Bengoe, Hertford.*
1893 Ayres, Mrs., *High Croft, Watford.*
- 1893 Baldwin, W. Wallis, *Netherheys, Watford.*
1879 *Barelay, Robert, *High Leigh, Hoddesdon.*
1891 Barelay, Robert P., *High Leigh, Hoddesdon.*
1891 Barker, George, *Kettlewells, St. Albans.*
1878 Barraud, Allan, *Bushey Heath, Watford.*
1889 Bates, H. Leslie, L.R.C.P. (Lond.), *Thorne House, St. Albans.*
1892 Batters, E. A. L., LL.B., B.A., F.L.S., *The Laurels, Wormley.*
1887 Beck, Ernest, *Hoddesdon.*
1877 Benskin, Mrs. Joseph, *Chalk Hill, Watford.*
1892 Benskin, Thomas, 196, *High Street, Watford.*
1880 Berkeley, B. Comyns, *Collett Hall, Ware.*
1883 *Berry, F. Haycraft, M.D. (Lond.), *Wansford House, Watford.*
1883 *Bickersteth, John P., *Grove Mill House, Watford.*

- 1880 Bishop, Mrs., *The Platts, Watford.*
 1892 Blackburn, H., *Nascot Grange, Watford.*
 1885 Blathwayt, A. P., *Frogmore, Watford.*
 1893 Bloomer, C. E., 22, *St. Alban's Road, Watford.*
 1892 Bolton, Mrs. A. E., 1, *London Road, St. Albans.*
 1887 Bosanquet, Percival, *Ponfield, Little Berkhamsted.*
 1875 *Brett, Alfred T., M.D., *Watford House, Watford.*
 1887 Brown, Arthur M., M.A., *Beech Grove, Tring.*
 1891 Brunton, Sydney, *Frogmore House, St. Albans.*
 1885 Burchell-Herne, Rev. H. F. H., *Bushey Grange, Watford.*
 1884 Burr, E. T., *Oakley Lodge, Clarendon Road, Watford.*
 1881 *Bushby, Lady Frances, *Wormley Bury, Hoddesdon.*
 1880 Butcher, H. O. F., *High Street, Ware.*
 1889 *Butler, Charles, *Warren Wood, Hatfield.*
 1879 Buxton, Alfred Fowell, 5, *Hyde Park Street, London, W.*
 1894 Buxton, Dudley, M.D., *Bushey Cottage, Bushey Heath, Watford.*
 1885 Buxton, John Henry, *Hunsdon Bury, Ware.*
 1879 Buxton, Thomas Fowell, *Easneye Park, Ware.*
- 1879 Campbell, Frank Maule, F.L.S., F.Z.S., F.R.M.S., F.E.S.,
 HON. SEC., *Rose Hill, Hoddesdon.*
 1875 Capell, Hon. Arthur, *Cassiobury Park, Watford.*
 1883 Capell, Hon. Colonel, *Lady's Close, Watford.*
 1875 *Carew, Mrs., *Carpenders Park, Watford.*
 1876 *Carew, Robert Marcus, *Carpenders Park, Watford.*
 1879 *Carlile, James W., *Ashendene, Hertford.*
 1886 Carter, W. R., B.A., LIBRARIAN, *Bushey Hall Road, Watford.*
 1891 Case, Henry, M.R.C.S., *Leavesden Asylum, Watford.*
 1893 Casson, R., *Woodford Road, Watford.*
 1875 Chater, Edward M., *St. Alban's Road, Watford.*
 1877 Clarendon, Right Honourable the Earl of, *Grove Park, Watford*; and 11, *Berkeley Square, London, W.*
 1894 Clarke, Adams, M.D., *Bushey, Watford.*
 1893 Cobb, Mrs., *Garston, Watford.*
 1886 Coles, William, 60, *Queen's Road, Watford.*
 1879 *Cowper, Right Honourable the Earl, K.G., *Panshanger, Hertford*; 5, *St. James' Square, London, S.W.*; and
Athenæum Club, S.W.
 1894 Cox, Alfred E., 78, *Queen's Road, Watford.*
 1876 *Croft, Richard Benyon, R.N., *Fanhams Hall, Ware.*
 1878 *Croft, Mrs., *Fanhams Hall, Ware.*
 1893 Crouch, Mrs., *Rossllyn, Watford.*
 1894 Curry, Charles Albert, *Woodoaks, Rickmansworth.*

- 1891 Daltry, B. H. R., 24, *Queen's Road, Hertford.*
 1888 Daw, S. J., *Elmhurst, Langley Park, Watford.*
 1885 Dennison, T. A., *Airedale House, Queen's Road, Watford.*
 1892 Dillon, C. E., *Lismore Cottage, Bushey, Watford.*
 1890 Downer, Frederick, *High Street, Watford.*
 1894 Dudgeon, Arthur, *Northbank, Watford.*
 1885 Durrant, John Hartley, F.E.S., Entomological Secretary to
 Lord Walsingham, *Merton Hall, Thetford.*
 1893 Duvall, John William, *The Grange, Ware.*
- 1893 Edmunds, Mrs., 86, *High Street, Watford.*
 1883 Ekins, Arthur Ernest, F.C.S., *Market Cross, St. Albans.*
 1892 Essex, Right Honourable the Earl of, *Cassiobury Park,
 Watford.*
 1875 *Evans, Sir John, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S.,
 V.P.S.A., F.L.S., F.G.S., etc., *Nash Mills, Hemel
 Hempstead.*
 1891 Evans, Lewis, F.S.A., *Belswains, Hemel Hempstead.*
 1893 Evelegh, Markham, *Essex Road, Watford.*
 1878 Ewing, Rev. J. A., M.A., *Westmill Rectory, Buntingford.*
- 1888 Farries, Thomas, 30, *Clarendon Road, Watford.*
 1892 Fisk, James, *High Street, St. Albans.*
 1892 Fisk, William J., *Street Lodge, Watford.*
 1875 *Fordham, H. George, F.G.S., *Odsey, Ashwell, Baldock.*
 1875 Fry, Clarence E., *Elmcote, Watford.*
- 1879 *Gibbs, Arthur E., F.L.S., F.E.S., CURATOR, *Avenue House,
 St. Albans.*
 1891 Gibbs, Richard, *The Hollies, St. Albans.*
 1875 Gibbs, Surgeon-Major J. G., *Riggendale Road, Streatham,
 London, S.W.*
 1879 Gilbert, Sir Joseph Henry, Ph.D., LL.D., F.R.S., F.L.S.,
 F.C.S., F.R.Met.Soc., *Harpenden.*
 1892 Gillman, Arthur R., *Springfield, Woodridings, Pinner.*
 1894 Goodwin, J., *Langley Park House, Watford.*
 1875 Green, George, *Field House, Watford.*
 1885 Green, Upfield, F.G.S., *Liebenheim, Watford.*
 1886 Griffith, Acton F., *Elmsfield, Hertford.*
 1880 Grimthorpe, Right Honourable Baron, LL.D., Q.C.,
 F.R.A.S., *Batch Wood, St. Albans; and 33, Queen
 Anne Street, London, W.*
 1875 Groome, John Edward, *King's Langley.*
 1891 Gruggen, W., L.R.C.P.E., 11, *Montpellier Road, Ealing.*

