TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

VOL. IX.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.,
Assoc. Inst. C.E.

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[To be inserted, in binding, before the Transactions.]

ERRATA.

Page 1, line 8, *for* 1895 *read* 1896.
,, 24, ,, 14 from bottom, *for* Eocene *read* Pleistocene.
,, 37, ,, 15, for *Kent* read *Berks.*
,, 72, Table VIII, 1892–93, Year, *for* 26·74 *read* 26·76.
,, ,, ,, X, 1893–94, Year, *for* 21·05 *read* 21·85.
,, 78, line 30, *for* wigeon *read* widgeon.
,, 227, Table XV, Nov., Min., Year, *for* 79 *read* 89.

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,, III.	(pp. lxxii and 274.)	....	March, 1886.
,, IV.	(pp. lii and 224.)	....	June, 1888.
,, V.	(pp. xlviii and 224.)	....	May, 1890.
,, VI.	(pp. lxx and 204.)	....	July, 1892.
,, VII.	(pp. lii and 244.)	....	April, 1894.
,, VIII.	(pp. lxxii and 212.)	....	November, 1896.

PROCEEDINGS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

ORDINARY MEETING, 23RD OCTOBER, 1895, AT ST. ALBANS.

Dr. JOHN MORISON, F.G.S., Vice-President, in the Chair.

The Rev. J. Frome-Wilkinson, M.A., F.L.S., Barley Rectory, Royston; Mr. Thomas James Mann, Hyde Hall, Sawbridgeworth; Mr. John F. Marchant, Heronsgate, Rickmansworth; and Mr. William Page, F.S.A., The White House, St. Albans, were proposed for membership of the Society.

The following lecture was delivered:—

"Charles Darwin: his Life and Work." By H. W. S. Worsley-Benison, F.L.S.

ORDINARY MEETING, 19TH NOVEMBER, 1895, AT WATFORD.

Dr. ALFRED T. BRETT in the Chair.

The Rev. J. Frome-Wilkinson, M.A., F.L.S.; Mr. T. J. Mann; Mr. J. F. Marchant; and Mr. William Page, F.S.A., were elected Members of the Society.

Mr. J. Fraser, F.R.C.V.S., Rochester House, St. Albans, and Miss Rose White, Lismore Lodge, St. Albans, were proposed for membership.

The following lecture was delivered:—

"Parasitic Fungi: their Mode of Attack and the Means of Prevention." By George Massee, F.L.S., F.R.M.S. (*Transactions*, Vol. IX, p. 14.)

In the absence of a lantern which had been promised, Mr. Massee illustrated his lecture on the blackboard, passing round some of his lantern slides.*

The CHAIRMAN said that the subject of the lecture was one of great practical importance, for the study of parasitic fungi had given rise to very valuable results, especially to the germ theory of disease. It had led to the study of bacteria, and had revolutionized the sciences of medicine and surgery.

* An oxy-hydrogen lantern has since been purchased by the Society.

Ordinary Meeting, 12th December, 1895, at Watford.

Arthur Stradling, Esq., M.R.C.S., F.Z.S., President, in the Chair.

Mr. J. Fraser and Miss Rose White were elected Members of the Society.

Mr. Cecil W. Lilley, The Chestnuts, Wealdstone, Harrow, was proposed for membership.

It was announced that the Council, in accordance with the Rules of the Society, had elected Mr. Arthur Stradling as President until the next Anniversary Meeting, to fill the vacancy caused by the death of the late President, Mr. Henry Seebohm; and as a mark of respect for his memory the meeting then adjourned, the following Report being taken as read:—

Report on the Conferences of Delegates to the British Association at Ipswich in 1895. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

As your Delegate to the Ipswich meeting of the British Association, I now present to the Society a report on the Conferences of Delegates of the Corresponding Societies held at that meeting.

The Conferences were held on the 12th and 17th of September, the first Conference being chiefly devoted to the question of co-operation in meteorological work, and the second as usual to discussion on the work of sectional Committees of the Association in which help may be afforded by provincial scientific societies. Mr. G. J. Symons, F.R.S., presided at the first Conference, and Dr. J. G. Garson at the second. There are four members of our Society on the Corresponding Societies Committee of the British Association, two of whom—Mr. Symons and your Delegate—attended both these Conferences.

It must be understood that this report is not exhaustive, much that was said being omitted or greatly abbreviated, its object being merely to bring before our Society the subjects discussed which are likely to be of interest to our members, and in the investigation of which they can assist.

First Conference.

Meteorological Observations.—The first Conference was opened by the Chairman, Mr. G. J. Symons, F.R.S., with an address on Meteorological Observations, of which I give a rather full abstract. The address was divided under the following headings:—

1. Meteorological observations in general.
2. Sea and river temperature.
3. Earth temperature at shallow and at great depths.
4. Phenological work.
5. Early meteorological records.
6. Records of river and well levels.
7. Records of floods and the placing of flood-marks.

In commencing his address, Mr. Symons dwelt upon the duties of the Corresponding Societies and the necessity for holding these Conferences. Each Society, he said, had a double duty: the duty to humanity of doing its best to interpret truthfully the lessons of the world in which we live, so that by increasing knowledge future generations may learn to make better use of its marvellous stores, and perchance repair some of the waste which has gone on in the past and which is still going on; and the duty of advancing the cause of the various bodies with which they were connected; for in these days, when a universal genius has become an impossibility, and progress can be effected only by limiting one's work to some corner of the field of science, there was great danger of specialization leading to forgetfulness of generalization, and of what is the end of all research. The necessity for intercommunication in the early years of this century rendered the formation of the British Association imperative, and this Conference and the work which it is doing were an equal necessity of the present time. How could workers in any branch of science know all that was being done by local effort without the index to their proceedings? The world was the better for the knowledge gained being rendered generally accessible, and both the British Association and the local societies gained the strength which arises from federation.

He had already intimated his opinion that if a man wishes to do good work for science he must take some field, or corner of a field, and labour there. He had only a corner—Rainfall—but he thought that he knew enough about some other parts of the field of meteorology to point out spots where good work could be done, and work precisely suitable for the members of their societies.

He would now take up the syllabus.

1. *Meteorological observations in general.*—The delegates were advised not to encourage the keeping of records from any but good instruments, properly placed. A hard frost occurred, and forthwith there was a crop of wonderful records, some from thermometers badly placed, some from thermometers which never were good, some from good thermometers allowed to go wrong. An incorrect statement was much worse than none at all; such records as they published should be worthy of their Society. It was by no means necessary to start with an elaborate and costly set of instruments; but the instruments should be good, and no records except from good and tested instruments properly placed should ever appear in their volumes. The Royal Meteorological Society had published, almost at cost price (1*s.*), an amply illustrated pamphlet, 'Hints to Observers,' which would show anyone what, and when, and how, observations ought to be made.

2. *Sea and river temperature.*—For a few years there was a Committee of the British Association studying river temperature; and Mr. Symons was sure that if their societies took up the investigation, a fresh committee could be appointed, so that we should not need to go to a German book to learn the details of the temperature of the Thames. The work was easy, healthy, and

inexpensive. Easy, because it merely involves a walk to a bridge, a jetty, or a pier-head, the lowering of the thermometer into the water, entering the reading, and carrying it home again; healthy, from the regularity of the walk; and inexpensive, because the verified K.O. thermometer and its copper case, cord, and everything, could be sent to any part of the country complete for a sovereign.

3. *Earth temperature at shallow and at great depths.*—The second half of this subject had often been brought before the delegates, the Underground Temperature Committee being the oldest one of the British Association. It deals chiefly with the temperature in mines and in deep shafts and wells. Anyone who could obtain good records at depths of, or exceeding, 1,000 feet, could do useful work, but he was doubtful whether much more could be learned in this country by observations at depths between 10 feet and 1,000 feet than we already know. Observations at shallow depths — say 3 inches to 10 feet—were becoming less rare than formerly, and the time was not distant when the law of temperature-variation for shallow depths would be known with sufficient accuracy. That much had yet to be ascertained, many persons learned by burst waterpipes last winter. He mentioned this as an illustration of the application of scientific records to the welfare of mankind, not as an indication that he considered the mischief to have been wholly produced by soil-temperature.

4. *Phenological work.*—He scarcely need tell them that the word phenology means the laws of the life-history of plants and animals; in fact, an endeavour to record the progress of the seasons, not by thermometers or by rain-gauges, but by plants, insects, and birds, and the study of the relations between the indications of the natural-history phenomena and those of the instruments, and efforts to separate cause and effect. It had always seemed to him to be a class of work peculiarly adapted for the local scientific societies. The Royal Meteorological Society had spent a considerable sum in promoting this work, and in the hands of Mr. E. Mawley it was progressing. He was not competent to pronounce any criticism upon the work beyond this, that Mr. Mawley had devoted himself to it, and had produced tables and diagrams of great interest. He thought that the naturalists should either co-operate heartily with the meteorologists, or else should show that the meteorologists are attempting the impossible or the undesirable.

5. *Early meteorological records.* — It was a prevalent idea (especially with executors) that old manuscript books of observations are useless. Addressing the delegates as representatives of large local bodies, many of them with museums and libraries, he invited them to see to it that any such records that they had were properly cared for.

Another suggestion — the practice was fortunately rapidly spreading of publishing the early parochial registers. If each society represented would make it a rule to go through all such publications as have been issued within its area, and print in chronological order all the notes on earthquakes, storms, frosts, floods, etc., which could be collected, much good would be done. Of course this could be done for unpublished as well as for published records.

6. *Records of river and well levels.*—The second half of this subject had so often been brought before them by Mr. De Rance, the Secretary of the Committee on Underground Waters, that he need merely mention it. The first part referred to a subject involved in his next and last heading.

7. *Records of floods and the placing of flood-marks.*—It was very strange that we were so nearly the worst nation in Europe for looking after our rivers. He did not refer to fouling by sewage and by manufacturing refuse, or to defective engineering, but to records of river-levels, to scale-marks on the bridges, to automatic recorders of their rise and fall, to arrangements for warning the owners of low-lying property when floods are probable, and to the classification, levelling, and publication in full, of particulars as to old flood-level marks, and the due marking of new ones when floods occur. He did not suggest that their societies should themselves do all this, but that they should bring the matter before their Parish and County Councils, and couple their request with the offer of any assistance in their power. Of course the suggestion would be received politely, the great cost would be urged, and in many cases nothing would be done. Years ago he suggested such arrangements to an influential man in York, but nothing was done. In 1892 York had a flood, not so bad as some on record, but one which cost the Corporation a very large sum; they paid it, and that steed having been stolen they figuratively locked the stable door by adopting all the arrangements suggested above. If the Councils did not take their advice, they must remember that the correspondence would be on their minutes, to be referred to when their town or district suffered as York did.

Captain G. R. Elwes laid upon the table a paper on the rainfall in Dorsetshire, compiled by Mr. H. S. Eaton, a member of the Dorset Natural History and Antiquarian Field Club, from records kept in the county for the last forty years. It was illustrated by maps and diagrams, one of the maps showing the rainfall, the other the elevation of the land. The Chairman said that Mr. Eaton's work was an admirable example of the way in which the rainfall of a county should be worked out, a labour requiring much patience and perseverance. He wished they could have such memoirs for every county. Your Delegate stated that about twenty years ago he began to record the rainfall of Hertfordshire with about twenty observers, and he had since done his best to add to their number, with the result that there were now about forty. He had obtained about thirty daily records, which were worked up and analyzed but not published in detail. In the 'Transactions of the Hertfordshire Natural History Society' much space was devoted to meteorological work and to phenology, and he hoped that the Societies in other counties would work similarly at these subjects. He trusted also that delegates would preserve any early meteorological records which they might discover.

Some other subjects were then discussed. Mr. De Rance mentioned the fact that two Committees of the British Association of which for many years he had been Secretary—that on Coast Erosion and that on the Circulation of Underground Waters—had just completed their labours in consequence of the admirable way in which their work had been taken up by the Corresponding Societies. Captain Elwes hoped that local societies might be induced to co-operate for the discovery of flint implements and the formulation of results. He wished that they would make this branch of investigation a more special feature than it was at present. And Mr. Osmund W. Jeffs, Secretary of the Committee for the Collection and Preservation of Geological Photographs, stated that the photographs collected would be placed in the Museum of Practical Geology, Jermyn Street, about 800 photographs having already been deposited there. As, however, a great many parts of the British Isles were still unrepresented, it was proposed that they should go on collecting, and he hoped that the delegates would mention this fact to their respective societies.

Second Conference.

The principal subjects brought before the second Conference were as follows:—Meteorological Photography, Seismological Observations, Geological Photographs, the Teaching of Geography in Schools, Anthropometric Measurements in Schools, and the Ethnographical Survey of the United Kingdom.

Meteorological Photography.—For information on the work of this Committee reference should be made to our 'Transactions,' Vol. VI, p. 162. It was stated at this Conference that the Committee was then arranging to take synchronous photographs of clouds in order to determine their altitude. The Committee wished to receive photographs of lightning, rainbows, halos, etc.

Seismological Observations.—The Earth-tremors Committee and that for investigating the Seismological Phenomena of Japan have been merged into one with the title of "Committee for Seismological Observations." Mr. White Wallis said that it was hoped that Professor Milne, who was particularly clever in designing inexpensive apparatus, might be able to produce suitable apparatus for taking seismological observations at a small cost, which might be widely distributed over the country and be largely used by members of local scientific societies. Observations could be taken in towns, for the instruments were practically unaffected by passing vibrations from railway-trains, etc., tremors of short duration not being represented on them. Darwin's bifilar pendulum was somewhat expensive; Professor Milne accomplished the same result in a much simpler way, at a total cost of from £20 to £25.

Geological Photographs.—Since the work of this Committee was brought before our Society (see 'Transactions,' Vol. VI, p. 136), a new circular has been sent out containing instructions as to the best kind of camera to use and the best methods of using it. Mr. A. S. Reid said that the Committee had at one time thought of bringing the work to a conclusion, but had lately felt that it would not be judicious to do so. Mr. Sowerbutts said that platinotype photographs were the best to send, as those printed by the bromide process often faded very rapidly, while platinotype prints would not. Your Delegate said that there would always be a reason for the existence of the Geological Photographs Committee, one of its chief objects being to obtain photographs of temporary sections.

An interchange of geological photographs was advocated by several delegates, and a discussion ensued on some practical difficulties attending it, such as the burden likely to be laid on the amateur photographer. Your Delegate suggested that arrangements might be made at the Jermyn Street Museum for the photographs to be printed and distributed at a small fixed charge for each size; and Mr. Reid inclined towards a plan brought under his notice by Mr. Gray of Belfast. A photographer had there been appointed who received the negatives taken by various members of the local society and furnished as many copies as were desired at a small charge, thus avoiding persecution of the amateur.

The Teaching of Geography in Schools.—At this meeting of the Association a Committee was appointed to consider and report on the position of geography in the educational system of the country. Mr. Sowerbutts referred to the difficulties at present thrown in the way of pupils who wish to become teachers of geography, marks gained in that subject not counting except in certain cases. It was probable that the Corresponding Societies might be asked to furnish certain information. The Rev. J. O. Bevan, having had a large experience of secondary schools, considered the statement which had been made at a former Conference that geography was absolutely ignored in secondary schools to be absolutely erroneous, though it was not taught in every primary school except in connection with reading. Your Delegate said that geography was taught in nearly all the schools with which he was acquainted, and was well taught in those of the Church Schools Company.

Anthropometric Measurements in Schools.—The Chairman, Dr. J. G. Garson, said that many schools had been doing good work in their own way, but unfortunately there had been no uniform system, so that the results at one school could not be compared with those at another. The Committee, after inquiring into the various systems practised, had drawn up a scheme which he hoped would prove acceptable to all the schools. It was of the highest importance that some uniform system should be adopted. Professor Windle of Birmingham would be happy to send a schedule of the various measurements required, and of the way in which they should be made. Dr. Brett said that since the York meeting of the British Association fifteen years ago it had been his custom as a medical man to record the weight, height, colour of hair and eyes, etc., of children in the schools he attended in Watford and its neighbourhood. He had up to that time made about three thousand observations, but had not as yet been able to put his records into shape.

Ethnographical Survey of the United Kingdom.—Mr. Hartland said that the Ethnographical Survey was a matter in which the Corresponding Societies were especially capable of rendering assistance; indeed, without their aid it was impossible that the work could be carried to a successful issue. The Committee drew up in the early part of the year a circular to the local societies offering them copies of the schedule; hitherto, however, there had been but little response from the local societies. The work of the Ethnographical Survey had so many branches that one of them could hardly fail to interest the more active members of the local societies. He hoped to be able to report progress at the next meeting, and would be glad, in the meantime, if the Corresponding Societies would circulate the schedules and bring the Survey under the notice of their members.

Dr. Garson drew attention to the great variety of the work desired by the Ethnographical Survey Committee. Besides the physical measurements required, and the colour of the hair, eyes, etc., there was a wide field for the amateur photographer, for those interested in folklore, linguistic differences, place-names, and local varieties in tastes and habits. The Committee, he said, had a certain number of instruments to place in the hands of those who would undertake measurements. Your Delegate stated that he had brought the work of this Committee before the Hertfordshire Natural History Society, but had failed to get any members to take it up. The questions asked were considered to be too inquisitorial, and the series of measurements, etc., required, too elaborate. Possibly a simpler system, or a simpler scheme as an alternative, might be found to answer better in practice, as more persons or scientific societies might then be found willing to undertake the work.

Mr. Hartland replied that, though they hoped in many cases to get the elaborate measurements asked for, they were glad to obtain such measurements and photographs as could be procured. He was afraid that the elaboration of their schedule must have acted to some extent as a deterrent, though it was drawn up to a standard to which they hoped to attain, not as necessarily obligatory in every case. Possibly, if this were understood, societies would respond more warmly than they had done to their appeals for help. He hoped that members who objected to take the elaborate measurements would take up the subjects of dialect, folklore, or historical or prehistoric monuments. They wanted information on all these points.

Dr. Garson remarked that the work might usefully be divided amongst various sub-committees; if that were done all societies could do good work in one department or another, if not in all.

The Rev. J. O. Bevan hoped that each Delegate would take an early opportunity of reporting the proceedings at these Conferences to the Society he represented, and the Chairman (Dr. Garson) said that he believed it was generally understood to be the duty of each Delegate to report their proceedings to his Society.

Appendix.

The following is a list of the Committees of the British Association to which assistance may be given by Provincial Scientific Societies, with the names and addresses of their Secretaries:—

The Application of Photography to the Elucidation of Meteorological Phenomena.—A. W. Clayden, M.A., St. John's, Polsloe Road, Exeter.

Seismological Observations.—Charles Davison, M.A., 373, Gillott Road, Birmingham; and Professor John Milne, F.R.S., Shide, Isle of Wight.

The Collection, Preservation, and Registration of Geological Photographs.—Osmund W. Jeffs, 92, Westbourne Street, Liverpool; and W. W. Watts, M.A., Geological Survey Office, Jermyn Street, London, S.W.

Investigation and Preservation of the Erratic Blocks of the British Isles.—P. F. Kendall, Yorkshire College, Leeds.

The Teaching of Natural Science in Elementary Schools.—Professor H. E. Armstrong, F.R.S., 55, Granville Park, Lewisham, London, S.E.

The Position of Geography in the Educational System of the Country.—A. J. Herbertson, University Hall, Edinburgh.

Anthropometric Measurements in Schools.—Professor Bertram Windle, B.Sc., Mason College, Birmingham.

Ethnographical Survey of the United Kingdom.—E. Sidney Hartland, Highgarth, Gloucester.

Ordinary Meeting, 21st January, 1896, at Watford.

Arthur Stradling, Esq., M.R.C.S., F.Z.S., President, in the Chair.

Mr. Cecil W. Lilley was elected a Member of the Society.

The senior Secretary (Mr. Hopkinson) read a letter he had received from Miss Seebohm, on behalf of Mrs. Seebohm, thanking the Society for the vote of condolence passed by the Council on the death of the late President of the Society, Mr. Henry Seebohm.

The following papers were read:—

1. "Notes on the Characeæ, with a List of Species from the South Midlands." By James Saunders. (*Transactions*, Vol. IX, p. 19.)

Specimens and diagrams were exhibited by Mr. Saunders in illustration of his paper.

2. "Notes on Birds observed last Spring at Mentone and elsewhere on the Continent." By T. Vaughan Roberts.

The President stated that the Society would in a few days be without a home, its Library and Collections having to be removed from the Board Room of the Endowed Schools because that room would be required for other purposes. The Library, he said, would probably be warehoused in the old Local Board Room at the Waterworks, where it would be practically inaccessible. He brought the matter before the meeting in the hope that someone present might be able to suggest a way out of the difficulty in which the Society was now placed.

The senior Secretary mentioned that in two days the Society would attain its majority, having been founded as the Watford Natural History Society on the 23rd of January, 1875.

Mr. F. C. Mahon and Mr. G. P. Neele were elected Auditors of the Accounts for the year 1895.

Anniversary Meeting, 25th February, 1896.

(At Watford.)

Arthur Stradling, Esq., M.R.C.S., F.Z.S., President, in the Chair.

The Report of the Council for the year 1895, and the Treasurer's Account of Income and Expenditure, were read and adopted.

Dr. Alfred Russel Wallace, F.R.S., F.L.S., Parkstone, Dorset, was elected an Honorary Member of the Society.

Mr. Frederick William Rudler, F.G.S., M.A.I., Curator of the Museum of Practical Geology, Jermyn Street, London, S.W., was elected a Corresponding Member.

An Address was delivered on behalf of the President by Prince Kropotkin, on "Mutual Aid amongst Animals." (*Transactions*, Vol. IX, p. 1.)

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.C.S., F.I.C.; John Morison, M.D., D.P.H., F.G.S.; T. Vaughan Roberts; George Rooper, F.Z.S.

Treasurer.—John Weall.

Honorary Secretaries. — John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc.; W. R. Carter, B.A.

Librarian.—Daniel Hill.

Curator.—A. E. Gibbs, F.L.S., F.E.S.

Other Members.—F. M. Campbell, F.L S., F.Z.S., F.R.M.S., F.E.S.; Alan F. Crossman; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc.; H. George Fordham; Henry Lewis; Edward Mawley, Pres. R. Met. Soc., F.R.H.S.;

William Ransom, F.S.A., F.L.S.; Stephen Salter; F. W. Silvester; the Rev. E. T. Vaughan, M.A.; G. Herbert Wailes, Assoc. M. Inst. C.E.; Henry Warner.

The thanks of the Society were accorded to Sir John Evans, K.C.B., retiring from the office of Vice-President; to Mr. F. Maule Campbell, retiring from the office of Honorary Secretary; to Mr. W. R. Carter, retiring from the office of Librarian; and to Dr. A. T. Brett, retiring from the Council.

Report of the Council for the Year 1895.

The presentation by the Council of the Hertfordshire Natural History Society of the 21st Annual Report, is an event of some importance. A scientific society which attains its majority, and which has done as much good local work in its twenty-first year as it did in the first year of its existence, will most probably live to a good old age; and the more the members of the society have devoted their energies to original local investigation, the more probable is it that a great longevity will be attained, for however closely we may study Nature, we shall always find that she has something new to tell us, her treasures being inexhaustible.

But such an event as this is not entirely a subject for congratulation. Looking back for twenty-one years we miss many once-familiar faces, and amongst them some of our most earnest and able workers, whose place we have found it hard to fill up, and perhaps in one or two cases impossible. When Sir John Evans (then Mr. Evans) took the chair as the first President of the Society, on the 11th of February, 1875, our roll was 53 members: only eight of these are now on our list. At that meeting 35 more were elected: only eight of these are still with us. At the close of that year the Society numbered 150: now, out of about 250 members, only 32 were on the first year's list.

It is also a matter for regret that there is no longer the general enthusiasm which there was at first, when both our Ordinary and Field Meetings were attended by a majority of our members, while in recent years the average attendance has been about ten per cent. This is, however, partly accounted for by the much wider area over which the members are now spread.

During the year twelve ordinary members have been elected, and one corresponding member; one member has compounded for her annual subscription; nineteen members have resigned; and we have to regret the loss by death of three honorary members (Professor Charles Cardale Babington, the Right Honourable Thomas Henry Huxley, and our President, Mr. Henry Seebohm), and of five ordinary members (Mrs. Ackworth of Potter's Bar, Mrs. Robins of Watford, Mr. G. Upton Robins of Wheathampstead, Mr. Isaac Robinson of Hertford, and the Right Honourable the Earl of Verulam).

The census of the Society at the end of the years 1894 and 1895 was as follows:—

	1894.	1895.
Honorary Members	20	17
Corresponding Members	1	2
Life Members	50	51
Annual Subscribers	193	180
	264	250

It is seldom that the scientific world has lost in a single year three men of such renown as Babington, Huxley, and Henry Seebohm, a very brief notice of each of whom must now be given.

When Professor Babington, in 1835, commenced the preparation of his 'Manual of British Botany,' the labours of Continental botanists were ignored in this country, no attempt having been made to bring into harmony the nomenclature followed on each side the English Channel; but with the appearance of the first edition of the 'Manual' a new era commenced, and with each successive edition (eight in all, from 1843 to 1881) the work of British and Foreign botanists was brought more and more into unison. The critical examination, also, of living plants rather than of herbarium specimens convinced Babington that the plants themselves must afford the characters for the definition of species—that we must not define a species arbitrarily and then attempt to place under it a number of slightly-differing plants—and this conclusion led him to raise to specific rank many forms which were then generally considered only to be varieties. The author of the 'Flora of Hertfordshire,' published by this Society, was a follower of Babington, working in the field with his 'Manual,' but Pryor was a pupil who went beyond his master, especially in his adoption and practical application of the views of the most advanced foreign botanists. Babington was born in 1808 (at Ludlow); his first scientific paper appeared in 1832, and was entomological; he was also an ardent archæologist; but since 1843 his books and papers have been almost entirely botanical. He was elected Professor of Botany at Cambridge University in 1861.

The death of Professor Huxley is a loss to literature as well as to science, for the lucidity of his exposition of scientific facts and theories, and the vigour of his style, will make his works take a high rank amongst the classics of science. He was the first Dean of the Royal College of Science, and for more than forty years was connected with the Science and Art Department, having succeeded Edward Forbes in 1854 as Lecturer on Natural History in the Central School of Science, which has been metamorphosed through the Royal School of Mines into the Royal College of Science. Essentially a biologist and palæontologist, Professor Huxley also devoted much attention to the higher problems of philosophical speculation, and by his popular exposition of the theories of Charles Darwin and Herbert Spencer, he has done more than any other man to convince those who have not studied the works of these two writers that natural selection is the chief factor in the origin of species.

Our late President, Mr. Henry Seebohm, was the founder of the firm of Seebohm & Dickstall, steel manufacturers, of Sheffield. He was a high authority on steel, a great traveller and geographer, being one of the Secretaries of the Royal Geographical Society, and the foremost ornithologist of the day. To these acquirements he added that of being a splendid lecturer, as those of our members who heard his lectures before this Society on the "Migration of Birds" and on "Siberia" will bear witness. He bequeathed to the British Museum his collection of birds, numbering nearly seventy thousand specimens, of which Sir W. H. Flower, Director of the Museum, says that "in extent and scientific value it is one of the most important that the British Museum has ever received." As a tribute of respect, the December meeting of the Society, being the first after his death, was adjourned after the formal business had been transacted.

Of the ordinary members whom we have lost by death it must suffice to say that Mr. Isaac Robinson was a contributor to our 'Transactions'; that Mr. Upton Robins more than once entertained the Society at his residence, Delaport, Wheathampstead; and that to the kindness of the Earl of Verulam we owe many a pleasant ramble in Gorhambury Park and the woods around it, with one visit to Gorhambury House, when he and other members of his family showed to the members of the Society his valuable collection of paintings and antiquities, etc., and pointed out their historical and other features of interest.

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

Jan. 29. The Relative Advantages of Hard and Soft Water, with Special Reference to the Supply of Watford; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

—— On the Advantages of a Supply of Soft Water for the Town of Watford; by Arthur King, M.B.

Feb. 26. Anniversary Address—The Stone Age in Hertfordshire; by Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc., Vice-President of the Society.

March 26. Report on the Rainfall in Hertfordshire in the year 1894; by John Hopkinson, F.L.S., F.G.S., F.R.Met Soc.

—— The Floods of November, 1894, in Hertfordshire; by John Hopkinson.

—— Notes on Birds observed in Hertfordshire during the year 1894; by Henry Lewis.

—— Notes on Birds frequenting the Neighbourhood of Heronsgate, Herts; by A. Sainsbury Verey, M.B.O.U.

April 23. Climatological Observations taken in Hertfordshire in the year 1894; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

—— Meteorological Observations taken at The Grange, St. Albans, during the year 1894; by John Hopkinson.

—— The Gale of the 24th of March, 1895, in Hertfordshire; by John Hopkinson.

—— Report on Phenological Phenomena observed in Hertfordshire during the year 1894; by Edward Mawley, F.R.Met. Soc., F.R.H.S.

April 23. Notes on Lepidoptera observed in Hertfordshire during the year 1894; by A. E. Gibbs, F.L.S., F.E.S.
—— The Blastopore of the Frog's Egg in Relation to the Hypoblast; by J. B. Russell, B.Sc.
Nov. 19. Parasitic Fungi: their Modes of Attack, and the Means of Prevention; by George Massee, F.L.S., F.R.M.S.
Dec. 12. Report on the Conferences of Delegates to the British Association at Ipswich in 1895; by John Hopkinson, F.L.S., F.G.S.

The following lectures were delivered at St. Albans:—

March 22. Extinct Monsters; by the Rev. Henry N. Hutchinson, B.A., F.G.S.
Oct. 23. Charles Darwin: his Life and Work; by H. W. S. Worsley-Benison, F.L.S.

The following Field Meetings were held during the year:—

May 11.—Tewin, Marden Hill, and Panshanger.
June 8.—Berkhamsted, Great Gaddesden, and Nettleden.
—— 15.—Chiltern Green and Luton Hoo Park.
—— 22.—Dunstable and Totternhoe.
Oct. 19.—The Grove Park and Woods, Watford.

A visit was also made to the British Museum (Natural History) on the 27th of April, when Mr. Arthur Stradling gave a demonstration in the Osteological Gallery on "Skulls and Skeletons."

The thanks of the Society are due to the Earl of Limerick for permission to visit his private grounds at Tewin Water, and for hospitality kindly afforded to the members; to Monsieur De Falbe for allowing Luton Hoo Park to be visited; to the Earl of Clarendon for his permission for the annual fungus foray to be held in Grove Park and the adjoining woods; and also to Sir John Evans for delivering the anniversary address in the absence of the President.

Four parts of the eighth volume of the present series of the Society's 'Transactions,' containing 136 pages and four plates, have been published, and the volume will be completed in three more parts, one of which has already been printed and will be issued in a few days.

The financial position of the Society is satisfactory, the income and expenditure being about the same. While it is due to the members to spend the whole of their subscriptions for their benefit, there are other sources of income, and in view of the fact that out of the £255 received from the present life members only £130 are invested, it would be advisable to spend no more than the annual subscriptions, and to invest all other receipts until the Society's indebtedness to the life members is covered by its invested funds. And this could well be done without curtailing the expenditure if all the members paid their subscriptions within the year for which they are due, or if the number of annual subscribers were considerably increased.

Near the end of the year the Society had notice from the Governors of the Watford Endowed Schools to remove its Library. Your Secretary at once endeavoured to find suitable quarters elsewhere in Watford, but without success, and the Council then appointed a Committee of members resident in Watford to find a room in which to place the Society's library, and, if possible, one contiguous to it in which to hold our meetings. The result of the labours of this Committee has been to ascertain that Watford does not possess a building in which the Society can hold meetings and also place its bookcases, which is certainly not a creditable position for the largest town in Hertfordshire to be in. The Committee eventually accepted the courteous offer of the Watford Urban District Council to place at the disposal of the Society for the temporary warehousing of its library, free of charge except for actual expenses, the old Local Board Room at the Waterworks, and the books and bookcases have recently been removed there. For the satisfactory carrying-out of this arrangement, which the Council considers to be the best that could have been made under the circumstances, the Society is indebted to Mr. Daniel Hill, under whose charge the books are now placed, and who will be pleased to lend out any to members on application to him, the borrowers defraying the expense of carriage.

The Society has taken an active part during the year in two important questions—the suggested softening of the water supplied to Watford, the papers read at the January meeting by Dr. King and Mr. Hopkinson being merely preliminary to a discussion on the subject; and the protection of certain birds which seem likely to become extinct in Hertfordshire, and of their eggs. The only official act which the late Mr. Henry Seebohm did for the Society during the short period of his presidency was signing a Memorial presented by the Society to the Hertfordshire County Council in favour of the protection of certain wild birds which are seriously diminishing in number and are in danger of extermination, and of their eggs, only birds of peculiar interest or of benefit to man being sought to be specially protected; the Memorial also recommended that the close time should not commence later than the 15th of February. The Memorial was referred to a sub-committee of the County Council, and has resulted in an order being made by the Home Secretary (dated 7th February, 1896) "varying the close-time, adding certain birds to the schedule of the Act of 1880, and prohibiting the taking or destroying the eggs of certain wild birds." All the birds specified in the Memorial of this Society are thus protected, and a few others have been added. The Memorial and the Order of the Home Secretary are appended to this Report.

Appendix A. The Memorial.

TO THE HERTFORDSHIRE COUNTY COUNCIL.

The Memorial of the Hertfordshire Natural History Society and Field Club.

Humbly sheweth—

Your Memorialists beg respectfully to represent to the Hertfordshire County Council as follows:—

I.—That the following wild birds are seriously diminishing in number and are in danger of extermination, viz.:—

Nightjar,	Stone Curlew,	Honey Buzzard,
Woodpeckers,	Grebes,	Hobby,
Kingfisher,	Crossbill,	Merlin,
Owls,	Buzzard,	Kestrel.

II.—That all these birds, except the Kingfisher, the Grebes, and the Crossbill, feed on animals (chiefly insects and the smaller Mammalia) injurious to agriculture or fruit crops, and are therefore beneficial to man.

III.—That the Kingfisher and the Large Crested Grebe are killed for the sake of their plumage, and therefore require special protection, the latter having become so scarce that it now only breeds in the County on the Tring Reservoirs.

IV.—That the Crossbill is one of the most interesting birds in the British Fauna, its beak being unique in form and structure, and although it seldom breeds in Britain, it is recorded to have bred in Hertfordshire, and there is reason to believe that it may again do so if unmolested.

V.—That although the killing or taking of the Nightjar, Woodpeckers, Kingfisher, Owls, Stone Curlew, and Grebes, between the 1st of March and the 1st of August is penalized by the "Wild Birds Protection Act of 1880," and this period has been altered in the County of Hertford to begin on the 1st of February and end on the 31st of August, yet the preservation of these birds, as well as of the others named, cannot be secured so long as their eggs can be taken or destroyed with impunity.

VI.—That as scarcely any birds breed in Hertfordshire before the middle of February, the object sought by the extension of the close-time would be sufficiently well attained if it were to commence on the 15th of February instead of on the 1st.

Your Memorialists therefore pray—

1st.—That you will, in accordance with the "Wild Birds Protection Act of 1894,"

(*a*) Apply to a Secretary of State to prohibit in the County of Hertford the taking or destroying of the eggs of all the above-named birds.

(*b*) Represent to a Secretary of State the desirability of applying the principle of the "Wild Birds Protection Act of 1880" to the Crossbill, Buzzard, Honey Buzzard, Hobby, Merlin, and Kestrel.

2nd.—That should you reduce the duration of the close-time, it be not made to commence later than the 15th of February.

And your Memorialists will ever pray, etc.

Signed on behalf of the Hertfordshire Natural History Society and Field Club, 23rd April, 1895.

HENRY SEEBOHM, *President.*
F. M. CAMPBELL,
JOHN HOPKINSON, *Honorary Secretaries.*

APPENDIX B. THE ORDER.

HERTFORDSHIRE COUNTY COUNCIL.

"Wild Birds Protection Act, 1880."
"Wild Birds Protection Act, 1894."

Order of Home Secretary, (*a*) varying the Close Time, (*b*) adding certain Birds to the Schedule of the Act of 1880, and (*c*) prohibiting the taking or destroying the Eggs of certain Wild Birds.

In pursuance of the powers conferred on me by the "Wild Birds Protection Act, 1880," and the "Wild Birds Protection Act, 1894," and upon application by the County Council of the Administrative County of Hertford, I hereby make the following Order:—

1. The time during which the killing or taking of Wild Birds is prohibited shall be varied throughout the County of Hertford, so as to be from the 15th day of February to the 15th day of August in each year.

2. The "Wild Birds Protection Act, 1880," shall apply within so much of the County of Hertford as is within the Metropolitan Police District to the following species of Wild Birds in the same manner as if those species were included in the Schedule to the Act:—

Shrikes,	Martins (2),	Buzzard,
Kestrel,	Swift,	Honey Buzzard,
Wryneck,	Bearded Tit,	Osprey,
Swallow,	Merlin,	Magpie.
	Hobby,	

3. The taking or destroying of the eggs of the following species of Wild Birds is prohibited within so much of the County of Hertford as is within the Metropolitan Police District:—

Nightingale,	Merlin,	Willow Warbler,
Goldfinch,	Hobby,	Chiffchaff,
Lark,	Buzzard,	Whitethroat,
Nightjar,	Honey Buzzard,	Lesser Whitethroat,
Woodpeckers,	Osprey,	Longtailed Tit,
Kingfisher,	Magpie,	Nuthatch,
Cuckoo,	Wheatear,	Wren,
Owls,	Stonechat,	Golden-crested Wren,
Shrikes,	Whinchat,	Wagtails (4),
Kestrel,	Redstart,	Hawfinch,
Wryneck,	Flycatchers (2),	Linnet,
Swallow,	Sedge Warbler,	Buntings (3),
Martins (2),	Reed Warbler,	Starling,
Swift,	Blackcap,	Landrail or Corncrake,
Bearded Tit,	Garden Warbler,	Coot.
	Wood Warbler,	

4. The taking or destroying of the eggs of the following species of Wild Birds is prohibited within so much of the County of Hertford as is not within the Metropolitan Police District:—

Nightingale,	Nightjar,	Crossbill,
Goldfinch,	Woodpeckers,	Buzzard,
Hawfinch,	Kingfisher,	Honey Buzzard,
Wryneck,	Owls,	Hobby,
Tree Creeper,	Stone Curlew,	Merlin,
Nuthatch,	Grebes,	Kestrel.
	Heron,	

5. The "Wild Birds Protection Act, 1880," shall apply within so much of the County of Hertford as is not within the Metropolitan Police District to the following species of Wild Birds in the same manner as if those species were included in the Schedule to the Act:—

Hawfinch,	Heron,	Hobby,
Wryneck,	Crossbill,	Merlin,
Tree Creeper,	Buzzard,	Kestrel.
Nuthatch,	Honey Buzzard,	

Given under my hand at Whitehall, this 5th day of February, 1896.

(Signed) M. W. RIDLEY.

INCOME AND EXPENDITURE FOR THE YEAR ENDING 31*st DECEMBER*, 1895.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1894	7	8	11	By Printing 'Transactions'	53	2	8
,, Entrance Fees	9	10	0	,, Miscellaneous Printing	5	6	6
,, Subscriptions for 1892	4	0	0	,, Expenses of Meetings	5	9	6
,, ,, ,, 1893	6	10	0	,, Reporting	1	1	0
,, ,, ,, 1894	16	10	0	,, Rent: Watford Endowed Schools	7	0	0
,, ,, ,, 1895	51	10	0	,, Library Expenses	6	0	8
,, ,, ,, 1896	8	0	0	,, Salary of Assistant	5	0	0
,, Life Composition Fee	5	0	0	,, Stationery	0	17	8
,, Dividends on £130 India 3 per cent. Stock	3	18	0	,, Postages	11	13	0
,, Sale of Publications ['Flora of Hertfordshire' £3 16*s*. 6*d*.; 'Transactions' £1 5*s*. 9*d*., less expenses]	5	2	3	,, Fire Insurance	0	12	6
				,, Sundry small expenses	1	6	4
				,, Balance at Bank	19	19	4
	£117	9	2		£117	9	2

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

Audited and found correct this 21st day of February, 1896, { GEORGE P. NEELE, F. C. MAHON.

Additions to the Library in 1895.

Presented.

Title.	Donor.
British Association for the Advancement of Science: Report for 1893. 8vo. London, 1894.	*The Association.*
———. Report for 1894. 8vo. London, 1895.	,,
Marine Biological Association of the United Kingdom. Journal. 1887–88, and New Series, Vols. i–iii (1889–92). 8vo. Plymouth.	*Sir John Evans.*
Ormerod, Eleanor A. Report on Observations of Injurious Insects and Common Farm Pests during the year 1894. 18th Report. 8vo. London, 1895.	*The Authoress.*
Whewell, Dr. William. The Plurality of Worlds. 8vo. London, 1854.	*Mr. J. Hopkinson.*

Received in Exchange.

American Museum of Natural History. Bulletin. Vol. vi. 8vo. New York, 1894.

Birmingham Natural History and Philosophical Society. Journal. Vol. i, Nos. 2–7. 8vo. Birmingham, 1894.

Boston (U.S.A.) Society of Natural History. Proceedings. Vol. xxvi, parts 2, 3. 8vo. Boston, 1894.

Brighton and Sussex Natural History and Philosophical Society. Report 1893–94. 8vo. Brighton, 1894.

Conchology, Journal of. Vol. vii, Nos. 9–12. 8vo. Leeds, 1894.

Edinburgh. Royal Physical Society. Proceedings. Session 1893–94. 8vo. Edinburgh, 1894.

Liverpool Geological Society. Proceedings. Vol. vii, part 2. 8vo. Liverpool, 1894.

London, Geological Society of. Abstracts of the Proceedings. Session 1894–95. 8vo. London, 1895.

———. Geologists' Association. Proceedings. Vol. xiv, parts 3–5. 8vo. London, 1895.

———. Quekett Microscopical Club. Journal. Series 2, vol. vi, Nos. 36, 37. 8vo. London, 1895.

———. Royal Meteorological Society. Quarterly Journal. Vol. xxi. 8vo. London, 1895.