- 1875 *Halsey, Thomas F., M.P., *Gaddesden Place, Hemel Hempstead*; and 73, *Eaton Place, London, S.W.*
- 1889 Harford, W. M., *Manor House, Bushey, Watford.*
- 1875 Harrison, Edward, *Upper Nascot, Watford.*
- 1880 Harvey, Rev. C. Wigan, M.A., *Throcking Rectory, Buntingford.*
- 1890 Headley, F. W., M.A., *Haileybury College, Hertford.*
- 1879 Heard, H. C., *Hailey Hall, Hertford.*
- 1887 Henty, Robert, *Langley House, Abbot's Langley.*
- 1885 Hill, Daniel, *Herga, St. Andrews, Watford.*
- 1881 Hill, William, F.G.S., *The Maples, Hitchin.*
- 1889 Hine, Harry, *Holywell Hill, St. Albans.*
- 1872 Hoare, Richard, *Marden Hill, Tewin, Hertford.*
- 1885 Hoddinot, E. H., 19, *Nassington Road, Hampstead, London, N.W.*
- 1875 Holland, Stephen Taprell, *Otterspool, Aldenham, Watford.*
- 1875 Holland-Hibbert, Hon. A. H., *Munden House, Watford.*
- 1894 Hope, Thomas, *St. Ronans, Watford.*
- 1875 Hopkinson, Mrs. James, *Holly Bank, Watford.*
- 1875 *Hopkinson, John, F.L.S. F.G.S., F.R.M.S., F.R.Met.Soc., HON. SEC. and EDITOR, *The Grange, St. Albans*; and *Margaret Street, Cavendish Square, London, W.*
- 1875 *Hopkinson, Mrs. John, *The Grange, St. Albans.*
- 1883 *Hovell, T. Mark, F.R.C.S. (Edin.), *Boreham Holt, Elstree*; and 3, *Mansfield Street, Cavendish Square, London, W.*
- 1892 *Hudson, George Bickersteth, M.P., *Watton, Hertford.*
- 1885 Hughes, T. McKenny, M.A., F.R.S., F.S.A., F.G.S., Professor of Geology in the University of Cambridge, *Trinity College, Cambridge.*
- 1887 Hunt, J. A., *Hoddesdon.*
- 1875 James, J. Henry, *Kingswood, Leavesden, Watford.*
- 1894 Janes, Clement, *Hunter's Farm, Leavesden, Watford.*
- 1877 Jeans, Mrs., *Eastleigh, Essex Road, Watford.*
- 1890 Jones, Charles E., *Russell Farm, Watford.*
- 1894 Jones, Picton, *Conishead, Watford.*
- 1893 Jourdain, Miss, *Corran, Watford.*
- 1879 Keyser, Charles Edward, F.S.A., *Merry Hill House, Bushey, Watford*; and 47, *Wilton Crescent, London, S.W.*
- 1893 Kember, Mrs., *Luton Road, Harpenden.*
- 1893 Kent, Harold, *Roseberry, Watford.*
- 1892 Knyvett, Felix Sumner, *Ashwellthorpe, Watford.*

- 1893 Lake, Miss, *Wellfords, Bricket Road, St. Albans.*
- 1876 *Lambert, Colonel George, F.S.A., *Coventry Street, Haymarket, London, W.*
- 1892 Larkin, John, *Delrow, Aldenham, Watford.*
- 1889 Lawrance, Venerable Archdeacon, M.A., *The Rectory, St. Albans.*
- 1892 Lees, William Henry, *Sandonbury, Royston.*
- 1892 Lewis, Arthur, *Sparrowswick, St. Albans.*
- 1880 Lewis, Henry, *Worley Road, St. Albans.*
- 1883 Lloyd, Frederick George, *Oakwood, Bexley, Kent.*
- 1890 *Longman, A. H., *Shendish, Hemel Hempstead.*
- 1891 *Lowe, Frederick, *Fulham, Tring.*
- 1889 *Loyd, E. H., *Langleybury, Watford.*
- 1891 *Lubbock, Henry, *Newberries, Radlett.*
- 1876 *Lucas, Francis, *Hitchin.*
- 1876 *Lucas, William, *The Firs, Hitchin.*
- 1876 McFarlane, W. McMurray, *Loudwater, Rickmansworth.*
- 1875 McGill, H. J., *Aldenham, Watford.*
- 1888 Maclean, Allen, L.R.C.S., *Harpenden Hall, Harpenden.*
- 1894 Mahon, F. C., *Wolfeville, Clarendon Road, Watford.*
- 1893 Manning, Percy, *North End House, Watford.*
- 1876 Manser, Edward, *Lea Side, Hertford.*
- 1881 *Marshall, Rev. C. J., M.A., *Shillingstone Rectory, Dorset.*
- 1875 *Marshall, Frank E., M.A., *Harrow.*
- 1890 Mawley, Edward, F.R.Met.Soc., F.R.H.S., *Rosebank, Berkhamsted.*
- 1885 Moore, Walter E., *Westfield, St. Andrews, Watford.*
- 1882 Morison, John, M.D., F.G.S., *Victoria Street, St. Albans.*
- 1893 Murray, A. T., *Harpely, Stratford Road, Watford.*
- 1893 Neele, G. P., *The Lawn, Clarendon Road, Watford.*
- 1889 Neish, J. Watson, *Highfield, Watford.*
- 1889 Nicholl, Digby S. W., F.L.S., F.G.S., *The Ham, Cowbridge, Glamorganshire.*
- 1883 Nicholson, Sir Charles, Bart., K.B., M.D., D.C.L., LL.D., F.G.S., F.R.Met.Soc., *The Grange, Totteridge.*
- 1875 Noakes, Simpson, *Bushey Heath, Watford.*
- 1886 Noel, E. F., *Manor House, Stanmore.*
- 1889 Norman, Edward H., *Moor Place, Much Hadham.*
- 1893 Norris, W. H., *Bengeo, Hertford.*
- 1894 Oddie, E. G., *Oxford Lodge, Watford.*
- 1889 *Ormerod, Miss Georgiana E., *Torrington House, St. Albans.*
- 1894 Osborne, Mrs., *Widcombe Lodge, Watford.*

- 1893 Pank, John Lovell, *Barnet*.
 1889 *Panton, J. A., *Cecil Lodge, Abbot's Langley*.
 1885 *Parker, Rev. J. D., LL.D., F.R.Met.Soc., *Bennington House, Stevenage*.
 1885 Peacock, T. J., *Queen Street, Watford*.
 1879 Phillips, Frederick W., *Manor House, Hitchin*.
 1876 *Pollard, Joseph, *High Down, Hitchin*.
 1879 Price, George, *High Street, Ware*.
 1887 Procter, Harold, *Hunton Bridge, Watford*.
 1881 *Pryor, Marlborough R., M.A., F.Z.S., *Weston Manor, Stevenage*.
 1892 Puddicombe, W. N., M.R.C.S., *London Road, St. Albans*.
- 1881 *Ransom, Francis, *Bedford Road, Hitchin*.
 1877 *Ransom, William, F.S.A., F.L.S., *Fairfield, Hitchin*.
 1893 Reader, F. W., *Glenroy, Watford*.
 1892 *Riggall, James K., 3, *Albert Terrae, Watford*.
 1887 Roberts, T. Vaughan, *Verulam House, Watford*.
 1891 Robins, G. Upton, *Delaport, Wheathamstead*.
 1884 Robins, Mrs., *The Elms, Watford*.
 1879 Robinson, Isaac, *Beninghoe, Hertford*.
 1875 Rooper, George, F.Z.S., *Nascot House, Watford*.
 1878 Ross, Captain George Ernest A., F.G.S., F.R.G.S., 8, *Collingham Gardens, Cromwell Road, London, S.W.*
 1888 *Rothschild, Honourable Walter, *Tring Park, Tring*.
 1893 Rowse, E. P., *Nutley, Watford*.
 1894 Rudyard, H. Ashton, M.D., *St. Alban's Road, Watford*.
- 1891 Sainsbury, Percy Hamilton, *Huskards, Watford*.
 1879 *Salisbury, Most Noble the Marquis of, K.G., D.C.L., F.R.S., *Hatfield House, Hatfield*; and 20, *Arlington Street, London, S.W.*
- 1891 Salter, Stephen, *Hills Court, Clarendon Road, Watford*.
 1885 Schreiber, W. F. D., *Dalton House, Watford*.
 1893 Scott, Duncan, M.D., *Station Road, Watford*.
 1894 Sedgwick, Rupert, 44, *High Street, Watford*.
 1883 *Seebohm, Frederick, *The Hermitage, Hitchin*.
 1878 Selby, Miss, *Battlers Green, Radlett*.
 1891 Sell, Miss A. C., *Fairfield House, Watford*.
 1880 Shelly, Charles Edward, M.A., M.D. (Cantab.), M.R.C.S., *Fore Street, Hertford*.
 1883 Sherry, Henry S., *Dynmore, Watford*.
 1889 Sibbald, J. G. E., 3, *Townshend Villas, Richmond, Surrey*.
 1875 Silvester, Frank W., *Hedges, St. Albans*.

- 1893 Slinn, E. J., *Langsyne, Watford.*
 1891 Slocombe, Edward, *Oxhey Warren, Watford.*
 1879 Smith, Abel, M.P., *Woodhall Park, Watton, Hertford*; and
 35, *Chesham Place, London, S.W.*
 1881 Smith, Abel H., M.P., *Watton, Hertford.*
 1891 Smith, Arthur, *Smallford, St. Albans.*
 1875 Smith, Joseph G., *Hamper Mills, Watford.*
 1880 *Smith, Robert, *Goldings, Hertford.*
 1879 Smith, Urban A., Assoc.M.Inst.C.E., *Beacon House, St.*
 Albans.
 1875 *Smith, W. Lepard, *The Riffel, Clarendon Road, Watford.*
 1880 *Smith-Bosanquet, Horace J., F.R.G.S., *Broxbourne Bury,*
 Hoddesdon.
 1890 *Solly, H. Reynolds, *Serge Hill, Bedmont.*
 1889 Spackman, J. Woolsey, *Chislehurst.*
 1894 Spencer, S. H., Junr., 45, *Gladstone Road, Watford.*
 1875 Stone, William T., *Oxhey Lane, Watford.*
 1883 Stradling, Arthur, M.R.C.S., F.Z.S., PRESIDENT, *Flores,*
 Watford.
 1893 Swindon, Miss, *The Hollies, St. Alban's Road, Watford.*
 1890 Syme, W. H., *Ottawa House, Queen's Road, Watford.*
- 1875 Thairlwall, F. J., 12, *Upper Park Road, London, N.W.*
 1887 Thornhill, James, F.L.S., *Oxford House, St. Albans.*
 1892 Topley, William, F.R.S., F.G.S., Assoc. Inst. C.E.,
 Geological Survey of England, 28, *Jermyn Street,*
 London, S.W.; and 13, *Havelock Road, Croydon.*
 1886 Tuck, Horace J., *St. Leonard's, Bengoe, Hertford.*
 1878 *Tuke, James Hack, *Hitchin.*
 1894 Turner, Thomas, *Oakleigh, Watford.*
- 1890 Van Raiïte, Charles, *Aldenham Abbey, Watford.*
 1878 Vaughan, Rev. Edward T., M.A., *Langleybury Vicarage,*
 Watford.
 1893 Vaux, E. P., *Densworth, Watford.*
 1892 Verey, A. Sainsbury, *Heronsgate, Rickmansworth.*
 1875 Verini, William, *Watford.*
 1879 Verulam, Right Honourable the Earl of, F.R.G.S., *Gorham-*
 bury, St. Albans.
 1886 Villiers, T. J., *Watford.*
- 1879 Wailes, G. Herbert, *Rounton, Watford.*
 1888 Walker, A. S., *Bonningtons, Stratford Road, Watford.*
 1875 Walker, J. Watson, *Cefn Llys, Stanley Road, Watford.*

- 1893 Wallen, Frederick, *Bricket Wood, St. Albans*; and 96, *Gower Street, London, W.C.*
- 1892 *Wardale, Rev. John, M.A., *Datchworth Rectory, Stevenage.*
- 1881 Warner, Henry, *Wormley, Hoddesdon.*
- 1881 Weall, John, TREASURER, *Rutland Lodge*, and 38, *High Street, Watford.*
- 1894 Wehrschmidt, Daniel A., *Cleveland, Bushey, Watford.*
- 1891 Weir, Percy Jenner, 7, *Bucklersbury, London, E.C.*
- 1894 Wells, T. P. Grosart, L.R.C.P. (Edin.), *St. Peter's Street, St. Albans.*
- 1880 White, S. Monckton, *Elmsleigh, St. Albans.*
- 1881 *Wigram, Miss E., *Moor Place, Much Hadham.*
- 1892 Wiles, Miss Jane, *George Street, St. Albans.*
- 1894 Williams, W. H., *Alexandra Road, Watford.*
- 1892 Wilks, E. T., F.R.G.S., *Monmouth House, High Street, Watford.*
- 1894 Wilson, Rev. Arthur, M.A., *Leavesden Vicarage, Watford.*
- 1875 *Wilson, Miss Mary, *Nutfield, Watford.*
- 1882 *Woods, Thomas Hoade, *Durrants, Watford.*
- 1893 Wyles, Walter C., *Carpenders, Watford.*
- 1888 Young, Walter P., F.R.M.S., *Hertford House, Albert Road, Battersea Park, London, S.W.*

TOPOGRAPHICAL INDEX TO THE MEMBERS.

An asterisk after a name indicates an Honorary Member ; an obelisk, a Corresponding Member.

ENGLAND.

BEDFORDSHIRE.

Luton—Saunders, J.†

BERKSHIRE.

Sunningdale—Hooker, Sir J. D.*

CAMBRIDGESHIRE.

Cambridge—Babington, Prof. C. | *Cambridge*—Hughes, Prof. T.
C.* | McK.

DORSETSHIRE.

Parkstone—Allman, Prof. G. J.* | *Shillingstone*—Marshall, Rev. C. J.

HAMPSHIRE.

Southampton—Whitaker, W.*

HERTFORDSHIRE.