———. ———. The Meteorological Record. Vol. xiv, Nos. 54–56. Vol. xv, Nos. 57, 58. 8vo. London [1895].

———. Royal Microscopical Society. Journal. New Series. [Vol. vii.] 8vo. London, 1895.

Manchester Geographical Society. Journal. Vol. ix, Nos. 10–12. Vol. x, Nos. 1, 2. 8vo. Manchester, 1895.

——— Geological Society. Transactions. Vol. xxiii, parts 3, 4. Vol. xxiv, parts 1, 2. 8vo. Manchester, 1895.

——— Literary and Philosophical Society. Memoirs and Proceedings. Series 4, vol. viii, No. 4. Vol. ix, Nos. 1–5. 8vo. Manchester, 1894–95.

——— Microscopical Society. Transactions and Report for 1894. 8vo. Manchester, 1895.

Microscopy and Natural Science, International Journal of. Series 3, vol. v, Nos. 25, 26. 8vo. Bath, 1895.

New York Academy of Sciences. Transactions, 1893–94. Vol. xiii. 8vo. New York, 1894.

——— State Library. Bulletin, January, 1895. 8vo. Albany, 1895.

——— ———. Additions, No. 2. November, 1894 (Subject-Index of Law Additions). 8vo. Albany, 1895.

——— ———. Bibliography. No. i. May, 1895 (Guide to the Study of J. A. M. Whistler, by Forsyth and Harrison). 8vo. Albany, 1895.

Northamptonshire Natural History Society and Field Club. Journal. Vol. vii, Nos. 57–60. 8vo. Northampton, 1894.

Rugby School Natural History Society. Report for the year 1894. 8vo. Rugby, 1895.

Somersetshire Archæological and Natural History Society. Proceedings, 1894. Vol. xx. 8vo. Taunton, 1894.

Trinidad Field Naturalists' Club. Report. Vol. ii, Nos. 5–11. 8vo. Port of Spain, 1895.

United States Department of Agriculture. The Common Crow of the United States. By Barrows and Schwarz. 8vo. Washington, 1894.

——— Fish Commission. Bulletin. Vol. xii (for 1892). 4to. Washington, 1894.

Upsala, University of. Geological Institution. Bulletin. Vol. i. Vol. ii, parts 1–3. 8vo. Upsala, 1892–95.

Wiltshire Archæological and Natural History Society. Catalogue of the Library. 8vo. Devizes, 1894.

———. Magazine. Vol. xxviii, Nos. 82–84. 8vo. Devizes, 1894.

———. Abstracts of Inquisitiones Post Mortem. Parts 2, 3. 8vo. Devizes, 1894.

Wisconsin Academy of Sciences. Transactions. Vol. ix, parts 1, 2. 8vo. Madison, 1893.

Yorkshire Naturalists' Union. Naturalist. New Series. Vol. xx. 8vo. London, 1895.

Purchased.

Botany, Journal of. Vol. xxxiii. 8vo. London, 1895.

British Rainfall for 1879, 1884–7, 1889, 1890. 8vo. London, 1880–91.

Entomologist. Vol. xxviii. 8vo. London, 1895.

Entomologists' Record. Vol. vi. 8vo. London, 1895.

Middlesex and Hertfordshire Notes and Queries. Vol. i. 8vo. London, 1895.

Natural History, The Royal. Nos. 15–25. 8vo. London, 1895.

Nature Notes. Vol. vi. (*Selborne Society.*) 8vo. London, 1895.

Novitates Zoologicæ. Vol. ii. 4to. Tring, 1895.

Zoologist. 3rd Series. Vol. xix. 8vo. London, 1895.

Ordinary Meeting, 17th March, 1896, at Watford.

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

Letters were read from Dr. Alfred Russel Wallace thanking the Society for his election as an Honorary Member, and from Mr. F. W. Rudler thanking the Society for his election as a Corresponding Member.

The following papers were read:—

1. "Hertfordshire Rainfall, Percolation, and Evaporation." By John Hopkinson, F.L.S., F.G.S., F.R. Met. Soc. (*Transactions*, Vol. IX, p. 33.)

2. "Notes on Lepidoptera observed in Hertfordshire during the year 1895." By A. E. Gibbs, F.L.S., F.E.S. (*Transactions*, Vol. IX, p. 27.)

3. "Notes on Birds observed in Hertfordshire during the year 1895." By Alan F. Crossman, F.L.S. (*Transactions*, Vol. IX, p. 73.)

Mr. S. H. Spencer, jun., exhibited two cases of moths, being specimens collected by him which were referred to in the Report of Mr. Gibbs.

Living specimens of *Helix arbustorum*, a snail found in abundance in Folly Lane, St. Albans, by Mr. R. T. Andrews, of Hertford, were exhibited on his behalf by Mr. A. E. Gibbs.

ORDINARY MEETING, 21ST APRIL, 1896, AT WATFORD.

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

The Right Honourable the Earl of Verulam, Sopwell, St. Albans, was proposed for membership of the Society.

The following papers were read :—

1. "Report on Phenological Phenomena observed in Hertfordshire during the year 1895." By Edward Mawley, Pres. R. Met. Soc., F.R.H.S. (*Transactions*, Vol. IX, p. 97.)

2. "List of Mosses collected in the Neighbourhood of Hertford." By Hugh Darton. (Communicated, with an Introduction, by James Saunders.) (*Transactions*, Vol. IX, p. 104.)

3. "On some Overlooked Records of Hertfordshire Plants." By B. Daydon Jackson, Sec. L.S. (*Transactions*, Vol. IX, p. 121.)

4. "Notes of the Observation of Swallows." By A. Sainsbury Verey, M.B.O.U. (*Transactions*, Vol. IX, p. 126.)

The following letter from Mr. Alfred F. Buxton, of Easneye, Ware, to the senior Secretary, was read :—

"Is the mechanism known by which a diving-duck keeps under water, apart from his swimming powers? I have frequently observed that wild ducks and dabchicks, two or three seconds before making the plunge, seem to sink in the water a quarter or half an inch without any other apparent motion. It also appears to me, but this is difficult of observation and therefore uncertain, that in coming up to the surface they do not use feet, tail, or wings, but merely float upwards. I should be very glad to know about these two points."

The following papers were taken as read :—

1. "Meteorological Observations taken at The Grange, St. Albans, during the year 1895." By John Hopkinson, F.L.S., F.G.S., F.R. Met. Soc. (*Transactions*, Vol. IX, p. 85.)

2. "Climatological Observations taken in Hertfordshire in the year 1895." By John Hopkinson. (*Transactions*, Vol. IX, p. 93.)

3. "Report on the Rainfall in Hertfordshire in the year 1895." By John Hopkinson. (*Transactions*, Vol. IX, p. 109.)

Field Meeting, 25th April, 1896.

ALDBURY AND ASHRIDGE PARK.

The locality chosen for the first Field Meeting of the year has frequently been visited by the Society, but there is no more attractive spot in Hertfordshire, the neighbourhood of Aldbury being of interest to the botanist, the geologist, and the antiquary, and also exceedingly picturesque. This meeting was under the direction of Mr. Alan F. Crossman, and was attended by upwards of thirty members, most of whom were from St. Albans, while Watford, Berkhamsted, and Ware each furnished a small contingent.

Assembling at Tring Station, the quaint little village of Aldbury was soon reached, and the stocks and whipping-post which stand by the side of the village pond brought to mind the primitive but inexpensive and effective punishments of olden times, of which the picturesque timbered houses are also relics well worth the attention of artist or photographer.

A steep ascent up the wooded hill on the right brought the party to the Monument, erected "In honour of Francis, third Duke of Bridgewater, 'Father of Inland Navigation,' 1832." The entrance to the steps up the interior of this monument is kept carefully locked up, and although the requisite order had been obtained, the cottage near where a key is kept and gingerbeer may usually be obtained, was found to be deserted at the time, and a key had to be procured elsewhere, causing a considerable delay. The time, however, was very pleasantly spent in a ramble in the neighbouring woods in search of wild flowers; but there was little found besides bluebells and primroses, both of which were flowering in profusion, the contrast between their bright and delicate colours giving quite a gay appearance to the green carpet of vegetation from which they sprang.

The Monument, which is 200 feet high, was then ascended, and a splendid view was obtained from its summit. St. Albans, with its Abbey, twelve miles to the south-east, was distinctly seen, with the range of hills beyond which mark the outcrop of the London Clay over the Chalk. But the greatest interest of the view is towards the north and north-west, and is due to the geological features of the country, which were pointed out by Mr. Hopkinson. Immediately below is the beautifully-wooded valley in which Aldbury is situated, and which has been cut out of the Lower Chalk by a stream which now seldom flows; beyond is the true escarpment of the Lower Chalk, with the Totternhoe Stone forming a projecting ridge, and passing into the Upper Greensand; in the middle distance is the Gault, forming the fertile Vale of Aylesbury, and rising into hills here and there; and the higher hills in the extreme distance mark the outcrop of the Lower Greensand. Just this side of Cheddington Station an outlier of the Lower Chalk forms a terraced hill called West End Hill, showing that the Chalk once extended much beyond its present limits, a mass of vast thickness and great extent having been removed by subaërial denudation. One of the Tring Reservoirs, the feeders of the Grand Junction Canal, was distinctly seen. The River Thame, a tributary of the higher waters of the Thames, also takes its rise amongst these reservoirs, or from springs which feed them.

Descending the hill to Aldbury, tea was partaken of at the "Greyhound," which has changed hands since it was last visited by the Society, with the result that prices have gone up a little, but this is only what may be expected when a pretty and interesting spot gets to be better known and more frequently visited.

On the way back to Tring Station a détour was made on to the slopes of Aldbury Owers, and the pasque-flower, *Anemone pulsatilla*, or *Pulsatilla vulgaris* as it is now more correctly but less elegantly called, was found to be in full flower. This pretty little plant only occurs on chalk downs, and nowhere else in Hertfordshire except on the Barton Hills. It was in order to see this plant in flower that this meeting was arranged to be so early in the year.

Field Meeting, 9th May, 1896.

KEW GARDENS.

A rather larger party than that which visited Aldbury, chiefly consisting of members from Watford and St. Albans, assembled at the principal entrance to Kew Gardens at about half-past three, most of the number having come viâ Willesden to Kew Bridge Station, crossing the Thames by the picturesque stone bridge which is soon to be replaced by one of iron.

The highly-heated glass houses devoted to the culture of tropical ferns, orchids, and cactuses were first visited, but in going through them the party became divided, and the following only refers to the small section of members with whom the writer wandered through the gardens.

In the Rock Gardens "we" were met by the Director, Mr. Thistleton Dyer, and although he could only spare a short time with us, this very interesting part of the Gardens was rendered still more interesting by his presence and remarks. The plants are chiefly Alpine, and include various species of dwarf *Phlox*, such as *subulata* and its varieties, of *Aubrieta*, *Lithospermum*, *Geum*, *Alyssum*, *Trillium*, *Ranunculus*, and *Primula*, including the little Japanese variety, and many other early-flowering plants then just in perfection, making the scene a gay one. In the water-lily house the large blue and white blossoms of the lilies were seen floating on the surface of the water. The great palm-house and other glass houses were also visited.

Some time was then spent in the Museums, the Museum of Economic Botany being specially interesting. Straw-plaiting is here illustrated by specimens from Hertfordshire. The "North" Gallery also proved very attractive, Miss North's beautiful paintings of flowers and floral scenes in various parts of the world, including the rich floral region of the tropics, being much admired.

Tea was then partaken of at the refreshment-rooms near the Temperate House, the hot afternoon making the rest in a shady spot very welcome.

The remainder of the afternoon was spent in the open gardens, which are very beautiful at this season of the year, the wealth of blossoms which will appear later being compensated for by the young green foliage now decking the trees and shrubs. By the side of the main avenue were seen the beds of late tulips in various shades of red, yellow, and white, including the curious parrot-tulip, but the earlier spring bulbous plants had ceased flowering, and the bulbs were ripening in the beds preparatory to being removed to make room for summer flowers. Rhododendrons of various species were coming into flower, and magnolias were also in bloom, and amongst the rhododendrons were seen the young lilies which of late have attained to such perfection in these gardens.

The meeting was under the direction of Mr. Daniel Hill, the Librarian of the Society.

Field Meeting, 13th May, 1896.

HATFIELD PARK.

The announcement that the Marquis of Salisbury had kindly granted permission for Hatfield House to be visited on this occasion attracted a large number of members and their friends, the party, which assembled at the principal entrance to Hatfield Park at about three o'clock, under the direction of Mr. Hopkinson, numbering upwards of seventy.

On leaving Hatfield Station the Park was entered by the great gates, erected not many years ago when this much more convenient approach to the mansion than the old one through the town was laid out, and the bridge over the main road which it necessitated was built. Instead of a descent to this road and then a steep ascent to the Church, up a narrow street, the mansion is now approached by a broad carriage-road half a mile in length with but a slight ascent, gracefully winding up towards the northern façade.

Hatfield House is one of the most perfect specimens yet remaining of a great Elizabethan mansion. Although erected after the virgin Queen had ceased to reign, it is in the architectural style which attained its chief perfection during her lifetime, and therefore goes by her name; and amongst the stately homes of England there are not many which equal, and there are very few which excel in interest this historic dwelling of the illustrious family of Cecil, now worthily represented by our present Prime Minister, who finds in the pursuit of Science a salutary relief from the arduous and onerous duties of his office.

The Bishop's Palace at Hatfield was a Royal residence in the sixteenth century, but just at the close of this period James the

First exchanged it, with the Manor of Hatfield, for Theobalds, the Hertfordshire mansion of Sir Robert Cecil. The Palace of Bishops and Kings was not, however, good enough for Sir Robert, and he pulled most of it down in the year 1607, and completed the building of a new mansion in 1611, at a cost, including the chapel, of a little more than £9,000. Nor was the park in which the house was situated large enough for him, so he enclosed two parks, Hatfield and Milwards. The whole of the present structure was not then erected, the west wing having been built so recently as 1835.

The house is in the form of a parallelogram, 280 feet long and 70 feet wide, with a wing at either end 100 feet long and 80 feet wide, a clock-tower 70 feet high in the centre of the main building, and turrets at the four projecting corners of the two wings.

Ascending the steps in front of the clock-tower the Marble Hall was entered. Here are pictures of Queen Mary, of Queen Elizabeth, and of Mary Queen of Scots, etc., and fine Gobelins tapestry representing the Garden of the Hesperides. Passing through the Cloisters, used as an armoury, the Chapel was entered, and its windows of Flemish glass attracted attention. Above the Cloisters runs the Long Gallery or Winter Drawing Room, 160 feet long and 20 feet wide. In the Library, which was next entered, are the valuable historic manuscripts known as the Cecil Papers, comprising some 13,000 letters from the reign of Henry the Eighth to that of James the First. King James' Drawing Room is quite a museum of curiosities of much historic interest but far too numerous to mention, and with many historic paintings, with which, indeed, Hatfield House abounds. The room of most interest to a scientific society was not seen. This is Lord Salisbury's laboratory, his "den" as he calls it. Here are the physical, chemical, and photographic apparatus with which his Lordship works at practical science, and it was here that he planned the electric lighting of the house by means of the water-power of the River Lea, which flows through his park, and also the present water-supply of Hatfield. Lord Salisbury's clear elucidation of what is known of the laws and what we still have to learn of the mysteries of science in his Address as President of the British Association at Oxford in 1894, which came as a surprise to many of his hearers, is thus seen to have been in great part derived from practical knowledge of the physics of Nature.

After inspecting the gardens and ornamental grounds, the old oak-tree under which it is said that Elizabeth was sitting when she was informed that she was Queen of England, was visited, and then the members proceeded to the "Vineyard," to view which Lord Salisbury had granted a special permit, which is a privilege now seldom allowed, and his Lordship's kindness was greatly appreciated. Here Sir Robert Cecil endeavoured to introduce the cultivation of the grape, and it is said that he planted about 20,000 vines, but the experiment was not a successful one. The principal features of the Vineyard are now the avenues of clipped and trained yews upon the terraces, and the beautifully-kept lawn which extends down to the bank of the River Lea.

Before leaving the Park by the town entrance the portion of the old Bishop's Palace, now converted into stables, was inspected; and the thanks of the members were expressed to the Marquis of Salisbury for the privileges he had granted to the Society on this and former occasions, and to the Director of the meeting for obtaining these privileges from his Lordship, and successfully carrying out the arrangements for the most popular and one of the most enjoyable field meetings which the Society had held for many years.

Field Meeting, 23rd May, 1896.

COLNEY HEATH AND NORTH MIMMS PARK.

This is the first field meeting in which the bicycle was brought into requisition to any considerable extent. Nearly all the members who attended were from St. Albans, and twenty-five went by train to Smallford Station, while seven cycled direct to the Church in North Mimms Park. The meeting was under the direction of Mr. T. P. Grosart Wells, who went with the larger party.

From Smallford Station the field-path was taken which leads to the little hamlet of Sleepshyde, whence another path was taken, which, after crossing the River Colne, here a tiny brook, leads into one of those picturesque disused lanes, grass-grown and overshadowed by trees, which are so frequent in Hertfordshire. This lane ends at a farmhouse near Colney Heath, and the walk was continued along another path which enters the road very near to North Mimms Park. This route is the most direct between the station and the park, but perhaps not the quickest for such a large party, the numerous stiles which had to be crossed causing a considerable delay and not a little merriment, especially at the last two, one on either side a hedge and so near together that some of the ladies showed their agility by taking the two at one bound.

On arriving at St. Mary's Church, in the park, the members were received by the Vicar, the Rev. G. S. Batty, and the cyclists were found to have arrived and to have ascended the tower.

The church is a beautiful structure of pure Decorated character. It contains a few old tombs and an unusual number of brasses, some of which are very fine. One, dating about the middle of the fifteenth century, represents a man and his wife and their ten children—four sons and six daughters. Near by is a remarkably fine brass to a man and his wife, the costume being that of the reign of Queen Elizabeth. In the vestry the Vicar showed a beautiful chalice of carved amber, mounted with silver-gilt, with eight female figures emblematical of virtues, under canopies, carved on the amber. "It was given," Cussans says, "by Lady Mews, by will, in 1751, to stand upon the altar of the church." It bears the date 1656. Mr. Batty also showed a silver-gilt cup, with cover, of beautiful workmanship, apparently Italian, and about a century more recent than the amber chalice. The early registers, dating from 1653, but not continuous, were also inspected.

After thanking Mr. Batty, the party left the church by the fine avenue of elms for the mansion, which was shown by the kind permission of the then owner, the late Mr. Walter H. Burns, for whom it had been greatly enlarged and was at that time being decorated. It is older than Hatfield House, having been built about the year 1600 by Sir Ralph Coningsby. The old manor-house of North Mimms, which the present building replaced, was also older than the Bishop's Palace of Hatfield, but, unlike that, no portion of it still remains. Hatfield House was built on the same plan as this, but much larger; now, owing to the extensive additions which have been made for Mr. Burns, this mansion rivals Hatfield House in size. Although the building is completed, the decorations were in too unfinished a state at the time of this visit to judge what the final effect will be.

After a brief visit to the gardens, the park was crossed by the Lady's Drive to Courser's Farm, where the members and their friends were very kindly entertained at tea by Mr. and Mrs. Giddins, after which Smallford Station was reached by way of Colney Heath, the cyclists returning by London Colney.

Field Meeting, 20th June, 1896.

HITCHIN.

This meeting was organized by the Geologists' Association of London, and was conducted by Mr. William Hill, F.G.S., a member of our Society.

Assembling at Hitchin Station at half-past two, the members of the two Societies walked by the side of the Great Northern Railway and then along a branch tram-line to Mr. T. Ransom's Lime Works near Grove Mill, about half a mile to the north of Hitchin. In the chalk-pit here a good section of the Lower Chalk is exposed, the highest bed containing its characteristic fossil, *Belemnitella plena*. In one part of the pit the Melbourn Rock overlies this bed, but it is not well shown here. Marking a great break in the fauna, this hard bed is considered to form the base of the Middle Chalk. It contains fishes, crustacea (lobsters, etc.), and many shells.

Returning to Hitchin Station the large chalk quarry by the side of the line was visited. It is in the Middle Chalk, and the section exposed is an upward continuation of that near Grove Mill, the Melbourn Rock here being near the base, and having, as in the Isle of Wight, a marly band both above and below it, but there much thicker than here. The chalk here is full of *Inoceramus*, and in the Melbourn Rock *Ptychodus mammillaris* was found. The most interesting portion of this section are the glacial beds overlying the Chalk. The actual junction of these beds with the Chalk is seen, and there is a great mass of coarse material at the junction, with ice-scratched stones and pebbles characteristic of the northern drift.

Hitchin Hill, just east of the town, was then visited. The high ground here is covered by a sheet of glacial drift extending right into Hitchin, and of considerable interest. In one pit it was seen to consist of an upper bed of clay and a lower bed of gravel and sand, well stratified, and showing current-bedding here and there. The gravel is composed chiefly of flints from the Chalk, and contains a great number of fossils which appear to have come from the north, many quartzites, and pebbles of white chalk.

The celebrated Hitchin Lake Bed at "The Folly" was next examined. It is a light-coloured, brown or whitish, soft calcareous loamy deposit, passing down in places into a dark-grey or almost black loam, and is below the brick-earth, which is the highest alluvial deposit here, and above a bed of gravel of which no one knows anything, not even whether it is of marine or fresh-water origin. Somewhat similar examples of ancient lake beds have been described in Lyell's 'Antiquity of Man' at Hoxne in Suffolk (p. 219, 4th ed.) and at Mundesley on the coast near Cromer (p. 267), and at Bedford there is a similar deposit resting on Oolitic strata. The Hitchin Lake Bed has already been described in our 'Transactions' (Vol. VIII, part 4, p. xxxvii). The following is a list of fossils found in it, from the 'Proceedings of the Geologists' Association' (vol. xiv, p. 417).

MAMMALIA:—*Ursus*, *Cervus elaphus*, *Rhinoceros*.

MOLLUSCA:—*Bythinia tentaculata*, *Limnæa auricularia*, *L. peregra*, *Planorbis carinatus*, *P. complanatus*, *P. spirorbis*, *Valvata cristata*, *V. piscinalis*, *Veletia* (*Ancylus*) *lacustris*, *Anodonta cygnæa* (?), *Sphærium corneum*.

OSTRACODA:—*Candona candida*, *Cypris Browniana*, *C. incongruens*, *C. reptans*.

PLANTÆ:—*Chara* (stems and fruit).

Cypris Browniana, which is found abundantly in this lake bed, is supposed to have become extinct.

The following derived fossils were found on the present occasion in the gravel which underlies the lake bed:—*Cardinia concinna* (from the Lias), *Pleuromya costata* and *P. crassa* (Lower Lias), *Serpula tetragona* ? (Cornbrash), and *Gryphæa bilobata* (Kelloway Rock).

Many shells were found in the lake bed, but they proved to be too fragile to be carried away.

Before leaving the brickfields at "The Folly," other sections were examined, and in a bed of gravel were found a *Sternbergia*, a plant from the Coal-measures, and *Avicula inæquivalvis*, a shell from the Kelloway Rock.

The party then walked back to Hitchin, the members of the Geologists' Association having tea at the Sun Hotel before leaving for London, and the members of the Hertfordshire Society returning to St. Albans, etc., by an earlier train.

Field Meeting, 18th July, 1896.

ALDENHAM HOUSE, ELSTREE.

The last Field Meeting of the summer was held at Aldenham House, the Hertfordshire seat of Lord Aldenham, by his kind permission. The preliminary arrangements were made by Mr. F. W. Silvester, but he was unable to be present at the meeting.

The members, most of whom had travelled by train to Elstree, assembled in front of Aldenham House at about half-past three, and were received by Mr. Vicary Gibbs, M.P., who kindly showed them over the house. Having to leave early Mr. Gibbs transferred the guidance of the party through the gardens and pleasure-grounds to Lord Aldenham's head-gardener, Mr. Edwin Beckett, F.R.H.S., by whom, under his Lordship's direction, they have recently been greatly improved and beautified.

Aldenham House stands in a park of about 200 acres, which nearly reaches from Elstree to Aldenham, and there is a main entrance from each of these villages. Approaching from Elstree, about half-way along the carriage-drive through the park, an artificial lake, the water in which is derived from Elstree Reservoir, is crossed by a pretty rustic bridge, and on either side the drive runs a row of fine young chestnut-trees. Many other trees have recently been planted in various parts of the park, in which, also, there are fine old trees; tall elms, spreading oaks, towering poplars, fragrant limes, shimmering beeches, quivering birches, and handsome chestnuts abounding.

The mansion is of red brick, and dates from about the end of the seventeenth century, but several of the principal rooms are of the time of Charles the First. The gardens encircle the house, and, with the pleasure-grounds, cover seventy-five acres. The lawn is planted with evergreens and flowering shrubs; the flower-garden is always effectively and tastefully planted; there are rose-gardens and gardens of American plants; and a lime-tree walk leads to the wild garden, or "wilderness" as it is called, the paths through which are all turfed; and then comes the "rootery," a spot in which roots of arboreal giants are utilized in working out various effects. In the wilderness and rootery are large patches of double-flowered bramble, hydrangeas, heaths, and climbing roses, which are allowed to grow unrestricted, giving a picturesque beauty not attained under more formal culture, and enhanced by the bracken and tall grasses which thrive beneath the fine oaks and other trees, chiefly devoted to the growth of fruit, flowers for cutting, and plants for decoration. A new kitchen-garden, two acres in extent, a new orchard, and the various glass houses, were also seen, and tea was then prepared by Mrs. Beckett, and partaken of underneath some splendid trees on the lawn.

The thanks of the party for the enjoyable afternoon which had been spent were accorded to Lord Aldenham, Mr. Vicary Gibbs, and Mr. and Mrs. Beckett.

Field Meeting, 10th October, 1896.

GORHAMBURY PARK, ST. ALBANS.

By the kind permission of the Earl of Verulam and Mr. J. B. Taylor, the annual Fungus Foray was held on the Gorhambury estate, the members assembling at the London and North-Western Station at two o'clock, walking along King Harry Lane and through the Verulam Woods and the "Hollows" into Gorhambury Park, and returning by the Gorhambury Road and the Water Walk by the side of the River Ver.

The Society's Recorder of Fungi, Mr. George Massee, F.L.S., would have been present had he not unfortunately been ill at the time, and in his absence Mr. Hopkinson undertook the collection of the fungi as well as the direction of the meeting, and sent to Kew for Mr. Massee the same evening specimens of all the species found by any of the party so far as he could recognize their distinctness.

The specimens, which were packed in moss, arrived in good condition, and Mr. Massee identified the species as follows, those new to Hertfordshire being indicated by an asterisk:—

Hymenomycetes.

Agaricus

(Amanita) spissus, *Fr.*
,, phalloides, *Fr.*
,, excelsus, *Fr.*
(Amanitopsis) vaginatus, *Fr.*
(Collybia) fusipes, *Bull.*
,, butryaceus, *Fr.*
,, radicatus, *Fr.*
(Tricholoma) albellus, *Fr.**
,, terreus, *Schæff.*
,, spermaticus, *Fr.**
(Clitocybe) fragrans, *Fr.*
,, cyathiformis, *Fr.*
,, brumalis, *Fr.*
,, ectypus, *Fr.**
(Laccaria) laccatus, *Berk.*
(Mycena) rugosus, *Fr.*
,, purus, *Fr.*
,, polygrammus, *Fr.*
,, galericulata, *Fr.*
,, pseudopurus, *Cke.*
(Clitopilus) orcella, *Bull.*
,, prunulus, *Scop.*
(Inocybe) pyriodorus, *Pers.*
,, incarnatus, *Bres.**
,, Bongardii, *Weissm.**
,, geophyllus, *Sow.*
(Galera) tener *Fr.*
(Hypholoma) fascicularis, *Huds.*
,, epixanthus, *Fr.*
,, violaceo-ater, *Letell.**
(Psalliota) hæmorrhoidarius, *Schultz.**
,, elvensis, *B. & Br.**
Coprinus atramentarius, *Fr.*
,, macrocephalus, *B. & Br.**
Russula nigricans, *Fr.*
,, depallens, *Fr.*
,, ochroleuca, *Fr.*
,, emetica, *Fr.*
,, fallax, *Fr.**
,, delica, *Fr.**
,, rubra, *Fr.*
Lactarius subdulcis, *Bull.*
,, blennius, *Fr.*
,, volemus, *Fr.*
Hygrophorus eburneus, *Fr.*
,, puniceus, *Fr.*
,, psittacinus, *Schæff.**
,, virgineus, *Fr.*
,, obrussens, *Fr.*
Marasmius peronatus, *Fr.*
,, ramealis, *Fr.*
Clavaria cristata, *Holmsk.**
,, cinerea, *Bull.**
,, abietina, *Schum.**
Stereum spadiceum, *Fr.**
Polystictus hispidus, *Fr.*
,, versicolor, *Fr.*

Gasteromycetes.

Bovista nigrescens, *Berk.*
Lycoperdon pyriforme, *Schæff.*
Scleroderma verrucosum, *Fr.*

Ascomycetes.

Helvella esculenta, *Pers.**
Xylaria hypoxylon, *Fr.*

"The collection," Mr. Massee remarks, "although numerically small, contained some very interesting forms. *Agaricus excelsus*, a very beautiful fungus, is everywhere rare. *Agaricus elvensis*, an edible fungus closely allied to the common mushroom but far superior in flavour, is also rare, having only previously been recorded from three localities. And *Agaricus violaceo-ater* is new to the British Flora, having hitherto been known to occur only in France.

"The collection also included characteristic examples illustrating the range in odours and flavours from those of a highly agreeable nature to the very opposite extreme. Amongst species possessing a very decided odour may be mentioned *Agaricus spermaticus*, in which the smell is very pronounced and equally disagreeable. *Agaricus fragrans*, on the other hand, has a strong and agreeable spicy smell, which remains after cooking, that is if properly conducted, the specimens being placed in a closed vessel, stewed gently for twenty minutes, and the vessel opened only when placed upon the table. *Agaricus purus* smells exactly like radishes, whereas *Agaricus pyriodorus*, as the name denotes, smells like ripe pears. Other British species, such as *Agaricus odorus*, have a very pleasant aroma, whereas *Hygrophorus fœtidus*, as would be expected from its specific name, is the reverse of pleasant, to say the least.

"There is a strong tendency on the part of some people to argue that there is a definite use for the presence of every product in the organic kingdom, a statement which would, of course, include the odours of fungi. Such statements are in a sense safe, even if nothing in support of the assertion is offered, inasmuch as our knowledge of the ways and means of life is yet very limited. No one has demonstrated that the odours possessed by the fungi named above, and many others, are of any service to the species emitting them. Fungi, in common with all other living organisms, require food, which when taken into the system is not of the exact chemical composition of the fungus itself. The food contains all the chemical elements required to form fungus flesh, with other chemical elements not required by the fungus. During the process of metabolism the elements of the food are separated, those useful to the fungus are retained, and the surplus elements rearrange themselves to form a new chemical substance, which may result in a brilliant colour, or a substance possessing a marked taste, smell, etc., which need not be of any further use to the fungus, but, as the organism is low down in the scale of life, and has no special arrangements for getting rid of by-products, they are retained in its structure. The common yeast-plant—*Saccharomyces cerevisiæ*—is a fungus, and, in common with other fungi, requires food; and it so happens that in assimilating its food the rejected elements are in those proportions which form alcohol and carbonic acid. Nevertheless, no one has shown that either of these products are of the slightest service to the fungus, although respectively utilized by the brewer and baker.

"Certain groups of fungi, however, have evolved the power of utilizing their by-products of metabolism. In the Phalloideæ, represented in England by the common "stinkhorn"—*Phallus impudicus*—and two other rarer species, we usually find associated a brilliant colouration and a most abominable fœtid smell. The colour and smell are only evident at the period when the very minute spores are mature and ready for dispersion. The spores at maturity are immersed in a sticky fluid which produces the strong smell, and also contains a very sweet substance allied to saccharine. Bluebottle-flies and other insects greedily devour this fœtid slime, and also the very minute spores which it contains; and thus, by means of insect agency, the spores of these fungi are disseminated. The bright colour and strong smell are the agents or advertisements by which the fungus makes known its whereabouts to its insect friends.

"It is interesting to note that, while scent and colour are utilized by fungi for spore-dissemination, these same products are used by many flowering plants for securing cross-fertilization, insects in both instances being the unconscious agents in effecting the desired object. It is well known that such agreeable and disagreeable odours and flavours are not uncommon amongst flowering plants, but it is not so well known that the same is the case with the fungi."

Agaricus excelsus was found by Mrs. Ashdown, and *A. violaceo-ater* by Mr. Hopkinson. That these were not common forms was recognized at the time of their discovery, but no such notice was taken of the finding of *Agaricus elvensis*, so that it is impossible to say who was its discoverer. Had Mr. Massee been present the number of distinct forms recognized would no doubt have been largely increased.

ORDINARY MEETING, 8TH DECEMBER, 1896, AT WATFORD.

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

The Right Honourable the Earl of Verulam was elected a Member of the Society.

Mr. F. Arthur Campion, Assoc.M.Inst.C.E, Netria, St. Albans, and Mr. J. Denison Jordan, Priory View, St. Albans, were proposed for membership.

The following papers were read:—

1. "On an Ancient British Coin found near Watford." By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas.R.S., V.P.S.A., etc. (*Transactions*, Vol. IX, p. 133.)

Mr. A. E. GIBBS showed a coin which had been picked up at St. Albans, and which appeared to be a farthing of the time of

Charles the Second. He also mentioned that a seventeenth-century token of Ralph Bradley (1662 or 1663) had been found in pulling down the Old Red Lion at St. Albans.

The PRESIDENT said that this paper, contributed by such a great authority as Sir John Evans, was very interesting. It was matter of regret that the author could not be present so that they might ask him questions about it. Some few years ago he (the speaker) made some notes of stamps and coins in the British Museum—the stamps being modern, of course, the coins being ancient—with a view to making a natural history on a numismatic and philatelic basis, and he found about 150 species of plants and animals wonderfully represented on coins principally from the mints of Ancient Greece and Italy. One would like to know of what material these ancient coins were made, so many of them retaining their superscription and figures on the face, after passing through all the vicissitudes to which currency was liable in their day, and being buried under conditions in which they were subjected to violence and certainly to chemical and other disintegrating action. The gold in the coin under discussion must have undergone some process of alloying to withstand attrition; pure gold, soft gold, would not have retained the impress of the horse's head and the inscription as this had done. Amongst the coins in the British Museum and others accessible to him were a number which represented in a marvellous degree the acme of pictorial art, not simply conventionalities, but really figures delineated from life. They were mostly from the ancient mints of Southern Italy and Greece. He remembered one delineation of an eagle, in which all the wing-feathers were absolutely correct, and another of a tortoise, in which the number and shape of the plates forming the carapace, which might be overlooked by a popular draughtsman, were actually true to nature. Another, that of a field-mouse, an issue of Metapontum, was readily distinguished from an ordinary mouse of Leucas; they were perfectly easy to be differentiated. In another case there was a cray-fish from Agrigentum, which was perfectly distinct from the prawns figured on the coins of Tarentum and Catania; the two were perfectly drawn and engraved, so that there was not the least difficulty for anyone with even a superficial knowledge of natural history to distinguish one from the other. He was struck with the remark that the Macedonian Philippus was associated with this coin. The only coins which he had seen with horses upon them were those which had representations of Philip II of Macedon. In the cities sacred to Apollo, the animals figured on the coins as a rule were the mouse, snake, raven, hawk, wolf, and grasshopper. Amongst plants, the olive and laurel were quite unmistakable in their reproduction. There was one, very interesting indeed, from the island of Cimolos, one of the Cyclades, where there was a great deal of fossiliferous chalk, and that was a coin showing a representation of the *Echinus*, the only delineation of a fossil in ancient art which he knew of, whether on coinage or anything else. There was one butterfly, in the island of Rhodes, with at least a score of bees and wasps, perfectly easy to be recognized and separated the one from the other. The most interesting group of the whole lot was one of about forty dogs, some few of which might be mythical, some apparently wild, but it showed that artificial selection had done a great deal at that date for the establishment of varieties, and the most notable were the boar-hound, the deer-hound, the grey-hound, and the terrier. There was no spaniel, but on a coin of Cumæ, a city near the Bay of Naples celebrated for its luxury, unexampled in these days, was the verisimilitude of a poodle. Most of the dogs corresponded with those of the present day. The osprey, the vulture, the golden eagle, several owls, and other birds were to be recognized. The ostrich was clearly delineated on a later Byzantine coin, with all its characteristic points perfect, even the two toes, which often escape the observation of draughtsmen who are not naturalists. But the most perfect of all representations were the Cretan wild goat and the swan of many cities, notably Camarina. The swan appeared in the issue of about a dozen mints, as perfect a portraiture of a natural-history object as one would like to see in illustration of a work of that science.

2. "On the Destruction of an Elm-Tree by Fungi at St. Albans." By George Abbey. Communicated by A. E. Gibbs, F.L.S., F.E.S. (*Transactions*, Vol. IX, p. 129.)

Mr. Neele alluded to the splendid elm-trees at the residence known as "The Elms" in Watford.

Mr. Vaughan Roberts said that he had measured the two trees in front of that house, and the circumference a foot from the ground was from 18 to 19 feet. The circumference of the tree referred to was 12 feet. The size of the tree was not always a proof of age; it depended upon soil and other circumstances. According to the age assumed for the tree under discussion, 150 years, that of the trees at "The Elms" would be very great.

The President remarked that the fact of the house being named from the trees would perhaps show that they were very old. The size no doubt depended greatly upon the kind of elm.

3. Report on the Conferences of Delegates to the British Association at Liverpool in 1896. By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

The Conferences were held on the 17th and 22nd of September, the first Conference being devoted to the question of the federation of Natural History Societies, and the second to that of a federal staff for local museums and to the consideration of the work of sectional Committees of the Association. In the absence, from illness, of Mr. W. Whitaker, F.R.S., the Chairman nominated by the Scientific Societies Committee, Dr. J. G. Garson presided at each Conference. Sir John Evans, K.C.B., F.R.S., President-elect of the British Association, was the Hertfordshire Natural History Society's Delegate to the Conferences.

First Conference.

In opening the proceedings the Chairman referred to the large number of delegates present as indicating the appreciation of the Corresponding Societies of their connection with the British Association, and he expressed the hope that the delegates would attend each of the Conferences, so that they might explain to their respective Societies the nature of the work in which they were asked to co-operate.

District Unions of Natural History Societies.—Mr. George Abbott, General Secretary of the South-Eastern Union of Natural History Societies, then read a paper with this title. He remarked that while local Natural History Societies had done much good work, yet in many cases their efforts had been weak, irregular, and desultory. He thought the chief cause of failure had been want of organization. A step in the right direction had been taken by the Unions of Scientific Societies already existing, such as those of Yorkshire and the East of Scotland, but he considered that the British Association did not sufficiently foster such unions. He therefore submitted the following scheme (here somewhat abridged) for the consideration of the Conference:—

1. *Districts.*—The United Kingdom should be divided into fifteen or twenty districts in which all Natural History Societies should be associated for mutual aid, counsel, and work, existing unions not being disturbed. They might vary in extent, and be dependent, in some measure, on railway facilities. From time to time the areas might be revised.

2. *Congress.* — Each union would have its annual congress attended by delegates and members from its affiliated societies. This would be held in a fresh town every year, with a new President, somewhat after the manner of the British Association. The congresses would probably take place in spring, but two should never be held on the same day.

3. *Union Committees.*—Each union would need a general secretary and a committee intimately acquainted with methods of work and the best ambitions of local societies.

4. *Corresponding Members.* — Each local society should appoint in every village in its district a corresponding member with some distinctive title, and certain privileges and advantages.

The work asked of him would be to—

(1) Forward surplus natural-history specimens to their Society's Museum.

(2) Supply prompt information on the following subjects:—

  (*a*) New geological sections.
  (*b*) Details of wells, borings, springs, etc.
  (*c*) Finds of geological and antiquarian interest.

(3) Answer such questions as the British Association or the local society may require.

(4) See to the preservation of historic buildings.

(5) Assist the Selborne Society in carrying out its objects.

In return he should be offered—

(1) Assistance in naming specimens, and in the formation of school museums.
(2) Free admission to lectures and excursions.
(3) Copies of Transactions.
(4) Free use of the Society's library.

Every village would soon, under this scheme, possess an agent, or registrar, who would be more and more able, as he gained experience, to further the aims of this Association.

5. *Income and Expenses.*—The unions would be supported by means of small contributions from the affiliated societies. Money would only be wanted for the expenses of an organizing secretary.

These unions would render important help to local societies, would bring isolated workers together, assist schools, colleges, technical institutes, and museums, start new societies, and revive waning ones. Economy of labour would be accomplished by a precise demarcation of area for each local society. This would be its sphere of work and influence; and in this area it would have a certain amount of responsibility in such matters as observation and research, and vigilance against encroachments on footpaths, commons, and wayside wastes. The unions might also, through their Central Committees, bring about improvements in publication, but joint publication would perhaps not be desirable in all cases. In this, as in other matters connected with the unions, *co-operation and not uniformity* should be the aim.

With objects so desirable and far-reaching in view, the cost could not be considered excessive, and the British Association would soon be repaid by obtaining prompt and direct communication with all the towns and villages in Great Britain, and by greater assistance in its research work and in all branches of knowledge which it was established to promote.

The Rev. E. P. Knubley remarked that the Yorkshire Naturalists' Union was, he believed, the largest union of scientific societies in England, having thirty-six affiliated associations. There were 500 members and 2,500 associates, making a total of 3,000 workers. He thought they owed much to their geographical position and to the great variety of rocks, scenery, soil, and climate in Yorkshire. As to the organization of the Union, it was based to a considerable extent on that of the British Association. Their President, a distinguished Yorkshireman, was elected annually. There were general secretaries, an executive Council of twelve members, and a general committee. Their work came under five sections — geology, botany, zoology, conchology, and entomology. In addition, much work was carried on by means of research committees, which were in direct communication with the British Association. Eight such committees were then in existence: a Boulder Committee; a Sea-Coast Erosion Committee; a Fossil Flora Committee; a Geological Photographs Committee; a Marine Biology Committee; a Micro-Zoological and Micro-Botanical

Committee; a Wild Birds and Eggs Protection Committee; and a Mycological Committee. All these Committees reported annually, and their reports were presented to the British Association. An annual meeting of the Union was held in one of the Yorkshire towns. For excursion purposes Yorkshire was divided into five districts, and a meeting was held annually in each of them. One meeting every year took place on the sea-coast. Great care was taken by the secretaries before each excursion to get all the geological, botanical, and other information obtainable about the place to be visited, and, when there, an endeavour was made to get each member to do some special work, every effort being made to train workers in the various departments of natural science.