<i>Abbot's Langley</i> —Henty, R.	<i>Hertford</i> —Andrews, R. T.
— Panton, J. A.	— Carlile, J. W.
<i>Barnet</i> —Pank, J. L.	— Cowper, Earl
<i>Bedmont</i> —Solly, H. R.	— Daltry, B. H. R.
<i>Berkhamsted</i> —Mawley, E.	— Griffith, A. F.
<i>Buntingford (Throcking)</i> —	— Heard, H. C.
Harvey, Rev. C. W.	— Manser, E.
— (<i>Westmill</i>)—Ewing, Rev.	— Robinson, I.
J. A.	— Shelly, Dr. C. E.
<i>Elstree</i> —Hovell, T. M.	— Smith, R.
<i>Harpenden</i> —Gilbert, Sir J. H.	— (<i>Bengeo</i>)—Austin, V.
— Kember, Mrs.	— — Norris, W. H.
— Maclean, A.	— — Tuck, H. J.
<i>Hatfield</i> —Butler, C.	— (<i>Haileybury</i>)—Headley, F.
— Salisbury, Marquis of	W.
<i>Hemel Hempstead</i> —Evans, Sir J.	— (<i>Tewin</i>)—Hoare, R.
— Evans, L.	— (<i>Watton</i>)—Hudson, G. B.
— Halsey, T. F.	— — Smith, A.
— Longman, A. H.	— — Smith, A. H.

- Hitchin*—Hill, W.
 — Lucas, F.
 — Lucas, W.
 — Phillips, F. W.
 — Pollard, J.
 — Ransom, F.
 — Ransom, W.
 — Seebohm, F.
 — Tuke, J. H.
Hoddesdon—Barelay, R.
 — Barelay, R. P.
 — Beek, E.
 — Bushby, Lady F.
 — Campbell, F. M.
 — Hunt, J. A.
 — Smith-Bosanquet, H. J.
 — Warner, H.
King's Langley—Groome, J. E.
Little Berkhamsted—Bosanquet,
 P.
Much Hadham—Norman, E. H.
 — Wigram, Miss E.
Odsey—Fordham, H. G.
Potter's Bar (Northaw)—
 Aekworth, Mrs.
Radlett—Lubbock, H.
 — Selby, Miss
Rickmansworth—Curry, C. A.
 — McFarlane, W. McM.
 — (*Heronsgate*)—Verey, A. S.
Royston—Lees, W. H.
St. Albans—Ashdown, C. H.
 — Barker, G.
 — Bates, H. L.
 — Bolton, Mrs. A. C.
 — Brunton, S.
 — Ekins, A. E.
 — Fisk, J.
 — Gibbs, A. E.
 — Gibbs, R.
 — Grimthorpe, Baron
 — Hine, H.
 — Hopkinson, J.
 — Hopkinson, Mrs.
 — Lake, Miss
 — Lawrance, Arehdeacon
 — Lewis, A.
 — Lewis, H.
 — Morison, Dr. J.
 — Ormerod, Miss
St. Albans—Ormerod, Miss E.
 A.*
 — Phillips, Mrs.
 — Puddicombe, W. N.
 — Silvester, F. W.
 — Smith, U. A.
 — Thornhill, J.
 — Verulam, Earl of
 — Wells, T. P. G.
 — White, S. M.
 — Wiles, Miss J.
 — (*Bricket Wood*)—Wallen,
 F.
 — (*Smallford*)—Smith, A.
Stevenage (Bennington)—Parker,
 Rev. J. D.
 — (*Datchworth*)—Wardale,
 Rev. J.
 — (*Weston*)—Pryor, M. R.
Totteridge—Nicholson, Sir C.
Tring—Brown, A. M.
 — Lowe, F.
 — Rothschild, Hon. W.
Ware—Berkeley, B. C.
 — Butcher, H. O. F.
 — Buxton, J. H.
 — Buxton, T. F.
 — Croft, R. B.
 — Croft, Mrs.
 — Duvall, J. W.
 — Price, G.
Watford—André, R.
 — Areher, Miss J.
 — Attfield, Prof. J.
 — Ayres, Mrs.
 — Baldwin, W. W.
 — Benskin, Mrs. J.
 — Benskin, T.
 — Berry, Dr. F. H.
 — Biekersteth, J. P.
 — Bishop, Mrs.
 — Blackburn, H.
 — Blathwayt, A. P.
 — Bloomer, C. E.
 — Brett, Dr. A. T.
 — Burehell-Herne, Rev. H.
 F. H.
 — Burr, E. T.
 — Capell, Hon. A.
 — Capell, Hon. Colonel

Watford—Carew, Mrs.
 — Carew, R. M.
 — Carter, W. R.
 — Casson, R.
 — Chater, E. M.
 — Clarendon, Earl of
 — Coles, W.
 — Cox, A. E.
 — Crouch, Mrs.
 — Daw, S. J.
 — Dennison, T. A.
 — Downer, F.
 — Dudgeon, A.
 — Duvall, J. W.
 — Edmunds, Mrs.
 — Essex, Earl of
 — Eveleigh, M.
 — Farries, T.
 — Fisk, W. J.
 — Fry, C. E.
 — Goodwin, J.
 — Green, G.
 — Green, U.
 — Harrison, E.
 — Hill, D.
 — Holland-Hibbert, Hon. A. H.
 — Hope, T.
 — Hopkinson, Mrs.
 — Jeans, Mrs.
 — Jones, C. E.
 — Jones, P.
 — Jourdain, Miss
 — Kent, H.
 — Knyvett, F. S.
 — Loyd, E. H.
 — Mahon, F. C.
 — Manning, P.
 — Moore, W. E.
 — Murray, A. T.
 — Neele, G. P.
 — Neish, J. W.
 — Oddie, E. G.
 — Osborne, Mrs.
 — Peacock, T. J.
 — Reader, F. W.
 — Riggall, J. K.
 — Roberts, T. V.
 — Robins, Mrs.
 — Rooper, G.
 — Rowse, E. P.

Watford—Rudyard, Dr. H. A.
 — Sainsbury, P. H.
 — Salter, S.
 — Schreiber, W. F. D.
 — Scott, Dr. D.
 — Sedgwick, R.
 — Sell, Miss A. C.
 — Sherry, H. S.
 — Slinn, E. J.
 — Slocombe, E.
 — Smith, J. G.
 — Smith, W. L.
 — Spencer, S. H., Jun.
 — Stone, W. T.
 — Stradling, A.
 — Swindon, Miss
 — Syme, W. H.
 — Turner, T.
 — Vaughan, Rev. E. T.
 — Vaux, E. P.
 — Verini, W.
 — Villiers, T. J.
 — Wailes, G. H.
 — Walker, A. S.
 — Walker, J. W.
 — Weall, J.
 — Wilks, E. T.
 — Williams, W. H.
 — Wilson, Miss M.
 — Woods, T. H.
 — Wyles, W. C.
 — (*Aldenham*)—Holland, S. T.
 — — Larkin, J.
 — — McGill, H. J.
 — — Van Raalte, C.
 — (*Bushey*)—Attenborough,
 Mrs.
 — — Barraud, A.
 — — Buxton, Dr. D.
 — — Clarke, Dr. A.
 — — Dillon, C. E.
 — — Harford, W. M.
 — — Keyser, C. E.
 — — Noakes, S.
 — — Wehrschmidt, D. A.
 — (*Garston*)—Cobb, Mrs.
 — (*Hunton Bridge*)—Procter,
 H.
 — (*Leavesden*)—Case, H.
 — — James, J. H.

<i>Watford (Leavesden)</i> —Janes, C. —— ——— Wilson, Rev. A.	<i>Wheatthamsted</i> —Robins, G. U. <i>Wormley</i> —Batters, E. A. L.
---	--

KENT.

<i>Bexley</i> —Lloyd, F. G. <i>Blackheath</i> —Glaisher, J.* <i>Chislehurst</i> —Spackman, J. W.	<i>Croydon</i> —Topley, W. <i>Farnborough</i> —Lubbock, Sir J.*
--	--

MIDDLESEX.

<i>Ealing</i> —Gruggen, W. —— Henslow, Rev. Prof. G.* <i>Harrow</i> —Marshall, F. E. <i>London</i> —Attfield, Prof. J. —— Buxton, A. F. —— Clarendon, Earl of —— Cooke, Dr. M. C.* —— Cowper, Earl —— Etheridge, R.* —— Flower, Sir W.* —— Geikie, Sir A.* —— Grimthorpe, Baron —— Halsey, T. F. —— Harting, J. E.* —— Hoddinot, E. H. —— Hopkinson, J. —— Hovell, T. M. —— Huxley, Rt. Hon. T. H.*	<i>London</i> —Jones, Prof. T. R.* —— Keyser, C. E. —— Lambert, G. —— Lubbock, Sir J.* —— Ross, Captain G. E. A. —— Salisbury, Marquis of —— Selater, Dr. P. L.* —— Seebohm, H.* —— Smith, A. —— Symons, G. J.* —— Thairlwall, F. J. —— Topley, W. —— Wallen, F. —— Weir, P. J. —— Whitaker, W.* <i>Pinner</i> —Gillman, A. <i>Stanmore</i> —Noel, E. F.
--	--

NORFOLK.

Thetford—Durrant, J. H.

SURREY.

<i>Kew</i> —Cooke, Dr. M. C.* <i>London</i> —Gibbs, J. G. —— Jackson, B. D.*	<i>London</i> —Young, W. P. <i>Richmond</i> —Sibbald, J. G. E.
--	---

SUSSEX.

Eastbourne—Huxley, Rt. Hon. T. H.*

WESTMORELAND.

Kendal—Brown, I.*

WALES.

GLAMORGANSHIRE.

Cowbridge—Nicholl, D. S. W.

END OF VOL. VII.

Dec. 7 4

APRIL]

Price 1s.

[1892.

TRANSACTIONS
 OF THE
 HERTFORDSHIRE
 NATURAL HISTORY SOCIETY
 AND
 FIELD CLUB.

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

VOL. VII. PART 1.

CONTENTS :

	PAGE
1. Anniversary Address—FRANCIS BACON. By the President, John Hopkinson. F.L.S., F.G.S., etc.	1

Parts 8 and 9 of Vol. VI, completing the volume, are in preparation, and will be published concurrently with the earlier parts of Vol. VII.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1892.

3

8e 11

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Public Library. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Public Library at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Library, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, The Limes, Grosvenor Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society.

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society.

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. Parts 1-6, price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD : STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.

Vice-Presidents:

ALFRED T. BRETT, M.D.

THE RIGHT HON. THE EARL OF CLARENDON.

R. B. CROFT, R.N., F.L.S., F.R.M.S.

JOHN EVANS, D.C.L., LL.D., Sc.D., Treas. R.S., Pres. S.A.

WILLIAM RANSOM, F.S.A., F.L.S.

C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., D.P.H., F.G.S., *Victoria Street, St. Albans.*

F. MAULE CAMPBELL, F.L.S., F.Z.S., etc., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER,
The Limes, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

PROF. ATTFIELD, M.A., Ph.D., F.R.S.

A. P. BLATHWAYT.

PERCIVAL BOSANQUET.

ARTHUR M. BROWN, M.A.

A. ETESON, M.D.

UPFIELD GREEN, F.G.S.

AUGUSTUS HAWKS.

GEORGE ROOPER, F.Z.S.

F. W. SILVESTER.

ARTHUR STRADLING, C.M.Z.S.

J. THORNHILL, F.L.S.

REV. E. T. VAUGHAN, M.A.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., F.L.S., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
COLEOPTERA.—Arthur Cottam, F.R.A.S., Eldercroft, Watford.
LEPIDOPTERA.—J. Hartley Durrant, F.E.S., Merton Hall, Thetford.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.
PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
BOTANY. { MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDEE AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

OCTOBER]

Price 1s.

[1892.

L. C. 7/04

TRANSACTIONS
OF THE
HERTFORDSHIRE
NATURAL HISTORY SOCIETY
AND
FIELD CLUB.

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

VOL. VII. PART 2.

CONTENTS :

	PAGE
2. Bats and some other Beasts. By George Rooper, F.Z.S.	37
3. Terrestrial British Quadrupeds existing in a Wild State at the Present Day. By T. Vaughan Roberts.....	41
4. Report on the Rainfall in Hertfordshire in 1891. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., President.....	53
5. Notes on Birds observed in Hertfordshire during the year 1891. By Henry Lewis	62

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1892.

£

Self

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Public Library. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Public Library at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Library, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Part 1, price 1s.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD: STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.

Vice-Presidents:

ALFRED T. BRETT, M.D.

THE RIGHT HON. THE EARL OF CLARENDON.

R. B. CROFT, R.N., F.L.S., F.R.M.S.

SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.

WILLIAM RANSOM, F.S.A., F.L.S.

C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., D.P.H., F.G.S., *Victoria Street, St. Albans.*

F. MAULE CAMPBELL, F.L.S., F.Z.S., etc., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

PROF. ATTFIELD, M.A., Ph.D., F.R.S.

A. P. BLATHWAYT.

PERCIVAL BOSANQUET.

ARTHUR M. BROWN, M.A.

A. ETESON, M.D.

UPFIELD GREEN, F.G.S.

AUGUSTUS HAWKS.

GEORGE ROOPER, F.Z.S.

F. W. SILVESTER.

ARTHUR STRADLING, C.M.Z.S.

J. THORNHILL, F.L.S.

REV. E. T. VAUGHAN, M.A.

RECORDERS.

PRE-HISTORIC ARCHAEOLOGY.—R. B. Croft, R.N., F.L.S., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
COLEOPTERA.—Arthur Cottam, F.R.A.S., Eldercroft, Watford.
LEPIDOPTERA.—J. Hartley Durrant, F.E.S., Merton Hall, Thetford.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.

BOTANY. { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDEE AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

Dec. 7/94

FEBRUARY]

Price 1s.

[1893.

TRANSACTIONS
 OF THE
 HERTFORDSHIRE
 NATURAL HISTORY SOCIETY
 AND
 FIELD CLUB.

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

VOL. VII. PART 3.