Mr. M. H. Mills gave some account of the organization of the Federated Institution of Mining Engineers. He said that the rules of the Federation had been carefully considered by the secretaries and councils of the various societies composing it, and it had been found that the best kind of federation was that which touched only the publication of their papers. Each society did its work independently, as before the existence of the Federation, but now they had one publication instead of many. Members of the societies composing the Federation paid but one subscription, a portion of it only being devoted to printing the publications.

Professor T. Johnson mentioned that in Ireland they had a good example of a Union. It comprised four clubs, one in Dublin, another in Belfast, a third in Cork, and a fourth in Limerick, which combined to form the Irish Field Club Union. A yearly meeting was held in various parts of the country, and they had a publication which was common property—the 'Irish Naturalist.' There was a poll-tax of twopence from each member to defray the expenses of the Union, and there was a Committee formed of the president and secretaries of the four societies. They had an arrangement by which a specialist belonging to one club could have his expenses paid if he lectured to another club. They were also forming a directory, so that students coming to Ireland would shortly be able to learn who was working at any given subject and where he might be found. They made a point of sending their specimens to museums. In addition, they had short courses of lectures to arouse the interest of amateurs, with occasional excursions. The fees received from persons attending the lectures were used for excursion purposes, the lecturer himself receiving nothing [beyond his expenses] from the course.

After a considerable amount of further discussion, in which most of the Delegates present took part, a sub-committee was appointed to consider the question and report to the Corresponding Societies Committee. The recommendations of this sub-committee were:—

(1) That Mr. G. Abbott's paper on "District Unions of Natural History Societies" be distributed by the Committee of the Corresponding Societies amongst *all* the Natural History Societies in the United Kingdom, with the request that their opinion on the feasibility of the plan advocated in the paper be communicated

as early as possible to the Corresponding Societies Committee for its report to the Conference of Delegates at Toronto in 1897.

(2) That the formation of District Unions of Natural History Societies is highly desirable and would be of general advantage.

(3) That the Committee of the Corresponding Societies be requested to take steps to encourage the formation of District Unions of Natural History Societies.

(4) That it should be distinctly understood that the formation of Unions would not in any way prevent the affiliation of individual Societies of such Unions to the British Association as at present.

Second Conference.

The above recommendations were read by Mr. Abbott as the Report of the sub-committee appointed at the first Conference, and the report was received and adopted. A resolution was then passed referring it to the Corresponding Societies Committee.

A Federal Staff for Local Museums.—This was the subject of a paper by Professor W. M. Flinders Petrie, D.C.L.

His suggestions, Professor Petrie said, only affected a distribution of labour, and would rather economize than require extra expenditure.

In all local museums the main difficulty of the management was that there was neither money nor work enough for a highly trained and competent man. It was in any case impossible to get a universal genius who could deal with every class of object equally well, and hardly any local museum could afford to pay for a first-class curator on any one subject. These difficulties were entirely the result of a want of co-operation.

According to the report of the Committee in 1887, there were fifty-six 1st class, fifty-five 2nd class, sixty-three 3rd class, and thirty 4th class museums in the kingdom. Setting aside the last two classes as mostly too poor to pay except for mere caretaking, there were 111 in the other classes; and deducting a few of the 1st class museums as being fully provided, there were 100 museums all of which endeavour to keep up to the mark by spending perhaps £30 to £200 a year on a curator.

The practical course would seem to be their union, in providing a federal staff, to circulate for all purposes requiring skilled knowledge, leaving the permanent attention to each place to devolve on a mere caretaker. If half of these 1st and 2nd class museums combined in paying £30 a year each, there would be enough to pay three first-rate men £500 a year apiece, and each museum would have a week of attention in the year from a geologist, and the same from a zoologist and an archæologist.

The duties of such a staff would be to arrange and label the new specimens acquired in the past year, taking sometimes a day, or perhaps a fortnight, at one place; to advise on alterations and improvements; to recommend purchases required to fill up gaps; to note duplicates and promote exchanges between museums; and to deliver a lecture on the principal novelties of their own subject in the past year. Such visitants, if well selected, would probably be welcome guests at the houses of some of those interested in the museum in each place.

The effect at the country museums would be that three times in the year a visitant would arrive for one of the three sections, would work everything up to date, stir the local interests by advice and a lecture, stimulate the caretaker, and arrange routine work that could be carried out before the next year's visit, and yet would not cost more than having down three lecturers for the local institution or society, apart from this work.

To many, perhaps most, museums, £30 for skilled work, and £30 or £40 for a caretaker, would be an economy on their present expenditure, while they would get far better attention. Such a system could not be suddenly started; but if there were an official base for it, curators could interchange work according to their specialities, and as each museum post fell vacant it might be placed in commission among the best curators in that district, until by gradual selection the most competent men were attached to forty or fifty museums, to be served in rotation. It was not impossible, Professor Petrie thought, that the highest class of the local museums might be glad to subscribe, so as to get special attention on subjects outside of the studies of their present curators.

Mr. W. E. Hoyle said that he hoped no action would be taken in this matter in such a way as to prevent co-operation with the Museums Association. Professor Petrie's scheme seemed to him a most simple and practical one, and he thought it would be a good thing for those specially interested in it to confer with the officials of the Museums Association with regard to it. The chief difficulty which he foresaw in carrying it out was the almost incredible inertia of museum committees. The Museums Association met once a year, and everyone who had attended its meetings had admitted their value in enabling curators to exchange ideas upon all museum questions. It had been in existence about six years, but hitherto very few societies had cared to go to the expense of sending their curators to its meetings. In the museum over which he had the honour to preside there were four assistant curators who were doing good work.

Mr. G. Abbott cordially supported Professor Petrie's suggestions, and thought that an increase in the number of Unions of Naturalists' Societies would greatly tend towards their general adoption.

Professor Johnson protested against the curators of our local museums being converted into mere caretakers, as he thought the tendency should be in the opposite direction. It would be well to urge our local societies to employ as their curator a specialist of some kind, and to give him a chance of rising above the position he held at first, rather than to make him feel that he would always be a mere caretaker dependent wholly on some one who came down occasionally from some centre of enlightenment. He knew an admirable curator in the north of Ireland, seventy years of age, and a specialist in three or four branches, who was then living on a salary of £70 per annum, and had to dust the tables, open the door, and act in general as a mere caretaker. This was a disgrace to the great town in which the museum was situated. Local museums should have a grant of £50 to £100, or even £150 for the payment of specialists.

Professor Petrie said that this was to a great extent a money question. He did not think that his suggestions necessarily involved additional expense. He thought it would be better that the money should be divided between the mere caretaker and the specialists, rather than that an attempt should be made to combine them by employing one man who could not possibly be a specialist on all points. Indeed, those curators who were more than mere caretakers, would by his plan receive a larger amount of money than before by rendering their services in a number of places, instead of being confined to one. It would be better to have a dozen men of science and fifty caretakers, than sixty curators all receiving a very inadequate salary.

Geological Photographs.—The secretaryship of the Geological Photographs Committee has been resigned by Mr. Osmund W. Jeffs and accepted by Mr. W. W. Watts, and the collection of photographs is now under his care in the library of the Museum of Practical Geology in Jermyn Street, where it is open to inspection. At this Conference Mr. Watts said that though much assistance had been received from Leicestershire and some other counties during the past year, a very large area in England was still unphotographed. Very few photographs had been received from the eastern counties. I regret to say that Hertfordshire is still one of the counties very poorly represented in the collection, the only photographs from our county being a few small ones (quarter-plate) taken by myself.

Erratic Blocks.—Mr. Watts stated that the work of the Erratic Blocks Committee was being largely done by the committees of local Societies, and that some Societies in Yorkshire were doing most admirable work. What is required is to record the position, height above the sea, lithological character, size, and origin (when possible) of our erratic blocks or boulders, to report other matters of interest connected with them, and to take measures for their preservation. Some of this work has been done for Hertfordshire by members of our Society, but much yet remains to be done. Reference should be made to a paper by Mr. H. George Fordham in our 'Transactions' (Vol. I, p. 163), which gives full information as to how to record our boulders.

Underground Waters.—Although the Committee for investigating this subject has ceased to exist, Mr. C. E. De Rance, its former Secretary, said that he hoped the delegates of the Corresponding Societies would urge their members to record carefully in their districts everything bearing on this matter, not only as regards the geological nature of the strata, but also as to the temperature of water obtained from considerable depths.

Much attention has lately been given to the circulation of underground waters in Hertfordshire in consequence of the attempts which have been made by London Water Companies, and others, to rob our county of its water to a greater extent than it is at present being robbed of it, and the subject has been brought before our Society on several occasions. (See 'Transactions,' Vol. VI, p. 136, and Vol. IX, p. 33.) Papers on the depth of water in wells have also been communicated ('Transactions,' Vol. V, p. 20, and Vol. VI, p. 31), and others are promised.

Ethnographical Survey.—The Secretary of the Ethnographical Survey Committee, Mr. Sidney Hartland, said that he wished to ask for the co-operation of the local Societies in the work of the Committee. Considerable progress had been made since he had asked their aid at Ipswich last year. During the present century the movements of our population had been immensely greater than in previous centuries. Still, there were places where there had been little change in that respect. As it was the object of the Committee to acquire a knowledge of the distinguishing characteristics of the various races of the British Isles, it was important that the measurements, etc., of individuals in any district should be those of persons whose families had lived there during a considerable period. There was no department in which it was more desirable to have speedy information than that of folklore. Much had been done with regard to the dialects of the different counties of England by the publication of the English Dialect Dictionary, but in Scotland and Ireland there was still much work to be done both in dialect and in folklore. Education, facilities for railway travelling, and industrial migrations were rapidly destroying local customs, dialects, and traditions, so that it was more important that speedy information about them should be obtained than that there should be an immediate supply of physical measurements. The historic and prehistoric monuments of a locality should also be noted. Mr. Hartland concluded by remarking that he would be glad to furnish any delegates interested in the subject with copies of the Ethnographical Committee's Schedules, or with any help in his power.

Mr. John Gray, Buchan Field Club, said that in his district they had begun to note the physical characteristics of the inhabitants by placing themselves at the entrance to a field where some sports were being held, and observing the colour of the eyes and hair, the contour of the nose, and other characteristics of people entering the field. They also measured about 200 persons in the grounds, and obtained some very interesting results. In addition they had obtained measurements, etc., of almost all the school-children of the district.

The Chairman remarked that Mr. Gray's Society was obtaining excellent results, and giving a good example of the work required. As the information asked for by the Ethnographical Survey Committee was of so many different kinds, it appeared to him that the formation of sub-committees by the local societies would greatly expedite the work. One sub-committee might confine itself to physical measurements, another to dialect and folklore, a third to ancient monuments, and so on. Then photographers were needed for illustrations of people and monuments; and persons with a turn for history might consider the historical evidence of continuity of race. Investigations of this kind would at once enrich the Transactions of a local society, and help the work of the British Association.

There is plenty of scope in Hertfordshire for the work of this Committee, but hitherto I have been unable to induce any member of our Society to take part in it, or in any branch of it. Much of the work can only be done satisfactorily by a medical man who visits country districts, but there are many branches of the inquiry on which almost anyone who has resided for some time in the county could give information.

Other Committees of the British Association to which assistance may be given by members of our Society are those on Meteorological Photography, on the Teaching of Natural Science in Elementary Schools, and on the position of Geography in the Educational System of the Country. These subjects were not brought before this Conference. A list of the Committees, with the names and addresses of their Secretaries, is appended to the previous report.

Mr. Hopkinson then read a letter which he had received from the Chairman and Secretary of the Corresponding Societies Committee of the British Association requesting to be favoured with a statement of the views of the Society on a suggestion for the formation of District Unions of Natural History Societies.

A discussion ensued in which the President, Mr. W. R. Carter, Mr. A. E. Gibbs, Mr. G. P. Neele, Mr. T. Vaughan Roberts, Mr. John Weall, and Mr. Hopkinson took part, and further discussion was deferred to the next meeting of the Society at Watford.

The President referred to the great loss which the Society had sustained by the death of Dr. Brett, who, he said, was eminently a local man, devoting his time and talents to the welfare of the town in which he lived, in which there is scarcely an institution with whose interests his name is not interwoven, in scarcely any one more than in this Society, the presidential chair of which he occupied with such advantage to the Society twenty years ago. He loved the organization, which he did much to foster, if not to found, and, taking enthusiastic pleasure in the study of Nature, it was his delight to promote and encourage that study in every way.

Mr. Hopkinson said that the Society originated in a conversation which he had with Dr. Brett in the year 1873. When he came to reside at Watford in September, 1874, they talked the matter over again, and that conversation resulted in the formation of the Society in the beginning of the following year, so that Dr. Brett was certainly one of the founders, and he thought that he might be considered the principal one.

A vote of sympathy with the Misses Brett and the rest of Dr. Brett's relatives was then carried, on the proposition of the President, in silence.

Ordinary Meeting, 10th December, 1896, at St. Albans.

Dr. John Morison, F.G.S., Vice-President, in the Chair.

Mr. Horace Tuppin, 68, Holywell Hill, St. Albans, was proposed for membership of the Society.

The following lecture was delivered:—

"Rambles by Forest, Field, and Flood." By James Saunders.

The lecturer introduced his subject with the remark that the love for natural-history objects such as butterflies, birds, and flowers, was the common heritage of humanity. This was most pronounced in childhood, and in Nature's children—the savage races. Whether these tastes were relics of the simple joys of Eden, or whether they were survivals of the habits of our remote arboreal ancestors, might be left to theologians and evolutionists to decide. The capacity for the perfect enjoyment of these things might vanish with the rolling years, but it might be replaced by another kind of pleasure which resulted from knowledge. An acquaintance with the life-history of our commoner species of plants and animals, a knowledge of their geographical distribution in space, and of their geological descent in time, would give an additional interest to our country walks. It would fill the world with acquaintances with whom we could hold mental converse, and it would modify our views of the position which man occupies in the scale of the universe.

In illustration of the various points referred to, lantern views were thrown upon the screen. Amongst the numerous subjects touched upon were the fertilization of the wild arum, cowslips, and primroses; the habits of the early spring flowers of coppices and woods, and many other denizens of our fields and hedgerows. References were also made to the alternation of generations as exhibited by ferns, horsetails, and mosses. Illustrations were given of the metamorphoses of butterflies and moths, and the curious changes which characterize the development of amphibians, especially as seen in frogs and newts. These remarks led up to a brief description of some points in the life-history of a group of organisms which link together the animal and vegetable kingdoms. These, the lecturer pointed out, also exhibited phenomena analogous to alternation of generations, and were known as Mycetozoa.

The slides illustrating this part of the subject were not perhaps so artistic as those exhibited earlier in the evening, but they had the merit of being photographs of creatures found in the South Midlands, most of them from Hertfordshire. In some instances the plasmodia of these organisms were prepared as lantern slides and projected upon the screen. One of these was of plasmodium kept for two years in a dried state and then revived by moisture and warmth. Concluding, the lecturer said that through the recent researches of local workers in this subject, it had been shown that out of the 180 species of Mycetozoa known to science as occurring in the whole world, about half of the forms occurred in Herts, Beds, and Bucks, and in one wood in Bedfordshire one third of the whole had been recorded in recent years.

The lecture was illustrated by means of the oxy-hydrogen lantern, kindly lent and manipulated by Mr. Thomas Askwith, to whom a vote of thanks was accorded.

ORDINARY MEETING, 22ND DECEMBER, 1896, AT WATFORD.

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

Mr. F. Arthur Campion, Assoc. M. Inst. C.E., and Mr. J. Denison Jordan, were elected Members of the Society.

The discussion on the formation of District Unions of Natural History Societies, adjourned from the meeting on 8th December, was continued, and the following resolutions were passed:—

1. That Unions of Natural History and Archæological Societies are desirable.
2. That the Hertfordshire Natural History Society is willing to join in the formation of a Union for the Registration District of the South-Midland Counties (Hertford, Buckingham, Oxford, Northampton, Huntingdon, Bedford, and Cambridge).
3. That should Registration Districts not be generally adopted for the Unions, the County of Essex be added to this Union.
4. That the chief objects of the Unions be to promote mutual intercourse, to provide lecturers, and to assist museums within their districts, the present independent publication of proceedings by each Society being continued.
5. That annual meetings or congresses of each Union be held in succession in the principal towns within its district.
6. That the Unions be managed by an Executive Council consisting of the President, Secretary or Secretaries, and one or two other members of each Society of which they are formed.
7. That the expenses of each Union be met by a small capitation-grant or percentage of the annual subscriptions contributed to each Society within it.
8. That the resolutions passed at this meeting be communicated to the Secretary of the Scientific Societies' Committee of the British Association.

Mr. T. Vaughan Roberts read a paper entitled "Extracts from a Naturalist's Notebook," being chiefly the results of his own observations in various departments of Natural History.

The President delivered a lecture on "Flying."

ORDINARY MEETING, 26TH JANUARY, 1897, AT WATFORD.

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

Mr. Horace Tuppin was elected a Member of the Society.

Mr. Thomas East Lones, M.A., LL.B., B.Sc., Rokeby Lodge, Watford, and Mrs. Morrow, 2, St. Andrew's Villas, Watford, were proposed for membership.

The following lecture was delivered:—

"The Röntgen or 'X' Rays." By Thomas Mansell, F.R.M.S., F.R.P.S. (*Transactions*, Vol. IX, p. 135.)

The lecture was illustrated by experiments and lantern slides.

Anniversary Meeting, 26th February, 1897.

(At Watford.)

Arthur Stradling, Esq., M.R.C.S., F.Z.S., President, in the Chair.

The Report of the Council for the year 1896, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address entitled "Serpents and Umbrellas."

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

President. — William Whitaker, B. A., F. R. S., F. G. S., Assoc. Inst. C. E.

Vice-Presidents.—John Morison, M.D., D.P.H., F.G.S.; T. Vaughan Roberts; George Rooper, F.Z.S.; Arthur Stradling, M.R.C.S., F.Z.S.

Treasurer.—John Weall.

Honorary Secretaries. — John Hopkinson, F. L. S., F. G. S., F.R.M.S., F.R.Met.Soc.; W. R. Carter, B.A.

Librarian.—Daniel Hill.

Curator.—A. E. Gibbs, F.L.S., F.E.S., F.R.H.S.

Other Members. — Charles Ashdown, F.C.S., F.R.G.S.; John Attfield, M.A., Ph.D., F.R.S., F.C.S., F.I.C.; F. M. Campbell, F.L.S., F.Z.S., F.R.M.S., F.E.S.; Alan F. Crossman, F.L.S.; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc.; Herbert George Fordham; Edward Mawley, Pres. R. Met. Soc., F.R.H.S.; George P. Neele; William Page, F.S.A.; William Ransom, F.S.A., F.L.S.; W. Lepard Smith; G. Herbert Wailes, Assoc. M. Inst. C.E.

The thanks of the Society were accorded to Mr. Arthur Stradling, retiring from the office of President; to Dr. John Attfield, F.R.S., retiring from the office of Vice-President; and to Mr. Henry Lewis, Mr. F. W. Silvester, and the Rev. E. T. Vaughan, retiring from the Council.

Report of the Council for the Year 1896.

In presenting the twenty-second Annual Report the Council of the Hertfordshire Natural History Society regrets to have to announce a considerable falling off in the number of members, due chiefly to two causes—the small number of members elected during the year, and the large number removed from the list for non-payment of subscription. A greater number than in any previous year have also been lost to the Society by death. On the other hand, it is satisfactory to be able to state that, although the attendance at the evening meetings has sometimes been small, all the field meetings have been most successful, both as regards the number taking part in them and the pleasure which has evidently been derived from them. With the exception of the field meeting which took place in July, at which time of the year from several causes the attendance is usually small, the number of members and their friends attending the field meetings was never less than thirty.

During the year five ordinary members have been elected, one honorary member, and one corresponding member; one member has compounded for his annual subscription; seven members have resigned; twenty-one have been removed from the list for non-payment of subscription for several years; and the Council regrets to have to record the loss of ten members by death—one honorary member, Mr. Isaac Brown; four life members, Dr. Alfred T. Brett, Mr. Francis Lucas, Miss Georgiana E. Ormerod, and Mr. J. Hack Tuke; and five annual subscribers, Mrs. Ackworth, Colonel Capell, Mr. Stephen Salter, Mr. W. T. Stone, and Mr. Henry Warner. This list includes two who died before 1896, Mr. Isaac Brown and Mrs. Ackworth, but their deaths had not been ascertained when the previous annual report was presented.

The census of the Society at the end of the years 1895 and 1896 was as follows:—

	1895.	1896.
Honorary Members	17	17
Corresponding Members	2	3
Life Members	51	48
Annual Subscribers	181	152
	251	220

Mr. Isaac Brown was doubtless best known to the members of this Society as one of the chief contributors to the first Flora of the County, the 'Flora Hertfordiensis' of Webb & Coleman, having been, during the time that he resided at Hitchin, Mr. Coleman's most valued coadjutor. His favourite study, however, was Astronomy; and for twenty-two years, while Principal of the Friends' Flounder's Institute at Ackworth in Yorkshire, he kept a meteorological register. He was a Fellow of the Royal Astronomical Society for forty-four years, and of the Royal Meteorological Society for forty-five years. He presented his botanical library and herbarium to the Hertfordshire Natural History Society in 1882, and was elected an honorary member of the Society in the following year. He was born at Amwellbury, near Ware, in 1803, and he died at Kendal on the 3rd of November, 1895.

The death of Dr. Brett on the 11th of last July removes from our ranks one of the founders of the Society; in fact, the idea of forming a Natural History Society at Watford originated in a conversation between him and your present senior Secretary in the summer of 1873. Dr. Brett had a very extensive medical practice, and until a very recent period held most of the professional appointments in Watford and its neighbourhood, yet he found time to take a prominent part in every movement for the benefit or advancement of his town and county, devoting especial attention to everything connected with technical instruction. He was one of the founders of the Watford Public Library and School of Science and Art, and for many years Honorary Librarian. But to no institution was he more devoted than to this Society, his active interest in its welfare never flagging for more than twenty-one years. He was one of the Trustees and the second President, and in addition to his two Presidential Addresses he read several papers before the Society which will be found in the 'Transactions.' He was born in London in 1828, received his professional education at Guy's Hospital, and came to Watford in 1850, residing here for forty-six years.

Miss Ormerod died on the 19th of August. Although not so well known as her younger sister, Miss Eleanor A. Ormerod, whose fame as an Economic Entomologist is worldwide, she had a thorough knowledge of Entomology. She was also an accomplished botanist and conchologist, a very talented artist, and a gifted linguist. She has designed and drawn numerous entomological diagrams, depicting a large number of the most important injurious insects in all their life-stages, which she has presented to Agricultural Colleges and Schools in this country and in our Colonies, and some form a portion of the Ormerod Collection of Economic Entomology in the University of Edinburgh. She thoroughly understood French, Italian, Spanish, and German, having mastered the latter comparatively late in life in order to read and translate German entomological works for her sister.

Mr. Stephen Salter and Mr. Henry Warner were members of the Council at the time of their death. They both took a great interest in the Society and frequently attended the field meetings, and the former was also a very regular attendant at the evening meetings, which Mr. Warner was only prevented from attending by residing so far east as Wormley.

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

Jan. 21.—Notes on the Characeæ, with a List of Species from the South Midlands; by James Saunders.

—— Notes on Birds observed last Spring at Mentone and elsewhere on the Continent; by T. Vaughan Roberts.

Feb. 25.—Anniversary Address — Mutual Aid amongst Animals; by Prince Kropotkin.

March 12.—Hertfordshire Rainfall, Percolation, and Evaporation; by John Hopkinson, F.L.S., F.G.S., F.R.Met. Soc.
Notes on Lepidoptera observed in Hertfordshire during the year 1895; by A. E. Gibbs, F.L.S., F.E.S.
—— Notes on Birds observed in Hertfordshire during the year 1895; by Alan F. Crossman, F.L.S.
April 21.—Report on the Rainfall in Hertfordshire in the year 1895; by John Hopkinson, F.L.S., F.G.S., etc.
—— Climatological Observations taken in Hertfordshire in the year 1895; by John Hopkinson.
—— Meteorological Observations taken at The Grange, St. Albans, during the year 1895; by John Hopkinson.
—— Report on Phenological Phenomena observed in Hertfordshire during the year 1895; by Edward Mawley, Pres. R. Met. Soc., F.R.H.S.
—— List of Mosses collected in the neighbourhood of Hertford; by Hugh Darton.
—— On some Overlooked Records of Hertfordshire Plants; by B. Daydon Jackson, Sec. L.S.
—— Notes on the Observation of Swallows; by A. Sainsbury Verey, Memb. Brit. Orn. Union.
Dec. 8.—On an Ancient British Coin found near Watford; by Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc.
—— On the Destruction of an Elm-Tree by Fungi at St. Albans; by George Abbey.
—— Report on the Conferences of Delegates to the British Association at Liverpool in 1896; by John Hopkinson, F.L.S., F.G.S., F.R.Met. Soc.
—— 22.—Extracts from a Naturalist's Notebook; by T. Vaughan Roberts.
—— Flying; by the President, Arthur Stradling, M.R.C.S., F.Z.S.

The following lecture was delivered at St. Albans:—

Dec. 10.—Rambles by Forest, Field, and Flood; by James Saunders.

At the meeting on the 8th of December a discussion was commenced on the advisability of forming Unions of Natural History Societies, and it was continued on the 22nd of December, when resolutions approving of the formation of such Unions were passed. These resolutions will be printed in the report of that meeting (see p. lii).

The following Field Meetings were held during the year:—

April 25.—Aldbury and Ashridge Park.
May 9.—Kew Gardens.
—— 13.—Hatfield House and Park.
—— 23.—Colney Heath and North Mimms Park.
June 20.—Hitchin.
July 18.—Aldenham House and Park, Elstree.
Oct. 10.—Gorhambury Park, St. Albans.

The meeting on the 20th of June was held in conjunction with the Geologists' Association of London; that on the 10th of October was the annual fungus foray.

For assistance at the field meetings in allowing the members and their friends to visit private houses and parks the Society is indebted to the Marquis of Salisbury, Hatfield House; to Mr. Walter H. Burns, North Mimms Park; to Lord Aldenham, Aldenham House; and to Mr. J. B. Taylor, Gorhambury. The

Society is also indebted to Prince Kropotkin for delivering the Anniversary Address, the President having been unable to do so from ill-health.

The eighth volume of the present series of the Society's 'Transactions' has been completed, and the ninth has been commenced, three parts of each, containing 220 pages and 10 plates, having been published during the year. Four-fifths of the papers in the eighth volume are of local interest. The Meteorology and Phenology of Hertfordshire are treated of in ten papers, the usual eight annual reports (on the rainfall, climatology, and phenology of the County, and on the meteorology of St. Albans, each for two years), an account of the floods of November, 1894, and a notice of the gale of the 24th of March, 1895; the Botany is represented by a paper on the Mycetozoa, with a list of species from Herts, Beds, and Bucks; the Entomology by annual reports on the Lepidoptera observed, and by a paper on the wasp infestation of 1893; and the Ornithology by the usual annual reports on the birds observed, and by a paper on birds frequenting the neighbourhood of Heronsgate. One of the Anniversary Addresses, on the Stone Age in Hertfordshire, and two papers on hard and soft water, with special reference to the supply of Watford, complete the local papers, twenty in all, to which may be added miscellaneous notes on Meteorology and Entomology. The papers which do not relate to Hertfordshire are five in number; a lecture on the Bronze Age, an Anniversary Address on Man (the title being "A Wonderful Animal"), and papers on the lower micro-organisms, on the egg of the frog, and on the natural history of the salmon. The only paper published in the 'Proceedings' is a report on the Conferences of Delegates to the British Association at Oxford in 1894, in which is pointed out work which may be done by members of the Society in assisting Committees of the British Association.

The volume is illustrated by the unusually large number of sixteen plates, and by eight other illustrations. Seven of the plates, representing bronze and stone implements, are reprints from woodcuts kindly lent by Sir John Evans and Mr. Worthington Smith, and nine were produced from photographs at the expense of the Society. The photographic illustration of the Reports of the Field Meetings has been continued in this volume, eight photographs taken by your Editor being reproduced on four of the plates. Three plates are original process-reproductions from photographs of the actual objects, and your Editor believes that in these plates the half-tone process has for the first time been successfully employed in showing flint implements and living plasmodium of a Mycetozoon.

Owing chiefly to more expense than usual having been incurred on the 'Transactions,' six parts having been issued with an unusually large number of illustrations, the expenditure during the year has been greater than the receipts, the balance being less at the end than at the beginning of the year; but in the present year not more than four parts of the 'Transactions' will be issued, and as it is not likely that there will be any exceptional expenditure it may be possible to carry out the recommendation made in last year's Report to spend only the amount received for annual subscriptions, leaving the miscellaneous receipts to be added to the invested funds of the Society.

The library is still at the old Board Room at the Waterworks, where it is carefully housed but practically inaccessible to the members. The donations received during the year have been numerous. They are chiefly exchanges from other Societies, and from the various scientific departments of the United States. Your librarian has gone carefully through the library and regrets to find many sets of serial publications incomplete. The library is outgrowing the space available for it, and the question of disposing of some of the books and unbound serial publications not likely to be read by the members may have to be considered by the Council and your trustees.

Although the Annual Reports are essentially retrospective, it has been usual to throw out hints in them for the future, and in no previous year has there been a more cogent reason for this practice than in the present one, the year of the "Diamond Jubilee" of our Queen. How to celebrate the longest reign of any English Sovereign is being considered by almost every public institution in the countries over which Queen Victoria has ruled for sixty years, and something should surely be done by the Hertfordshire Natural History Society. To help charitable institutions, especially our Hospitals, is an admirable way of commemorating this event, but a scientific institution is the only one which can well appeal to a scientific society, as such. It is intended this year to found a scientific institution for Hertfordshire, to the fund for which many members of this Society have already largely contributed. To the proposed Hertfordshire County Museum some forty members of this Society have already promised to contribute nearly £600, out of a total amount slightly exceeding £1,300. An excellent site at St. Albans has generously been offered by Earl Spencer, and although, for the complete scheme of the Committee which has been appointed, £5,000 is required, it has been decided to commence operations by putting up a building which can be enlarged at any future time so soon as the sum of £2,000 has been raised. If forty members of the Society can give £600, an average of £15 each, surely the remaining one hundred and eighty can give another £600, an average of less than £3 10*s.* each, and if they do so the success of the scheme will be assured. The Council therefore ventures to ask for a subscription from every member of the Society who has not yet promised one, sums of even 10*s.* being acceptable. It is intended to include within the walls of the Museum a scientific library and also a lecture-room in which meetings of this Society may be held.

Such a commemoration of the Queen's reign will be peculiarly appropriate, for it is mainly to her and to her Consort, Prince Albert, in the earlier years of her reign, that we owe the magnificent group

INCOME AND EXPENDITURE FOR THE YEAR ENDING 31*st* *DECEMBER*, 1896.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1895	19	19	4	By Printing 'Transactions'	79	8	9
,, Entrance Fees	4	0	0	,, Miscellaneous Printing	7	10	0
,, Subscriptions for 1892	0	10	0	,, Expenses of Meetings	4	15	4
,, ,, ,, 1893	1	10	0	,, Reporting	1	1	0
,, ,, ,, 1894	4	0	0	,, Library Expenses	9	8	9
,, ,, ,, 1895	16	10	0	,, Salary of Assistant	5	0	0
,, ,, ,, 1896	56	0	0	,, Stationery	2	2	1
,, ,, ,, 1897	18	0	0	,, Postages	16	0	0
,, Life Composition Fee	5	0	0	,, Fire Insurance	0	12	6
,, Dividends on £130 India 3 per cent. Stock.	2	18	6	,, Sundry small expenses	1	10	4
,, Sale of Publications ['Flora of Hertfordshire' 18*s*.; 'Transactions' 3*s*. 1*d*., less expenses]	1	1	1	,, Transfer of India 3 per cent. Stock	0	2	6
				,, Balance at Bank	1	17	8
	£129	8	11		£129	8	11

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

Audited and found correct this 23rd day of February, 1897, { GEORGE P. NEELE, F. C. MAHON.

of Museums at South Kensington. It was Prince Albert who not only suggested the idea of the great London Exhibition of 1851, but also that the surplus receipts from that Exhibition should be invested in the purchase of land whereon to build Museums and other institutions for the advancement of the Art, Science, and Industries of our country.

Another way in which this year might be commemorated by the Society is by the members endeavouring to bring up our roll to a larger number than in any previous year. If one in every three members would induce a friend to join the Society the total number of members would be raised to about three hundred, which is a considerably larger number than at any previous time.

The Council has appointed Dr. John Attfield, F.R.S., a Trustee of the Society in place of the late Dr. Brett, and has arranged for the dividends on the invested funds to be paid to the Society's Bankers, instead of, as before, to one of the Trustees.

Additions to the Library in 1896.

Presented.

Title.	Donor.
Binnie, A. R. On Mean or Average Annual Rainfall. (Proc. Inst. Civ. Eng.) 8vo. London, 1892 . .	*The Author.*
British Association for the Advancement of Science. Report for 1895 (Ipswich). 8vo. London, 1896 .	*The Association.*
Etheridge, R. Fossils of the British Islands. Vol. i. Palæozoic. 4to. Oxford, 1888	*Mr. J. Hopkinson.*
Evans, Sir J. On some Roman Coins found at Brickendonbury, Hertford. (Numis. Chron.) 8vo. London, 1896	*The Author.*
Lawes, Sir J. B., and Sir J. H. Gilbert. Results of the Rothamsted Experiments for the Years 1893-96. 4to. London, 1894-96	*Sir John Lawes.*
Marriott, W. The Meteorological Record. Vol. xiv, No. 56; vol. xv, Nos. 57, 58. (Roy. Met. Soc.) 8vo. London, 1896	*Sir John Evans.*
Ormerod, Eleanor A. Report of Observations of Injurious Insects and Common Farm Pests during the Year 1890. 8vo. London, 1891	*The Authoress.*
Royal Meteorological Society. Quarterly Journal. Vols. iii-xxi. 8vo. London, 1877-93 . . .	*Sir John Evans.*
Royal Society. Report of the Meteorological Council for the Year ending March, 1895. 8vo. London, 1895	,,
Science Gossip. Vol. ii, Nos. 22-24; vol. iii, Nos. 25, 27-29	*Mr. A. E. Gibbs.*
Symons, G. J. (Ed.). Monthly Meteorological Magazine. Vols. xxx and xxxi. 8vo. London, 1895-96 . .	*The Editor.*

Received in Exchange.

American Museum of Natural History. Report for the Year 1895. 8vo. New York, 1896.

Bath Natural History and Antiquarian Field Club. Proceedings. Vol. viii, part 3. 8vo. Bath, 1896.

BELFAST NATURALISTS' FIELD CLUB. Annual Report and Proceedings for 1895–96. 8vo. Belfast, 1896.

BIRMINGHAM NATURAL HISTORY AND PHILOSOPHICAL SOCIETY. Journal. Vol. i, Nos. 8–13. Vol. ii, No. 1. 8vo. Birmingham, 1895–96.

BOSTON (U.S.A.) SOCIETY OF NATURAL HISTORY. Proceedings. Vol. xxvii. 8vo. Boston, 1895.

BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY. Abstract of Papers and Report, 1895. 8vo. Brighton, 1895.

BRISTOL NATURALISTS' SOCIETY. Proceedings. Vol. viii, part 1. 8vo. Bristol, 1896.

CARDIFF NATURALISTS' SOCIETY. Transactions. Vol. xxvi, part 2. Vol. xxvii, part 1. 8vo. Cardiff, 1895–96.

CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB. Transactions. 1894–96. 8vo. Croydon, 1894–96.

EALING NATURAL SCIENCE AND MICROSCOPICAL CLUB. Report and Transactions, 1895–96. 8vo. Ealing, 1896.

EDINBURGH GEOLOGICAL SOCIETY. Transactions. Vol. vii, part 2. 8vo. Edinburgh, 1896.

———. ROYAL PHYSICAL SOCIETY. Proceedings. 1894–95. 8vo. Edinburgh, 1896.

GLASGOW NATURAL HISTORY SOCIETY. Proceedings. Vol. iv, part 2. 8vo. Glasgow, 1895.

———, PHILOSOPHICAL SOCIETY OF. Proceedings. Vol. xxvi. 8vo. Glasgow, 1895.

LONDON, GEOLOGICAL SOCIETY OF. Abstracts of the Proceedings. Session 1895–96. 8vo. London, 1896.

———. GEOLOGISTS' ASSOCIATION. Proceedings. Vol. xiv, parts 6–10. 8vo. London, 1896.

———. QUEKETT MICROSCOPICAL CLUB. Journal. Series 2, vol. vi, Nos. 38, 39. 8vo. London, 1896.

———. ROYAL METEOROLOGICAL SOCIETY. Quarterly Journal. Vol. xxii. 8vo. London, 1896.

———. ROYAL MICROSCOPICAL SOCIETY. Journal. New Series. Vol. viii, part 1. 8vo. London, 1896.

MANCHESTER GEOGRAPHICAL SOCIETY. Journal. Vol. xi, parts 1–3, 7–9. 8vo. Manchester, 1896.

——— GEOLOGICAL SOCIETY. Transactions. Vol. xxvi, parts 5–7, 9, 10. 8vo. Manchester, 1896.

——— LITERARY AND PHILOSOPHICAL SOCIETY. Memoirs and Proceedings. Vol. x, parts 2, 3. 8vo. Manchester, 1895.

MERIDAN (U.S.A.) SCIENTIFIC ASSOCIATION. Transactions. Vol. vii. 8vo. Meridan, 1895.

MICROSCOPY AND NATURAL SCIENCE, INTERNATIONAL JOURNAL OF. Vol. vii, parts 29–32. 8vo. London, 1895.

NEW YORK STATE MUSEUM. Bulletin. Vol. iii, Nos. 14, 15. 8vo. New York, 1896.

NORFOLK AND NORWICH NATURALISTS' SOCIETY. Transactions. Vol. vii, part 2. 8vo. Norwich, 1896.

PHILADELPHIA ACADEMY OF NATURAL SCIENCE. Proceedings. January–March, 1896. 8vo. Philadelphia, 1896.

ROCHESTER (U.S.A.) ACADEMY OF NATURAL SCIENCE. Proceedings. Vol. iii. 8vo. Rochester, N.Y., 1896.

RUGBY SCHOOL NATURAL HISTORY SOCIETY. Report for the year 1895. 8vo. Rugby, 1896.

SOUTHPORT METEOROLOGICAL DEPARTMENT. Report for the year 1895. 4to. Southport, 1896.

UNITED STATES DEPARTMENT OF AGRICULTURE. Bulletin. No. 10.—The North American Shrews. No. 11.—The North American Weasels. No. 12.—The North American Moles and Lemmings. 8vo. Washington, 1896.

———. The Jack Rabbits of the United States. By T. S. Palmer. *Ib.*

United States Geological Survey. Annual Report for 1893–94, parts 1–4. 4to. Washington, 1895.

———. Bulletin. No. 123.—Dictionary of Geographical Positions. By H. Garnet. No. 124.—Revision of the American Fossil Cockroaches. No. 125.—The Constitution of the Silicates. By W. F. Clarke. No. 126.—A Mineralogical Lexicon of Franklin, Hampshire, and Hampden Counties. By B. K. Emerson. No. 128.—The Bear River Formation and its Characteristic Fauna. By C. A. White. No. 129.—Earthquakes in California in 1894. By C. D. Perrine. No. 131.—Report of Progress of the Division of Hydrography for the Calendar Years 1893 and 1894. By F. H. Newell. No. 132.—The Disseminated Lead-Ores of South-Eastern Missouri. By A. Winslow. No. 133.—Contributions to the Cretaceous Palæontology of the Pacific Coast. By T. W. Stanton. No. 134.—The Cambrian Rocks of Pennsylvania. By C. D. Walcott. 8vo. Washington, 1895.

Upsala, University of. Bulletin of the Geological Institution. Vol. ii, part 2, No. 4. 8vo. Upsala, 1895.

———. Arsskrift. 1870, Nos. 1, 3. 1872, No. 1. 1873, No. 2. 1874, No. 2. 1875, Nos. 1, 4, 5. 8vo. Upsala, 1870–75.

Wiltshire Archæological and Natural History Society. Magazine. Vol. xxviii, Nos. 85, 86. 8vo. Devizes, 1895.

———. Catalogue of Antiquities in the Museum. Part 1. *Ib.*

———. Abstracts of Inquisitiones Post Mortem. Part 4. *Ib.*

Purchased.

Botany, Journal of. Vol. xxxiv. 8vo. London, 1896.

Buckler, W. The Larvæ of the British Butterflies and Moths. Vol. ii. Noctuæ. (*Ray Society.*) 8vo. London, 1895.

Entomologist. Vol. xxix. 8vo. London, 1896.

Entomologists' Record. Vol. vii. 8vo. London, 1896.

Middlesex and Hertfordshire Notes and Queries. Vol. ii. 8vo. London, 1896.

Nature Notes. Vol. vii. (*Selborne Society.*) 8vo. London, 1896.

Novitates Zoologicæ. Vol. iii. 4to. Tring, 1896.

Ornithologist. Vol. i. (*All published.*) 8vo. London, 1896.

Royal Natural History. Vol. vi. 8vo. London, 1896.

Year-book of the Scientific and Learned Societies of Great Britain and Ireland . . . 1894, 1895. 8vo. London, 1895–96.

Zoologist. 3rd Series. Vol. xx. 8vo. London, 1896.