	PAGE
6. Meteorological Observations taken at The Grange, St. Albans, during the year 1891. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., President	69
7. A Naturalist's Calendar for Mid-Hertfordshire. By J. J. Willis.....	76
8. Report on Phenological Phenomena observed in Hertfordshire during the year 1891. By Edward Mawley, F.R.Met.Soc., F.R.H.S.....	85
9. Coal: its Nature, Origin, Position, and Extent; and its Range under the South of England. By Prof. T. Rupert Jones, F.R.S., F.G.S. Plates I. and II.	89

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD:

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1893.
5

eW

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Public Library at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Library, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-3. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD : STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.

Vice-Presidents:

ALFRED T. BRETT, M.D.

THE RIGHT HON. THE EARL OF CLARENDON.

R. B. CROFT, R.N., F.L.S., F.R.M.S.

SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.

WILLIAM RANSOM, F.S.A., F.L.S.

C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., D.P.H., F.G.S., *Victoria Street, St. Albans.*

F. MAULE CAMPBELL, F.L.S., F.Z.S., etc., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

PROF. ATTFIELD, M.A., PH.D., F.R.S.

A. P. BLATHWAYT.

PERCIVAL BOSANQUET.

ARTHUR M. BROWN, M.A.

A. ETESON, M.D.

UPFIELD GREEN, F.G.S.

AUGUSTUS HAWKS.

GEORGE ROOPER, F.Z.S.

F. W. SILVESTER.

ARTHUR STRADLING, C.M.Z.S.

J. THORNHILL, F.L.S.

REV. E. T. VAUGHAN, M.A.

RECORDERS.

PRE-HISTORIC ARCHAEOLOGY.—R. B. Croft, R.N., F.L.S., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
COLEOPTERA.—Arthur Cottam, F.R.A.S., Eldereroft, Watford.
LEPIDOPTERA.—J. Hartley Durrant, F.E.S., Merton Hall, Thetford.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.

BOTANY. { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI, HEPATICÆ, CHARACÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDÆ AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PRENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

APRIL.]

Price 1s.

[1893.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

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

VOL. VII. PART 4.

CONTENTS :

	PAGE
10. Anniversary Address—CHARLES DARWIN. By the President, John Hopkinson, F.L.S., F.G.S., etc.	101

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET

1893.

£

de W

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Public Library at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Library, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-3. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD: STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., C.M.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
THE RIGHT HON. THE EARL OF CLARENDON.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.
WILLIAM RANSOM, F.S.A., F.L.S.
C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., F.G.S., *Victoria Street, St. Albans.*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
ARTHUR M. BROWN, M.A.
R. B. CROFT, R.N.
UPFIELD GREEN, F.G.S.
AUGUSTUS HAWKS.

DANIEL HILL.
T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
J. THORNHILL, F.L.S.
REV. E. T. VAUGHAN, M.A.
PERCY JENNER WEIR.

RECORDERS.

PRE-HISTORIC ARCHAEOLOGY.—R. B. Croft, R.N., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
LEPIDOPTERA.—J. Hartley Durrant, F.E.S., Merton Hall, Thetford.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.

BOTANY. { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDEÆ AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

JULY.]

Price 1s.

[1893.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

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

VOL. VII. PART 5.

CONTENTS :

	PAGE
11. Notes on the Mycetozoa, with a List of Species from Hertfordshire and Bedfordshire. By James Saunders	137
12. Ice and its Work. By John Morison, M.D., F.G.S.	147
13. Climatological Observations taken in Hertfordshire in the year 1891. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. Plate III.	157
14. Notes on Birds observed in Hertfordshire during the year 1892. By Henry Lewis	161

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1893.

274

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Society, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-5. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD: STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., C.M.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
THE RIGHT HON. THE EARL OF CLARENDON.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.
WILLIAM RANSOM, F.S.A., F.L.S.
C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., F.G.S., *Victoria Street, St. Albans.*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
ARTHUR M. BROWN, M.A.
R. B. CROFT, R.N.
UPFIELD GREEN, F.G.S.
AUGUSTUS HAWKS.

DANIEL HILL.
T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
J. THORNHILL, F.L.S.
REV. E. T. VAUGHAN, M.A.
PERCY JENNER WEIR.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
LEPIDOPTERA.—A. E. Gibbs, F.L.S., The Hollies, St. Albans.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.

BOTANY. { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDEE AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

SEPTEMBER.]

Price 1s.

[1893.

TRANSACTIONS
OF THE
HERTFORDSHIRE
NATURAL HISTORY SOCIETY
AND
FIELD CLUB.

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

VOL. VII. PART 6.

CONTENTS :

	PAGE
15. Notes on some Hertfordshire Mammalia. By T. Vaughan Roberts	169
16. Meteorological Observations taken at The Grange, St. Albans, during the year 1892. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.	175
17. Report on Phenological Phenomena observed in Hertfordshire during the year 1892. By Edward Mawley, F.R.Met.Soc., F.R.H.S.	182
18. Notes on Lepidoptera observed in Hertfordshire. By A. E. Gibbs, F.L.S.	187
19. Climatological Observations taken in Hertfordshire in the year 1892. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. (To be concluded in Part 7.)	199

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1893.

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Society, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-5. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD : STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., C.M.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
THE RIGHT HON. THE EARL OF CLARENDON.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.
WILLIAM RANSOM, F.S.A., F.L.S.
C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., F.G.S., *Victoria Street, St. Albans.*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S.,
The Hollies, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
ARTHUR M. BROWN, M.A.
R. B. CROFT, R.N.
UPFIELD GREEN, F.G.S.
AUGUSTUS HAWKS.

DANIEL HILL.
T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
J. THORNHILL, F.L.S.
REV. E. T. VAUGHAN, M.A.
PERCY JENNER WEIR.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., Fanbams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
LEPIDOPTERA.—A. E. Gibbs, F.L.S., The Hollies, St. Albans.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.
BOTANY. { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI, HEPATICÆ, CHARACEÆ AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDÆÆ AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

NOVEMBER.]

Price 1s.

[1893.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

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

VOL. VII. PART 7.

CONTENTS :

PAGE

19. Climatological Observations taken in Hertfordshire in the year 1892. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. (Continued from Part 6.)	201
20. Report on the Rainfall in Hertfordshire in 1892. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.	203
21. Observations of Temperature and Rainfall taken at Throcking Rectory, Buntingford, 1880-89. By the Rev. C. W. Harvey, M.A.....	213
22. The Climate of Watford, deduced from Meteorological Observations taken during the ten years 1877-86. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.	219
23. A List of Hertfordshire Hepaticæ. By A. E. Gibbs, F.L.S.....	233

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET

1893.

£

eW

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, and Pre-historic Archæology of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Natural History, Microscopy, and Photography. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, Ware, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Society, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant Secretary, H. J. Wardale, 3, Adela Terrace, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-7. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW

HERTFORD: STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., C.M.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
THE RIGHT HON. THE EARL OF CLARENDON.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.
WILLIAM RANSOM, F.S.A., F.L.S.
C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., F.G.S., *Victoria Street, St. Albans.*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S., F.E.S.,
Hill Street, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
ARTHUR M. BROWN, M.A.
R. B. CROFT, R.N.
UPFIELD GREEN, F.G.S.
AUGUSTUS HAWKS.

DANIEL HILL.
T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
J. THORNHILL, F.L.S.
REV. E. T. VAUGHAN, M.A.
PERCY JENNER WEIR.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
 { AVES.—Henry Lewis, St. Albans.
 { REPTILIA AND AMPHIBIA.—Arthur Stradling, C.M.Z.S., Watford.
 { LEPIDOPTERA.—A. E. Gibbs, F.L.S., The Hollies, St. Albans.
 { ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
 { MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
 { ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.
 { PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
 { MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
 { F.L.S., The Hollies, St. Albans.
BOTANY. { FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
 { DESMIDEE AND DIATOMACEÆ.—Francis Ransom, Hitchin.
 { DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

FEBRUARY.]

Price 1s. 6d.

[1894.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

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

VOL. VII. PART 8.

CONTENTS :

PAGE

Proceedings, Session 1891-2	ix
Report of the Council for the year 1891	xiii
Balance Sheet for the year 1891	xv
Additions to the Library in 1891	xvi
Reports of the Field Meetings in 1891. (Illustrated)	xx
Proceedings, Session 1892-93	xxxii
Man and Ape. By Arthur Stradling, F.Z.S.	xxxiv
Report of the Council for the year 1892	xxxviii
Balance Sheet for the year 1892	xli
Additions to the Library in 1892	xlii
Reports of the Field Meetings in 1892. (Illustrated)	xliv

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1894.

4

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archaeology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Society, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Bushey Hall Road, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., The Hollies, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant, Mr. Bennett, Watford Endowed Schools. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries

JOHN MORISON, M.D., F.G.S., St. Albans.

F. M. CAMPBELL, F.L.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society

VOL. I. 1875-78. (328 pages). Price 10s. 6d.

In Parts:—1-6, and 8-10, 1s. each; 7, 1s. 6d.

VOL. II. 1878-80. (336 pages). Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society

VOL. I. 1880-82. (352 pages). Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages). Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages). Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages). Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages). Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. Parts 1-7. Price 1s. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD : STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., F.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
THE RIGHT HON. THE EARL OF CLARENDON.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.
WILLIAM RANSOM, F.S.A., F.L.S.
C. E. SHELLY, M.A., M.D.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN MORISON, M.D., F.G.S., *Victoria Street, St. Albans.*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S., F.E.S.,
Avenue House, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
ARTHUR M. BROWN, M.A.
R. B. CROFT, R.N.
UPFIELD GREEN, F.G.S.
AUGUSTUS HAWKS.

DANIEL HILL.
T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
J. THORNHILL, F.L.S.
REV. E. T. VAUGHAN, M.A.
PERCY JENNER WEIR.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, F.Z.S., Watford.
LEPIDOPTERA.—A. E. Gibbs, F.L.S., The Hollies, St. Albans.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.
PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
BOTANY. { MUSCI, HEPATICÆ, CHARACEÆ, AND LICHENES.—A. E. Gibbs,
F.L.S., The Hollies, St. Albans.
FUNGI.—M. C. Cooke, LL.D., 146, Junction Road, London, N.
DESMIDÆ AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.

Dec. 7

APRIL.]

Price 1s. 6d.

[1894.

TRANSACTIONS
 OF THE
 HERTFORDSHIRE
 NATURAL HISTORY SOCIETY
 AND
 FIELD CLUB.

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

VOL. VII. PART 9.

CONTENTS :

Oak Tree on Hedges Farm, near St. Albans, struck by Lightning, 29th June, 1893	<i>Frontispiece</i>
Title Page, Table of Contents, etc.	PAGE i
Index	237
List of Members	1
Topographical Index to the Members	13
(Rules, revised 23rd January, 1894. <i>Issued to Members only.</i>)	

LONDON :

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER ROW.

HERTFORD :

STEPHEN AUSTIN AND SONS, PRINTERS, FORE STREET.

1894.

Σ

HERTFORDSHIRE NATURAL HISTORY SOCIETY
AND FIELD CLUB.

THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archæology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

The head-quarters of the Society are at the Watford Endowed Schools. Here the Society has a Library of over 1200 volumes of Scientific Works, which are lent free to Members; and also a Museum, the chief feature of which is the Herbarium of the authors of the first Flora of the County, Messrs. Coleman and Webb.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10s., and an Annual Subscription of 10s., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

Donations to the Society, and letters relating thereto, should be addressed to the Librarian, W. R. Carter, B.A., Endowed Schools, Watford; and to the Museum, to the Curator, A. E. Gibbs, F.L.S., Avenue House, St. Albans. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members may obtain any of the publications of the Society, postage free, by remitting the price to the Assistant, Mr. Bennett, Endowed Schools, Watford. They may also be obtained through any bookseller.

Forms of proposal for Membership, and any further information, may be obtained on application to either of the Honorary Secretaries—

JOHN HOPKINSON, F.L.S., F.G.S., etc., The Grange, St. Albans.
F. M. CAMPBELL, F.L.S., F.Z.S., etc., Rose Hill, Hoddesdon.

PUBLICATIONS OF THE SOCIETY.

A FLORA OF HERTFORDSHIRE.

By the late A. R. PRYOR, B.A., F.L.S.

Edited by B. DAYDON JACKSON, Sec.L.S.

With an Introduction on the

GEOLOGY, CLIMATE, BOTANICAL HISTORY, etc., of the COUNTY,

By JOHN HOPKINSON, F.L.S., F.G.S., and the EDITOR.

Post 8vo., pp. lviii and 588, with three Maps. Price 14s.

Transactions of the Watford Natural History Society.

VOL. I. 1875-78. (328 pages.) Price 10s. 6d.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1878-80. (336 pages.) Price 10s. 6d.

In Parts:—1, 2, 4, 5, and 6, 1s. 6d. each; 3, 7, and 8, 1s. each.

Transactions of the Hertfordshire Natural History Society.

VOL. I. 1880-82. (352 pages.) Price 11s.

In Parts:—1, 2, 3, and 5, 1s. 6d. each; 4, 6, 7, 8, and 9, 1s. each.

VOL. II. 1882-84. (366 pages.) Price 11s. 6d.

In Parts:—1-4, and 6, 1s. 6d. each; 5, 7, 8, and 9, 1s. each.

VOL. III. 1884-86. (358 pages.) Price 11s. 6d.

In Parts:—1, 2, 3, 5, and 6, 1s. 6d. each; 4, 7, 8, and 9, 1s. each.

VOL. IV. 1886-88. (296 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. V. 1888-90. (288 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VI. 1890-92. (290 pages.) Price 9s. In 9 Parts, 1s. each.

VOL. VII. 1892-94. (312 pages.) Price 10s.

In Parts:—1-7, 1s. each; 8 and 9, 1s. 6d. each.

The Meteorite of the 20th of November, 1887.

By H. GEORGE FORDHAM, F.G.S.

32 pages, with Coloured Map. Price 1s.

Water and Water-Supply.

By JOHN HOPKINSON, F.L.S., F.G.S., etc.

36 pages, with Coloured Map. Price 1s.

Catalogue of the Library.

60 pages (with Supplement). Price 1s. 6d. Supplement (8 pp.) 3d.

LONDON:

GURNEY & JACKSON, SUCCESSORS TO VAN VOORST, PATERNOSTER Row.

HERTFORD: STEPHEN AUSTIN & SONS.

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

COUNCIL.