Ordinary Meeting, 23rd March, 1897, at Watford.

William Whitaker, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

The President thanked the Society for the honour they had done him in electing him, and expressed the hope that he would be able to be present at most of the Society's meetings.

Mr. Thomas East Lones, M.A., LL.B., B.Sc., and Mrs. Morrow, were elected Members of the Society.

Miss E. M. Harry, Fairfield Road, Watford, and Dr. Reid, St. Alban's Road, Watford, were proposed for membership.

The following papers were read :—

1. "Report on the Rainfall in Hertfordshire during the year 1896." By John Hopkinson, F.L.S., F.G.S., F.R. Met. Soc., Assoc. Inst. C.E. (*Transactions*, Vol. IX, p. 139.)

2. "Notes on some Plants collected in Hertfordshire by Miss Maria Ransom, 1838–40." By James Saunders. (*Transactions*, Vol. IX, p. 167.)

3. "Notes on Birds observed in Hertfordshire during the year 1896." By Alan F. Crossman, F.L.S. (*Transactions*, Vol. IX, p. 148.)

4. "On some Roman Coins found at Brickendonbury, Hertford." By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc. (*Transactions*, Vol. IX, p. 169.)

ORDINARY MEETING, 6TH APRIL, 1897, AT ST. ALBANS.

WILLIAM WHITAKER, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

The following papers were read:—

1. "The Earthquake of the 17th of December, 1896, as it affected the County of Hertford." By Herbert George Fordham. (*Transactions*, Vol. IX, p. 183.)

2. "Water-Levels in the Chalk near Royston." By Harold Warren, Assoc. M. Inst. C.E. Communicated by H. G. Fordham. (*Transactions*, Vol. IX, p. 209.)

3. "Meteorological Observations taken at The Grange, St. Albans, during the year 1896." By John Hopkinson, F.L.S., F.G.S., F.R. Met. Soc., Assoc. Inst. C.E. (*Transactions*, Vol. IX, p. 175.)

4. "The Climate of St. Albans, deduced from Meteorological Observations taken during the Ten Years 1887–1896." By John Hopkinson. (*Transactions*, Vol. IX, p. 215.)

ORDINARY MEETING, 30TH APRIL, 1897, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

Miss E. M. Harry and Dr. Reid were elected Members of the Society.

The following papers were read:—

1. "Notes on the Birds of North Hertfordshire." By Joseph P. Nunn. Communicated by Alan F. Crossman, F.L.S. (*Transactions*, Vol. IX, p. 163.)

2. "Report on Phenological Phenomena observed in Hertfordshire during the year 1896." By Edward Mawley, Pres. R. Met. Soc., F.R.H.S. (*Transactions*, Vol. IX, p. 229.)

3. "Notes on Lepidoptera observed in the Neighbourhood of Watford in the year 1896." By S. H. Spencer, Jun. (*Transactions*, Vol. IX, p. 236.)

4. "Climatological Observations taken in Hertfordshire in the year 1896." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst. C.E. (*Transactions*, Vol. IX, p. 241.)

Field Meeting, 3rd April, 1897.

CHESHAM AND TYLER'S HILL.

The first Field Meeting of the season was held in very unfavourable weather, the day being bitterly cold, rain threatening and a little falling, and the roads and paths being muddy from the heavy rains of the previous month. The meeting was organized by the Geologists' Association of London and was under the direction of Mr. Upfield Green, F.G.S., the Hertfordshire Society being invited to join in it, but no member took advantage of this invitation who was not also a member of the Geologists' Association.

Leaving Chesham Station at about 3 o'clock, a somewhat steep hill was ascended and the fields were crossed to the brickfields on Tyler's Hill, also known as Cowcroft. This is a wooded hill of which the upper part consists of an outlier of the Lower Eocene beds capped by a thin bed of Drift. The outlier is one of a series which range in a line nearly parallel with the north-western boundary of the main mass of the Tertiary strata of which they at one time formed a part, the intervening portion having been removed by denudation. The presence of these outliers is probably due to a slight change of dip of the Chalk on which they rest causing the beds to lie in a trough and so affording them protection from denudation. That they now form the highest ground is due to subaërial denudation having less effect upon such beds of clay and sand than upon the chalk by which they are surrounded, which probably undergoes more waste from chemical dissolution than from mechanical attrition. The wood on Tyler's Hill, the presence of which is due to the nature of the subsoil formed by the outlier, also affords a great protection from denudation, most of the rain which falls upon it being absorbed by the trees so that it does not wash away the soil.

Several sections in the brickfields were examined. In one about 25 feet of the Reading Beds are exposed, the upper portion consisting of about ten feet of white sand with a thin bed of clay on the top, and the lower of about twelve feet of greyish sands and laminated clay reposing on a layer of green-coated unwater-worn flints and of pebbles which rests on a nearly level surface of the Upper Chalk. In another section the surface of the Chalk was seen to be very irregular, in fact worn away so as to form pinnacles between which is clay with unworn flints, pebbles, and broken shells, and with brick-earth on the top. And in a third section about fifteen feet of the Reading Beds are surmounted by about twelve feet of the Basement Bed of the London Clay, the Reading Beds consisting of buff sands passing upwards into mottled red and white sands, and the Basement Bed of laminated sandy clay reposing on a layer of flint-pebbles, in which layer sharks' teeth (*Lamna*) were found.

From Tyler's Hill the party crossed the valley of the Chess to Aldridge's Dell, where there is a chalk-pit in which the Chalk Rock is exposed, and a few fossils were found in it.

On returning to Chesham tea was partaken of at the Chess Vale Hotel.

In the 'Proceedings of the Geologists' Association,' vol. xv, p. 89, will be found a list of fossils obtained from the Basement Bed of the London Clay at Tyler's Hill, and from the Chalk Rock at Aldridge's Dell.

Field Meeting, 24th April, 1897.

THE VALLEY OF THE BOURNE, BOXMOOR.

For fourteen years no water had flowed over the surface of the ground down the Valley of the Bourne, but that the very wet winter of 1896–97 would cause the Bourne to flow this year there could not be the slightest doubt, and, to see if it were flowing, the present writer twice visited the valley in March before any water actually appeared above the surface. On the second occasion it was ascertained that the cellar of an inn at the lower end of the valley, which had been dry for years, was flooded. With much labour the water had been taken out, but the next day it was as full as before, showing that the cause of the flooding was the raising of the plane of saturation of the chalk which occurs preparatory to the outburst of the Bourne.

Most of the members taking part in this meeting walked from Boxmoor Station, which was left at a quarter to three, to Bourne End, where tea was ordered at the White Hart Inn, to be ready on the return of the party from the source of the Bourne.

The stream had already been seen flowing through the culvert under the main road, and just after leaving the hamlet by the bye-road which runs up the valley it was found that the volume of water flowing down the usually dry bed of the Bourne was so great as to flood this road and bar further progress. A way was, however, found through the meadows, and the stream was followed for three miles from its junction with the Bulbourne. Several times it had to be crossed, and while some of the party jumped over it, or into it, bridges were improvised for others out of hurdles and bundles of wood; at one spot a plank thrown across broke under the weight of one of the members. The water was flowing rapidly, here and there widening out into ponds, and a gravel-pit on its course was full of water. At Bottom Farm there was a considerable sheet of water, and not far above it the stream disappeared altogether for a time, flowing underground only owing to the surface of the ground having been raised to carry across the valley the lane which leads to Harratt's End. There is a culvert under the lane, but the water had not risen high enough to reach it. This raising of the ground had another effect above the lane, for here the water had accumulated, forming a large but shallow pond, above which it was still flowing freely for nearly half a mile, the source of the Bourne at this time being just where the valley takes a sharp turn to the north-west. It was here flowing sluggishly through marshy ground, its first appearance as a running stream being at the extreme corner of a field of grass, the next, a ploughed field, merely having indications of surface-saturation in the presence of mud. The valley which the Bourne has formed continues for a mile and a half beyond this point, nearly to Cross Oak, the bed of the stream from the head of the valley to about half a mile below Bottom Farm marking the boundary between the counties of Herts and Bucks.

The object of the expedition,—to trace the Bourne to its source,—having been achieved by the President and the majority of the party, the valley was descended to Bourne End without any mishaps in crossing the stream, and tea was found to be waiting, not the first edition, for some of the members had returned earlier and had tea with others who never reached the main party.

Before the party dispersed, the President made some remarks on the phenomena presented by the Bourne. He said that the general slope of the country here was from north to south, and that the inclination of the underground water-level in the Chalk roughly followed the slope of the surface. Rain would percolate into the Chalk until it was saturated, and when any permeable formation was full of water it was practically impermeable, for it could not receive a further quantity. With an average rainfall the water which percolates into the Chalk remained underground, but with a certain increase the slope of the underground water-level became greater than that of the surface of the ground, and the water consequently rose above the surface, the underground reservoir overflowing, and in this instance forming the Hertfordshire Bourne. There were other bournes in the southern counties, such as the Croydon Bourne, which commenced to flow in February, nearly two months earlier than this, the reason probably being that the outcrop of the Chalk at Croydon was narrower and steeper.

Mr. Hopkinson then gave a list of the recorded instances of the flowing of the Hertfordshire Bourne,—in 1853, 1873, 1876, 1877, 1879, 1881, and 1883,—with the dates of the commencement of the flow and the position of the source; and also the average rainfall in the neighbourhood for the last four months of the year 1896. The mean of ten stations,—two at Tring, two at Cowroast, one at Northchurch, two at Berkhamsted, one at Great Gaddesden, and two at Hemel Hempstead,—was as follows:—September, 6·80 inches; October, 3·57; November, 1·26; December, 4·25; giving a total for the four months of 15·88 inches, which is nearly six inches in excess of the average. The rainfall had also, he said, been rather heavy during the first three months of 1897, especially in March, but the present month of April, in which the Bourne commenced to flow, was so far drier than usual.

Mr. Urban Smith estimated the present rate of the flow to be about two million gallons a day.

(On visiting the valley of the Bourne on the 19th of June, water was found to be still flowing between half a mile and a mile above Bourne End, but at the end of the month the flow had quite ceased.)

Field Meeting, 1st May, 1897.

ABBOT'S RIPTON AND HUNTINGDON.

The widening of the line of the Great Northern Railway, which is now being carried on in the neighbourhood of Huntingdon, has exposed an interesting section of the Oxford Clay, a division of the Middle Oolite formation, and the overlying Boulder Clay. The work is being executed under the superintendence of Mr. F. A. Campion, Assoc. M. Inst. C.E., and under his guidance the section was examined. Most of the members, with their President, Mr. W. Whitaker, F.R.S., travelled from St. Albans by the 10.55 train, were met by others at Hatfield, and arrived at Abbot's Ripton at 1 o'clock.

Lunch having been partaken of at the Inn near the station, the walk along the line towards Huntingdon was commenced, and the section of Boulder Clay in Stukeley cutting was soon in view. This proved to be a very interesting exposure, the Boulder Clay being unusually full of both large and small scratched or glaciated boulders, many of which were found to be full of fossils. Most of these boulders must have drifted with the great ice-sheet from the north, for amongst the rocks represented were seen several specimens of Tealby Limestone from Lincolnshire, Carboniferous Limestone and Coal Measure Sandstone from still further north, and an igneous rock probably brought from a greater distance than any of the rocks of aqueous origin. With these were huge flints, some very distinctly glaciated, and hard chalk boulders also ice-scratched. The prevailing fossils appear to be gryphæas and belemnites of Oolitic and Liassic age, but some of the Carboniferous Limestone boulders also contained fossils.

The Oxford Clay, from which many fossils have been obtained by Mr. Campion for the Hertfordshire Museum, was not well seen, the best sections of it having been covered up.

After the deposition of the Boulder Clay, a milder climate prevailed, and in a more recent deposit have been found horns of the wild ox, antlers of the red deer, and remains of other animals which roamed through the forests of those days; but one of the most interesting finds which has been made is that of a large number of human remains with a few pieces of very primitive pottery. Most of these were found when excavating for the foundations of the new bridge where the railway crosses the Ermine Street at Huntingdon, the remains being five feet below the present surface of the ground. After examining this bed a large number of human bones and a few skulls from it were seen. The teeth are in a remarkably perfect state of preservation, but they are ground down quite flat, this being presumably due to wear from the mastication of food not free from grit. Another interesting point about these human remains is the size of some of the bones, one thigh bone being that of a man who must have been at least seven feet in height. It is probable that this is the site of a battlefield of Saxon times. Examples of these remains may be seen in the temporary museum in the Market Place, St. Albans.

Proceeding along the Ermine Street into Huntingdon, the house in which Oliver Cromwell was born was pointed out (now No. 82, Ermine Street); and in All Saints' Church was seen the entry of his baptism on the 29th of April, 1599 (four days after his birth), and also of the resting, within the walls of the church, of the body of Mary Queen of Scots, in 1612, on its way from Peterborough Cathedral to Westminster Abbey. Before the church was visited, tea was partaken of at the Fountain Inn, nearly opposite, an excellent repast being provided. There is one other church in Huntingdon, St. Mary's, but at one time there were fifteen churches in and around the town.

Leaving by an evening train, St. Albans was reached at a quarter to ten, after an enjoyable and interesting day in perfect weather, the excellent arrangements made by Mr. Campion conducing much to the success of the meeting.

Field Meeting, 22nd May, 1897.

ASTON AND BENNINGTON.

This was one of the most enjoyable field meetings which has ever been held, the weather being perfect for a long walk, a cool breeze tempering the rays of a bright sun only occasionally obscured by a passing cloud, a beautiful part of the county being visited, and much of interest being seen; and yet very few members of the Society took part in it, the number of the party being only ten. It was under the direction of Mr. Hopkinson, who had devoted the two previous Saturdays to finding out the prettiest walk and making the necessary arrangements.

Starting from Knebworth Station at about half-past eleven, the road leading to Aston was taken for a short distance, and then a path across the fields to Bragbury End. Crossing a tributary of the Beane, a pretty woodland walk was taken to Aston Bury, an old manor-house probably built by the Botelers in the early part of the sixteenth century. It was formerly surrounded by a moat, in part of which water still stands, and at the eastern end it is said there was once a chapel. There are two remarkably fine carved oak staircases, one at each end of the house, leading up to a room at the top extending the whole length of the house, 113 feet. Various conjectures were made as to the use of this room, which seems to have been at one time a place for Roman Catholic worship, is said at another to have been a county ball-room, and may at another again have been a common dormitory for the men employed on the estate. The front of the house, which is partly overgrown with ivy, is very fine, but the back, which faces south, and commands a pretty view of wood and hill, is spoilt by the windows having been bricked up at the time the window-tax was imposed.

Proceeding through meadows and across the park of Aston House, the church, dedicated to St. Mary, was soon reached, and here the members were met by the Rector, the Rev. G. V. Oddie, who showed the parish register, dating from 1558. Much of the earlier portion of this is a remarkable example of fine penmanship. There is an entry of the sums subscribed in the parish towards the expense of rebuilding St. Paul's Cathedral, amounting to £16 6*s.* 8*d.* There is not much of interest in the church, but the old rood-screen is curious, one end being carved in the Decorated and the other in the Perpendicular style.

After a bread-and-cheese lunch at the village inn, the Rose and Crown, the walk was continued to Bennington, first crossing the Beane by a foot-bridge, and then walking through the High Wood and across the park of Bennington Lordship, permission to do so, and also to see the ruins of the old Castle, having been kindly granted by Mr. A. P. Pickering. St. Peter's Church, just outside the ancient castle moat, was first visited. It is perhaps the most beautifully-situated church in the county, unless that of Amwell may claim the palm. It contains two fine old monuments, one being the effigies of a Crusader and his wife, by the arms on the side of the tomb evidently of the family of Benstede, and the other, of a later period, being the effigies of a Lancastrian and his wife, probably Sir John de Benstede and his wife Joan. The church was built in the early part of the fourteenth century, and the first monument, supposed by Cussans to be that of the builder, is evidently of much older date. The parish register dates from the year 1538.

Bennington Lordship is a comparatively modern residence built within the ruined walls of an old moated castle. The moat has been drained, and its once perpendicular sides are now steep slopes tastefully laid out as part of the grounds of the house. Here and there portions of the original walls of the castle have been left in their ruined state, but in places, apparently with the view of adding to the picturesqueness of the grounds, portions of the castle have evidently been pulled down and rebuilt in other positions, each door and window having been put together exactly as they were originally built in the early part of the twelfth century. This was done by a Proctor of some generations back, and has given rise to an impression that the ruins are possibly all "made ruins," but such is not the case. Parts of the walls, with windows and doorways, of a castle which from the style of architecture of these windows and doorways must have been built between the years 1100 and 1150, are still remaining in their original position, but the ruined gateway has been erected at a much more recent date where was once the drawbridge over the moat. But while to an antiquary it may be a matter for regret that any alterations have been made in the old ruins, it cannot be denied that the work has been most artistically carried out. The site of the Castle, there is some reason to believe, was a seat of one of the Kings of Mercia at least as long ago as the year 850.

The village of Bennington, with its quaint old houses, is almost as well worth seeing as its church and its castle, and to one of these, the Bell Inn, the members then proceeded, arriving at the exact time stated on the notice of the meeting, 4 o'clock, and finding tea ready for them.

The return walk was taken through Aston, but by a totally different route from that by which Bennington had been reached, the high road being followed as far as Aston, and Knebworth Station being reached from there by field-paths and for some distance through meadows by the side of a stream.

Field Meeting, 29th May, 1897.

KEW GARDENS.

A fairly good number of members with their friends met at the Principal Entrance to the Gardens, the greater part from Watford and St. Albans; some others, including the senior Secretary, were deprived of the pleasure of being present owing to being caught, on starting from London, in a heavy storm of rain, fortunately occurring whilst most were in the train.

The Rock Gardens were first visited, many interesting and beautiful flowers being pointed out, such as the *Trillium* or "Trinity Flower," so called from all its parts being in threes, various species of *Saxifraga*, *Aubrietia*, and *Trollius*, a few orchids, and the later Primulaceæ. The beds of *Iris germanica* were much admired; the beautiful forms and colouring of the flowers would run the orchids a close race were they not so ephemeral.

Many fine plants were seen in the Botanic Section, also two lady gardeners in "rational costume" and blue aprons assidously dutch-hoeing the beds.

The various hot-houses were next inspected, in one of which a very fine young seedling plant of *Lodoïcea seychellensia* was pointed out, with its double seed-nut still attached; the nut, long known on the Maldive coast and used as a poison antidote, was supposed to be the fruit of a submarine tree, hence the name "Cocoa-de-Mer." This belief obtained credence until the discovery of the Seychelles group, when the tree was found with fruit. It reaches to a height of about 100 feet, and grows on three only out of the thirty islands comprising the group. Many attempts have been made to introduce this beautiful tree elsewhere, all resulting in failure; it is believed that the plant at Kew is the only one in Europe. The Orchids also were inspected and much admired, some specimens being very fine. The Saracenias and Insectivorous plants then came in for a share of attention.

The Tropical Economic House, with its tea, cocoa, pepper, allspice, and other plants producing food, caused much interest; and in the "Greenhouse" many pretty flowers, the hybrids from *Cineraria cruenta* and the Himalayan rhododendrons, were noticed.

The beautiful collection of paintings from all parts of the world made by the late Miss M. North and bequeathed by her to Kew Gardens, now forming the "North" Gallery, was next inspected. The Succulent House, with its very curious occupants, was also visited. In the Palm House some fruiting bananas were pointed out, but the bunches were not well set. The Temperate House, also, was inspected. Tea was then partaken of at the Refreshment Rooms near.

The Azalea and Rhododendron Gardens were then visited. The variety of colour of the azalea, and the charm of evergreen foliage combined with the gorgeous colouring of the flowers of the rhododendron, should lead these plants to be more frequently cultivated than they are now. It has been pointed out that they can be grown in good turfy loam without the aid of peat.

It was somewhat late for the daffodils, scillas, tulips, and other flowers planted in the grass, but enough was left to show how beautiful this so-called "naturalization" of bulbs can be made by judicious planting, the display being commenced by the winter aconite in January, and continued by the various narcissi, scillas, tulips, etc., well into June. A meadow which has to be mown might be made beautiful until the scythe, and no perceptible damage would be done to the hay.

The meeting was under the direction of Mr. Daniel Hill, the Society's Librarian, to whom the Editor is indebted for this report.

Field Meeting, 12th June, 1897.

SOPWELL, ST. ALBANS.

Just before St. Albans is reached from London by the Midland Railway, there may be seen between the line and the River Ver a number of pits of sand and gravel extending over a considerable area. Near the river the gravel has evidently been worked for a long time, but the pits on the higher ground near the line have only recently been opened. The pits are on the Sopwell estate belonging to the Earl of Verulam, and it was the principal object of this meeting to examine them by his invitation. It was thought, however, that it would be well to first see something more of the Ver and its valley, and Bricket Wood Station was selected as the starting-point.

The meeting was under the direction of the President of the Society, Mr. W. Whitaker, F.R.S., and Mr. Hopkinson. At starting the party was not a large one, but eventually numbered upwards of thirty. In the meadows below Hansteads the meeting of the waters of the Colne and Ver was seen, the Ver here being much the larger stream, although considered to be a tributary of the Colne. An attempt at an explanation of this anomaly has already been given in our 'Transactions' (Vol. VI, p. xxix). Waterside Farm, where a tiny stream flows into the Ver off the Boulder Clay of Bricket Wood, was then visited, and its pretty garden by the river shown by the Misses Elwes. The Ver has no other existing tributary, except a few miles higher up its valley at the village of Redbourn, which doubtless takes its name from a bourne which is recorded to have formerly sometimes flowed there, presaging sickness and dire distress. The reason is that the Ver, throughout its course, flows entirely on the Chalk and with this exception has no subsidiary valley of sufficient depth to reach the plane of saturation, the only bed upon the Chalk in the valley of the Ver sufficiently impermeable to throw off water being the Boulder Clay at Bricket Wood.

At Moor Mill the river was crossed and a path through the meadows on its left bank taken for about half a mile, when it was again crossed, only to be re-crossed finally at Park Street, and by this means the walk to Sopwell was entirely through the meadows. On the way the members were met by the Earl of Verulam, who kindly invited them to his residence and provided tea, which was much appreciated after the walk of four or five miles on a hot and sunny afternoon, for this was the first hot day of the summer and the sky was cloudless. Lord Verulam has a collection of "curios" of various kinds which attracted much interest; and on a table he had spread out a large number of specimens from his gravel-pits, including drifted fossils such as echinoderms and gryphæas, flints of peculiar shape, and rocks from much older formations than any in this neighbourhood, drifted by ice from the north. Some very interesting fossils collected by the Hon. Captain Grimston, F.G.S., were also seen, and remarks upon them were made by him. These are chiefly from the Crag of the Norfolk coast. Some of the rarest have been presented by him to the British Museum, and casts of these were shown.

Lord Verulam then conducted the party to a large pit of gravel and sand on the high ground to the north-west of his residence, and then to the gravel-pits nearer the river. After they had been examined, the President, Mr. Whitaker, was called upon to make some remarks, and, referring to the first pit visited, he said that sand finely bedded, or current-bedded sand, must have been deposited there by water, though he could not say definitely whether this deposit of sand and gravel was of marine or of fresh-water origin, no shells native to the deposit having been left in it, but only rolled echinoderms and inocerami which had come out of the Chalk. The greater number of the stones are flints from the Chalk, and an enormous quantity of chalk must have been destroyed to leave these flints. In the neighbourhood there was sometimes overlying the gravel a bed of loam which he thought was decomposed Boulder Clay. This gravel, therefore, was really part of the Glacial Drift. It was highly permeable, water easily getting through it. Although it was of Glacial age, it was not necessarily of glacial origin, for during the period in which icy conditions prevailed there were intervals of milder climate.

After thanking the Earl of Verulam for his kindness the party dispersed, a very pleasant and interesting afternoon having been spent.

Field Meeting, 19th June, 1897.

TRING PARK AND MUSEUM.

The party assembled at the Zoological Museum which the Hon. Walter Rothschild has established at Tring on the confines of Lord Rothschild's residence, Tring Park, and visited the Museum by his permission, this day (a Saturday) not being one on which it is open to the public. The meeting was under the management of Mr. W. R. Carter, and the members were shown over the Museum by the Director, Mr. E. Hartert.

Several fine specimens of the *Apteryx*, a wingless bird from New Zealand, first attracted attention. These birds are rather larger than our domestic fowl, and lay an egg much larger than that of a common turkey. A very much larger egg is of course that of the ostrich. There is also a model of the egg of a *Dinornis* with a *replica* skeleton of the bird accurately modelled from the original. The ostrich is a survival from a group of gigantic birds, some of which have been non-existent for many centuries, and several of these are here exhibited.

Mr. Hartert then pointed out the aquatic bird section, comprising such birds as the waders, cormorants, and gulls. Immediately opposite these is a case containing the minor feathered denizens of our woodlands and heaths, and near to them are the birds of the hawk tribe, the beautiful plumage of the snowy owls being much admired. Still richer and more important for study than the stuffed birds is the large collection of bird-skins, which is kept in two adjoining rooms. The monkeys attracted much attention. A grand specimen of the gorilla figures prominently, and on his left stands a still more hideous relative, the ourang-utan. Amongst the smaller species the "howlers" are, perhaps, of most interest. Travellers in South America are well acquainted with their unearthly vocal powers. Poor old Sally, for many years when alive the centre of attraction in the Monkey House of the Zoological Gardens, is here so realistically set up as almost to appear to live again.

Next were seen some of the predatory Mammalia—the lion of the plains of Asia and Africa, and his crafty kinsman the Bengal tiger, the jaguar, the puma or American lion, and the cheetah or Indian hunting leopard. Amongst them is a wild cat, a creature believed to be just on the verge of extinction in Britain, the last specimens seen being in the most remote districts of the Highlands of Scotland. There is also here a hybrid between a lion and a tiger.

The first floor is reached by a pretty staircase lined with photographs of animals, etc., and here, suspended from the ceiling, are huge white sharks and other monsters of the deep, overhanging the walrus, the tapir, and the giraffe. Around are cases full of smaller creatures, chiefly Invertebrata, for the Museum is as rich in them as it is in the more conspicuously exhibited Vertebrata. It was, however, thought desirable to leave the detailed examination of these to some future visit. Adjoining the first floor is the zebra room, and above it, reached by an iron staircase, a very rich collection of antelopes is exhibited.

Some living animals in an adjoining enclosure were then seen, and a pleasant walk was taken through the park, where emus and kangaroos appeared to be as much at home as in their native haunts. The fallow deer were much more shy, no sooner seen than out of sight. A gigantic tortoise, one of the largest in existence, on the other hand, took no notice whatever of his visitors, and an emu resented being disturbed while sitting on a clutch of its eggs.

On leaving the park, Mr. Hartert was cordially thanked for his kind attention and requested to convey the thanks of the party to the Hon. Walter Rothschild. Tea was then partaken of in Tring, and the station was reached after a pleasant drive round the Reservoirs.

Field Meeting, 23rd October, 1897.

CASSIOBURY PARK, WATFORD.

By the kind permission of the Earl of Essex and Sir Matthew White Ridley the annual Fungus Foray was held in Cassiobury Park, the Swiss Cottage woods, and the Woodwalks adjoining Cassiobury House. The foray was under the direction of Mr. Hopkinson, and the Fungi were identified by Mr. George Massee, F.L.S., of Kew.

In the morning a party of eight (assembling at the principal entrance at ten o'clock) crossed the Park to the grounds of the Swiss Cottage, finding about twenty species in the park, and increasing the number to nearly one hundred, besides several species not identified at the time, in the damp woods on the opposite side of the River Gade to the Swiss Cottage, which proved to be a prolific hunting-ground, especially for the minuter forms.

In the afternoon the members, increased in number to upwards of twenty, entered the Cassiobury Woodwalks and strolled along the old coach-road which passes through these (now) private grounds. The search for fungi was here made under difficulties. The woods are preserved, and the members were restrained by an over-zealous keeper from deviating out of this road, beyond its banks at least, for fear a pheasant might be disturbed. It was afterwards ascertained that the keeper was exceeding his duty, the Earl of Essex having kindly intended the members to have free access to all parts of his beautiful Woodwalks. However, this restriction did not much interfere with the success of the afternoon's foray, the number of species found in the morning being nearly doubled, and there was again a much larger proportion of microscopic fungi than has usually been found on former occasions.

The great find of the day was that of *Agaricus* (*Clitocybe*) *Sadleri*, discovered by Miss Buchanan. The species was first found growing in the Botanic Gardens in Glasgow, and it has now been added to the Hertfordshire Flora by a young lady whose native place is the same as that of the fungus, or at least as that whence came our knowledge of its existence as a species. Miss Buchanan was also fortunate in finding another rare species, *Daldinia concentrica*.

After a brief visit to the gardens of Cassiobury House, the Woodwalks were left, and the members were kindly entertained at tea by the Society's Librarian, Mr. Daniel Hill, and his sister, at their residence, "Herga."

It was a beautifully fine day, though rather dull in the morning, bright and warm in the afternoon, and the sunshine brought out in perfection the varied autumnal tints of the foliage. Altogether, an interesting and enjoyable day was spent, and with the satisfactory result of beating any previous record in the number of species of fungi found.

The following is a list of the species determined by Mr. Massee, those new to Hertfordshire being distinguished by an asterisk:—

HYMENOMYCETES.

Agaricineæ.

Agaricus

(Amanita) phalloides, *Fr.*
,, mappa, *Batsch.*
,, muscarius, *L.*
,, rubescens, *Pers.*
,, asper, *Fr.**
,, vaginatus, *Bull.*
(Lepiota) procerus, *Scop.*
,, mastoideus, *Fr.*
,, clypeolarius, *Bull.*
,, cristatus, *Fr.*
,, carcharias, *Pers.*
,, granulosus, *Batsch.*
,, delicatus, *Fr.**
(Armillaria) ramentaceus, *Bull.*
,, melleus, *Vahl.*
,, mucidus, *Fr.*
(Tricholoma) spermaticus, *Fr.*
, flavobrunneus, *Fr.*
,, albobrunneus, *Pers.*
,, rutilans, *Schæff.*
,, imbricatus, *Fr.*
,, terreus, *Schæff.*
(Tricholoma) saponaceus, *Fr.*
,, cuneifolius, *Fr.**
,, carneus, *Bull.*
,, personatus, *Fr.*
,, nudus, *Bull.*
,, panæolus, *Fr.*
,, sordidus, *Fr.*
(Clitocybe) nebularis, *Batsch.*
,, clavipes, *Fr.*
,, phyllophilus, *Fr.*
,, candicans, *Fr.*
,, fumosus, *Pers.*
,, infundibuliformis, *Schæff.*
,, gilvus, *Pers.*
,, tuba, *Fr.*
,, cyathiformis, *Fr.*
,, brumalis, *Fr.*
,, ditopus, *Fr.*
,, fragrans, *Sow.*
,, laccatus, *Scop.*
,, Sadleri, *Berk.*
(Collybia) radicatus, *Rehl.*
,, platyphyllus, *Fr.*
,, fusipes, *Bull.*
,, maculatus, *A. & S.*
,, butryaceus, *Bull.*

(Collybia) confluens, *Pers.*
,, tuberosus, *Bull.*
,, xanthopus, *Fr.**
,, dryophilus, *Bull.*
,, rancidus, *Fr.*
,, ambustus, *Fr.**
(Mycena) pelianthinus, *Berk.*
,, purus, *Pers.*
,, luteo-albus, *Bolt.*
,, flavo-albus, *Fr.*
,, rugosus, *Fr.*
,, galericulatus, *Scop.*
,, ,, *var.* calopus, *Fr.*
,, polygrammus, *Bull.*
,, atro-cyaneus, *Batsch.**
,, alcalinus, *Fr.*
,, ammoniacus, *Fr.*
,, metatus, *Fr.*
,, stanneus, *Fr.*
,, filopes, *Bull.*
,, sanguinolentus, *A. & S.*
,, galopus, *Fr.*
,, tenerrimus, *Berk.*
,, corticola, *Schum.*
(Omphalia) hydrogrammus, *Fr.**
,, hepaticus, *Batsch.**
,, fibula, *Bull.**
,, ,, *var.* Swartzii, *Fr.**
(Pleurotus) ostreatus, *Jacq.*
(Entoloma) lividus, *Fr.**
,, jubatus, *Fr.*
,, sericeus, *Bull.*
,, nidorosus, *Fr.*
,, rhodopolius, *Fr.**
(Clitopilus) undatus, *Fr.*
(Nolanea) pascuus, *Pers.*
(Claudopus) depluens, *Batsch.*
(Pholiota) togularis, *Bull.*
,, ægerita, *Fr.**
,, squarrosus, *Bull.*
,, adiposus, *Fr.*
(Inocybe) calamistratus, *Fr.**
,, incarnatus, *Bres.**
,, Bongardii, *Weissm.**
,, perbrevis, *Weissm.**
,, geophyllus, *Sow.*
(Hebeloma) mesophæus, *Fr.*
,, petiginosus, *Fr.**
(Flammula) lentus, *Pers.*
,, flavidus, *Schæff.**
,, picreus, *Fr.**
(Naucoria) melinoides, *Fr.*
(Galera) tener, *Schæff.*
,, hypnorum, *Batsch.*
(Tubaria) furfuraceus, *Pers.*
(Psalliota) arvensis, *Schæff.*
,, dermoxantha, *Pat.**
(Stropharia) æruginosus, *Curt.*
,, coronillus, *Bull.**
,, squamosus, *Fr.*
,, stercorarius, *Fr.*
(Stropharia) sublateritius, *Fr.*
,, epixanthus, *Fr.**
,, fascicularis, *Huds.*
,, velutinus, *Pers.*
(Hypholoma) appendiculatus, *Bull.**
,, hydrophilus, *Bull.*
(Psilocybe) sarcocephalus, *Fr.*
,, semilanceatus, *Fr.*
,, spadiceus, *Schæff.*
(Psathyra) corrugis, *Pers.*
,, semivestitus, *B. & Br.*
(Panæolus) phalenarum, *Fr.*
,, campanulatus, *L.*
,, papilionaceus, *Bull.*
(Psyathyrella) gracilis, *Fr.*

Coprinus comatus, *Fr.*
,, atramentarius, *Fr.*
,, micaceus, *Fr.*
Bolbitius tener, *Berk.**
Cortinarius prasinus, *Fr.**
,, elatior, *Fr.*
Paxillus involutus, *Batsch.*
,, paradoxus, *Kalchb.**
Hygrophorus pratensis, *Pers.*
,, virgineus, *Wulf.*
,, niveus, *Scop.*
,, coccineus, *Schæff.**
,, miniatus, *Fr.**
,, puniceus, *Fr.*
,, psittacinus, *Schæff.*
Lactarius turpis, *Fr.*
Russula nigricans, *Fr.*
,, furcata, *Fr.*
Marasmius rotula, *Fr.*
Lentinus cochleatus, *Fr.**
Panus stypticus, *Fr.**

Polyporeæ.

Boletus scaber, *Fr.*
,, luridus, *Schæff.*
Polyporus squamosus, *Fr.*
,, chioneus, *Fr.*
Fomes ferruginosus, *Mass.**
,, annosus, *Fr.*
Polystictus versicolor, *Fr.*
,, hirsutus, *Fr.*
Poria sanguinolenta, *A. & S.*
,, vaporaria, *Fr.*

Thelephoreæ.

Stereum purpureum, *Pers.*
,, rugosum, *Fr.**
,, hirsutum, *Fr.*
Corticium comedens, *Fr.*
,, sambuci, *Fr.*
,, arachnoidium, *B. & Br.*
,, sebaceum, *Mass.*
Hymenochæte corrugata, *Lev.**
Peniophora cinerea, *Cke.*
,, velutina, *Cke.**
,, incarnata, *Mass.**

Thelephora laciniata, *Pers.*
Coniophora arida, *Karst.**
Hirneola auricula-judæ, *Berk.**

Clavarieæ.
Typhula gracilis, *Berk.**
,, erythropus, *Fr.**
Clavaria fragilis, *Holmsk.*
,, vermicularis, *Scop.*
Calocera cornea, *Fr.*

GASTROMYCETES.
Lycoperdon pyriforme, *Schæff.*
Ithyphallus impudicus, *Fr.*
Sphærobolus stellatus, *Tode.**

PYRENOMYCETES.
Rhytisma acerinum, *Fr.*
Leptosphæria acuta, *Fr.*
Byssosphæria aquila, *Fr.**
Daldinia concentrica, *Fr.**
Xylaria hypoxylon, *Fr.*
Xylaria polymorpha, *Fr.*
Hypomyces rosellus, *Tul.**
Sphærella fragrariæ, *Fr.**

HYPHOMYCETES.
Microstroma album, *Sacc.**
Botrytis cinerea, *Pers.**
Verticillium lateritium, *Berk.**
Acrostalagmus cinnabarinus, *Corda.**
Mucrosporium sphærocephalum, *Sacc.**
Tubercularia æsculi, *Opiz.**
,, vulgaris, *Tode.*
Epicoccum purpurascens, *Ehrh.**

MYXOGASTRES.
Chondrioderma difforme, *Rost.*
Spumaria alba, *DC.**
Craterium rubiginosum, *Mass.**
Stemonitis fusca, *Rost.*
Arcyria nutans, *Rost.**
Trichia scabra, *Rost.*
Tubulina cylindrica, *Rost.**

Mr. Massee contributes the following remarks on some of the rarer or more interesting species in the above list:—

Agaricus (*Clitocybe*) *Sadleri.*—This very rare species, which has only been collected two or three times previously, was first found growing on a damp tub in the Glasgow Botanic Garden. It is unknown outside Britain.

Agaricus (*Collybia*) *tuberosa.*—A peculiar little species, always growing on the decayed pileus of some large agaric, more especially on that of *Russula nigricans.* The mycelium forms a little sclerotium.

Agaricus (*Collybia*) *xanthopus.*—This is often confounded with *A. dryophilus*, from which it differs in the broad gills being much cut away behind.

Agaricus (*Psalliota*) *dermoxantha.*—A species only quite recently recorded as British. It closely resembles *A. arvensis*, the "horse-mushroom," but is distinguished among other features by becoming primrose-yellow when cut or bruised. It is esculent.

Lentinus cochleatus.—A clustered, trumpet-shaped, tough fungus, with a pleasant spicy smell resembling aniseed. Edible.

Boletus luridus.—A large, showy fungus. The flesh is very pale yellow, but instantly changes to a deep indigo-blue when cut or bruised. Poisonous.

Fomes annosus.—A parasitic fungus which is very destructive to fir-trees. The base of the trunk is first attacked, and the tree is eventually killed. This fungus is by some called *Trametes radiciperda.*

Poria sanguinolenta.—Forms a thin broadly-effused crust on decaying timber. Pure white, but becoming stained blood-red when bruised. Rare.

Poria vaporaria.—Very common on decaying timber; sometimes becoming a true and destructive parasite.

Stereum rugosum.—Forms a dirty-white, inseparable crust on branches. A true parasite, very destructive to the cherry-laurel.

Stereum hirsutum.—Very showy. Common as a saprophyte on decaying timber; but at times becoming a very destructive parasite on trees of various kinds.

Clavaria vermicularis.—A fragile little fungus, resembling a dense cluster of crow-quills tied together; pure white. Although individually small, it is a social species, growing in great abundance among short grass, and it is one of the most delicious of esculent species, being almost indistinguishable from "cheese-straws" in flavour when properly cooked.

Rhytisma acerinum.—Forms the conspicuous black patches on living sycamore leaves. Diseased leaves fall early; hence, when the disease is present in quantity, and appears year after year, as is usually the case, the tree is seriously injured by the parasite. The class of spores which inoculate the young leaves in spring are only formed on the black patches of fallen leaves which have rotted on the ground during the winter; hence, if all diseased leaves were collected and burned during the autumn before the spores are mature, the disease would be checked.

Daldinia concentrica.—Amongst the largest of Pyrenomycetous Fungi, and by no means common in Britain. The genus illustrates an ancient and almost extinct type, its three or four species being very widely distributed, especially in tropical regions.

Sphærella fragrariæ.—The cause of a very serious disease to cultivated strawberries, more or less covering the leaves with purplish red patches, each having a pale central spot. When the leaves are badly diseased they fail to perform their functions, hence there is a lack of elaborated food-supply, and consequently a poor crop of fruit the year following the attack. This disease can be held in check by spraying at intervals, until the flowers expand, with a solution of potassium-sulphide—two ounces dissolved in three gallons of water.

TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

I.

ANNIVERSARY ADDRESS.

MUTUAL AID AMONGST ANIMALS.

By Prince Kropotkin.

Delivered at the Annual Meeting, 25th February, 1895, at Watford.

Ladies and Gentlemen,—

I feel very much the honour of having been asked by your President to deliver to you—the members of the Hertfordshire Natural History Society—the Anniversary Address on his behalf. Perhaps, an Address on one of those subjects which are engaging most the attention of the scientific world at the present moment would have been more interesting to you than one on the subject I have chosen. However, the important recent discovery of the new photography, which was placed before us by Professor Röntgen, has been so extensively dealt with in the daily Press during the six months which have elapsed since it was first announced, that really very little can be added of interest to that which is already known about the now famous "X rays."

With regard to the news that Nansen has reached the North Pole and is now returning to Europe, a few words will be sufficient. A report has been circulated, as you know, that on the 13th of February a telegram was received at Irkutsk, anticipating the Yakutsk mail, and bearing the news that Dr. Nansen had been to the Pole, that he had discovered a new land, and was already on his journey back. I have learned from the Russian Press that the Governor-General of Siberia, having been besieged on all sides for authentic information about Nansen, has telegraphed to the little town of Kirensk—the terminus of the telegraph-line to North Siberia — ordering a special messenger to be sent to Yakutsk, to get information from there; and as soon as that special messenger returns, the Governor-General will communicate all information to the Geographical Society at St. Petersburg, whence the information will then be sent to London. In the meantime, only conjectures can be made as to the probability of the news. Perhaps I am a little prejudiced in favour of the route which has been taken by Nansen. It is now known that Nansen did not go so far east as he at first expected, and it is believed that, having entered the Kara Sea, he very probably pushed north-eastwards. This route is the one which we advocated in Russia for an Arctic expedition, when it was going to be sent out in 1871, and which I intended to join, but failed to do so because the low state of the Russian finances prevented the expedition from being sent out at all. Our idea was that if we pushed northwards, but west of Nova Zembla, we should soon find land, and that that would stop our advance; and as a matter of fact, this land was discovered the following year by the Austrian expedition. But we thought that if we went north-east of Nova Zembla we should have all the advantage of the warm current, and might penetrate further north than in any other direction. It is believed by most geographers, including the President of the Geographical Society of London, that Nansen really took that route; and in such case he probably went to the 82nd or the 83rd degree of latitude, and found an archipelago of land there. Whether he has or has not reached the North Pole, he is the man of all others in the world who is best entitled to the honour of reaching it. All that we can now do is to wait in the expectation that the special messenger of the Governor-General of Siberia will return with the information that the Yakutsk mail has brought satisfactory news from Nansen.

I will now proceed with the subject of my address—"Mutual Aid amongst Animals."

If we look at Nature, not as it appears in books, but as it is in reality, we shall at once perceive that there are two sets of facts characteristic of the life of animals. One is that some species live upon others, in many instances continually fighting with the species which they make their food; and the other is, that amongst most species there is a great deal of mutual support—of life in societies, in which they aid each other in the struggle against the difficulties of natural conditions.

Now the question arises: "Which of these two sets of relations between animals is the more important for the continuance of their existence, evolution, and progressive development?" For the last thirty-five years a great deal of importance has been attached to the fact of the mutual struggle amongst animals, while the effects of mutual support have been totally ignored and neglected. This has, no doubt, partly arisen from the importance which was given by Darwin to the struggle for existence as the chief factor in natural selection. Darwin's position in respect to this subject is well known, and it can be summed up in very few words. His argument is that every animal and vegetable, if not interfered with by others, would multiply so rapidly that in a very short time the descendants would become so numerous that there would not be room for them to exist; and that therefore there goes on amongst them a fearful competition for life, in which those individuals alone survive which are best fitted to the surrounding medium in which they dwell.

The theory of Evolution has placed the sciences of Palæontology and Biology upon a philosophical basis; in fact, it may almost be said to have created the science of Biology. It has been proved that evolution is continually going on, that throughout the whole of the strata of the earth, from the earliest fossiliferous rocks to the present time, species have continually varied in accordance with the different circumstances in which they have been placed. But while it has been proved that Natural Selection must have played a very important part in securing those variations which were useful to the species, Science, during the last thirty years, has put forward more and more that other factor, indicated by Lamarck, and which Herbert Spencer has described as direct accommodation to the influence exercised by surrounding circumstances, or adaptation to environment. Many other causes of progressive development, besides natural selection, have been indicated, such as physiological selection and sexual selection. Already, in his first work on the subject, 'The Origin of Species,' Darwin warned his followers against taking the term of "struggle for life" in too narrow a sense. This warning, however, has not been heeded generally; and many who are not much acquainted with the life of animals took up these words and used them in a wrong sense, construing them so as to give the idea that all organisms are continually struggling against each other for the sheer means of existence. Every day in our human affairs we now hear these words, "the struggle for life." If a tribe of Red Indians be exterminated, or if men be found dying of hunger in rich societies, it is put down to the struggle for life. Darwin warned his followers against this narrow conception, and said that they must understand the term "rather in its metaphorical sense" than in its direct sense; and in his second great work, 'The Descent of Man,' he developed his ideas so as to show that mutual aid and mutual support amongst animals are the most important factors for the development of moral sentiments and for the maintenance of the species, especially of the human species. In that work he said that "those species which contain the greatest number of mutually sympathetic individuals have the greatest chance of surviving and of leaving progeny." And he attributed to life in societies such an importance that man, he said, could not have been derived from any species which lived an isolated life, like the orang-outang or the gorilla, but, on the contrary, that he must have taken his origin from some sociable species like the chimpanzee, for sociability was the greatest factor in the survival and progress of his species. Nevertheless, these ideas have been utterly neglected, and Darwin's followers continue to attribute to struggle within the species the chief importance as a factor of evolution. In the year 1887, Huxley, who had long been the most popular exponent of Darwin's views, even came forward with an article about mutual struggle, in which he said that Nature was nothing but a gladiator-show where everything was red in blood—"Nature red in tooth and claw," as Tennyson has expressed it; and that in Nature the pitiless extermination of everyone — the pitiless self-assertion of the individual—is the guiding principle; so that from Nature we can learn no moral lesson because she is essentially immoral.

This is what has led me to come forward and ask whether it is true that this is the lesson of Nature. A Russian Professor of Zoology, Kessler, a man of much experience, who has travelled a great deal in Europe and Asia, delivered a lecture some time ago in which he pointed out that besides the law of struggle there was the law of mutual aid, which was much more important *for the progressive evolution of the species* than the law of mutual struggle. It will, I am sure, be found that Professor Kessler's idea is more in accordance with Nature, as it is in reality, than the idea at which Professor Huxley arrived from the latest studies of his life. If the opinion of those who have studied Nature in the forest and the jungle, more than in the laboratory, be taken, I am sure it will be found that the majority will take this view of Nature. If it be endeavoured to appreciate statistically which is the more important—mutual struggle or mutual aid—no result, of course, can be arrived at. The question can only be put in this way: "Which is the more important for the preservation and maintenance of the species and for its further progressive evolution?" The answer of all naturalists who have a direct knowledge of animal life would be "Mutual support."

In illustration of this position we may take some of the lower animals, such as the burrowing beetle. You may walk into your garden and often see four or five of these beetles assisting one another to bury in the earth some dead animal, in order that they may therein deposit their eggs. They do not fight for suitable places, but assist each other to prepare a place to put their eggs in.

As another instance from the lower animals we may take the land-crabs, amongst which the same principle applies. At certain seasons of the year these animals may be seen migrating in considerable numbers. Though previously scattered about, they must come together before they move in their great migration-colonies.

Take, again, the so-called king-crab, or *Limula*. I remember one day at the Brighton Aquarium seeing one of these animals, with its big carapace, overturned and lying upon its back. For two hours I watched with admiration the repeated endeavours of other crabs to overturn it and put it upright. First one and then another came from the bottom to the crab in distress and worked under it, trying to lift it and put it into its proper position. When changing their carapace at certain seasons, the common crabs are defenceless, and Erasmus Darwin had already observed how other crabs keep guard around the defenceless one to protect him from other animals which might wound him. The observation has been fully confirmed lately.

Among many others of the lower animals numbers of such facts will be found to confirm the view of the advantage of mutual support, even amongst the Invertebrata. Amongst the insects there are numberless facts of this nature. Professor Forel has spent much time in the study of the ants of Switzerland, and he has published a wonderful book in which he describes their manner of living, giving facts which seem almost incredible, but which have been confirmed by Sir John Lubbock, who has also devoted much time to the study of the habits and customs of the ants. Above all other animals, except perhaps man, the ants realize the need for common labour. When one ant gets into trouble the others speedily go to its assistance. When one of them makes a mistake in the construction of a vault, others go at once and destroy it and make another properly. When any other animal attacks or comes to destroy an ant's nest, all the ants rush to save the larvæ. They work together to make those enclosures in which they keep their milk-cows. It is well known that the ants keep a certain kind of animal — aphides — off the back of which they lick a sweet liquid, and it has been observed how they capture these insects and make a place in which to secure them. All such work is done in common, and it has been observed how the ants support each other in their labours, and in obtaining nourishment. When two ants meet they exchange some sort of conversation, and if one of them has his crop full of this liquid from the aphides he lifts his antennæ and allows his hungry friend to take some of this liquid for himself. You can never find two ants from the same colony which will not exchange this token of friendship. At one time Sir John Lubbock would not believe that this was possible, but he afterwards fully verified it. This custom is so important that it will very often be found that if two ants from different colonies which are not in friendly relations with each other happen to meet, and one allows the other to lick this syrup, they become friends. But, on the other hand, if two ants from the same nest meet, and one has refused to its family relations to thus share its food, it is treated as an enemy. This fact has been perfectly well established by men who have made close observations of the habits of these interesting insects.

With these relations existing, let us remark what is the result. The ant is a very small insect; it has no carapace to protect it; it has no formidable powers of attack: but in their numbers—in their thousands—the ants are feared by much more important animals. When a sack of ants is emptied upon a meadow, the grasshoppers and spiders, and many other larger animals, at once take to flight. Wasps, even, are attacked by ants. The ants are very severe towards their enemies outside, their wars from nest to nest are sometimes very cruel, but within the nest they find that mutual aid and support are the best means of protecting them against many enemies. However, in addition to the unity which exists in the individual nests, federations of ants' nests have been found. Forel has described such federations, and one of the best naturalists of this country, H. W. Bates, has described in his admirable book, 'The Naturalist on the Amazons,' how, upon the pampas of South America, there exists such federations of white ants, or termites, there being continuous intercommunication between a number of nests.

Turning now our attention for a while to bees and wasps, we cannot say that amongst bees mutual support is instinctive. On the contrary, they have often been found to become demoralized by sipping whiskey or other spirits, and then they become very antagonistic to each other. When they live in a hive near to a sugar-factory, where they can find plenty of syrup, they lose the habits of work, and begin living by plundering other nests. However, natural selection comes in here and eventually cuts off the generation of those individuals which abandon the life of common work and mutual support.

When there is mutual support amongst the Invertebrata it is said to be instinct, and no consciousness is thought to exist, but there is also plenty of mutual support amongst the higher animals as well.

A few examples from the life of birds will show best to what extent they mutually support each other. Birds seldom go about alone; they are always to be seen in numbers; and mutual aid and friendship are ever to be observed in their doings. They thus accomplish many things which they could not otherwise do. We find mutual support even among the Raptores. Syevertsoff, the well-known ornithologist of Russia, mentions that he once saw five large white eagles soaring in the air at certain distances apart. As soon as one of them had discovered something which was good to eat, such as carrion, he descended, and immediately every one of the other eagles also descended to the same place, and soon there might be seen ten or twenty of the same species of eagle feeding upon the carrion, while thousands of other birds stood near waiting to take their turn. When such a feast is going on there is always one eagle keeping watch as a sentinel until the others have finished their meal. There are many cases of this kind in which there can be no possibility of a mistake.

The kites and vultures are continually going together in associations for hunting; they not only hunt by themselves, but as soon as they see an eagle which has something good to eat, they rush at it and take away the prey. The eagle is the larger and stronger of the two species, but the kites coming together, little birds as they are in comparison with the eagle, they attack it and take away its food. The kites of Brazil may be found continually in associations of six or seven. Certain vultures are well known for their admirable capacities for association. These are the most sociable birds of their tribe, and may constantly be found living by two or three families in the same nest, the female birds sitting in turn upon the eggs. This has so often been observed that it has caused one species of the vulture to be called Sociable. Many species of hawks have the same character. They may frequently be seen enjoying sports together, for they not only go together for utilitarian purposes, but also for enjoyment. They delight in sharing the joys of life together.

Some of the hawks and kestrels enjoy similar social sports. Several of them go out together in one direction, and having flown straight for a distance they return. They are continually indulging in this kind of sport, but always in company, never singly. The little Egyptian vultures live in such close friendship with each other that the zoologists who have described them say that they have never seen them quarrel. The hawks, also, and especially the Brazilian falcons, are noted for their sociability.

There are species of birds which are in decay. Which are these? Syevertsoff, who was one of the best ornithologists, did not hesitate in saying that they are the species which lack sociability, living in antagonism to each other. The sociable species, on the other hand, are on the increase. It may be asked how it can be ascertained whether a species is on the increase or is decreasing. There is no census, but there is something which brings the knowledge. When a species has a great number of varieties, then we may be sure that it is on the increase, and not only increasing in numbers, but also spreading its territories; but if a species has no varieties, or if a genus is represented by only a single species, then may we be sure that this species, or this genus, is in a condition of decay and likely to die out. It is the sociable animals which are increasing, for they are represented by numerous varieties, while the unsociable animals are only represented by a few. This difference between the sociable and the unsociable species of the Raptores is especially striking.

The pelicans offer another instance of sociability. They have large fishery associations; they live by forty or fifty thousand together in America; they continually hunt in association. Having made a half-circle from the shore, surrounding the fish, they gradually come together, closing in the half-circle, and they thus secure the fish. They work exactly as a man would work with a net, which he would gradually draw towards the shore, reducing the space between the net and the shore. Every night these pelicans return to their own place, never quarrelling for the possession of it; every flock and division has its own home, returning to the same place night after night, and keeping possession of it for years and years.

The sparrows have a very bad reputation amongst English farmers, but their sociability lies beyond doubt. You know the Greek philosopher who said: "As I was speaking, I saw a sparrow discover that there is some corn which has been spilt near the barn, and he came to tell it to his friends." But the sparrows not only tell each other where there is food to be found, but quite lately there was in 'Nature' a complaint of what these "impudent" birds are doing in Australia. When they see a bird of prey they come in great numbers and chase it, and they have been seen to keep a bird of prey, which had sought refuge from them in a bush, confined there for a whole day, by the vast numbers with which they surrounded him.

Those who wish to get an insight into the real life of the birds should go and see one of the lakes of Asia, or of South Russia, or of the far west of America—one of those lakes where myriads of birds may be seen assembling on the shores. Thousands upon thousands of ducks and water-fowl of almost every kind may be seen living there and enjoying their existence in perfect harmony, sentries keeping watch to give the signal upon the approach of an enemy. Then will be heard the dismal cry of the hungry bird of prey, but as soon as it appears the sentries surround it and the whole of the other birds take their action as a warning signal for them to begin to conceal their little ones. If the bird of prey be very hungry it will try to make a dash into this multitude of living beings. If it be successful in getting amongst them they will all unite to attack it; they will splash water at it and blind it; they will gather round it in such numbers and in such a manner as to bewilder it; and the bird of prey is compelled to retreat. The great destruction comes not in the mature age, but in the young and early days of life, and that is the reason why the birds come together in such numbers to protect their progeny from birds of prey.

Go to the Arctic lands, where whole mountains are covered with grebes, gulls, and other birds. There you will find millions and millions of birds belonging to twenty different species living together. You will find the dotterels, which present the ideal of family life, and on that account the inhabitants of the Arctic regions regret to kill them; countless varieties of ducks; the egotistic swans, and so on, all living in perfect harmony. The most striking illustration of mutual support among birds is in their migrations. Every year, millions of them leave the northern countries for the shores of Africa and India, coming together in their thousands before they begin their journey, waiting for those which have been kept by their youngsters being not quite ready to undertake the flight; and then one morning disappearing, all having left in one night. It has often been asked by naturalists whether the larger birds do not help the smaller ones when crossing the seas; this is hardly probable, but it is certain that some smaller birds have been seen within the emigrating columns of much bigger birds.

You may be inclined to say that the associations which exist between animals are all utilitarian—are associations for protection and for aiding migration—but there are plenty of associations amongst all birds which are meant simply for the joys of life. Every autumn hundreds of birds come together and spend their lives in company. The species which will be commingled are very different. It is really astonishing how different are the species which meet together and how different are their habits. They devote every day a couple of hours to getting food, and then they enjoy their lives in sport and simply in "the joy of life."

With regard to the proportion between the numbers of the carnivorous mammals and those which are living in societies, it will be found that the former are very much less numerous than the latter. Such animals as lions and tigers which produce upon us the impression of conflict and antagonism are very small in number, but everywhere the world teems with animals which are gregarious. It even seems very probable that before the intervention of man in the destruction of animals the carnivorous animals were chiefly the scavengers of the animal world. When the Europeans took possession of America they saw large droves of buffaloes traversing the country from north to south, so dense that the buffalo-columns would keep the emigrant for two days in the same spot, there being no possibility to pierce the column and to pass through; and more recently, when South Africa was opened up by Europeans, there were found numberless herds of gazelles and antelopes. Following these columns there are always the carnivorous animals which prey upon the weaker antelopes which fall behind the main herds. But even amongst the carnivorous animals it will be found that continually they unite for common hunt. The wolves, as we all know, organize themselves into packs for hunting. In fact, it is only the feline animals—those of the cat tribe—which live more or less an isolated life. The canine animals, such as dogs, wolves, and foxes, are all naturally social.

The black bears of Kamschatka were once sociable, even with man, but hunting by man has destroyed their sociability and harmlessness. Steller, the naturalist who visited the peninsula in the last century, tells that, in the house in which he was once staying, the parents were afraid that their boy had been lost, but they eventually found him in a wood playing with the black bears. Foxes, which live isolated here, where they are hunted, are found living in herds in Northern Asia, and the numerous associations of the polar foxes were the plague of the naturalists who visited the country in the last century. All the Rodents, such as the marmots, prairie dogs, and rabbits, are sociable animals, and naturalists relish in telling us about the social life of the inhabitants of the great prairies of Asia and America. In the case of such animals as the ground-squirrels, when their houses are unearthed ample provision will be found to be laid away; and although they may appear to some people to be miserly, during the winter two or three of these little animals will often be found to be living together. Thus it appears that very many different kinds of animals, and in immense numbers, live together in mutual support, and that the characters of their societies widely differ in different species.

In the class of insects the highest are the ants, bees, and wasps; of the birds the highest are the parrots; amongst the mammals the highest are the apes and man; and all these are the most sociable of their class. A sociable life is a guarantee of security, and therefore of the attainment of old age, and at the same time of further development of the species. Mutual support is the way to a higher intelligence which always reaches its highest degree in the most sociable species: the highly sociable parrot has not been called in vain the man-bird or the bird-man.

With regard to the apes and monkeys, we know that nearly all of their species are highly sociable, and that those which are not, such as the orang-outang or the gorilla, must be considered as decaying species. There is a great deal of friendship displayed between monkeys; and the protection which they find in their vigilant societies is such that Brehm made the remark that they seldom die from any enemies, but chiefly die from old age only. The monkeys are always together, and it is very difficult for any bird or beast of prey to surprise them, as they are always on the alert. In fact, the monkeys have only one dangerous enemy—the creatures which your President has taken for the subject of his studies; I allude to the snakes.

Taking into account the whole mass of evidence showing the extent of mutual aid and support in animal societies, we are bound to return to the views which Darwin emphasized in his second great work, 'The Descent of Man.' We must bear in view that there are two different aspects of animal life—the aspect of the struggle for the sheer means of existence, and that of mutual support—and recognize that this last is the more important of the two for the progressive development of the species; the more so, as most animals know better means to resort to in case of scarcity than to fight for the few means of existence at hand. Take, for instance, the beavers. When they become too numerous to live in any one particular spot, they do not fight for the few means of subsistence, but they divide into parties and migrate, one party going up the river and the other down the river. When there is a great demand for a particular kind of food, the birds do not fight to the bitter end for that food, but they widen their feeding-areas, or they migrate, while some of them take to other kinds of food.

Certain species—the most sociable and consequently the most intelligent—do even more than that. Thus, through the researches of Moggeridge, who died some years ago on the shores of France, and devoted the last years of his life to the observation of agriculture among ants, it is well known that the ants prepare the soil and plant the seeds of certain grass which they like; that they weed out all other grasses which are not good for their food; and that when the seeds of this grass are ready, they collect them and prevent them from fully germinating by treating them, it is supposed, with some acid which only allows of their germination to the extent which renders them best suited for their food. The ants of the Tropics—the so-called parasol-ants—have even been found to carry on horticulture, making beds for their plantations out of chewed pellets of the leaves they collect.

All things taken into consideration, the lesson of Nature is not competition, but the avoidance of competition. When the means of living become scarce, struggle for these means sets in, and when the struggle becomes hard, there is no progress possible. When drought or late snowstorms deprive the horses of America or Siberia of food, there is a general lowering of vitality in the whole of the herd. There is a general regress of the species, not progress. Suppose that Watford were besieged, and the whole population were reduced to living on half-rations, or even still further pressed, who would be the most likely to survive? Would it be the most intelligent, the best all round who would survive? Certainly not. The ordeal would lower the vitality of everyone, all—the best and the worst—would suffer alike, and a general regressive movement in the whole population would take place, as is well known from direct observations upon garrisons which have undergone such an ordeal. The fact is most certain that if natural selection had to act only when food was scant and must be fought for, it could produce but retrogression. The chief progress in animal societies, and in human societies as well, has been achieved during periods of plenty.

To say that the lesson of Nature is a lesson of immorality is to ignore the real teachings of Nature. The true lesson of Nature is *not* one of immorality: it shows, on the contrary, that those species which know best how to support each other are those which attain the greatest amount of success in their evolution.

II.

PARASITIC FUNGI: THEIR MODE OF ATTACK AND THE MEANS OF ITS PREVENTION.

By George Massee, F.L.S., F.R.M.S.

Abstract of a Lecture delivered at Watford, 19th November, 1895.

Although the subject of Parasitic Fungi is one upon which I have delivered several discourses, I am bound to confess that every one of them has been a signal failure from the point of view of certain members of my audience who expected to have details of their own grievances and to hear of remedies for the particular ailments of their own plants. If anyone has come here this evening with that idea they will be disappointed, for my object is not to treat of the particular cases of injury inflicted by certain species of Fungi, but to give a general idea of their work and nature, and of the broad principles which should guide us in our attempts to prevent them from doing injury.

The life-history of the higher plants is simple compared with that of these lowly organisms. When one of their seeds germinates a plant springs up which is like the one from which the seed was procured. When, for instance, a chestnut or a beech-nut is planted and germinates, there is recognized from the first something growing as a chestnut or beech-tree, as the case may be, which as time goes on will bear fruit similar to that from which it springs. It is not so with Fungi. At one time they look like one specific thing, and at another phase of their life-history they appear to be something totally different, so different indeed that until their history had been traced they were classified as belonging to different groups. In the present day we can afford to laugh at such mistakes when we find them in old books, but it is by the work of the older writers that we are now able to prove step by step that several of the different forms with which we are familiar often belong to one and the same organism.

Differences in Fungi often arise from what they grow upon. If the spores of one kind of fungus, or even of one individual plant, be taken and sown upon different kinds of food-material, they may give rise to what appear to be totally different things. Low down in plant-life, as well as in animal-life, it has been found that forms are fairly elastic, not almost rigidly alike, as each species usually is in the higher forms of life. There is in them a certain amount of elasticity which enables them to present themselves under different appearances and to do different work, depending on the circumstances under which they are placed. For instance, common yeast, with which we are all familiar, under different circumstances assumes different forms, the internal machinery adapting itself to the work which has to be done, the fungus in one case producing alcohol, and in another sugar, with no alcohol at all, and, if examined under the microscope, looking totally different.

The change in a fungus, however, is different from that in an individual who varies his pursuits. Such an individual does not grow two pairs of legs or arms as he needs them, while a fungus will, in its own province, do such a thing; but a simple parasitic fungus can only do one thing at a time, not having the advantage of the division of labour which we possess.

Coming now to our special subject, plant-diseases caused by fungi, there are some whose general aspect would have been recognized at once by the aid of the lantern from the representations of them which I have brought with me, but failing that I will represent their characteristic features on the black-board.

One of the broadest rules which can be laid down with respect to fungoid diseases is that all fungi are favoured in their development by the presence of acids, while alkalies are detrimental to them. On the other hand, the group of allied organisms—the Bacteria, which are popularly known as "germs"—do not thrive under the action of acids. Farmers have said that the introduction of artificial manures has brought nearly all the common plant-diseases which are due to fungi, and from their standpoint this is practically the case; but the scientific explanation is that these manures, or most of them, are prepared from raw, crude acids, and the acids which are present in all the rich modern manures, such as bone-manure and superphosphate, favour the development of the fungi which do so much injury. They do not, of course, create the fungi; they merely favour their development in the soil, giving them an advantage in their struggle to hold their own against hundreds of other organisms.

One of the most familiar instances of diseases caused by fungi is that known as "finger-and-toe." It was known long before it became so common as it is now, but it was only known that it was something wrong with the root of a cabbage or of a turnip. The lumps and swellings on the roots of these and other plants, called "finger-and-toe" disease, have now been traced to a minute organism belonging to the Mycetozoa, called *Plasmodiophora brassicæ*. This minute organism has done injury to the extent of thousands of pounds to the farmers in England, but it is one of those things which can easily be got rid of. A few drops of ammonia in a bucketful of water, if applied to the roots of the plant attacked, will prevent its growth, and lime in a soluble condition will kill the spores. If quicklime be spread over the soil, such a solution will be formed when rain falls. Potash, however, is better than lime, because, when in solution, it is the best manure for plants, and without it turnips cannot have their best feeding properties, although it is possible to grow one species of turnip when potash is not present. This fungus grows rapidly in the soil at the present day owing to the amount of acid that is supplied by so-called artificial manures, and that is the reason why farmers say that with the introduction of these manures "finger-and-toe" disease became rampant.

Hertfordshire is a rose-growing county, and probably all the rose-growers have been troubled by finding the leaves and flowers of their rose-trees covered with mildew of a greyish white colour, which begins to show itself in the budding stage of the plant, grows with it through the year, and in the end destroys it. The name of this fungus is *Sphærotheca pannosa*. It is called *pannosa* because it forms a felt-like film of mycelium on the plant. It travels all over a leaf, and, when it has collected a sufficient amount of nutriment from the substance of the leaf, it creeps off and spreads over other leaves, after a time falling off in a fine powder. This is what is commonly known as mildew, and in all cases of mildew the course of the disease is the same and the mode of attack is the same. The great object which the fungus has in view is rapid distribution. It is blown about by the wind, and any of it in this state of fine powder which alights on the leaves of rose-trees germinates when rain falls, this stage of its growth being known as *oidium*. Its time of attack is when the leaves are expanding, and, as the tree develops, the young shoots will be found to be covered with the same kind of thing, and in addition black specks will be seen studded over them. The object of this second kind of fruit is to tide the fungus over the winter; the leaves of the tree perishing with the autumn, having done their work, the fungus must be able to maintain its existence on the woody tissue. Another kind of fruit, more complicated altogether, is the result of fertilization. The spores contained in this kind will not always germinate in the same way, varying according to the nature of the food supplied by the plant on which they have been produced. In the spring, when the rose-tree is beginning to expand its buds, the temperature is just that which is required for the germination of the spores, which then produce still smaller spores, like fine powder. These are blown about by the wind and find places in the opening leaf-buds of surrounding rose-trees, there repeating the process.

There are sent to Kew myriads of examples of such plant-diseases every year, but there is no cure for the diseases when once established, although they may be checked. When the leaf-buds are beginning to expand they should be syringed or sprayed, using a bottle something like a hairdresser's, filled with Condy's fluid—mere watering will not do. By using Condy's fluid, which can neither kill nor hurt any plant, and spraying the trees once or twice a week, all the fungi will be killed during the early development of the leaves. If, however, the disease comes out as mildew it shows that it has done its work, and that the injury has been done inside the leaves, the so-called vegetative portion of the fungus being inside the leaf; and unless this stage were anticipated there would be no chance of success in preventing the further development of the disease.

When geraniums are attacked by mildew I would recommend spraying the plants in the conservatory, where myriads of germs would be killed and no harm would be done. It may have been noticed that geraniums which have been cut where they are diseased shrivel up. They do not die because they are cut and wounded, but because a fungus has destroyed all the sap, which it would not have done had they been sprayed with this fluid.

There is another form of microscopic fungus, with which all must be familiar in the shape of little bright red coral-like spots generally seen on dead sticks and branches. These are what are termed "wound-parasites"; they do not possess the power of attacking living plants, but will only fix upon those parts which have been rubbed or broken, whence the name. They are to be found on black currants and red currants, and they are especially partial to the common sycamore. Early in the summer, and in fact in spring, these bright red spots appear. There are some forty or fifty species, but the commonest is that known as *Nectria cinnabarina*, the spots of which when examined under the microscope appear to stand up like little warts.

There is not, after all, much mystery in the development of fungoid diseases. There are certain fungi which can only attack dead matter, and there are others which can only attack living matter; so that we have two groups—saprophytes and parasites. If a saprophyte be carefully cultivated it can be induced to become a parasite, and if the spores are taken and the process is repeated five or six times, a true parasite will in the end be obtained.

I will now refer to another kind of fungus altogether, one like a toadstool. *Agaricus melleus* grows at the roots of trees. And in speaking of this I may remark that in Germany there are special forest schools with professors of plant biology, which we might do well to have in England. The *melleus* does injury to the extent of millions of pounds in forests, and particularly in Germany, where the woods and forests are immense. It commences at the root and goes up the whole of the tree. It is one of those things which are exceedingly difficult to combat, and I have seen orchards devastated by this one fungus. A method of defence is trenching and the filling of the trenches with quicklime or wood-ashes—the latter because they possess a certain amount of potash.

There is another fungus similar to this which is prevalent in French and German vineyards and attacks almost everything. It is commonly called a root-fungus, because it does its work underground. Several cases of its attack have been reported in England. It is known as *Dematophora vastatrix*, and, owing to the rapidity with which its mycelium spreads in the ground, proves very destructive. The same method of prevention as with *Agaricus melleus*, namely trenching, is the most practicable, filling in with a solution of potash salts of any kind, or sprinkling with paraffin oil.

The most highly evolved of all the fungi are the puffballs or Phalloideæ, the main agent for the dispersion of which is the wind. Everyone is now familiar with colour and scent in connection with the fertilization of plants. The one remarkable feature of this group of fungi is the brilliancy of their colours. Of course this is a strong feature in all groups of fungi, but the brilliant colours in this particular group are always attractive, while these fungi have in addition a strong scent. The combination of scent and colour attracts insects, which disperse the spores, but in other groups wind is the chief agent of spore-dispersal.

In concluding these remarks I may mention the great importance of preventive measures, for, when once an attack gets established, cure is almost impossible. The one general remedy which has been used for whole groups of fungus-attacks is that which is generally known as Bordeaux mixture. It contains two or three per cent. of sulphate of copper in water, and is very often mixed with a certain amount of quicklime. The great difficulty in combating plant-diseases is in the thorough wetting of the leaves, which should be sprayed with very fine spray both on their upper and under surfaces. A small amount of soft soap mixed with the solution causes it to adhere better to the foliage.

The prevalent opinion that, owing to long-continued cultivation and intercrossing of cultivated plants, the power of resisting fungoid attacks is lowered, is not supported by facts. Botanists are well aware that, in a wild state, almost every kind of plant is attacked by one or more species of parasitic fungi. On the other hand, it is only when almost every individual of a cultivated crop is injured that the practical man considers the attack of these same fungi as constituting a disease. Once upon a time the same ideas held good in the case of cholera and scarlet-fever; at the present time we have learned the value of isolation and preventive measures in such cases; but, unfortunately, those most interested in the cultivation of plants have yet to learn that the same rule holds good in the case of plant-diseases. This condition of things can only be remedied when the present ignorance or indifference is replaced by the amount of sound knowledge which will result in unity of action. It is practically useless on the part of one individual to carry out the known methods for the prevention of fungoid and insect pests, if his neighbours, through lack of the required knowledge, unconsciously favour the spread of the same.

III.

NOTES ON THE CHARACEÆ, WITH A LIST OF SPECIES FROM THE SOUTH MIDLANDS.

By James Saunders.

Read at Watford, 21st January, 1896.

General Appearance and Mode of Occurrence.

The plants known as the *Characeæ* or Stoneworts are an entirely aquatic group, living in pools, canals, lakes, and quiet rivers, as well as less frequently in rapid streams. The English name "stonewort" is applied on account of the amount of lime which is secreted in the tissues of some of their genera. When growing they are always submerged, and if exposed to the air they rapidly die. Some are so sensitive to dry air that I have often found it expedient to put my specimens under pressure at the moment of gathering, a precaution the neglect of which I have frequently had to regret.

The stoneworts vary in colour from a dark green to a greyish green, and, when growing in clear water, they may usually be recognized by their denseness and rigid habit. In quiet and deep pools they grow erect or nearly so; in shallow brooks they are prostrate, and in these situations they are sometimes grey and very brittle from the incrustation of lime.

Some of the species, especially those of the genus *Chara*, have a peculiar fetid odour which is very noticeable when the plants are exposed to the effects of drought. They are sometimes so malodorous that their presence may be detected by the organs of smell when one is passing near them. This is most perceptible in the evening, and I have sometimes been thus apprised of their presence when it has been too dark to see them.

The foliage is reduced to branch-like organs. The whole of the plant above the roots is green, and hence can assimilate. As this function is so widely distributed in the individual, growth is rapid. Sometimes they occupy nearly the whole of the space in a recently-made pool, especially in clay- or marl-pits. In this respect they may be styled "the pioneers of aquatic vegetation," to quote from a paper by Messrs. H. and J. Groves. In their decay they produce soil in which other forms of vegetation speedily grow.

They are singularly independent of their roots, which are small, and serve mainly for attachment. As they can flourish in situations devoid of vegetable soil, it is evident that they grow upon the carbon-dioxide contained in the water, their tissues being permeable to the fluid in which they live. So little do they depend upon their roots for sustenance that we had plants under cultivation for a year which were devoid of those organs, they having been broken off in obtaining the specimens.

It is noteworthy that until the last 15 or 20 years the Characeæ have received but scant attention from British botanists. This cannot have been on account of their obscurity, for they often occur in large masses. It may have been that they were regarded as ill-adapted to make presentable specimens for the herbarium; but this is now proved to be erroneous, chiefly through the skill and industry of Messrs. H. and J. Groves, who have expressed the opinion that "no plants better repay a little care" ('Journ. Botany,' 1880). These gentlemen have added largely to our knowledge of this group, especially with regard to the critical determination of species; they have also enlisted the sympathies of observers in various parts of the British Isles, through whose efforts many interesting points have been brought to light both as to the distribution and as to the existence of species previously unrecorded for Britain. Hitherto the South Midlands had been a comparatively unexplored region in this respect. The list appended to this paper represents fairly the forms now known to exist in this district.

Life-History.

The reproductive organs are known as globules (♂) and nucules (♀). The former are spherical and are composed of eight flat cells. These are shield-shaped, and from the inner side of each of them there projects a cylindrical cell, which bears at its apex a number of delicate filaments composed of a row of disk-shaped cells, each of which contains an antherozoid. These are slender spiral threads thickened at one end and terminating at the other in two delicate cilia. The globules when ripe break up into the eight parts of which they are composed, and the filaments rupture and allow the antherozoids to escape. This usually happens in the morning, and the antherozoids have the power of locomotion for several hours. As a single globule contains from 20,000 to 40,000 of these organs, the fertilization of the nucules is usually effected—at least, if one may judge by the abundance of them which may be found on the fertile branches. Parthenogenesis also occurs.

The fruit-bearing organs consist externally of fine spiral cells, the apices of which form the "coronula" of the nucule. When fully ripe the antherozoids find their way through minute clefts between the coronal cells, and thus reach the oosphere, which they fertilize. A change takes place in the colour of the ripening fruit, which eventually falls off and awaits development when conditions are favourable. The fruits upon germination give rise to a pro-embryo, which attains only small dimensions, and consists of a single row of cells with limited apical growth. From the pro-embryo the sexual-bearing plant is produced, which is usually developed at nearly right angles to the former (*vide* Sach's 'Text-book of Botany,' ed. 2, p. 293). In the growth of the plant the internodes are formed of a single elongated cell which often becomes spiral.

In the genus *Chara* the stem and branchlets are covered with cortical cells. The number of these parallel cortical cells bearing a constant relation to the branchlets in the whorls, this peculiarity is used in the classification of these plants. Other points are the characters of the coronula, the relative position of the nucules and globules, and the number of cells in the ultimate branchlets.

In the younger cells the phenomenon of cyclosis, or circulation of the protoplasmic contents, can be observed. To succeed in this may require some amount of patience, as the motion may be arrested in preparing the specimen for examination. After a time the granular contents of each cell will be seen to move slowly along one side, to traverse the width of the cell at one end, and then to continue its course along the other side. These movements continue indefinitely and are in one direction. In this respect they agree with the same phenomenon as seen in *Elodea*, and differ from it as it occurs in the Mycetozoa, in which the circulation is alternately in opposite directions. This display of energy is most evident in the youngest cells. Is it therefore connected with growth? It can hardly be an accompaniment of assimilation, for it is visible with artificial light other than electric.

One of the unsolved problems in the life-history of the Characeæ is the irregularity of their appearance. It does not follow that because a certain species occurs in a pool in any one year it will reappear the next year, and this notwithstanding the vast number of fruits which lie in the mud from the previous season's growth. It has been suggested by the Messrs. Groves that the excessive development one year may exhaust that particular station of certain constituents necessary for the growth of these plants. This will probably account for the phenomenon in cases where, after a season of abundance, they are absent for several successive years. It does not, however, cover the whole field of observation, for they may be singularly persistent even in a very small area, the same species occurring for several seasons in succession.

The following notes, although referring only to a portion of South Beds, were carefully taken and will illustrate the foregoing remarks.

In 1883 *Chara vulgaris* nearly filled a pond at Great Bramingham, and fruited abundantly. It died away *in situ*, and did not reappear the next season. Up to 1895 not a trace of it has been visible, although the spot has been frequently examined. The mud of the pool must have been crowded with ripe nucules in an environment apparently favourable to germination. The pond here referred to, as well as the others on which observations were made, were but little liable to interference by artificial agencies.

Chara hispida, which is the largest British species, seems fairly constant in its occurrence, as it has grown for several years in succession in ponds at Totternhoe. In one pool it has been remarkably persistent, but in 1895 the quantity of it was diminished, as it was choked by the excessive growth of sedges.

Nitella opaca grew in Reed Pond, Sundon, in 1883 and 1884, but was absent for several years afterwards. In another pool near this one *N. opaca* was abundant in 1885, but it was replaced by a large growth of *Chara vulgaris*, whilst there was no trace of the former species. In 1882 and 1883 *N. opaca* was plentiful in the River Lea at Biscot, but since that date no trace of it has been seen, although *C. vulgaris* has been fairly regular in its appearance until 1895, when that also disappeared. In January, 1896, no stonewort of any kind was growing in that station.

Tolypella glomerata grew plentifully in a pond at Leagrave, called Icknield Hole, in 1885, but has not been found there since, although carefully sought for. Not long previous to its appearance in 1885 the pond had been cleaned out, which gave the plant an opportunity to develop. The pool is now filled with a *Batrachium* and *Potamogeton densus*. *T. glomerata* also grew in abundance in a large tank at Wellbury, Herts, in 1888, but has not been observed there since, its place having been occupied by *Chara vulgaris*, which has grown there for several seasons since 1888.

Tolypella intricata was first observed in the South Midlands in 1883. In March of that year it was noticed in a small pool, about three yards in diameter, at Little Bramingham. In the following April, Mr. H. Groves, in company with myself, visited the spot, when it was seen that the pond was nearly filled with the plant, which was in fine condition. Mr. Groves remarked when seeing it that he would travel 100 miles any day to observe such a sight. Specimens were collected, but a large quantity was left to deposit its fruit. In the autumn of the same year the pool was dried up through drought, the *Tolypella* disappearing and leaving no visible trace of its existence. In the following year (1884) it failed to appear. The spot was visited every few weeks from early in the spring to late in the autumn, and in so small an area it could not have escaped detection had it been present. In 1885 it was fairly plentiful; in 1886 and 1887 it grew in small quantity only; and during the autumn of 1888 it was in fair abundance, at which period it was seen to be in fine fruit, although spring is the normal time for this function. It reappeared in the spring and summer of 1889, but had disappeared by the 1st of September of that year; in 1890 it was in fine condition during the spring, but gradually dwindled away in the following autumn. For the next four years we have no notes as to its occurrence in this station, although it was visited by us on several occasions during this period. In April, 1895, it was seen in small quantity, but it is absent at the present time (Jan. 1896).

The foregoing notes are given in detail, as they describe the first British records of the occurrence of *Tolypella intricata* for two or more successive seasons in the same station.

In another spot, about two miles north of Bramingham, is a pool about 15 feet by 3 feet in dimensions, situate in Sundon Wood. In this small area there have been fine growths of *T. intricata* in the years 1891 to 1895. Specimens have been preserved of gatherings made 4th April, 1891; 22nd May, 1892; 16th April, 1893; 15th April, 1894; and 14th April, 1895.

At Totternhoe, in connection with the enclosure of the common lands, several small drinking-ponds were made on the rough pasture called the Litany. In the spring of 1893 three of these contained *T. intricata*, two of them scantily and the third in great luxuriance. In 1894 it was absent from all three of these ponds, although they had not dried up during the previous summer. In 1895 it was absent from the pool in which it was so abundant in 1893, and occurred plentifully in one of the others in which it previously grew sparingly.

The question naturally arises as to the reason of the erratic appearance of the Characeæ, and also why in a given locality a species may be present one season and in subsequent years be replaced by a totally different one. It is not unusual, however, to find two or more species growing in the same pool. Replies to these queries are yet wanting, or rather no solution of these problems have suggested themselves to the mind of the writer. Observations have been carried on for 13 or 14 years with the hope of obtaining sufficient material to at least theorize on the subject, but as yet this would be premature.

Probably the most noteworthy record is the finding of *Nitella mucronata*, a species which had only once before been recognized in England. This was by Mr. Borrer, who discovered it in a ditch at West Grinstead, in Sussex, in 1858. About the year 1880 Mr. H. Groves made a special journey to this spot in the hope of finding the plant, but it had disappeared from Borrer's station. Its re-discovery in this country is due to Mr. C. H. Davies, of Bedford. Specimens of the plant were sent to me, with others, by Mr. Davies, senior, early in October, 1882, with a request to have them determined. The one referred to was doubtfully named *N. flexilis*, but as it was barren and very fragmentary it was forwarded to Messrs. Groves for authoritative opinion. A letter was received by return of post naming it *mucronata*, and expressing much pleasure that it had again been found in England. Under these circumstances I felt desirous of visiting the spot to see it growing. The afternoon appointed turned out very wet, but I proceeded to the place with Mr. C. H. Davies, when, to our dismay, the station was found to be inundated, owing to the heavy rains for which October was remarkable. Said my companion: "We cannot get it." My reply was: "How deep is the pool?" But that was unknown, and could not be judged by reason of the discolouration of the water. After a little consideration the only practicable plan seemed to be to wade barefoot through the flood, sheltered by a huge umbrella to keep off a little of the overhead deluge. This was attempted, and, by the verbal guidance of the lad, and gauging the depth with a stick, the shallowest parts were chosen. Eventually a water-hole was reached where the *Nitella* was supposed to grow. Carefully groping in the turgid pool with a hooked stick, the only materials brought up were dead leaves, twigs, and such rubbish as would be swept in by the flood. Almost despairing of success by reason of the rain above and the waters beneath, the question was shouted to the youth at the brink: "Is there another water-hole?" The reply was returned: "Yes, a little further on, near the next willow-tree." A few more steps and this was reached, when fortunately at the second sweep some of the much-desired plant was brought up. A fair supply was obtained, and living plants were forwarded to Messrs. Groves, and also to the Gardens of Cambridge and Kew.