President:

ARTHUR STRADLING, M.R.C.S., F.Z.S.

Vice-Presidents:

PROF. JOHN ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., F.I.C.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A.
UPFIELD GREEN, F.G.S.
JOHN MORISON, M.D., D.P.H., F.G.S.

Treasurer:

JOHN WEALL, *Watford.*

Honorary Secretaries:

JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., *The Grange, St. Albans*
F. MAULE CAMPBELL, F.L.S., F.Z.S., F.R.M.S., *Rose Hill, Hoddesdon.*

Librarian:

W. R. CARTER, B.A.,
Bushey Hall Road, Watford.

Curator:

A. E. GIBBS, F.L.S., F.E.S.,
Avenue House, St. Albans.

Other Members:

A. P. BLATHWAYT.
ALFRED T. BRETT, M.D.
R. B. CROFT, R.N.
DANIEL HILL.
HENRY LEWIS.
WILLIAM RANSOM, F.S.A., F.L.S.

T. VAUGHAN ROBERTS.
GEORGE ROOPER, F.Z.S.
STEPHEN SALTER.
F. W. SILVESTER.
HENRY WARNER.

RECORDERS.

PRE-HISTORIC ARCHÆOLOGY.—R. B. Croft, R.N., Fanhams Hall, Ware.

ZOOLOGY. { MAMMALIA.—T. Vaughan Roberts, Verulam House, Watford.
AVES.—Henry Lewis, St. Albans.
REPTILIA AND AMPHIBIA.—Arthur Stradling, F.Z.S., Watford.
LEPIDOPTERA.—A. E. Gibbs, F.L.S., Avenue House, St. Albans.
ARACHNIDA.—F. M. Campbell, F.L.S., Rose Hill, Hoddesdon.
MOLLUSCA.—John Hopkinson, F.L.S., The Grange, St. Albans.
ROTIFERA AND PROTOZOA.—F. W. Phillips, Manor House, Hitchin.
PHANEROGAMIA AND FILICES.—Miss Selby, Battler's Green.
MUSCI AND HEPATICÆ.—A. E. Gibbs, F.L.S., Avenue House,
St. Albans.
BOTANY. { FUNGI.—James Saunders, Luton.
DESMIDEE AND DIATOMACEÆ.—Francis Ransom, Hitchin.
DISEASES OF PLANTS.—A. T. Brett, M.D., Watford House.

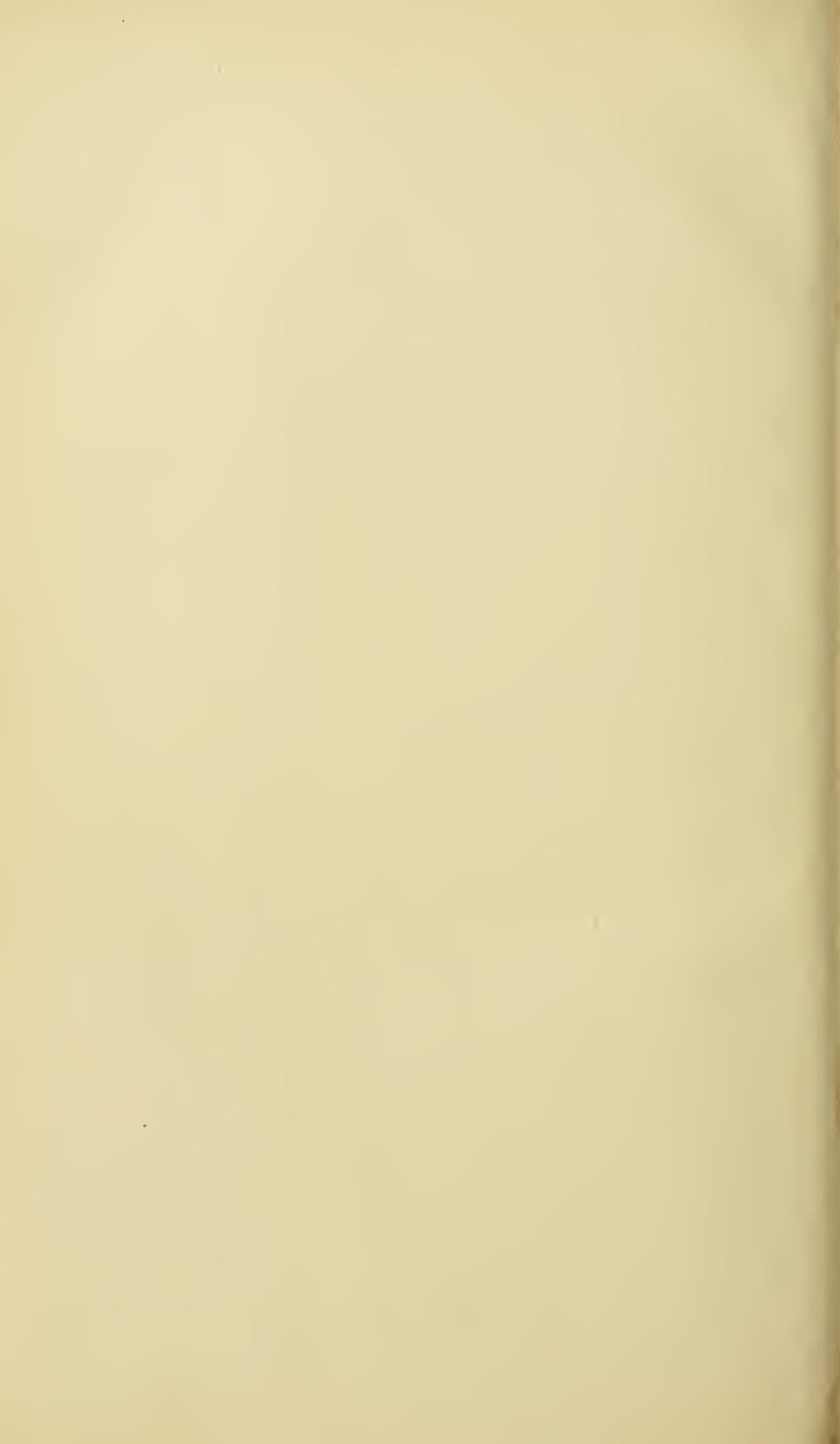
GEOLOGY.—John Morison, M.D., F.G.S., St. Albans.

METEOROLOGY.—John Hopkinson, F.L.S., F.G.S., The Grange, St. Albans.

PHENOLOGY.—Edward Mawley, F.R.Met.Soc., Rosebank, Berkhamsted.

Bankers:

LONDON AND COUNTY BANK, WATFORD.





3 2044 106 261 076

DIGEST OF THE
LIBRARY REGULATIONS.

No book shall be taken from the Library without the record of the Librarian.

No person shall be allowed to retain more than five volumes at any one time, unless by special vote of the Council.

Books may be kept out one calendar month; no longer without renewal, and renewal may not be granted more than twice.

A fine of five cents per day incurred for every volume not returned within the time specified by the rules.

The Librarian may demand the return of a book after the expiration of ten days from the date of borrowing.

Certain books, so designated, cannot be taken from the Library without special permission.

All books must be returned at least two weeks previous to the Annual Meeting.

Persons are responsible for all injury or loss of books charged to their name.