Geographical Distribution.

The Characeæ are very widely distributed, as is often the case with the fresh-water flora. They are most abundant in temperate regions, but they grow in almost all parts of Europe, Asia, Africa, America, and Australia. Our two commonest Charas, *C. fragilis* and *C. vulgaris*, are well-nigh ubiquitous; as is also our most frequent Nitella, *N. opaca*.

The dispersal of the fruits of these plants over such a large area is probably due chiefly to the agency of aquatic birds. The fruits are minute and light, and are frequently lodged in the mud or clay of ponds. Anyone who has observed the margins of these land-locked waters, especially in rural haunts, will have noticed the marks of the feet of birds, and it is easy to see that the fruits of aquatic plants occurring in such conditions might often be carried long distances by the birds. The mud attached to the birds' feet would be softened when other waters were visited, and their contained fruits would be left to germinate if the conditions were favourable.

Fossil Characeæ.

The wide distribution of the Characeæ also suggests a high antiquity. In this respect, however, they bear no comparison with such ancient types of plants as ferns and equisetums. The earliest known appearance of the stoneworts is in beds of Eocene age, in which they are represented by their curious spherical fruits. These are sometimes present in great numbers and well preserved, showing even their external ornamentation. Through the courtesy of Mr. Henry Wood, of Cambridge, I have been enabled to prepare for the museum of the Society specimens of these fruits which were obtained from the Eocene beds of Cambridgeshire.

In this connection may be mentioned the occurrence of these fruits in a semi-fossil condition in the bed of an ancient pond at Hitchin, which was exposed by digging-operations. They are especially interesting in that they form a connecting-link between the fossil Characeæ of the later geological periods and those of the present time.

It would be interesting if the evolution of this group could be traced, but the materials at present available are not sufficient for the purpose. During the lapse of time between the close of the Cretaceous period and the beginning of the Eocene there were doubtless many changes in the organic world. The records of this lengthy period are either destroyed or have not yet been brought to light.

CHARACEÆ OF THE SOUTH MIDLANDS.

In commending the study of the Characeæ to the members of this Society, it is with the full persuasion that the patient observer will be amply rewarded for his exertions and will extend our knowledge of the distribution of these plants. At the least the pursuit would furnish healthy recreation, if even it were not repaid by the scientific success which a sanguine temperament may desire. The appended list of Characeæ from the South Midlands will show that these plants are well represented in this district. The records to which no authority is appended are now given for the first time, and I have indicated where I can corroborate the records of others by the usual mark (!).

HERTFORDSHIRE.

Chara fragilis, Desv. IVEL.—Offley, Hitchin. BRENT.—Totteridge Green; hb. *Forster, Flora Herts*, 1887, p. 516.

C. vulgaris, L. IVEL.—Offley, Hitchin; *Saunders*, 1883, in *Flora Herts*, p. 516. Old Wellbury, Hitchin. COLNE.—Bennets End, Hemel Hempstead. LEA.—Ditches by the river at Hertford and Cheshunt; *Groves*, in *Flora Herts*, 1887, p. 516.

Tolypella glomerata, Chevall. IVEL.—Old Wellbury, Hitchin.

T. intricata, Leonh. LEA.—Ditches near Broxbourne, 1886; *T. B. Blow*, in *Flora Herts*, p. 516.

Nitella translucens, Ag. BRENT.—Totteridge Green; hb. *Forster* (there recently; *H. Groves*), *Flora Herts*, 1887, p. 517.

N. flexilis, Ag. COLNE.—Pond near Elstree. BRENT.—Totteridge Green; hb. *Forster* (there recently; *H. Groves*), *Flora Herts*, 1887, p. 517.

N. opaca, Ag. LEA.—Brickendon, 1881; *T. B. Blow*, in *Flora Herts*, p. 517.

BEDFORDSHIRE.

Chara fragilis, Desv.—Flitwick. Leagrave. Luton Hoo. Var. *capillacea*.—Totternhoe. Var. *Hedwigii*.—Limbury.

C. contraria, Kuetz.—Totternhoe; *H. Groves* and *J. S.*

C. hispida, L.—Maulden; *C. Crouch*. Limbury. Totternhoe. Luton Hoo.

C. vulgaris, L.—River Ouse; *H. Davies*. Totternhoe, etc. Var. *longibracteata*.—Biscot. River Lea, Luton.

Tolypella glomerata, Chevall.—Near Bedford; *H. Davies*. Leagrave.

T. intricata, A. Br.—Bramingham. Sundon. Totternhoe. Lidlington; *C. Crouch*.

Nitella mucronata, Kuetz.—River Ouse, Bedford, 1882; *H. Davies* (also in 1883! and 1884!); *H. Groves*, in 1888. River Ivel, near Sandy, 1891.

N. opaca, Ag.—Sundon!; *H. Groves*. Biscot. Bramingham.

Buckinghamshire.

Chara fragilis, Desv.—Little Brickhill. Woburn Sands. Var. *capillacea*.—Little Brickhill.

C. hispida, L.—Little Brickhill.

C. vulgaris, L.—(Loc. not specified); *Nicholson*, in *Journ. Bot.* 1883. Var. *longibracteata*.—(Loc. not spec.); *Piffard*, in *Journ. Bot.* 1885. Var. *papillata*. — Newport Pagnell; *Piffard*.

Tolypella glomerata, Chevall. — Castlethorpe; *H. N. Dixon*, in *Journ. Bot.* 1895.

Nitella opaca, Ag.—(Loc. not specified); *J. Groves*, in *Journ. Bot.* 1885.

Postscript, *April*, 1896.

On the 12th of April I visited Little Bramingham, and found that *Tolypella intricata* was absent from the small pool in which it was last seen in April, 1895; it was also absent from the small pond in Sundon Wood, north of Bramingham, from which I gathered it in the spring of every year from 1891 to 1895. On the 18th of April I visited Totternhoe and found that this species was absent from the pool at the Litany where it was first seen, the place being now choked with a growth of coarse vegetation. It was fairly plentiful in the second pool, where it grew scantily in April, 1895. It also occurred sparingly in several places in the old bed of the stream, which was diverted at the time of the enclosure of the common. *Chara contraria* had disappeared from its only known station in this district, where it was plentiful in 1893.

IV.

NOTES ON LEPIDOPTERA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1895.

By A. E. Gibbs, F.L.S., F.E.S.

Read at Watford, 17th March, 1896.

My personal observations during the past year have been very few indeed. With the exception of some evenings profitably spent amongst the sallows in the spring, I have been able to do but little entomological work, and I am sorry to say that several observers who in past years have aided me very materially by sending useful information for my annual report have no longer been able to pursue their studies in this branch of science. I have, however, received a most valuable list of captures from Mr. S. H. Spencer, jun., of Watford, who is an enthusiastic collector and a careful observer, and to whom I am indebted for much of the information given in the present report. To Mrs. G. W. N. Harrison, of Barnet, my thanks are also due for sending to me notes of her observations on the rearing of several species of our common Lepidoptera.

Sallow-beating in April yielded very good results. Mr. Arthur Lewis and I commenced our season's work by beating, on the 10th of April, some sallows at Sparrowswick, St. Albans, and in the neighbouring woods. We found *Tæniocampa gracilis* in some quantity; and subsequent search at Bricket Wood revealed the presence of two moths which as a rule are scarce with us, namely, *T. miniosa* and *T. populeti*. Of *T. miniosa*, Mr. Spencer, who was working in the same locality, took two specimens, and Mr. Lewis and I captured three. *T. populeti* proved to be more abundant still, Mr. Spencer securing five, whilst we took several. One curious fact which we noticed at the same time that we were working at sallow-beating was the great abundance of the early thorn moth (*Selenia bilunaria*), and especially was this the fact on the night of the 17th of April. It was a damp night after a heavy thunderstorm at 6 o'clock. We had not been very successful at the sallow blossoms, the bushes being very wet, and *T. gracilis* being the only moth we thought it worth while to secure specimens of; but at about 9 o'clock we noticed at the corner of the scrubs near the brickfields a number of Geometers flying about, and they turned out to be the early thorn moth. On standing still we found that they flew to the light of our lantern, and we were able easily to capture about a dozen in pill-boxes without the aid of a net.

I was unable to do much sugaring during the year, and I cannot give any information on the results of this method, except that I believe Mr. Arthur Lewis met with a fair amount of success in his garden and grounds at Sparrowswick.

One of the chief features of Mr. Spencer's report is the good work which he has been enabled to do at the electric light in the neighbourhood of Watford. This light appears to offer great attraction to moths, and Mr. Spencer tells me that on warm and cloudy nights they come from far and near in great abundance. On one such night he "pill-boxed" thirty-one different species within an hour and a half, the commoner insects, such as *Xylophasia monoglypha* and *Plusia gamma*, literally swarming to the electric light.

Butterflies.

Mr. F. Latchmore, of Hitchin, records the unusual abundance of orange-tips (*Anthocaris cardamines*) in that locality. They appeared, he tells me, earlier than usual, and the lanes abounded with them. Mr. S. H. Spencer says that he and his friend Mr. Wigg found the larvæ of this butterfly feeding on the seed-vessels of *Sisymbrium alliaria* in Rouse Barn Lane on the 8th and 23rd of June.

Although 1895 could not be called a *Colias edusa* year, like 1892, when the insect appeared in thousands, still many specimens were observed. I have three records of its appearance in Hertfordshire. Mr. Arthur Lewis saw one at St. Albans on the 18th of August; and Mr. Latchmore tells me that it was quite common on the banks of the Great Northern Railway at Hitchin, where Dr. Davis caught eight or nine good specimens and observed many others. One specimen was taken at Radlett. Mr. Latchmore also says that the brimstone butterfly (*Gonepteryx rhamni*) was fairly common. He remarks: "How well preserved they look when they emerge from their winter hybernation! How seldom also do they air themselves in the previous autumn!" The railway-banks and ridings at Bricket Wood are favourite haunts of this conspicuous and brilliant insect, which likes to sun itself on a bright spring day after its long winter's sleep. Mrs. Harrison, of Barnet, tells me that last year she first observed the brimstone butterfly on the wing on the 22nd of March, which was a bright sunny day with a temperature of 56°.

Mrs. Harrison has also been rearing that well-known insect the small tortoiseshell butterfly, and has made a very interesting observation with regard to it. She noticed that the autumn brood remained a much shorter time in the chrysalis state than the first brood; pupation occupying from ten to twelve days instead of twenty-one.

Moths.

Sphinges.—Turning now to the Heterocera, the Sphinges claim our first attention, and at the head of the list stands the death's head hawk-moth (*Acherontia atropos*). Mr. Harold Gatward reports several captures of this insect at Hitchin, and Mr. F. Latchmore had one specimen sent to him which was caught in a garden close to the town. Mr. Spencer had a very damaged specimen of the convolvulus hawk-moth (*Sphinx convolvuli*), an insect which is not very common in this part of Hertfordshire, brought to him on the 26th of September. Its congener the privet hawk-moth (*S. ligustri*) is also recorded from Watford by the same observer, who netted a specimen at the electric light. Its proboscis, thorax, and legs were covered with a yellow pollen. The elephant hawk-moth has not been recorded during the year, but two of our commonest sphinges, the eyed hawk-moth (*Smerinthus ocellatus*) and the poplar hawk-moth (*S. populi*), were both observed. A specimen of the former was sent to me by Mr. Kent, jun., of St. Albans, on the 21st of May, and an unusually fine specimen of the latter, measuring 3¼ inches from tip to tip of its wings, was captured by Mrs. Harrison at Barnet on the 19th of June. The only other hawk-moth which I have to record is the humming-bird hawk-moth (*Macroglossa stellatarum*), a specimen of which was sent to me by Mr. A. C. Smith, of St. Peter's Street, St. Albans, having been taken by him in the house. Two years previously this moth was unusually abundant, as my report for the year 1893 shows.

Bombyces.—Mrs. Harrison reports the capture of the larva of a wood leopard-moth (*Zeuzera pyrina*), which, however, she did not succeed in rearing. It is not easy to induce these insects to feed; they are wood-borers, and in a state of nature they feed on the living wood of various trees, but when kept in captivity they generally sicken and die. An extraordinary find of larvæ of the emperor-moth (*Saturnia pavonia*) is recorded by Mr. Latchmore. He and Dr. Davis were fishing one evening in July, when, the sport not being very brisk, the doctor abandoned his rod and searched for caterpillars in an osier-bed. On one osier-bush he found no less than fifty fine full-fed specimens of this beautiful larva. Mr. Latchmore points out that there seem to be two different coloured varieties of the larva, and that he has noticed this fact also among many other species. He asks if the colours are the distinguishing marks of the male and female. Possibly some of our members may have studied this subject, and can give some information upon it. So far as my own limited observations go, variety in colour appears to be generally the result of the environment of the insect, and is adopted for protective purposes.

One of the species of moths which Mrs. Harrison reared during 1894 was the drinker-moth (*Odonestis potatoria*), the larvæ of which are frequently to be found by the roadside feeding upon grasses. She was much struck with the muscular power of this caterpillar, one of which succeeded, in its eagerness for food, in shaking the vessel in which the grass was placed. Mrs. Harrison says that the movement of the jaws when the caterpillar is eating is audible. She noticed that when they are spinning their cocoon they change the position of the head, making, with no little difficulty, within the limited dimensions of the cocoon when only half constructed, a complete somersault, at nearly regular intervals of twenty minutes. They appear to complete the cocoon in about ten hours, at least by that time it is so opaque that nothing further can be seen of the creature's movements. The emerging of the young larvæ from the eggs is a point worth noting, and is always full of interest. Mrs. Harrison tells me that in the case of this species it appears to take from 1 minute 40 seconds to 2 minutes. When hatched they devour their egg-shells very voraciously.

Another larva, with regard to which Mrs. Harrison contributes some interesting notes, is that of the gipsy-moth (*Ocneria dispar*). She writes to me that she was very much struck with the brilliancy of colouring of this caterpillar, especially in its early stages, which, so far as she can discover, is not done justice to in the text-books. The blue-grey down its back is so rich in colour as to be almost of a violet tinge; the yellow introduced is of a pure tone and very brilliant; while the black tufts are like velvet. It has altogether quite a striking and resplendent appearance.

The Bombyces recorded by Mr. Spencer are as follows:—

Lithosia mesomella.—Five specimens beaten from heather at Bricket Wood, June 16, 22, July 6.

Euchelia Jacobææ.—Larvæ very abundant on ragwort near Watford Tunnel.

Drepana binaria.—One specimen taken at electric light, August 7.

D. cultraria.—One specimen at electric light.

Dicranura furcula.—One specimen at electric light, August 16.

Lophopteryx camelina.—One specimen at electric light.

Notodonta dictæoides.—Three specimens at electric light, August 14, 16, 17.

N. dromedarius.—Two specimens at electric light, August 16.

Thyatira derasa.—Several specimens at electric light.

Bricket Wood is an old locality of mine for *Lithosia mesomella.* I beat it out of the undergrowth there years ago, and I have also taken it at rest on the trees in the wood.

NOCTUÆ.—Mr. Spencer contributes a valuable list of captures of Noctuæ. The species which he records are as follows:—

Diloba cæruleocephala.—Larvæ very abundant on hawthorn hedges near Aldenham.

Leucania lithargyria.—Several specimens taken at electric light.

L. pallens.—Abundant at electric light.

Tapinostola fulva.—One specimen at electric light.

Calamia lutosa.—Seven specimens at electric light.

Gortyna ochracea.—Several at electric light. Found larvæ feeding on the stems of thistles at Bricket Wood and also on burdock in Whippendale Wood, June 16.

Hydrœcia nictitans.—At sugar near The Hall, Bushey, July 27, August 14.

H. micacia.—Four specimens at electric light, September 9.

Xylophasia monoglypha.—In swarms at electric light and sugar.

Neuronia popularis.—Fairly plentiful at electric light, August 12, 16, September 9.

Charæas graminis.—Two specimens at electric light, August 14, 16.

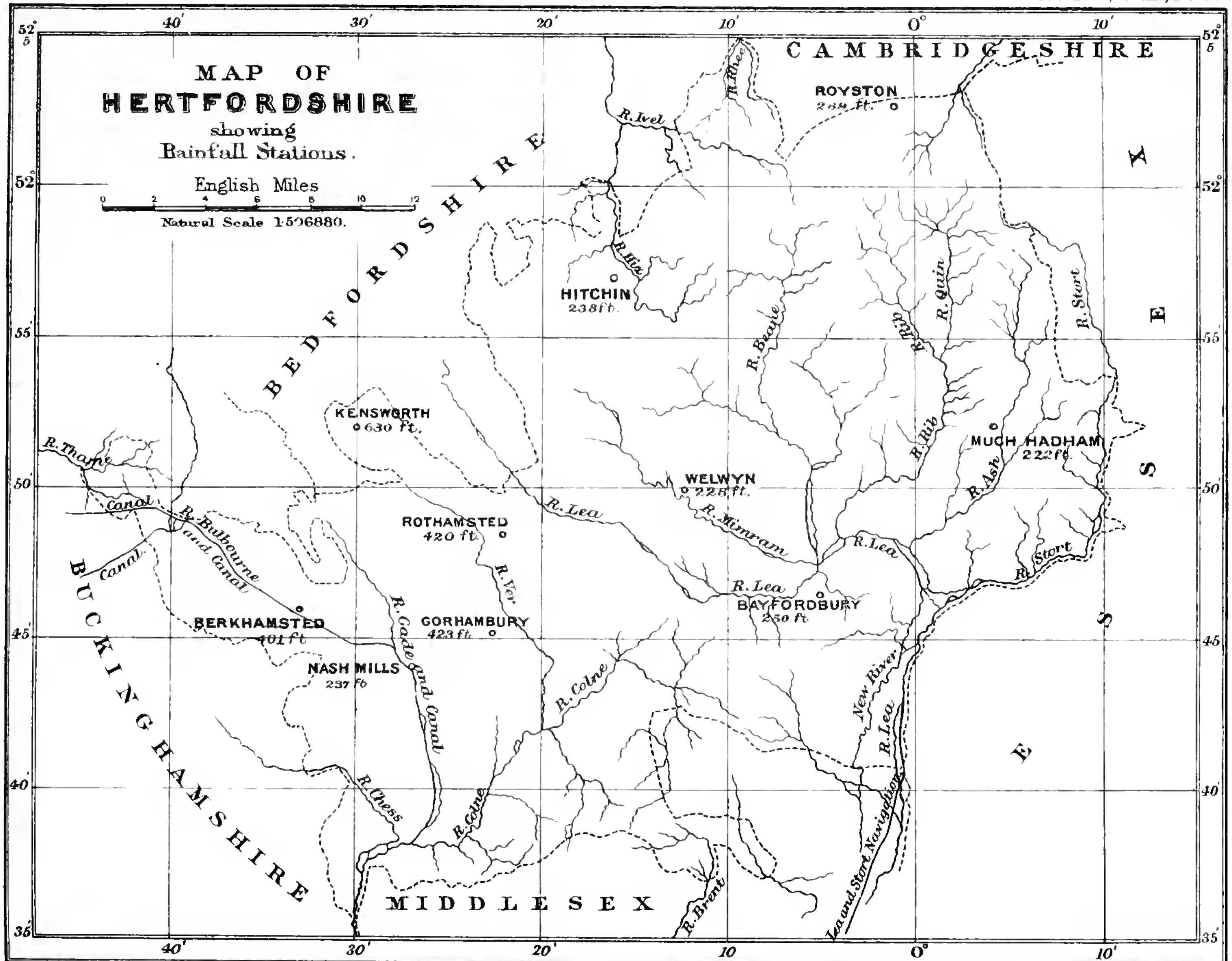
Cerigo matura.—One specimen at electric light, and one at sugar.
Luperina cespitis.—One specimen at electric light.
Apamea ophiogramma.—Two specimens at electric light.
Miana arcuosa.—One specimen at electric light, July 10.
Caradrina quadripunctata.—One specimen at electric light.
Agrotis tritici.—One specimen at electric light.
A. obscura.—One specimen at electric light.
Triphæna ianthina.—One specimen at electric light.
Amphipyra pyramidea.—Several at sugar and electric light.
A. tragopogonis.—Fairly plentiful at electric light.
Tæniocampa populeti.—Five specimens at sallow in Bricket Wood, April 10, 11, 12.
T. gracilis.—Five ditto.
T. miniosa.—Two ditto.
T. munda.—Two ditto.
Orthosia upsilon.—One specimen at sugar near Scott's Wood, Rickmansworth, July 27.
Anchocelis pistacina.—Fairly plentiful at electric light.
A. lunosa.—Abundant at electric light.
A. litura.—Eight specimens at electric light.
Xanthia flavago.—One specimen at electric light.
X. gilvago.—Seventeen specimens at electric light.
Tethea subtusa.—One specimen at electric light, August 12.
Calymnia diffinis.—One specimen at electric light.
Dianthœcia capsincola.—One at electric light.
D. cucubali.—One at dusk, two at electric light.
D. carphophaga.—Found forty larvæ of this moth on the bladder-campion (*Silene inflata*) in a field near Chandler's Cross, Watford, on the 29th of June. Each larva was feeding inside the calyx on the matured ovary of withered flowers. The whole forty pupated, and one perfect imago appeared on the 19th of August. The others are still in the pupa state.
Hecatera serena.—One specimen at sugar in Rouse Barn Lane. Three at electric light, July 10.
Polia flavicincta.—Several specimens at electric light.
Miselia oxyacanthæ.—Several specimens at electric light.
Phlogophora meticulosa.—Abundant at electric light.
Aplecta nebulosa.—Two specimens bred from larvæ taken at sallow catkins, Bricket Wood.
Xylocampa areola.—Two specimens from the trunks of oak-trees, Bricket Wood.
Plusia iota.—Many damaged specimens at electric light.
P. gamma.—Abundant at electric light, in fine condition.
Euclidia glyphica.—Fairly plentiful on railway-bank near Bricket Wood, June 3.
Brephos parthenias.—Saw a few flying around tall sallows at Bricket Wood, April 13.

The only additions which I have to make to Mr. Spencer's list of Noctuæ are the capture of the chamomile shark-moth (*Cucullia* *chamomillæ*) in my own garden, this being the first record for St. Albans and the third for the county; and the finding at rest on a tree in Luton Hoo Park, on the occasion of our field meeting there in June, of *Dianthœcia nana*, Mr. Arthur Lewis being the fortunate captor, but this was not in our county, being a Bedfordshire record.

GEOMETRÆ.—The only record which Mr. Bowyer, of Haileybury, is able to send me this year is that of the capture of *Cidaris silaceata* at Haileybury. Mr. Spencer has sent to me the following list of Geometers captured in the neighbourhood of Watford:—

Epione apiciaria.—One specimen at electric light, August 16.
Eugonia alniaria.—Two specimens at electric light.
E. fuscantaria.—Twenty specimens at electric light and many others seen, August 14 to September 9.
Himera pennaria.—On oak trunks in Aldenham Wood and at electric light.
Tephrosia luridata.—One specimen at dusk in Aldenham Wood.
Geometra papilionaria.—One specimen at electric light, July 10.
Phorodesma pustulata.—One specimen in Aldenham Wood, June 20.
Bupalus piniaria.—Very plentiful around the tops of the Scotch firs on Chipperfield Common; five specimens caught. One damaged specimen taken at dusk in Aldenham Wood.
Eupithecia succenturiata.—One specimen at electric light, July 10.
Triphosa dubitata.—One specimen at electric light.
Eubolia plumbaria.—Very plentiful on Chipperfield Common among the gorse, juniper, and bracken, June 22.

In conclusion, I again tender my thanks to those ladies and gentlemen who have favoured me with specimens and notes, and I wish to ask them and other observers to communicate to me any observations which they may make during the present year.



J. Hopkinson, del.

E. Weller, lith.

V.

HERTFORDSHIRE RAINFALL, PERCOLATION, AND EVAPORATION.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

*Read at Watford, 17th March, 1896.**

PLATE I.

For the last sixteen [now twenty] years I have made a special study of the Meteorology of Hertfordshire, having taken meteorological observations in the county during that period (from 1876 to 1886 at Watford, and from 1887 to the present time at St. Albans) in accordance with the regulations of the Royal Meteorological Society. For the years 1875 to 1879 and 1887 to 1891 I have collected records of the rainfall from all parts of the county, the records for the years 1880 to 1886 having been collected by the Rev. C. W. Harvey, F.R.Met.Soc. The general results of the whole of these records, with tables showing the monthly rainfall at all the stations, forming together a continuous series of seventeen annual reports on the rainfall in Hertfordshire, have been published in the 'Transactions of the Hertfordshire Natural History Society.'

The rainfall, percolation, and evaporation tables accompanying this Statement, have been compiled by me from information communicated to me and to Mr. Harvey by the observers during the last seventeen years, including several old records; from returns sent to me by observers at my request for this special inquiry; and from tables published in the 'Proceedings of the Institution of Civil Engineers.'

Rainfall.

The rainfall tables (Tables I to XI) comprise every complete record of rainfall in Hertfordshire for the last twenty years at least, for which I have been able to obtain the monthly fall of rain, with the mean for the half-century ending 31st March, 1892. As I consider it desirable to give the summer and winter rainfall separately, *annual* returns only have been of no use to me, and this has somewhat restricted the number and in some cases the length of the records, but I believe that the ten rainfall stations are so situated that they represent the county as fairly as such a small number could be expected to do, their records giving an average annual rainfall slightly in excess of the true average.

In order to test their representative character I have deduced

* Reprinted *verbatim* from the Appendices to the 'Report of the Royal Commission on Metropolitan Water Supply,' 1893.

the mean rainfall at all the stations in Hertfordshire for which monthly returns have been published in the 'Transactions of the Hertfordshire Natural History Society,' varying in number from twenty-six to thirty-six, for the fifteen years 1877 to 1891, adopting this period because the number previous to the year 1877 is considerably less than twenty-six, and I find that the returns for the whole of the stations give a mean rainfall of 27·55 inches per annum for this period, while the returns for the ten stations give a mean of 27·79 inches for the same period, showing an excess of 0·24 inch, being a little less than one per cent. As a further test I have computed the mean annual rainfall at twenty-one stations in the county for the decade 1880 to 1889, this being a period which admits of comparisons being made with tables compiled by Mr. G. J. Symons, F.R.S., and with conclusions arrived at by him, and I find the result to be almost precisely the same, the mean at these stations for this period being 26·84 inches per annum, while the mean at the ten stations for the same period is 27·13 inches, showing an excess of 0·29 inch, being a little more than one per cent.

It may therefore be assumed that the mean values deduced from the records of these ten rainfall stations should be reduced by about one per cent. to give the true mean rainfall for Hertfordshire.

In order to avoid repetition I shall use the term "year" for the twelve months ending 31st March in all cases except when "calendar year" is specified. The terms "average" and "mean" are used synonymously to signify the average of all the values, not the mean between the extremes. The terms "ratio" and "percentage" are also used synonymously, the mean in the tables being considered as 100 instead of as unity in order to avoid the use of decimals in the ratio columns. All measurements of rain are given in inches of depth, sometimes abbreviated "ins."

In each rainfall table the column headed "Summer" gives the rainfall from 1st April to 30th September, that headed "Winter" the rainfall from 1st October to 31st March, and that headed "year" the rainfall from 1st April to 31st March, all these tables ending 31st March, 1892. The column headed "Winter Ratio" gives the percentage in each winter to the mean winter rainfall of the period included in each table, the winter rainfall only being thus treated because, as will hereafter be shown, upon it depends almost entirely the amount of percolation into the Chalk, and consequently the permanent or dry-weather flow of our rivers and the amount of water available for our water-supply. The columns headed "Mean of each three successive Winters" give the mean rainfall and percentage to the mean for every three winters in succession because the period of three years is the one adopted by engineers in investigations on water-supply as that on which an estimate of probable minimum supply should be based.

Table I, showing the mean summer, winter, and annual rainfall in Hertfordshire for the half-century ending 31st March, 1892, has been compiled from Tables II to XI in the following manner.

The whole of the stations being represented for the last twenty years, the arithmetical mean of the values in these ten tables is given for these years without any adjustment. Some one or more of the stations not being represented for the first thirty years, an adjustment has been made, where it is required, to the arithmetical mean in accordance with the ratio, during the last twenty years, the rainfall at the stations represented bears to the mean rainfall at the whole of the ten stations during the same period. The mean annual rainfall at these ten stations for the twenty years 1872 to 1892 (April to March) being 27·71 inches, the adjustments are as follows:—For the eight years 1842–50, *minus* $4\frac{3}{4}$ per cent., Nash Mills being the only station represented, and its mean annual rainfall for 1872–92 being 29·01 ins.; for the year 1850–51, *plus* 2 per cent., Nash Mills and Hitchin being the stations represented, and their mean annual rainfall for 1872–92 being 27·32 ins.; for the two years 1851–53, *plus* $5\frac{1}{2}$ per cent., Nash Mills, Hitchin, and Royston being the stations represented, and their mean annual rainfall for 1872–92 being 26·18 ins.; and for the three years 1853–56, *plus* 2 per cent., Nash Mills, Hitchin, Royston, and Rothamsted being the stations represented, and their mean annual rainfall for 1872–92 being 27·19 ins. No adjustment has been made for the sixteen years 1856–72, the rainfall at the stations represented during this period being, during the twenty years 1872–92, sufficiently near the mean at the whole of the ten stations, viz., in 1856–60 (five stations), 27·77 ins.; in 1860–66 (seven stations), also 27·77 ins.; in 1866–70 (eight stations), 27·61 ins.; and in 1870–72 (nine stations), 27·78 ins.

The mean annual rainfall in Hertfordshire, as shown by this table, for the half-century ending 31st March, 1892, is 26·33 ins., the mean summer rainfall being 13·24 ins., and the mean winter rainfall 13·09 ins.

Dividing the half-century into two equal periods of twenty-five years each, we have the following result:—

Quarter-Century.	Summer.		Winter.		Year.	
	Ins.	Ratio.	Ins.	Ratio.	Ins.	Ratio.
1842-67 . . .	12·92	$97\frac{1}{2}$	12·62	$96\frac{1}{2}$	25·54	97
1867-92 . . .	13·56	$102\frac{1}{2}$	13·56	$103\frac{1}{2}$	27·12	103
Mean . . .	13·24	100	13·09	100	26·33	100

The rainfall during the first quarter-century was thus 3 per cent. below the mean for the half-century, and the rainfall during the last quarter-century was 3 per cent. above it, the winter rainfall deviating $\frac{1}{2}$ per cent. more from the mean.

Dividing the half-century into five periods of ten years each, we have the following result:—

Decade.	Summer.		Winter.		Year.	
	Ins.	Ratio.	Ins.	Ratio.	Ins.	Ratio.
1842-52 . . .	11·35	86	11·68	97	24·03	91½
1852-62 . . .	14·66	110½	11·24	93½	26·90	102
1862-72 . . .	12·34	93	12·95	99	25·29	96
1872-82 . . .	15·03	113½	14·21	108½	29·24	111
1882-92 . . .	12·82	97	13·37	102	26·19	99½
Mean . . .	13·24	100	13·09	100	26·33	100

The rainfall during the first and third decade was thus appreciably below the mean for the half-century, during the fourth decade considerably above the mean, and during the second and fifth decades very near the mean. The winter rainfall shows a considerable increase in recent years, for during the first and second decades together it averaged 5 per cent. in defect of the mean for the half-century, and during the fourth and fifth decades together, 5 per cent. in excess of the mean, being very near the mean during the third decade.

The progressive increase in the rainfall during the half-century, if longer periods than decades are considered, may be clearly shown by taking successive periods of twenty years ending 1862, 1872, 1882, and 1892, thus:—

Period.	Summer.		Winter.		Year.	
	Ins.	Ratio.	Ins.	Ratio.	Ins.	Ratio.
1842-62 . . .	13·00	98	12·46	95	25·46	96½
1852-72 . . .	13·50	102	12·60	96	26·10	99
1862-82 . . .	13·69	103	13·58	104	27·27	103½
1872-92 . . .	13·93	105	13·79	105	27·72	105

If reliance can be placed on very old records, it would seem that there has been a slight increase in the rainfall in the south-east of England during the last century, that is to say, that the rainfall during the fifty years 1842–92 was greater than during the fifty years 1792–1842, but half a century is a sufficiently long period for the purpose of this inquiry. It must not, however, be presumed that there is a secular increase in the rainfall which is likely to continue, for there are many considerations which would lead us to infer that the reverse is the case, the heavy rainfall of recent years being a mere episode in a period of declining rainfall, if measured by centuries instead of decades, so that we should look forward to a considerably reduced rainfall in the distant future, and to a lowering of the plane of permanent saturation in the Chalk of the Thames Basin from natural causes. The destruction of forests and the lowering of the surface of the ground by subaërial denudation must tend to reduce the rainfall, while this reduction, and the loss of water which must take place from its gradual percolation to a lower level owing to the secular cooling of the earth, must in time lower the surface and lessen the contents of the underground reservoir on which we now depend for a considerable portion of our water-supply.

As examples of old records in the Thames Valley may be mentioned Sunbury in Middlesex, with a mean annual rainfall of 23·72 ins. for the forty-two calendar years 1797 to 1838; Sandhurst in Kent, with a mean of 23·89 ins. for the forty calendar years 1820 to 1859; and Cobham in Surrey, with a mean of 23·75 ins. for the thirty-five calendar years 1825 to 1859.

At the commencement of this statement I showed that the mean rainfall derived directly from the records of our ten stations, would most probably be about 1 per cent. in excess of the true mean for the county. If we make this deduction our mean annual rainfall will be 26·07 inches. It will now be shown that this probable excess of 1 per cent. is more than accounted for by the smaller of our two principal river-basins, that of the Colne, having a greater rainfall than the larger one, that of the Lea, and each of these unequal areas being represented by the same number of rainfall stations.

Tables II to VI give the rainfall at five stations in the catchment-basin of the River Colne. For the twenty years 1872–92, they show a mean annual rainfall of 29·56 ins., the mean summer rainfall being 14·69 ins., and the mean winter rainfall, 14·87 ins.

Tables VII to XI give the rainfall at five stations in the catchment-basin of the River Lea. (Two of these stations, Hitchin and Royston, are just over the watershed on the north.) For the twenty years 1872–92, these tables show a mean annual rainfall of 25·87 ins., the mean summer rainfall being 13·16 ins., and the mean winter rainfall, 12·71 ins.

To reduce these values to the mean for the half-century, a deduction of 5 per cent. is required (see p. 36). The corrected values are as follows:—

Catchment-Basin.	Summer.		Winter.		Year.	
	Ins.	Ratio.	Ins.	Ratio.	Ins.	Ratio.
Colne . . .	13·96	106	14·12	108	28·08	107
Lea	12·51	94	12·07	92	24·58	93
Mean . . .	13·24	100	13·09	100	26·33	100

The area of Hertfordshire is 633 square miles. It will be convenient, and sufficiently precise for our purpose, to consider its area to be 630 square miles. If the county be divided along the water-parting of the Colne and Lea, the Colne catchment-basin (including very small portions of the basins of the Thame and the Brent) will be found to have an area of about 220 square miles, and the Lea catchment-basin (including a small portion of the basin of the Great Ouse) an area of about 410 square miles. It is evident that a correction is required for the disparity of areas in order to obtain an approximately true mean for the county, the effect of its application being to reduce the mean derived directly from the records of the ten stations. Multiplying the inches of rainfall in each area by the square miles it contains, and dividing the product by the number of square miles in the two areas, the resultant mean is 25·80 ins., thus:—

$$\frac{(28{\cdot}08 \times 220) + (24{\cdot}58 \times 410)}{630} = 25{\cdot}80$$

The following results have now been arrived at by three different methods:—

Mean rainfall derived directly from the records of ten stations: 26·33 ins. Mean rainfall corrected by comparing ten calendar years' rainfall with the mean at 21 stations, and fifteen calendar years' rainfall with the mean at a varying number of stations (26 to 36): 26·07 ins. Mean rainfall corrected for disparity of distribution of the ten stations: 25·80 ins. The mean of these results, the first of which is certainly too high, is 26·07 ins. I therefore think that we should adopt 26 inches as the nearest possible approach in round numbers to our mean annual rainfall, of which 12·93 ins. will be our summer, and 13·07 ins. our winter rainfall.

The availability of rainfall for water-supply depends very much upon how the rain falls. In heavy falls of short duration some of the rain may run off the ground into ditches, and thence into the rivers and cause floods, and if followed by drought much moisture may evaporate, and consequently the percolation may be comparatively small. With gentle rain continuing for a long period, on the other hand, there will be a considerable amount of percolation, but little evaporation, owing to the atmosphere being kept in a more than usually humid state, and no loss by water running off the ground. This is, no doubt, especially the case in a chalk district. If rain fell every day in Hertfordshire, the daily fall would be about 0·07 in.; but the mean number of days per annum on which at least 0·01 in. falls is about 170, and therefore the average per diem on the days on which it does fall is about 0·153 in., the falls recorded varying from 0·01 in. (the least quantity measured as a rule) to upwards of 4 inches. Similarly, two moderately wet months following one another would probably give a rather greater percolation than would a very wet month followed by a very dry one.

Temperature also must have a considerable effect upon evaporation. The higher the temperature, the brighter (or less obscured) the sun, the more moisture will the atmosphere absorb, and the more will be drawn up to form clouds. And perhaps the varying velocity of the wind will cause a still greater difference in the amount of evaporation, and consequently in that of percolation. But, one year with another, these causes of varying evaporation will tend to equalize themselves, and variations in rainfall only need be considered here.

During the twelve calendar years 1880 to 1891 there has once been, in 24 hours, a fall of rain exceeding 4 inches (17th July, 1890, at Moor Park, Rickmansworth, 4·19 ins.); there has once been a fall of from 3½ to 4 inches (12th July, 1889, at High Down, Hitchin, 3·76 ins., and at Welwyn Rectory, and Fanhams Hall, Ware, 3·50 ins.); there has twice been a fall of from 3 to 3½ inches (26th June, 1888, at Rothamsted, 3·24 ins., and 12th July, 1889, at five stations in the county); there has twice been a fall of from 2½ to 3 inches (12th July, 1889, at seven stations, and 17th July, 1890, at four); falls of from 2 to 2½ inches have been recorded on eight occasions, at three stations each on the average; falls of from 1½ to 2 inches have been recorded on twenty-five occasions (that is, about twice a year) at from three to four stations each on the average; and falls of from 1 inch to 1½ have been recorded on seventy-eight occasions (that is, from six to seven times a year) at from four to five stations each on the average. Falls of at least an inch were general over the county on five occasions during the last twelve years, viz.: on 17th December, 1881; 10th September, 1885; 12th July, 1889; 17th July, 1890; and 20th August, 1891. On two of these occasions, 12th July, 1889, and 17th July, 1890, the general fall in the county was at least 2 inches.

During the half-century ending 31st March, 1892, the greatest fall of rain in the county in any month was 8·41 ins. at Tring Vicarage in October, 1891, and the least was no rain at six stations (out of thirty-six) in February, 1891. At the ten stations for which rainfall tables are here given, the greatest fall in any summer was 25·75 ins. at Rothamsted in 1879, and the least was 6·05 at Hitchin in 1870; the greatest fall in any winter was 23·69 ins. at Gorhambury in 1882–83, and the least was 5·12 ins. at Royston in 1879–80; the greatest fall in any year was 41·34 ins. at Gorhambury in 1882–83, and the least was 16·60 ins. at Royston in 1870–71. Except in the yearly fall, the date of the extreme anywhere has coincided with the date of the extreme in the county, that is to say, the wettest and the driest summer, winter, and month throughout the county have been the same as the wettest and the driest summer, winter, and month at any one station. But the year with the greatest mean rainfall in the county was 1852–53, with 36·89 inches, and the year with the least mean rainfall was 1854–55, with 19·33 inches. In the calendar years, and including stations not represented in our ten rainfall tables, the greatest fall of rain in any one year was 42·56 ins. at Moor Park, Rickmansworth, in 1879, and the least was 15·79 ins. at Barley, near Royston, in 1884.

In the half-century ending 31st March, 1892, the wettest year was 1852–53, mean rainfall 37·08 ins. or 40 per cent. above the average for the half-century (the average here being taken at 26·33 inches), the next was 1882–83, mean 34·77 ins. or 32 per cent. above the average; the driest year was 1854–55, mean 19·33 ins. or 27 per cent. below the average; the next was 1870–71, mean 19·70 ins. or 25 per cent. below the average. The wettest two years in succession were 1875–76 and 1876–77, mean 33·10 ins. or 26 per cent. above the average; the next were 1859–60 and 1860–61, mean 31·52 ins. or 20 per cent. above the average; the driest two years were 1863–64 and 1864–65, mean 21·48 ins.; the next were 1873–74 and 1874–75, mean 21·69 ins, both about 18 per cent. below the average. The wettest three years in succession were 1880–81 to 1882–83, mean 31·99 ins., and 1878–79 to 1880–81, mean 31·86 ins., both about 21 per cent. above the average; the driest three years were 1844–45 to 1846–47, mean 22·58 ins., and 1862–63 to 1864–65, mean 22·62 ins., both about 14 per cent. below the average.

Percolation and Evaporation.

Tables XII to XIV have been compiled from tables published in the 'Proceedings of the Institution of Civil Engineers,' but for the purpose of this inquiry they are in a totally different form from that of the original tables, and they give results which can only be derived from them by calculation. Tables XII and XIII give results of experiments made by Messrs. Dickinson & Co., at Nash Mills, on percolation through chalk and soil with grass growing on the surface. Tables XIV and XV give results of experiments made by Mr. Charles Greaves, at Lea Bridge, on percolation through soil with grass growing on the surface, and on evaporation from the surface of water in a tank moored on a flowing stream. And Table XVI gives results of experiments made by Messrs. Lawes and Gilbert, at Rothamsted, on percolation of rain through soil with the surface kept free from vegetation.

From Table XII, which gives the percolation through 3 feet of chalk with grass growing on the surface, at Nash Mills, for the thirty years ending 31st March, 1884, and the difference from the rainfall, considered as evaporation, the following general results may be deduced :—

Period.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	14·08	2·12	15%	11·96	85%
Winter . .	13·76	8·43	61%	5·33	39%
Year . .	27·84	10·55	38%	17·29	62%

Only a small area in the county is likely to have such a porous subsoil as is here represented by a gauge containing broken pieces of chalk.

The results given in Table XIII are of the greatest value in this inquiry, for here we have a soil in as nearly as possible the usual condition of the soil over the Chalk area of Hertfordshire. The table gives the percolation of rain through 3 feet of soil with grass growing on the surface, at Nash Mills, for the forty-two years ending 31st March, 1884, and the difference from the rainfall, considered as evaporation, and the following general results may be deduced from it:—

Period.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	13·71	0·70	5%	13·01	95%
Winter . .	13·69	6·07	44%	7·62	56%
Year . .	27·40	6·77	24½%	20·63	75½%

Table XIV gives the percolation of rain through 3 feet of soil such as usually covers the Chalk in Hertfordshire, with grass growing on the surface, at Lea Bridge, for the twenty-one years ending 31st March, 1873, and the difference from the rainfall, considered as evaporation, and the following general results may be deduced from it:—

Period.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	12·85	0·87	7%	11·98	93%
Winter . .	13·09	6·15	47%	6·94	53%
Year . .	25·94	7·02	27%	18 92	73%

That two independent series of experiments extending over different periods of time, and carried on at a considerable distance apart, should give a mean annual percolation differing only 2½ per cent. from each other, is in itself a testimony to their general accuracy. Of the two series, the experiments at Nash Mills seem to be more likely to give accurate results than those at Lea Bridge, in the first place because they have extended over a much longer period of time, and in the second because the Nash Mills gauge gives the smallest percolation. Both gauges being artificially filled with soil, they must be more apt to let through a greater quantity of water than would percolate through undisturbed soil than a less quantity. Soil, also, must frequently expand and contract, and when contracting in a gauge it must part from the sides of the gauge and so leave around it a space, however small, down which water will pass more freely than through natural soil.

In the following table, therefore, in which the average percentage of percolation and evaporation given by the two series of experiments is calculated on the mean rainfall of Hertfordshire, the amount of percolation is probably rather overstated, and that of evaporation rather understated. The summer and winter rainfall are assumed to be equal.

Period.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	13·00	0·78	6%	12·22	94%
Winter . .	13·00	5·98	46%	7·02	54%
Year . .	26·00	6·76	26%	19·24	74%

From Table XV it would appear that evaporation from water is very little greater than it is from the surface of grass-covered soil. At Lea Bridge, for the thirteen years ending 31st March, 1873, with a mean annual rainfall of 25·93 inches, of which 12·16 ins. fell in the summer, and 13·77 ins. in the winter, the mean annual evaporation was 20·73 ins., or 80 per cent. of the rainfall, the evaporation in summer being 15·91 ins., or 131 per cent. of the summer rainfall, and in winter 4·82 ins., or 35 per cent. of the winter rainfall. Thus the evaporation in summer was rather more than three times that in winter; or, relatively to the rainfall, nearly four times.

These experiments are perhaps of more value in showing the great difference there is between the amount of evaporation in summer and in winter, than in showing the actual amount of evaporation from the surface of water. That this probably averages nearer 18 inches than 21, seems to be shown by a very careful series of experiments made at Strathfield Turgiss with a gauge now in the possession of Mr. Symons, who is continuing the experiments in London (at Camden Square).

That there is a very great increase in the amount of percolation through soil when its surface is kept free from vegetation, is shown by Table XVI. This table gives the percolation of rain through 5 feet of soil, the surface of which is frequently heed to keep it free from vegetation, in a gauge one-thousandth of an acre in area, at Rothamsted, during the twenty-one years ending 31st March, 1892, and the following general results may be deduced from it :—

Period.	Rainfall	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	15·26	3·88	25%	11·38	75%
Winter . .	14·85	10·02	67%	4·83	33%
Year . .	30·11	13·90	46%	16·21	54%

These results do not represent anything which takes place in nature throughout the year in this country, for nowhere have we soil in a natural state which is constantly free from vegetation of any kind; but the experiments are instructive in showing the maximum percolation possible through ordinary soil with the greatest artificial aid to it in the frequent hoeing of the surface in order to keep it quite free from vegetation.

The table is also of value in this inquiry in another respect. No other published results of experiments on percolation are of a more recent date than 1884, while here I am able to give the results up to the date at which all my rainfall tables terminate, viz., the 31st of March, 1892. If the twenty-one years are divided into three equal periods of seven years each, it will be found that during the first seven years the percolation was 83⅔ per cent. of that of the whole period, during the next seven years 117 per cent., and during the last seven years 99⅓ per cent., or practically the average of the whole period.

The mean annual rainfall during the twenty-one years covered by this table having been 30·11 ins., and the mean at Rothamsted during the thirty-nine years 1853–92, as shown in Table VI, having been 28·46 ins., the mean annual percolation during the shorter period must have been much greater than it would have been during the longer period. But there is a still greater difference between this annual rainfall of 30·11 ins. and the mean annual rainfall in Hertfordshire for the last half-century, viz., 26 inches. The problem is, therefore, to determine, if possible, what would probably have been the percolation at Rothamsted if the rainfall there had been the same as the county average.

We are not justified in assuming that all the rain which falls in wet years in excess of that which falls in dry years percolates, or that it all evaporates, nor that the percentage of percolation and evaporation to rainfall is the same, with a varying amount of rain. It therefore seems to me that the only way in which a satisfactory conclusion can be arrived at is to analyze this table, computing the mean rainfall and percolation in so many of the drier years as have together a mean rainfall about equal to the county mean. Out of the twenty-one years I find that the ten driest years have a mean rainfall of 25·87 ins., and a mean percolation of 10·28 ins., and that the eleven driest years have a mean rainfall of 26·23 ins., and a mean percolation of 10·44 ins. Averaging these results, the mean rainfall is 26·05 ins., almost the same as our county mean, and the mean percolation 10·36 ins. Proceeding in the same way with the summer and winter rainfall of these years, the general results are as follows:—

Period.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio to Rain.	Ins.	Ratio to Rain.
Summer .	13·40	2·62	19%	10·78	81%
Winter . .	12·65	7·68	60%	4·97	40%
Year . .	26·05	10·30	39½%	15·75	60½%

If the accuracy of these conclusions, and also of the experiments on which they are founded, be admitted, it follows that with the mean county rainfall the percolation at Rothamsted would exceed the mean of that at Nash Mills and Lea Bridge by 1·84 in., or 13 per cent. of the rainfall in the summer, 1·70 in., or 14 per cent. of the rainfall in the winter, and 3·54 ins., or 13½ per cent. of the rainfall in the year, the excess representing the decreased amount of evaporation due to the absence of vegetation at Rothamsted.

In the course of a discussion at a meeting of the Institution of Civil Engineers in March, 1891, Dr. J. H. Gilbert [now Sir Henry Gilbert] said that he and Sir John Lawes considered that the deduction from the amount of percolation through soil destitute of vegetation which should be made for the presence of vegetation would vary from 2 to 7 inches or more per annum from downs or waste lands to heavily cropped land; and that "taking the average of a large area around London, partly covered with vegetation and partly bare, over a number of seasons, they thought that between 3 and 4 inches should be deducted," a conclusion which is confirmed, or at least very strongly supported, by the above investigation.

In order to test the difference in percolation and evaporation in wet and dry years, where there is vegetation, I have selected from the forty-two years' record of percolation at Nash Mills, the six wettest summers, winters, and years, and the six driest summers, winters, and years, and have computed the averages of rainfall, percolation, and evaporation, and the ratio of each to the mean rainfall, percolation, and evaporation of the whole period.

The six wettest summers, winters, and years give the following averages:—

Period.	Rainfall.		Percolation.		Evaporation.	
	Ins.	Ratio to Mean.	Ins.	Ratio to Mean.	Ins.	Ratio to Mean.
Summer	19·03	145%	2·33	333%	17·60	135%
Winter	20·93	153%	11·31	186%	9·62	126%
Year .	36·99	135%	11·69	173%	25·30	122%

Thus, with six summers' rainfall averaging 45 per cent. above the forty-two years' mean, the percolation averaged 233 per cent. above it, and the evaporation only 35 per cent. above it. In the winters and years the difference was much less, but even in the six wettest years, with a rainfall averaging one-third above the mean, the percolation increased more than three times as much as did the evaporation.

The following averages are given by the six driest summers, winters, and years:—

Period.	Rainfall.		Percolation.		Evaporation.	
	Ins.	Ratio to Mean.	Ins.	Ratio to Mean.	Ins.	Ratio to Mean.
Summer	8·81	64%	0·07	10%	8·74	67%
Winter	8·59	63%	1·97	32%	6·62	87%
Year .	19·94	73%	3·49	52%	16·45	80%

Thus, with six summers' rainfall averaging 36 per cent. below the forty-two years' mean, the percolation averaged 90 per cent. below it, and the evaporation only 33 per cent. below it. In the winters the reduction in the rainfall made very little difference to the amount of evaporation, for with a rainfall 37 per cent. below the mean, the evaporation was only 13 per cent. below it, while the percolation was as much as 68 per cent. below it, the reduction in evaporation being scarcely one-fifth that in percolation. The average winter percolation being nearly eight times as much as the average summer percolation, we see what a very great difference a small rainfall in the winter will make to the annual percolation. With about three-quarters the average annual rainfall, the percolation is reduced to nearly half the average, while there is only a reduction of one-fifth in the evaporation.

These results may now be applied to the rainfall in the catchment-basins of the rivers Colne and Lea. With a total divergence of 17·05 ins. in the rainfall, there is a divergence of 8·20 ins. in the percolation, or rather less than half. Assuming that the difference between the rainfall and percolation proceeds at an uniform rate, for every inch of rainfall there will be a difference of 0·48 inch in percolation, and on this supposition the following will represent approximately the mean annual percolation and evaporation in the two divisions of our county, the mean for the county being added for comparison :—

Catchment-Basin.	Rainfall.	Percolation.		Evaporation.	
	Ins.	Ins.	Ratio.	Ins.	Ratio.
Colne . .	28·08	7·72	$27\frac{1}{2}$%	20·36	$72\frac{1}{2}$%
Lea . .	24·58	6·08	$24\frac{3}{4}$%	18·50	$75\frac{1}{4}$%
County .	26·00	6·76	26%	19·24	74%

The River Colne leaves our county at Harefield, and at about that point, or a little higher, it has been proposed to withdraw from the Chalk a large quantity of water for the supply of London. The River Lea is regularly gauged at Feilde's Weir, and above that point is included all the area of chalk within its basin. It will be convenient to estimate the areas of these two catchment-basins, irrespective of the boundaries of Hertfordshire, above these points. The method I have pursued is that of drawing the areas on stout paper, cutting them out, and weighing them. The result I have arrived at is that the area of the Colne above Harefield is approximately 235 square miles, and that the area of the Lea above Feilde's Weir is approximately 410 square miles. In the catchment-basin of the Colne about 195 square miles are on the Chalk, and about 40 square miles are on Tertiaries (Reading Beds and London Clay). In the catchment-basin of the Lea about 295 square miles are on the Chalk, and about 115 square miles are on Tertiaries (Reading Beds and London Clay). The following appear to be approximately the areas drained by the tributary streams, and by the main streams outside the basins of their tributaries :—

Catchment-Basins.		Chalk.	Tertiaries.	Total.
		Square miles.	Square miles.	Square miles.
Colne above Harefield	Chess . .	36	2	38
	Gade . .	88	2	90
	Ver . . .	36	1	37
	Colne . .	35	35	70
Lea above Feilde's Weir	Lea . . .	67	23	90
	Mimram .	30	2	32
	Beane . .	83	5	88
	Rib . . .	52	5	57
	Ash . . .	35	10	45
	Stort . .	28	70	98
Total		490	155	645

It has been estimated by Mr. W. Whitaker, F.R.S., that in the Geological Survey Maps, sheets 7 and 46 S.E., in which much the greater portion of the above area is represented, out of nearly 600 miles square coloured as bare Chalk, the Chalk which would be coloured as bare on Maps showing the Drift beds, occupies only about 34 per cent. of the area, $21\frac{1}{2}$ per cent. of the Chalk area being covered by permeable beds, 41 per cent. by mixed beds (partly permeable and partly impermeable), and $3\frac{1}{2}$ per cent. by impermeable beds. I have converted the square miles given by Mr. Whitaker into percentages of the whole area. If we consider the mixed beds as half permeable and half impermeable, it follows that 24 per cent. ($20\frac{1}{2} + 3\frac{1}{2}$) should be deducted from the area of Chalk, that is Chalk not covered by Tertiary beds, to arrive at the area of permeable strata. The Chalk area of the Colne must therefore be reduced from 195 square miles to 148, and the Chalk area of the Lea from 295 square miles to 224.

An inch of rain per annum percolating throughout an area of a square mile will yield 39,623 gallons of water per diem. Therefore 7·72 ins. percolating per annum through the 148 square miles of permeable strata in the catchment-basin of the Colne and its tributaries above Harefield will yield about 45 million gallons per diem, and 6·08 ins. percolating per annum through the 224 square miles of permeable strata in the catchment-basin of the Lea and its tributaries above Feilde's Weir will yield about 54 million gallons per diem. The total yield from percolation through the Chalk is therefore 99 million gallons per diem.

To the amount of rain which percolates through the Chalk should be added that which runs off the surface of the impermeable strata. It is very difficult to form any estimate of this. There must be much more evaporation from the surface of impermeable beds than from the surface of permeable beds, for wherever water stands it must be exposed much longer to evaporating influences (the heat of the sun, drying winds, etc.) than when it sinks beneath the surface. If we assume that impermeable beds yield with ordinary, or not very heavy, rainfall, half the amount of water that permeable beds do, we shall probably be very near the mark. On this assumption the 87 square miles (40 + 47) of impermeable beds in the Colne area will yield about $12\frac{1}{2}$ million gallons per diem, and the 186 square miles (115 + 71) of impermeable beds in the Lea area will yield about $20\frac{1}{2}$ million gallons per diem. This brings the yield of the Colne area above Harefield to $57\frac{1}{2}$ million gallons, and that of the Lea area above Feilde's Weir to $74\frac{1}{2}$ million gallons. The total yield of the two areas with ordinary rainfall should therefore be about 132 million gallons per diem.

But occasionally we have very heavy rain, which runs rapidly off impermeable beds; when excessively heavy it may even run off permeable beds, but that is rarely the case. It is as impossible to estimate the yield of these heavy falls, as it would be futile to rely upon them for our water-supply. They temporarily augment the volume of water in our rivers, sometimes to such an extent that they cause floods, but their effects soon cease.

Even the estimated extra supply of 33 million gallons per diem derived from rain running off impermeable beds should not all be counted on as available for water-supply. It is essentially a winter supply, and in winter less water is required than in summer. We should therefore base our estimate of what we can rely upon on the available summer supply, and this is almost entirely derived from the rain which percolates through the Chalk in winter. With a gentle rain, even if long continued, it is seldom that any runs off the surface into our rivers in summer; it is only when there is a very heavy rain that it does so, and then only on impermeable beds, except perhaps once a year or so when about an inch falls in a few hours. The occasional flooding of the Lea Valley below Feilde's Weir, when very heavy rain falls in the summer, is, doubtless, almost entirely due to the large Tertiary area in the Valley of the Stort (two and a half times that of the Chalk area). In the Colne Valley I have never seen any of the tributaries of the Colne flooded in summer. Their valleys are entirely cut out of the Chalk, except that they have about five square miles of Tertiary outliers in them. But of the 70 square miles in the Colne Valley alone (*i.e.*, excluding its tributaries) above Harefield, about half are occupied by Tertiary beds, and when two or three inches of rain fall in as many days, which very rarely happens, or when a long wet period culminates in a heavy, though smaller, fall than this, whether in winter or summer, the valley is flooded for a day or two about Watford and Rickmansworth. This water quickly runs off, and its presence is not an indication that the Chalk is saturated up to it. The Chalk doubtless receives some flood-water from impermeable beds, as in swallow-holes, but I believe that there is only one district where any very considerable quantity is thus absorbed, and that is the upper valley of the Colne near North Mimms, which will be referred to presently.

It might be suggested that flood-water could be utilized by making reservoirs where our valleys are subject to inundation, but such water is wholly unsuitable for drinking purposes. Excessively heavy rain carries off everything loose with which it comes in contact, and as much of our land is heavily manured, a considerable quantity of manure must be carried off it. Nearly all our Sewage Farms are on the banks of our rivers, necessarily on low land and liable to be flooded, water at such times running off them into the rivers. Water, therefore, should not be drawn from our rivers in times of flood, much less should flood-water be stored for future supply.

The results given above are based on the average rainfall and percolation for a long period. But we cannot rely upon the average, or anything near the average, year by year, or for a short series of years. Taking the average ratio of percolation in the experiments on percolation through soil at Nash Mills, Lea Bridge, and Rothamsted, so far as either series of experiments is available for the half-century ending 31st March, 1892, the following will be found to be the percentage to the mean in each year:—

Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio	Year.	Ratio.
1842-43	157	1852-53	168	1862-63	97	1872-73	140	1882-83	164
43-44	145	53-54	61	63-64	54	73-74	27	83-84	77
44-45	105	54-55	28	64-65	74	74-75	56	84-85	88
45-46	133	55-56	92	65-66	172	75-76	108	85-86	123
46-47	90	56-57	75	66-67	101	76-77	142	86-87	99
47-48	132	57-58	105	67-68	50	77-78	80	87-88	71
48-49	102	58-59	23	68-69	118	78-79	128	88-89	98
49-50	21	59-60	138	69-70	76	79-80	128	89-90	115
50-51	125	60-61	153	70-71	71	80-81	175	90-91	63
51-52	55	61-62	109	71-72	79	81-82	94	91-92	126
1842-52	106½	1852-62	95	1862-72	89	1872-82	108	1882-92	102½

The smallest ratio of percolation in any year was 21 per cent. in 1849–50, the next, 23 per cent. in 1858–59; the smallest in any two years in succession was 41½ per cent. in 1873–74 and 1874–75, the next, 44½ per cent. in 1853–54 and 1854–55; the smallest in any three years in succession was 60 per cent. in 1853–54 to 1855–56, the next, 64 per cent. in 1873–74 to 1875–76. We may, therefore, expect to have three years in succession with an average percolation of about 4 inches of rain, being 60 per cent. of our county average of 6·76 inches. We may also have three successive years with an average percolation of 9¾ inches of rain, being 44 per cent. above the average, as in 1878–79 to 1880–81.

If, instead of taking the ratio to the mean of the three series of experiments, we take the actual amount of percolation through soil at Nash Mills and Lea Bridge, it will be found that for the three years 1854–55 to 1856–57, the average annual percolation at Lea Bridge was 3·63 ins., and that for the three years 1869–70 to 1871–72 at Nash Mills it was 3·75 ins. Even if we take such a long period as six years, we get a mean annual percolation of less than 4½ inches, for during the six years 1853–54 to 1858–59, at Lea Bridge, the average was 4·33 ins., and during the six years 1866–67 to 1871–72, at Nash Mills, it was 4·30 ins.

In three successive years, therefore, the average annual supply from the catchment-basins of the Colne and Lea may be from about 35 to 40 per cent. less than the estimated average for half a century, and in six successive years it may be about 25 per cent. less than this average.

It may be noticed that the ratio of percolation during the second, fourth, and fifth decade of the half-century corresponds very closely with the ratio of winter rainfall during these decades, the difference being $1\frac{1}{2}$, $\frac{1}{2}$, and $\frac{1}{2}$ per cent. respectively; not nearly so closely in any decade with the ratio of annual rainfall; and that it does not correspond at all with the ratio of summer rainfall. If the ratio of percolation be calculated on the mean proportions to the rainfall in summer and winter at Nash Mills and Lea Bridge, that is 6 per cent. of the summer rainfall and 46 per cent. of the winter rainfall, the ratios of percolation in each decade should be as follows:—First decade, 96 per cent.; second, $95\frac{1}{2}$ per cent.; third, 98 per cent; fourth, 109 per cent.; and fifth, $101\frac{1}{2}$ per cent. The differences between these calculated ratios and the actual ratios as given in the above table, for the second, fourth, and fifth decade, are respectively $\frac{1}{2}$, 1, and 1 per cent., thus showing that it makes very little difference whether we estimate the percolation on the proper proportion of summer and winter rainfall or on the winter rainfall alone.

The much higher ratio of percolation than of rainfall to the mean of the whole period in the first decade seems to be due to excessive percolation during the first few years of the experiments at Nash Mills. There must always be an undue amount of percolation for some time after the natural soil has been disturbed. The same thing is shown at the commencement of the experiments at Lea Bridge, but here the normal percolation was reached much sooner than at Nash Mills. At Rothamsted, where the soil was not disturbed, the gauges being built up around it, there was no excessive percolation at the commencement of the experiments. The small ratio of percolation in the third decade, which is the mean of the ratios at Nash Mills and Lea Bridge, is due to there being a very small amount of percolation at Nash Mills during two years of rather small rainfall. The character of the rainfall may be the cause of this, but that could only be ascertained by an examination of the daily fall.

The period from which the mean ratio of percolation at Rothamsted is taken (the last 21 years) having a rainfall 5 per cent. above the average for the half-century, all the ratios during this period are lower than they would have been if the experiments there had been carried on for the half-century, for the *mean* percolation would then have been less. For the last eight years the ratios are to the mean of the percolation at Rothamsted only, and therefore they are a little too low, as will doubtless appear when the results of experiments at Nash Mills and Lea Bridge during these eight years are made known.

In calculating the areas of the different catchment-basins, and the probable yield of water from the rain which falls on them, I have assumed hitherto that the water-partings on the surface of the country correspond with the water-partings underground; that is to say, that the rain which percolates in each catchment-basin keeps within that basin after it arrives at the plane of saturation in the Chalk; but there are good grounds for inferring that such is not always the case. Some of the rain which falls in the upper part of the Colne basin almost certainly is carried underground into the Lea basin, while none which falls in any part of the Lea is likely to get into the basin of the Colne.

Two causes combine to produce this effect: one natural, the other artificial. The natural cause is the dip of the Chalk from N.W. to S.E., from the Colne to the Lea. The artificial cause is the lowering of the plane of saturation of the Chalk in the Lea valley by the large amount of water pumped from great depths.

The Chalk is our great water-bearing stratum; firstly, owing to its pervious nature, the whole of it being permeable, but its permeability or water-bearing capacity decreasing towards its base; and secondly, because the water contained in it is held up by the Gault Clay on which it rests, the Upper Greensand, which usually in other districts separates these two formations, being absent or reduced to a very thin bed. The Gault is usually spoken of as an absolutely impervious bed of clay, but no rock (using the term in its geological sense) which is in the least moist can be absolutely impervious to moisture. The loss of water by percolation through the Gault must, however, be very slight, and we may consider it to be practically impervious.

The permeable Chalk and the underlying impermeable Gault dip slightly in Hertfordshire from N.W. to S.E., the gradient being at least 60 feet to the mile in the N.W. and 30 feet to the mile in the S.E.

The inclination of our valleys, and consequently of our rivers, and of the surface of the underground water in the Chalk is less than this, varying from about 24 feet to the mile in the N.W. to about 12 feet to the mile in the S.E.

Some of the rain which percolates into the Chalk must filter slowly through it, some must get into cracks or fissures which are more or less vertical and are called "pipes," and some may be rapidly carried away in "swallow-holes." Pipes are frequently seen in vertical or oblique sections, as in chalk-pits and railway-cuttings, when the chalk is not protected from the percolation of water into it by impermeable beds of clay reposing upon it, but when there are such impermeable beds no "pipes" are seen, showing that water does not then percolate into and dissolve it to any appreciable extent. These "pipes" may in course of time be so enlarged, and the chalk in which they are formed may be so much dissolved away, that they become "swallow-holes," the difference between "pipes" and "swallow-holes" being that in pipes the insoluble residue of the chalk is left more or less in its original position, the beds above gradually sinking and taking the place of the soluble residue, so that no open channel is left, and in "swallow-holes" the chalk is washed away with all its contents, such as flints, and an open channel is formed, down which large quantities of water may freely pass.

At intervals in the Upper Chalk, layers of flints occur, with usually a few feet of chalk between them. They are absent below the Chalk Rock which forms the boundary between the Upper and the Middle Chalk.

The interstices in the layers of flints being more open than in the solid chalk between them, and the dip of the Chalk being at a higher angle than the dip of the plane of saturation, water finding its way into these layers will flow more readily, or more quickly, along them than it will flow in the solid chalk, which offers a very great frictional resistance to its passage. The dip of the Chalk being from N.W. to S.E., there must be a natural tendency for water to flow in that direction.

The water-parting between the catchment-basins of the Colne and Lea from near Dunstable on the N.W. to a little beyond Hatfield on the S.E., trends nearly in the same direction as the Chalk dips, but at this point it takes a turn to the S. From a N. and S. direction it turns a little to the W. near Northaw, and continues in the same direction to near Barnet. If, therefore, water is flowing in the Chalk from N.W. to S.E., it must, to the S. of Hatfield, flow, underground of course, out of the basin of the Colne and into that of the Lea.

On the opposite or W. side of the Colne basin, as far S. as Harefield at least, there is no such cause for an accession of water underground, so that the underground reservoir of the basin of the Lea will obtain an accession of water at the expense of that of the Colne, while the loss to the Colne will not be compensated for from an outside source.

The Lea basin, on the other hand, probably loses more water on the E. than it gains from the Colne on the W., for the boundary of its watershed on that side runs in a N.E. to S.W. direction. This is almost on the strike of the Chalk, or at a right angle to its dip, and therefore the natural flow of the water in the Chalk will be almost directly away from the basin of the Lea on its south-eastern boundary.

The abstraction of a large quantity of water from the Chalk in the Lea basin must tend, by lowering the plane of saturation, to enlarge the subterranean basin, causing the water-parting underground to gradually recede beyond the water-parting above ground. How far this is the case in this or any district, can only be ascertained by actual hydro-geological surveys such as have been carried on by Mr. Joseph Lucas.

That the plane of saturation in the Chalk should not be unduly lowered is most important for the welfare of Hertfordshire, our chief industries — agriculture, watercress-growing, brewing, and paper-making—being dependent, for their successful carrying on, upon the presence of a certain amount of moisture in the subsoil in the case of agriculture, and upon an abundant supply of water in the Chalk in the case of the other industries.

Our rivers are chiefly fed by the natural overflow of the water in the Chalk, which finds its way to the surface in springs, most of which are in the banks and beds of the rivers, their flow being thus constantly augmented without accession of water from any tributary streams.

Owing to the permeable character of the Chalk, the water in any river flowing over it, if no impermeable bed intervene, would sink through it and disappear from the surface if the plane of saturation were lower than the river-bed.

The Chalk is well known to be more impervious under the London Clay than where it comes to the surface, this being most probably due in part to the pressure of the London Clay and the Woolwich and Reading beds on which it rests, and in part to the thick bed of clay preventing the percolation of water into it, and consequently preventing it from becoming more porous by the dissolving action of water and carbonic acid. Water, therefore, flowing in the Chalk from N.W. to S.E., meets with a partial obstruction when it gets to this denser chalk under the London Clay, and this must have the effect of retarding its rate of flow towards the Thames.

The preservation of this partial barrier to the comparatively free passage of the water is necessary to prevent it from running too freely away from the higher ground to the wells under London, as it might do but for this, notwithstanding the impediment to its flow by friction in its passage laterally through the Chalk.

The abstraction of a large quantity of water by pumping from a considerable depth anywhere in the Chalk, but more especially along or near the line of its outcrop from under the Tertiary beds, which line extends in Herts from near Bishop's Stortford in the N.E. to Rickmansworth in the S.W., would be equivalent to the destruction of this partial barrier, as the water would be removed much more rapidly than it could percolate through the Chalk under the London Clay.

Such abstraction of water by deep pumping anywhere along this line, and the removal to a distance of the water raised, would unduly lower the surface of the water in the Chalk at the points of abstraction, and this lowering would gradually extend in dry seasons over the whole of the Chalk area to the N.W. The springs which now find their way into our rivers would be drawn upon, and would not only cease to rise, but in extreme cases might be converted into "swallow-holes," the water in the rivers sinking into the channels which have been formed by the springs.

This conclusion is not merely formed from theoretical considerations, but also from a change which must have taken place in a district well known to me, and which may have taken place in others. This district is the upper portion of the Valley of the Colne.

All the water which flows down the Colne from the London Clay area on the S. towards North Mimms is now usually absorbed by "swallow-holes" at Potterells and in the bed of the Colne between Potterells and the London Clay area. I have seen this part of the River Colne under almost every variety of condition; when the water did not reach so far as the "swallow-holes" at Potterells, sinking into the bed of the river in other (smaller) "swallow-holes" above this point; when the water was rushing down them with great force (one at least is so large that a man might be carried down it); and when the level of the underground water had been so raised by the winter's rain that a lake was formed at this point, the water flowing out of it along the usually dry channel of the Colne through North Mimms Park. In this park there is a mansion overlooking this dry river-bed. As it faces the north, I think it must have been built when water flowed much more frequently from Potterells than it does now; for surely the mansion would not have been built with this aspect, to overlook the bed of a river which is now dry except for a short time during or after very wet winters.

I have long been puzzled to account for the phenomena here presented, until it occurred to me that the plane of saturation in the Chalk may have been lowered as far as this spot by the abstraction of water at the pumping-stations in the Valley of the Lea, 8 miles to the east, or E.S.E. I have since then ascertained that the late Robert William Mylne formed the opinion that the Amwell Springs in the Valley of the Lea are fed by water from these swallow-holes. Whether this be the case or not, it will be apparent that water getting into the Chalk here and meeting with beds of flints, will be more likely to follow the dip of these beds towards the S.E. than it would be to follow, underground, the course of the Colne in a directly opposite direction to the dip of the Chalk, for it could only follow this direction by percolating through beds offering varying degrees of resistance to its passage, which would not be the case if it followed the dip of the Chalk.

If the water-level in the Chalk, in whichever direction from the river these swallow-holes convey water away from it, were higher than the bed of the river, the channels which now usually convey water from the river would convey water from the saturated chalk into the river. Even if they do not directly communicate by open passages with higher strata, hydrostatic pressure would cause the water in them to rise into the river. This may occasionally happen now, and if the channels existed when the plane of saturation inclined downwards from the higher ground around them permanently, as it now only does occasionally, these channels, if then existing, would have been the channels of springs.

The water flowing down the Colne, where it is joined by its tributary the Ver, is now usually only a small fraction of that flowing down the Ver. If such had been the case when these rivers were named, the Ver would have been considered the main stream, with the name of Colne, or the river below the junction of the two would have been called the Ver.

The catchment-basin of the Colne, above its junction with the Ver, has a greater area than the catchment-basin of the Ver, the chief reason why the Colne is here so much smaller than the Ver being that so much water is lost to it in swallow-holes. Another reason is that the Ver drains a larger area of permeable beds.

The Ver is much farther from any point of great abstraction of water than is the upper part of the Colne, and its waters are considerably augmented by springs in its bed at various points.

The conclusion is irresistible that if a great quantity of water were abstracted from the Chalk at Watford, Rickmansworth, or Harefield, the same thing would happen to the Ver as has doubtless happened to the Colne, the springs in its bed would be converted into swallow-holes, and the same would happen to the Gade (with its tributary the Bulbourne) and the Chess.

When a great quantity of water is pumped from a well in the Chalk, an *inverted* cone of exhaustion is formed, its apex being at the point of abstraction or surface of the water in the well after the water has been lowered by pumping, and its base (inverted) at the plane of saturation of the Chalk.

This is not a true cone, for its outline, in section, will not be straight, but curved something like this— , the reason being that the effect of the abstraction of water, in partially drying the chalk, will be greater near the well than at a distance from it. The deeper the well, and the lower the point to which the water is reduced, and the greater the distance to which lateral headings are driven, the larger will this cone of exhaustion be, and the greater will be the area injuriously affected by it.

As water will percolate more rapidly through layers of flints than through solid chalk, in sinking a well in the Upper Chalk, water will naturally flow freely into it as each layer of flints is reached, and slowly into it from the chalk between the layers. It might therefore be possible to abstract a large quantity of water from a lower bed of flints without immediately drawing the water out of a higher bed, but as the whole of the Upper Chalk is very permeable, sooner or later the water in the higher bed of flints must percolate through the chalk between the two layers and get into the lower layer, if that be exhausted, or partially exhausted of the water it contains.

The whole of the Chalk being thus permeable, though varying in the degree of permeability, a guarantee that a well will be carried a certain depth into it and will be "steined" to that depth and made quite watertight so as to prevent water from getting into it from an adjoining stream flowing over the Chalk, or from other (shallower) wells in its vicinity, is of no more value than would be a guarantee that water would only be pumped from the bottom of a tank in order not to lower the surface of the water at or near the top of it, except that in the case of the tank the water would be immediately lowered, and in the case of the Chalk it would take some time to percolate from the higher level to the lower. A more precise parallel, obviously, would be found in a filter, and no one would contend that water could be drawn from the bottom of a filter without lowering the surface at the top of it, although some time would be taken for the water to filter through.

Therefore, experiments *of short duration*, made with the object of testing the effect of pumping in one well upon the level of the water in an adjoining well, are of no value; it may be some time before the effect shows, but the cone of exhaustion of one must eventually intersect the cone of exhaustion of the other. It may also be a long time before the abstraction of water from a deep well affects the flow of an adjoining stream on the Chalk, but that it must eventually do so is certain.

If, however, the water raised be used in the district from which it is obtained, that is to say, if it be not conveyed away to a distance, as from the Colne Valley or the Lea Valley to London, the river flowing by on the Chalk will only be depleted above the point of abstraction, for all the water raised from the Chalk will be returned to the river, the greater part probably as effluent water from sewage. The water we raise in Hertfordshire for the supply of our towns, except the comparatively small amount sent away by brewers and mineral-water manufacturers, does not reduce the volume of the Colne and Lea below the points where they leave our county, so that we only take what is our own, and we restore it after we have made use of it, robbing no one. If it be taken from us and conveyed to London, it is sent into the Thames below London; our rivers are completely robbed of it; and their volume below the points of intake, if the water be taken directly from the rivers, and both above and below, if it be taken from the Chalk, will be permanently reduced.

Table I.—Mean Rainfall in Hertfordshire for the Half-Century ending 31st March, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1842-43	11·57	12·83	24·40	98			
43-44	13·37	14·68	28·05	112			
44-45	7·69	12·49	20·18	95	1845	13·33	102
45-46	11·02	13·26	24·28	101	46	13·48	103
46-47	10·95	12·32	23·27	94	47	12·69	97
47-48	10·77	15·09	25·86	115	48	13·56	103
48-49	12·38	12·85	25·23	98	49	13·42	102
49-50	13·25	8·17	21·42	63	50	12·04	92
1850-51	12·23	14·26	26·49	109	1851	11·76	90
51-52	10·31	10·84	21·15	83	52	11·09	85
52-53	18·50	18·58	37·08	142	53	14·56	111
53-54	16·27	8·95	25·22	68	54	12·79	98
54-55	9·70	9·63	19·33	74	55	12·39	95
55-56	13·34	13·55	26·89	103	56	10·71	82
56-57	14·98	11·73	26·71	90	57	11·64	89
57-58	14·80	11·83	26·63	90	58	12·37	94
58-59	13·04	9·12	22·16	170	59	10·89	83
59-60	16·58	15·15	31·73	16	60	12·03	92
1860-61	19·50	11·81	31·31	90	1861	12·03	92
61-62	9·96	12·16	22·12	93	62	13·04	100
62-63	13·81	11·08	24·89	85	63	11·68	89
63-64	12·13	10·63	22·76	81	64	11·29	86
64-65	8·47	11·74	20·21	90	65	11·15	85
65-66	12·46	19·68	32·14	150	66	14·02	107
66-67	16·21	13·09	29·30	100	67	14·84	113
67-68	14·97	11·22	26·19	86	68	14·66	112
68-69	10·07	16·04	26·11	122	69	13·45	103
69-70	11·88	12·68	24·56	97	70	13·31	102
1870-71	7·51	12·19	19·70	93	1871	13·64	104
71-72	15·93	11·18	27·11	85	72	12·02	92
72-73	13·69	19·44	33·13	148	73	14·27	109
73-74	11·65	9·59	21·24	73	74	13·40	102
74-75	10·75	11·40	22·15	87	75	13·48	103
75-76	15·99	17·10	33·09	131	76	12·70	97
76-77	13·67	19·45	33·12	148	77	15·98	122
77-78	14·51	12·42	26·93	95	78	16·32	125
78-79	18·15	14·54	32·69	111	79	15·47	118
79-80	22·56	6·30	28·86	48	80	11·09	85
1880-81	16·21	17·83	34·04	136	1881	12·89	98
81-82	13·15	14·02	27·17	107	82	12·72	97
82-83	14·53	20·24	34·77	155	83	17·36	133
83-84	13·65	11·53	25·18	88	84	15·26	117
84-85	10·08	12·63	22·71	97	85	14·80	113
85-86	13·66	14·75	28·41	113	86	12·97	99
86-87	11·55	15·07	26·62	115	87	14·15	108
87-88	9·13	11·34	20·47	87	88	13·72	105
88-89	13·64	11·50	25·14	88	89	12·64	97
89-90	16·72	11·57	28·29	88	90	11·47	88

	Ins.	Ins.	Ins.	%		Ins.	%
1890-91	11·65	8·50	20·15	65	1891	10·52	80
91-92	13·60	16·61	30·21	127	92	12·23	93
Mean	13·24	13·09	26·33	100			

Table II.—Rainfall at Nash Mills, Hemel Hempstead, 1st April, 1834, to 31st March, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%			
1834-35	13·27	10·91	24·18	80			
35-36	11·99	16·39	28·38	120		Ins.	%
36-37	12·20	16·71	28·91	123	1837	14·67	108
37-38	9·80	9·81	19·61	72	38	14·30	105
38-39	10·81	12·58	23·39	92	39	13·03	96
39-40	17·41	14·71	32·12	108	40	12·33	90
1840-41	9·68	10·32	20·00	76	1841	12·54	92
41-42	16·95	16·56	33·51	121	42	13·86	102
42-43	12·15	13·46	25·61	99	43	13·45	99
43-44	14·04	15·41	29·45	113	44	15·14	111
44-45	8·07	13·11	21·18	96	45	13·99	103
45-46	11·57	13·93	25·50	102	46	14·15	104
46-47	11·50	12·93	24·43	95	47	13·32	98
47-48	11·31	15·84	27·15	116	48	14·23	104
48-49	13·00	13·49	26·49	99	49	14·09	103
49-50	13·91	8·58	22·49	63	50	12·64	93
1850-51	11·82	14·71	26·53	108	1851	12·26	90
51-52	9·25	10·75	20·00	79	52	11·35	83
52-53	19·97	20·27	40·24	149	53	15·24	112
53-54	16·79	9·66	26·45	71	54	13·56	99
54-55	9·47	9·32	18·79	68	55	13·08	96
55-56	12·66	14·48	27·14	106	56	11·15	82
56-57	14·86	11·96	26·82	88	57	11·92	87
57-58	14·11	11·81	25·92	87	58	12·75	94
58-59	12·27	9·64	21·91	71	59	11·14	82
59-60	18·31	16·49	34·80	121	60	12·64	93
1860-61	20·40	11·56	31·96	85	1861	12·56	92
61-62	10·38	12·63	23·01	93	62	13·56	99
62-63	14·37	11·01	25·38	81	63	11·73	86
63-64	13·40	9·24	22·64	68	64	10·96	80
64-65	8·42	10·93	19·35	80	65	10·39	76
65-66	12·60	20·00	32·60	147	66	13·39	98
66-67	15·59	12·60	28·19	92	67	14·51	106
67-68	14·37	11·36	25·73	83	68	14·65	107
68-69	10·05	17·58	27·63	129	69	13·85	102
69-70	12·80	13·33	26·13	98	70	14·09	103
1870-71	7·59	12·54	20·13	92	1871	14·48	106
71-72	16·09	11·25	27·34	83	72	12·37	91
72-73	14·44	21·55	35·99	158	73	15·11	111
73-74	11·29	8·91	20·20	65	74	13·90	102
74-75	10·71	11·69	22·40	86	75	14·05	103

	Ins.	Ins.	Ins.	%		Ins.	%
1875-76	15·00	17·28	32·28	127	1876	12·63	93
76-77	14·25	20·69	34·94	152	77	16·55	122
77-78	13·74	13·74	27·48	101	78	17·24	127
78-79	18·46	14·62	33·08	107	79	16·35	120
79-80	25·09	5·84	30·93	43	80	11·40	84
1880-81	16·40	20·37	36·77	149	1881	13·61	100
81-82	14·85	14·82	29·67	109	82	13·68	100
82-83	16·52	22·67	39·19	166	83	19·29	142
83-84	13·92	12·95	26·87	95	84	16·81	123
84-85	9·76	14·53	24·29	107	85	16·72	123
85-86	14·04	15·16	29·20	111	86	14·21	104
86-87	12·22	16·31	28·53	120	87	15·33	112
87-88	9·24	12·64	21·88	93	88	14·70	108
88-89	14·20	12·29	26·49	89	89	13·75	101
89-90	16·61	10·57	27·18	78	90	11·83	87
1890-91	11·65	8·82	20·47	65	1891	10·46	77
91-92	14·50	16·95	31·45	125	92	12·11	89
Mean	13·45	13·64	27·09	100			

TABLE III.—RAINFALL AT KENSWORTH, 1ST APRIL, 1870, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean for each three successive Winters		
					Ending 31st Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1870-71	7·44	13·25	20·69	94			
71-72	17·56	11·61	29·17	82			
72-73	13·38	19·86	33·24	141	1873	14·91	106
73-74	13·82	10·35	24·17	74	74	13·94	99
74-75	10·07	11·61	21·68	83	75	13·94	99
75-76	17·34	18·07	35·41	128	76	13·34	95
76-77	14·90	19·99	34·89	142	77	16·56	117
77-78	16·68	13·62	30·30	97	78	17·23	122
78-79	20·81	13 81	34·62	98	79	15·81	112
79-80	24·26	6·91	31·17	49	80	11·45	81
1880-81	18·52	15·85	34·37	112	1881	12·19	87
81-82	14·46	14·15	28·61	100	82	12·30	87
82-83	15·22	20·89	36·11	148	83	16·96	120
83-84	13·44	11·53	24·97	82	84	15·52	110
84-85	11·32	12·98	24·30	92	85	15·13	107
85-86	13 64	15·20	28·84	108	86	13·24	94
86-87	11·98	15·63	27·61	111	87	14·60	104
87-88	9·53	11·54	21·07	82	88	14·12	100
88-89	13·39	13·16	26·55	94	89	13·44	95
89-90	18·55	12·33	30·88	87	90	12·34	88
1890-91	13·54	8·43	21·97	60	1891	11·31	80
91-92	14·31	19·17	33·48	136	92	13·31	95
Mean	14·73	14 09	28·82	100			

Table IV.—Rainfall at Berkhamsted, 1st April, 1856, to 31st March, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
	Ins.	Ins.	Ins.	%	Ending 31st Mar.	Mean	Ratio.
						Ins.	%
1856-57	16·99	13·78	30·77	92			
57-58	14·42	12·27	26·69	82			
58-59	13·18	11·12	24·30	74	1859	12·39	83
59-60	17·53	16·90	34·43	113	60	13·43	90
1860-61	21·27	13·16	34·43	88	1861	13·73	92
61-62	11·17	14·52	25·69	97	62	14·86	99
62-63	14·07	12·78	26·85	85	63	13·49	90
63-64	13·81	12·24	26·05	82	64	13·18	88
64-65	9·25	12·93	22·18	86	65	12·65	84
65-66	11·95	21·91	33·86	146	66	15·69	105
66-67	18·31	14·73	33·04	98	67	16·52	110
67-68	15·61	12·72	28·33	85	68	16·45	110
68-69	12·97	18·56	31·53	124	69	15·34	102
69-70	12·90	14·33	27·23	95	70	15·20	101
1870-71	9·40	14·16	23·56	94	1871	15·68	104
71-72	16·90	12·69	29·59	85	72	13·73	91
72-73	15·63	22·82	38·45	152	73	16·56	110
73-74	13·24	11·05	24·29	74	74	15·52	104
74-75	11·97	13·32	25·29	89	75	15·73	105
75-76	16·98	19·56	36·54	130	76	14·64	98
76-77	14·60	21·24	35·84	142	77	18·04	120
77-78	14·44	14·38	28·82	96	78	18·39	123
78-79	20·42	17·40	37·82	116	79	17·67	118
79-80	24·65	6·91	31·56	46	80	12·90	86
1880-81	18·35	20·56	38·91	137	1881	14·96	100
81-82	15·11	14·91	30·02	99	82	14·13	94
82-83	16·08	23·32	39·40	156	83	19·60	131
83-84	13·38	12·86	26·24	86	84	17·03	114
84-85	10·67	14·31	24·98	95	85	16·83	112
85-86	12·33	16·32	28·65	109	86	14·50	97
86-87	11·05	17·03	28·08	113	87	15·89	106
87-88	8·82	12·43	21·25	83	88	15·26	102
88-89	13·10	13·68	26·78	91	89	14·38	96
89-90	14·61	12·17	26·78	81	90	12·76	85
1890-91	11·65	8·36	20·01	56	1891	11·40	76
91-92	13·15	18·55	31·70	124	92	13·03	87
Mean	14·44	15·00	29·44	100			

TABLE V.—RAINFALL AT GORHAMBURY, ST. ALBANS, 1ST APRIL, 1860, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31st Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1860-61	19·33	12·34	31·67	85			
61-62	10·60	12·83	23·43	89			
62-63	15·30	12·28	27·58	85	1863	12·48	86
63-64	13·45	10·65	24·10	74	64	11·92	82
64-65	10·04	12·02	22·06	83	65	11·65	81
65-66	12·59	22·06	34·65	152	66	14·91	103
66-67	17·48	13·91	31·39	96	67	16·00	111
67-68	16·06	11·89	27·95	82	68	15·95	110
68-69	10·78	17·34	28·12	120	69	14·38	99
69-70	12·05	14·29	26·34	99	70	14·50	100
1870-71	8·99	13·14	22·13	91	1871	14·92	103
71-72	16·66	11·89	28·55	82	72	13·11	91
72-73	15·60	22·62	38·22	156	73	15·88	110
73-74	11·54	9·45	20·99	65	74	14·65	101
74-75	11·16	12·42	23·58	86	75	14·83	103
75-76	15·90	16·34	32·24	113	76	12·74	88
76-77	14·08	20·55	34·63	142	77	16·44	114
77-78	16·29	13·76	30·05	95	78	16·88	117
78-79	17·83	12·50	30·33	86	79	15·60	108
79-80	22·50	7·39	29·89	51	80	11·22	78
1880-81	16·17	22·21	38·38	154	1881	14·03	97
81-82	14·14	15·57	29·71	108	82	15·06	104
82-83	17·65	23·69	41·34	164	83	20·49	142
83-84	14·49	13·72	28·21	95	84	17·66	122
84-85	10·46	15·02	25·48	104	85	17·48	121
85-86	15 06	14·70	29·76	102	86	14·48	100
86-87	11·51	15·31	26·82	106	87	14·94	103
87-88	9·30	11·64	20·94	80	88	13·88	96
88-89	13·92	11·75	25·67	81	89	12·90	89
89-90	16·36	11·35	27·71	79	90	11·58	80
1890-91	10·97	8·71	19·68	60	1891	10·60	73
91-92	13·71	19·50	33·21	135	92	13·19	91
Mean	14·12	14·46	28·58	100			

TABLE VI.—RAINFALL AT ROTHAMSTED, HARPENDEN, 1ST APRIL, 1853, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31st Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%			
1853-54	17.54	9.61	27.15	70			
54-55	10.28	9.53	19.81	69		Ins.	%
55-56	15.50	14.82	30.32	107	1856	11.32	82
56-57	15.52	12.27	27.79	89	57	12.21	88
57-58	15.32	11.93	27.25	86	58	13.01	94
58-59	12.35	9.53	21.88	69	59	11.58	84
59-60	17.38	14.59	31.97	106	60	12.02	87
1860-61	21.50	11.14	32.64	81	1861	11.75	85
61-62	10.98	12.45	23.43	90	62	12.73	92
62-63	15.74	12.81	28.55	93	63	12.13	88
63-64	13.04	10.73	23.77	78	64	12.00	87
64-65	9.71	11.56	21.27	84	65	11.70	85
65-66	12.47	20.33	32.80	147	66	14.21	103
66-67	18.25	13.34	31.59	97	67	15.08	109
67-68	15.54	11.55	27.09	84	68	15.07	109
68-69	10.21	14.32	24.53	104	69	13.07	95
69-70	11.62	13.33	24.95	96	70	13.07	95
1870-71	7.79	12.76	20.55	92	1871	13.47	97
71-72	17.22	11.52	28.74	83	72	12.54	91
72-73	14.13	19.99	34.12	145	73	14.75	107
73-74	11.68	9.83	21.51	71	74	13.78	100
74-75	13.10	13.40	26.50	97	75	14.41	104
75-76	17.39	19.28	36.67	140	76	14.17	103
76-77	14.92	21.36	36.28	155	77	18.01	130
77-78	14.43	13.92	28.35	101	78	18.19	131
78-79	18.66	16.97	35.63	123	79	17.42	126
79-80	25.75	7.03	32.78	51	80	12.64	91
1880-81	17.06	19.32	36.38	140	1881	14.44	105
81-82	13.76	16.06	29.82	116	82	14.14	102
82-83	16.37	21.77	38.14	158	83	19.05	138
83-84	14.64	12.81	27.45	93	84	16.88	122
84-85	11.15	14.11	25.26	102	85	16.23	117
85-86	14.88	15.56	30.44	113	86	14.16	103
86-87	12.58	16.02	28.60	116	87	15.23	110
87-88	9.19	11.86	21.05	86	88	14.48	105
88-89	16 56	12.36	28.92	89	89	13.41	97
89-90	19.14	12.83	31.97	93	90	12.35	89
1890-91	13.36	8.99	22.35	65	1891	11.39	82
91-92	14.61	16.85	31.46	122	92	12.89	93
Mean	14.65	13.81	28.46	100			

TABLE VII.—RAINFALL AT THE FIRS, HITCHIN, 1ST APRIL, 1850, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters. Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1850-51	12·16	13·25	25·41	110			
51-52	10·92	10·47	21·39	87			
52-53	16·58	16·59	33·17	138	1853	13·44	112
53-54	15·84	7·69	23·53	64	54	11·58	96
54-55	9·27	9·52	18·79	79	55	11·27	94
55-56	12·00	11·83	23·83	99	56	9·68	81
56-57	15·39	9·38	24·77	78	57	10·21	85
57-58	15·95	11·70	27·65	97	58	10·97	91
58-59	14·02	7·10	21·12	59	59	9·38	78
59-60	16·11	14·04	30·15	117	60	10·95	91
1860-61	18·57	11·40	29·97	95	1861	10·85	90
61-62	8·64	10·93	19·57	91	62	12·12	101
62-63	12·44	9·17	21·61	76	63	10·50	87
63-64	10·97	10·93	21·90	91	64	10·34	86
64-65	7·25	10·71	17·96	89	65	10·27	85
65-66	13·46	18·43	31·89	154	66	13·36	111
66-67	13·70	12·03	25·73	100	67	13·72	114
67-68	13·90	9·94	23·84	83	68	13·47	112
68-69	10·46	14·02	24·48	117	69	12·00	100
69-70	10·83	11·01	21·84	92	70	11·66	97
1870-71	6·05	11 13	17·18	93	1871	12·05	100
71-72	14·18	13·10	27·28	109	72	11·75	98
72-73	11·82	13·81	25·63	115	73	12·68	106
73-74	10·96	10·49	21·45	87	74	12·47	104
74-75	9·98	11·39	21·37	95	75	11·90	99
75-76	15·96	17·38	33·34	145	76	13·09	109
76-77	12·62	17·43	30·05	145	77	15·40	128
77-78	14·85	11·10	25·95	92	78	15·30	127
78-79	17·44	12·48	29·92	104	79	13·67	114
79-80	20·42	7·27	27·69	61	80	10·28	86
1880-81	15·77	15·26	31·03	127	1881	11·67	97
81-82	11·83	11·96	23·79	100	82	11·50	96
82-83	13·63	18·08	31·71	151	83	15·10	126
83-84	13·36	9·85	23·21	82	84	13·30	111
84-85	10·92	11·15	22·07	93	85	13·03	109
85-86	14·17	13·94	28·11	116	86	11·65	97
86-87	10·76	15·05	25·81	125	87	13·38	111
87-88	8·96	10·51	19·47	88	88	13·17	110
88-89	11·44	9·83	21·27	82	89	11·80	98
89-90	15·55	10·77	26·32	90	90	10·37	87
1890-91	10·87	7·21	18·08	60	1891	9·27	77
91-92	12·25	15·27	27·52	127	92	11·08	92
Mean	12·91	12·01	24·92	100			

Table VIII.—Rainfall at Welwyn, 1st April, 1872, to 31st March, 1892.

Year.	Summer. Ap.-Sept.	Winter, Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
	Ins.	Ins.	Ins.	%	Ending 31 Mar.	Mean.	Ratio.
1872-73	12·77	18·28	31·05	137		Ins.	%
73-74	11·32	8·81	20·13	66			
74-75	12·41	10·11	22·52	76	1875	12·40	93
75-76	16·32	16·83	33·15	126	76	11·92	89
76-77	12·94	18·72	31·66	140	77	15·22	114
77-78	13·80	11·53	25·33	86	78	15·69	118
78-79	16·95	16·51	33·46	124	79	15·59	117
79-80	19·80	5·63	25·43	42	80	11·22	84
1880-81	15·00	17·11	32·11	128	1881	13·08	98
81-82	12·73	13·58	26·31	102	82	12·11	91
82-83	14·54	18·62	33·16	139	83	16·44	123
83-84	12·97	11·16	24·13	84	84	14·45	108
84-85	10·10	12·18	22·28	91	85	13·99	105
85-86	13·50	15·60	29·10	117	86	12·98	97
86-87	12·41	13·88	26·29	104	87	13·89	104
87-88	9·21	10·54	19·75	79	88	13·34	100
88-89	14·56	11·08	25·64	83	89	11·83	89
89-90	17·72	11·70	29·42	88	90	11·11	83
1890-91	12·23	9·66	21·89	72	1891	10·81	81
91-92	13·83	15·46	29·29	116	92	12·27	92
Mean	13·75	13·35	27·10	100			

Table IX.—Rainfall at Bayfordbury, Hertford, 1st April, 1860, to 31st March, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
	Ins.	Ins.	Ins.	%	Ending 31st Mar.	Mean.	Ratio.
1860-61	17·92	11·74	29·66	91			
61-62	9·30	11·73	21·03	91		Ins.	%
62-63	12·71	9·90	22·61	77	1863	11·12	86
63-64	11·54	9·93	21·47	77	64	10·55	82
64-65	7·67	12·28	19·96	96	65	10·71	83
65-66	12·07	18·41	30·48	143	66	13·54	105
66-67	15·96	13·55	29·51	105	67	14·75	115
67-68	14·28	10·34	24·62	81	68	14·10	110
68-69	8·31	16·74	25·05	130	69	13·54	105
69-70	11·51	12·38	23·89	96	70	13·15	102
1870-71	6·08	11·95	18·03	93	1871	13·69	106
71-72	15·70	10·15	25·85	79	72	11·49	89
72-73	12·74	20·72	33·46	161	73	14·27	111
73-74	11·27	9·97	21·24	78	74	13·61	106
74-75	9·74	10·58	20·32	82	75	13·76	107

	Ins.	Ins.	Ins.	%		Ins.	%
1875-76	15·78	16·25	32·03	126	1876	12·27	95
76-77	12·74	20·09	32·83	156	77	15·64	121
77-78	12·90	11·59	24·49	90	78	15·98	124
78-79	21·26	13·86	35·82	108	79	15·18	118
79-80	20·72	5·40	26·12	42	80	10·28	80
1880-81	14·90	15·98	30·88	124	1881	11·75	91
81-82	11·43	13·43	24·86	104	82	11·60	90
82-83	11·98	18·53	30·51	144	83	15·98	124
83-84	10·78	10·88	21·66	85	84	14·28	111
84-85	8·57	10·78	19·35	84	85	13·36	104
85-86	12·98	14·19	27·17	110	86	11·95	93
86-87	10·49	14·34	24·83	111	87	13·10	102
87-88	9·43	10·63	20·06	83	88	13·05	101
88-89	12·43	10·57	23·00	82	89	11·85	92
89-90	17·11	11·83	28·94	92	90	11·01	86
1890-91	10·41	8·34	18·75	65	1891	10·25	89
91-92	12·97	14·86	27·83	115	92	11·68	91
Mean	12·64	12·87	25·51	100			

TABLE X.—RAINFALL AT MUCH HADHAM, 1ST APRIL, 1866, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31st Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1866-67	16·56	13·12	29·68	101			
67-68	15·58	11·78	27·36	91			
68-69	7·72	16·36	24·08	126	1869	13·75	106
69-70	12·14	12·16	24·30	94	70	13·43	104
1870-71	7·41	11·04	18·45	85	1871	13·19	102
71-72	15·61	10·04	25·65	77	72	11·08	86
72-73	13·52	18·78	32·30	145	73	13·29	103
73-74	12·62	8·76	21·38	68	74	12·53	97
74-75	10·23	10·04	20·27	77	75	12·53	97
75-76	14·27	15·52	29·79	120	76	11·44	88
76-77	12·91	18·47	31·38	143	77	14·68	113
77-78	13·41	11·06	24·47	85	78	15·02	116
78-79	16·39	15·00	31·39	116	79	14·84	115
79-80	20·59	5·54	26·13	43	80	10·53	81
1880-81	15·12	17·02	32·14	131	1881	12·52	97
81-82	11·90	14·06	25·96	108	82	12·21	94
82-83	12·36	18·11	30·47	140	83	16·40	127
83-84	13·14	10·85	23·99	84	84	14·34	111
84-85	9·38	11·73	21·11	91	85	13·56	105
85-86	13·47	14·19	27·66	110	86	12·26	95
86-87	10·99	14·22	25·21	110	87	13·38	103
87-88	9·36	11·09	20·45	86	88	13·17	102
88-89	14·82	11·16	25·98	86	89	12·16	94
89-90	16·68	11·62	28·30	90	90	11·29	87
1890-91	12·12	9·25	21·37	71	1891	10·68	83
91-92	13·85	15·78	29·63	122	92	12·22	94
Mean	13·16	12·95	26·11	100			

TABLE XI.—RAINFALL AT ROYSTON, 1ST APRIL, 1851, TO 31ST MARCH, 1892.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters. Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1851-52	9·13	9·64	18·77	85			
52-53	16·04	15·98	32·02	142			
53-54	13·61	8·17	21·78	73	1854	11·26	100
54-55	9·03	9·37	18·40	83	55	11·17	99
55-56	12·15	12·04	24·19	107	56	9·86	87
56-57	12·14	11·26	23·40	100	57	10·89	97
57-58	14·17	11·46	25·63	102	58	11·59	103
58-59	13·37	8·21	21·58	73	59	10·31	91
59-60	13·59	13·73	27·32	122	60	11·13	99
1860-61	17·51	11·36	28·87	101	1861	11·10	99
61-62	8·65	10·02	18·67	89	62	11·70	104
62-63	12·07	9·62	21·69	85	63	10·33	92
63-64	8·71	10·69	19·40	95	64	10·11	90
64-65	6·92	11·74	18·66	104	65	10·68	95
65-66	12·05	16·63	28·68	147	66	13·02	115
66-67	13·84	11·48	25·32	102	67	13·28	118
67-68	14·43	10·14	24·57	90	68	12·75	113
68-69	10·03	13·43	23·46	119	69	11·68	104
69-70	11·20	10·58	21·78	94	70	11·38	101
1870-71	6·84	9·76	16·60	86	1871	11·26	100
71-72	13·48	8·37	21·85	74	72	9·57	85
72-73	12·84	15·98	28·82	142	73	11·37	101
73-74	8·78	8·28	17·06	73	74	10·88	96
74-75	8·11	9·46	17·57	84	75	11·24	100
75-76	14·93	14·46	29·39	128	76	10·73	95
76-77	12·73	15·92	28·65	141	77	13·28	118
77-78	14·50	9·55	24·05	85	78	13·31	118
78-79	12·60	12·23	24·83	108	79	12·90	114
79-80	21·84	5·12	26·96	45	80	9·30	82
1880-81	14·79	14·62	29·41	130	1881	10·99	97
81-82	11·24	11·67	22·91	103	82	10·47	93
82-83	10·96	16·67	27·63	148	83	14·32	127
83-84	16·34	8·70	25·04	77	84	12·35	109
84-85	8·49	9·52	18·01	84	85	11·63	103
85-86	12·57	12·60	25·17	112	86	10·27	91
86-87	11·53	12·86	24·39	114	87	11·66	103
87-88	8·24	10·55	18·79	94	88	12·00	106
88-89	11·95	9·17	21·12	81	89	10·86	96
89-90	14·85	10·56	25·41	94	90	10·09	90
1890-91	9·73	7·19	16·92	64	1891	8·97	80
91-92	12·81	13·68	26·49	121	92	10·48	93
Mean	12·16	11·28	23·44	100			

TABLE XII.—PERCOLATION THROUGH 3 FEET OF CHALK WITH GRASS GROWING ON THE SURFACE; AND EVAPORATION FROM THE SURFACE, BEING THE DIFFERENCE BETWEEN THE PERCOLATION AND THE RAINFALL; AT NASH MILLS, HEMEL HEMPSTEAD, 1ST APRIL, 1854, TO 31ST MARCH, 1884.

Year.	Percolation.				Evaporation.			
	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.		Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.	
	Ins.	Ins.	Ins.	%	Ins.	Ins.	Ins.	%
1854-55	...	3·45	3·45	33	9·47	5·87	15·34	89
55-56	2·30	10·47	12·77	121	10·36	4·01	14·37	83
56-57	3·09	7·19	10·28	98	11·77	4·77	16·54	96
57-58	1·32	7·16	8·48	80	12·79	4·65	17·44	101
58-59	·84	2·69	3·53	34	11·43	6·95	18·38	106
59-60	4·22	12·44	16·66	158	14·09	4·05	18·14	105
1860-61	8·94	7·55	16·49	156	11·46	4·01	15·47	90
61-62	1·02	8·19	9·21	87	9·36	4·44	13·80	80
62-63	1·77	5·50	7·27	68	12·60	5·51	18·11	105
63-64	·19	5·89	6·08	58	13·21	3·35	16·56	96
64-65	·45	3·55	4·00	38	7·97	7·38	15·35	89
65-66	...	12·05	12·05	114	12·60	7·95	20·55	119
66-67	·20	6·97	7·17	67	15·39	5·63	21·02	116
67-68	1·39	5·36	6·75	64	12·98	6·00	18·98	110
68-69	·42	11·21	11·63	110	9·63	6·37	16·00	93
69-70	2·00	8·76	10·76	102	10·80	4·57	15·37	89
1870-71	...	5·35	5·35	51	7·59	7·19	14·78	86
71-72	1·72	9·50	11·22	106	14·37	1·75	16·12	93
72-73	2·70	16·05	18·75	178	11·74	5·50	17·24	100
73-74	...	4·40	4·40	42	11·29	4·51	15·80	91
74-75	·65	5·57	6·22	59	10·06	6·12	16·18	94
75-76	3·46	10·29	13·75	130	11·54	6·99	18·53	108
76-77	1·15	11·77	12·92	123	13·10	8·92	22·02	127
77-78	1·60	8·91	10·51	100	12·14	4·83	16·97	98
78-79	5·11	7·94	13·05	124	13·35	6·68	20·03	116
79-80	12·82	4·28	17·10	162	12·27	1·56	13·83	80
1880-81	3·20	13·36	16·56	157	13·20	7·01	20·21	117
81-82	...	11·38	11·38	108	14·85	3·44	18·29	106
82-83	2·64	17·16	19·80	188	13·88	5·51	19·39	112
83-84	·33	8·56	8·89	84	13·59	4·39	17·98	104
Mean	2·12	8·43	10·55	100	11·96	5·33	17·29	100

TABLE XIII.—PERCOLATION THROUGH 3 FEET OF SOIL WITH GRASS GROWING ON THE SURFACE; AND EVAPORATION FROM THE SURFACE, BEING THE DIFFERENCE BETWEEN THE PERCOLATION AND THE RAINFALL; AT NASH MILLS, HEMEL HEMPSTEAD, 1ST APRIL, 1842, TO 31ST MARCH, 1884.

Year.	Percolation.				Evaporation.			
	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.		Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.	
	Ins.	Ins.	Ins.	%	Ins.	Ins.	Ins.	%
1842-43	1·30	9·34	10·64	157	10·85	4·12	14·97	73
43-44	·99	8·86	9·85	145	13·05	6·55	19·60	95
44-45	...	7·10	7·10	105	8·07	6·01	14·08	68
45-46	...	9·01	9·01	133	11·57	4·92	16·49	80
46-47	·28	5·84	6·12	90	11·22	7·09	18·31	89
47-48	...	8·94	8·94	132	11·31	6·90	18·21	88
48-49	·70	6·22	6·92	102	12·30	7·27	19·57	95
49-50	...	1·44	1·44	21	13·91	7·14	21·05	102
1850-51	...	8·49	8·49	125	11·82	6·22	18·04	87
51-52	·04	3·66	3·70	55	9·21	7·09	16·30	79
52-53	1·50	10·74	12·24	181	18·47	9·53	28·00	136
53-54	·24	4·22	4·46	66	16·55	5·44	21·99	107
54-55	...	2·45	2·45	36	9·47	6·87	16·34	79
55-56	·19	6·82	7·01	103	12·47	7·66	20·13	98
56-57	2·79	3·73	6·52	96	12·07	8·23	20·30	98
57-58	1·11	5·64	6·75	100	13·00	6·17	19·17	93
58-59	·80	·09	·89	13	11·47	9·55	21·02	102
59-60	...	9·27	9·27	137	18·31	7·22	25·53	124
1860-61	3·16	7·61	10·77	159	17·24	3·95	21·19	103
61-62	1·13	7·42	8·55	126	9·25	5·21	14·46	70
62-63	2·39	3·56	5·95	88	11·98	7·45	19·43	94
63-64	...	3·18	3·18	48	13·40	6·06	19·46	94
64-65	·35	3·42	3·77	56	8·07	7·51	15·58	76
65-66	...	10·47	10·47	155	12·60	9·53	22·13	107
66-67	·03	4·64	4·67	69	15·56	7·96	23·52	114
67-68	·18	2·03	2·21	33	14·19	9·33	23·52	114
68-69	·04	7·64	7·68	113	10·01	9·94	19·95	97
69-70	·02	4·50	4·52	67	12·78	8·83	21·61	105
1870-71	...	2·08	2·08	31	7·59	10·46	18·05	88
71-72	...	4·65	4·65	69	16·09	6·60	22·69	110
72-73	1·00	11·25	12·25	181	13·44	10·30	23·74	115
73-74	...	1·86	1·86	27	11·29	7·05	18·34	89
74-75	·05	4·15	4·20	62	10·66	7·54	18·20	88
75-76	...	6·08	6·08	90	15·00	11·20	26·20	126
76-77	·50	10·13	10·63	157	13·75	10·56	24·31	118
77-78	1·04	4·00	5·04	74	12·70	9·74	22·44	109
78-79	2 16	5·75	7·91	117	16·30	8·87	25·17	122
79-80	6·94	2·79	9·73	144	18·15	3·05	21·20	103
1880-81	...	13·59	13·59	201	16·40	6·78	23·18	112
81-82	...	6·24	6·24	92	14·85	8·58	23·43	114
82-83	·48	11 67	12·15	179	16·04	11·00	27·04	131
83-84	...	4·53	4·53	67	13·92	8·42	22·34	108
Mean	·70	6·07	6·77	100	13·01	7·62	20·63	100

TABLE XIV.—PERCOLATION THROUGH 3 FEET OF SOIL WITH GRASS GROWING ON THE SURFACE; AND EVAPORATION FROM THE SURFACE, BEING THE DIFFERENCE BETWEEN THE PERCOLATION AND THE RAINFALL; AT LEA BRIDGE, 1ST APRIL, 1852, TO 31ST MARCH, 1873.

Year.	Percolation.				Evaporation.			
	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.		Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-March.	
	Ins.	Ins.	Ins.	%	Ins.	Ins.	Ins.	%
1852-53	2·00	8·87	10·87	155	14·50	7·63	22·13	117
53-54	2·00	2·00	4·00	57	15·00	7·50	22·50	119
54-55	...	1·42	1·42	20	9·00	7·60	16·60	88
55-56	·03	5·72	5·75	82	10·66	9·09	19·75	105
56-57	·14	3·59	3·73	53	13·82	6·56	20·38	108
57-58	1·92	5·78	7·70	110	13·46	6·97	20·43	108
58-59	1·40	·90	2·30	33	12·35	7·96	20·31	107
59-60	·60	9·21	9·81	140	14·98	4·89	19·87	105
1860-61	4·23	6·12	10·35	147	15·60	7·65	23 25	123
61-62	·19	6·20	6·39	91	9·32	8·30	17·62	93
62-63	1·65	5·85	7·50	107	11·50	5·00	16 50	87
63-64	...	4·24	4·24	60	10·48	5·71	16·19	86
64-65	·06	6·33	6·39	91	7·65	4·27	11·92	63
65-66	·86	12·44	13·30	190	12·12	5·97	18·09	96
66-67	1·42	7·87	9·29	133	14·33	7·12	21·45	113
67-68	·09	4·60	4·69	67	14·39	6·46	20·85	110
68-69	·04	8·59	8·63	123	7·79	7·45	15·24	81
69-70	·16	5·82	5·98	85	9·59	6·85	16·44	86
1870-71	·05	7·71	7·76	110	6·91	6·33	13·24	70
71-72	·45	6·80	7·25	103	14·53	5·05	19·58	103
72-73	1·06	9·04	10·10	144	13·59	11·29	24·88	132
Mean	·87	6·15	7·02	100	11·98	6·94	18·92	100

TABLE XV.—RAINFALL, AND EVAPORATION FROM THE SURFACE OF WATER, AT LEA BRIDGE, 1ST APRIL, 1860, TO 31ST MARCH, 1873.

Year.	Rainfall.			Evaporation.			
	Summer. Ap.-Sept	Winter. Oct.-Mar.	Year. Ap.-Mar.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-Mar.	
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	%
1860-61	19·83	13·77	33·60	16 83	5·77	22·60	109
61-62	9·51	14·50	24·01	18·52	5·62	24·14	117
62-63	13·15	10·85	24·00	13·52	3·98	17·50	84
63-64	10·48	9·95	20 43	14·85	2·58	17·43	84
64-65	7·71	10·60	18·31	16·21	2 98	19·19	93

	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	%
1865-66	12·98	18·41	31·39	16·85	3·17	20·02	97
66-67	15·75	14·99	30·74	15·25	5·86	21·11	102
67-68	14·48	11·06	25·54	14·35	4·93	19·28	93
68-69	7·83	16·04	23·87	19·08	7·42	26·50	128
69-70	9·75	12·67	22·42	13·87	4·67	18·54	89
1870-71	6·96	14·04	21·00	16·96	4·79	21·75	105
71-72	14·98	11·85	26·83	14·35	4·73	19·08	92
72-73	14·65	20·33	34·98	16·15	6·21	22·36	108
Mean	12·16	13·77	25·93	15·91	4·82	20·73	100

TABLE XVI.—PERCOLATION THROUGH 5 FEET OF SOIL WITH THE SURFACE KEPT FREE FROM VEGETATION; AND EVAPORATION FROM THE SURFACE, BEING THE DIFFERENCE BETWEEN THE PERCOLATION AND THE RAINFALL; AT ROTHAMSTED, HARPENDEN, 1ST APRIL, 1871, TO 31ST MARCH, 1892.

Year.	Percolation.				Evaporation.			
	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-Mar.		Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. April-Mar.	
	Ins.	Ins.	Ins.	%	Ins.	Ins.	Ins.	%
1871-72	3·25	5·60	8·85	64	13·97	5·92	19·89	123
72-73	1·57	11·64	13·21	95	12·56	8·35	20·91	129
73-74	·58	3·16	3·74	27	11·10	6·67	17·77	110
74-75	·79	6·21	7·00	50	12·31	7·19	19·50	120
75-76	4·59	12·97	17·56	126	12·80	6·31	19·11	118
76-77	3·82	15·31	19·13	138	11·10	6·05	17·15	106
77-78	3·06	8·75	11·81	85	11·37	5·17	16·54	102
78-79	5·99	13·25	19·24	139	12·67	3·72	16·39	101
79-80	11·94	3·82	15·76	113	13·81	3·21	17·02	105
1880-81	5·54	15·15	20·69	149	11·52	4·17	15·69	97
81-82	3·03	10·20	13·23	95	10·73	5·86	16·59	102
82-83	3·82	17·09	20·91	150	12·55	4·68	17·23	106
83-84	3·55	8·41	11·96	86	11·09	4·40	15·49	96
84-85	2·59	9·58	12·17	88	8·56	4·53	13·09	81
85-86	4·54	12·57	17·11	123	10·34	2·99	13·33	82
86-87	2·76	11·00	13·76	99	9·82	5·02	14·84	92
87-88	·90	9·02	9·92	71	8·29	2·84	11·13	69
88-89	5·55	8·10	13·65	98	11·01	4·26	15·27	94
89-90	6·77	9·28	16·05	115	12·37	3·55	15·92	98
1890-91	2·94	5·80	8·74	63	10·42	3·19	13·61	84
91-92	3·95	13·50	17·45	126	10·66	3·35	14·01	86
Mean	3·88	10·02	13·90	100	11·38	4·83	16·21	100

SUPPLEMENTARY TABLES.

To Table I.—Mean Rainfall in Hertfordshire.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters. Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	13·86	12·90	26·76	99	1893	12·67	97
93-94	8·36	14·53	22·89	111	94	14·68	112
94-95	13·34	14·13	27·47	108	95	13·86	106
95-96	12·00	13·87	25·87	106	96	14·18	108

To Table II.—Rainfall at Nash Mills, Hemel Hempstead.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	14·25	13·14	27·39	97	1893	12·97	95
93-94	7·44	16·46	23·90	121	94	15·52	114
94-95	14·10	14·68	28·78	108	95	14·76	109
95-96	12·13	13·86	25·99	102	96	15·00	110

To Table III.—Rainfall at Kensworth.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	14·56	12·89	27·45	92	1893	13·50	96
93-94	8·87	14·96	23·83	106	94	15·67	111
94-95	13·58	16·52	30·10	117	95	14·79	105
95-96	14·49	15·75	30·24	112	96	15·74	112

To Table IV.—Rainfall at Berkhamsted.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	14·68	13·56	28·24	90	1893	13·49	90
93-94	7·61	16·12	23·73	108	94	16·08	107
94-95	12·99	15·95	28·94	106	95	15·21	101
95-96	11·97	14·57	26·54	97	96	15·55	104

To Table V.—Rainfall at Gorhambury, St. Albans.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	14·10	13·78	27·88	95	1893	14·00	97
93-94	9·69	17·87	27·56	124	94	17·05	118
94-95	15·99	15·95	31·94	110	95	15·87	110
95-96	12·61	15·34	27·95	106	96	16·39	113

To Table VI.—Rainfall at Rothamsted, Harpenden.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	13·90	13·76	27·66	100	1893	13·20	96
93-94	9·00	16·54	25·54	120	94	15·72	114
94-95	14·08	14·95	29·03	109	95	15·08	109
95-96	12·87	15·46	28·33	112	96	15·65	113

To Table VII.—Rainfall at The Firs, Hitchin.

Year.	Summer. Ap.-Sept.	Winter. Oct.-Mar.	Year. Ap.-Mar.	Winter Ratio.	Mean of each three successive Winters.		
					Ending 31 Mar.	Mean.	Ratio.
	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	13·46	11·30	24·76	94	1893	11·26	94
93-94	7·80	12·35	20·15	103	94	12·97	108
94-95	13·45	12·99	26·44	108	95	12·21	102
95-96	12·99	12·97	25·96	108	96	12·77	106

To Table VIII.—Rainfall at Welwyn.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	13·67	13·09	26·74	98	1893	12·73	95
93-94	8·93	12·95	21·88	97	94	13·83	104
94-95	12·79	13·11	25·90	98	95	13·05	98
95-96	11·39	13·70	25·09	103	96	13·25	99

To Table IX.—Rainfall at Bayfordbury, Hertford.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	12·93	12·41	25·34	97	1893	11·87	92
93-94	7·44	13·15	20·59	102	94	13·47	105
94-95	11·56	12·25	23·81	95	95	12·60	98
95-96	9·65	12·57	22·22	99	96	12·66	99

To Table X.—Rainfall at Much Hadham.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	12·94	13·37	26·31	103	1893	12·77	99
93-94	7·91	13·94	21·05	108	94	14·36	111
94-95	13·55	12·90	26·45	100	95	13·40	104
95-96	10·30	13·11	23·41	101	96	13·32	103

To Table XI.—Rainfall at Royston.

	Ins.	Ins.	Ins.	%		Ins.	%
1892-93	14·11	11·75	25·86	104	1893	10·87	96
93-94	8·92	10·90	19·82	97	94	12·11	108
94-95	11·30	12·02	23·32	107	95	11·56	103
95-96	11·62	11·38	23·00	101	96	11·43	102

VI.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1895.

By Alan F. Crossman, F.L.S.

Read at Watford, 17th March, 1896.

I have not lived in Hertfordshire long enough to know very much about the distribution of the birds of the county; but from what I have already seen, and from studying the former records of the rarer species, I should think that our county, considering its physical features and its position, would afford to the field-naturalist plenty of opportunities for studying the habits of many kinds of birds. There are certainly some birds breeding in Hertfordshire which do not nest in the majority of the English counties, or at any rate in such numbers as they do with us. First among these, comes that splendid bird the great crested grebe. Few counties, with the exception of Norfolk, can claim that this bird nests with them in such numbers as it does with us at the Tring Reservoirs; while it is not everywhere that one can find the pochard, tufted duck, and shoveller breeding.

I have great pleasure in announcing that, owing to the representations of the Hertfordshire Natural History Society, an order has been made by the Home Secretary, under the 'Wild Birds Protection Act, 1894,' adding certain birds to the schedule of the Wild Birds Protection Acts, 1880 and 1881, and also protecting the eggs of certain birds which are mentioned in the order. I sincerely hope that these Acts, with the Order, will be enforced, and that all the members of this Society will do their best to spread a knowledge of them. All game-preservers should forbid their keepers to kill the owls and hawks, as most birds of these species do a great deal of good, in fact very much more good than harm. Farmers also ought to protect these birds, as they are extremely useful in keeping down mice and other small animals, which otherwise would increase in such quantities as to become a regular plague.

Turning now to my proper subject, which is a report on the Birds of Hertfordshire for the year 1895, I have three birds to add to the list. Two of these did not actually occur in 1895, but as they have not yet been recorded in our 'Transactions,' it becomes my duty to mention them in my report. There is another bird which I think should be added to our list; of this I can, however, find no actual record. The bird I am referring to is the great bustard. In the 'Dictionary of Birds,' edited by Professor Newton, under the heading of "Bustard," comes the following sentence: "From other English counties, as Cambridgeshire, Hertfordshire, and Berkshire, it disappeared without note being taken of the event. . . . " In Morris' 'British Birds' it is stated that Ray and Willoughby mentioned Royston Heath as a place frequented by this species. These statements seem to point to the fact that the bustard was formerly resident in Hertfordshire, but there is still no specific mention of the bird having been actually obtained in the county. Very probably, indeed, this is nearly all that will ever now be known about its occurrence here, unless some one seeing this report may call to mind having heard somebody in days gone by speaking about the bird having been obtained or seen in Hertfordshire. Besides these birds I have to mention the occurrence of several others, which, although not new to the list, are only very occasional visitors to our county.

1. White Wagtail (*Motacilla alba*).—This bird does not appear to have been recorded before in Hertfordshire, although most probably it occurs annually. Mr. Rivers first mentioned its occurrence in our county, for in a letter to me he stated that he had seen one of these birds in company with two pied wagtails at Sawbridgeworth, on March 17th last year. On April 6th I saw a bird of this species at Wilstone Reservoir, feeding on some floating masses of reeds which had been washed down by the force of the storms of March. On April 21st Mr. Rivers examined a wagtail's nest in a thick yew hedge, and found that there were twelve eggs in it. Three of these eggs he afterwards sent to me for examination, and one of them is certainly different from the others, though whether it is a white wagtail's egg or not, I do not attempt to say, but it seems extremely probable that such is the case, as Mr. Rivers saw both a white and a pied wagtail about round the nest. During the spring and summer I saw several white wagtails, and I have good reason to believe that the species nested near Berkhamsted and reared its young, inasmuch as I saw some young wagtails about the place where I had continually seen a pair of birds of the white species. Mr. Kearton, in his recent book on 'British Birds' Nests,' remarks of this bird: "Migratory, but little is known of its comings and goings. Although a common bird on the Continent, only a few well-authenticated instances of its breeding in the British Isles are on record, and those in the southern counties of England. It is, however, thought that it may often have been overlooked from the fact that its general appearance and eggs are so similar to those of the pied wagtail to all except the practical and experienced ornithologist." Mr. Saunders, in his 'Manual of British Birds,' says: "This bird occurs all over Europe and Northern Asia, as well as in Asia Minor, Palestine, and Northern Africa. The situations selected for the nest are similar to those chosen by the pied wagtail, while the eggs, though sometimes of a rather bluer grey with bolder ashy markings, frequently cannot be distinguished from those of that bird, and their average measurements are identical." The bird practically takes the place of the pied wagtail on the Continent.

2. Two-barred Crossbill (*Loxia bifasciata*).—In the 'Zoologist' for 1893, there is a note from Mr. H. Somers Rivers of the supposed occurrence of the American white-winged crossbill (*L. leucoptera*) in Hertfordshire. I wrote to Mr. Rivers for

particulars, which he gave me, and he also most kindly lent me the bird for inspection. I showed it to Mr. Hartert, Curator of the Tring Museum, and he, after referring to the late Mr. Seebohm's book on 'British Birds,' decided that it must be *L. bifasciata*, that is the two-barred crossbill, and not the American species. This bird was shot by Mr. Rivers on January 11th, 1890, in a larch wood at Tharbies, near Sawbridgeworth. It was swinging underneath a branch at the top of a tree, and was alone at the time. From its general plumage, which was a dull green, it appears to be a female, but unfortunately the sex was not ascertained by dissection. According to Saunders' 'Manual of British Birds,' "this bird inhabits the coniferous forests of Northern Russia and Siberia, as far as the Pacific; wandering in autumn and winter to South Sweden, Denmark, Heligoland, North Germany, Holland, Belgium, the North of France, North Italy, Austria, and Poland." In the British Isles the first recorded specimen was obtained near Belfast in Ireland, in 1802, since which time several specimens have been obtained in the United Kingdom. The American form is considered by many authorities to be only entitled to subspecific distinction.

3. Baillon's Crake (*Porzana Bailloni*).—Mr. W. H. M. Ayres, in a note to the 'Zoologist' for 1892, recorded the occurrence of this bird in Hertfordshire. The specimen in question was shot on October 24th, 1891, in the marshes near Cheshunt, which were then in flood. The bird was in good plumage, but very thin. It was sent to Mr. Rowland Ward for preservation, and was identified by him. In the fourth edition of Yarrell's 'British Birds,' mention is made that this bird appears to be somewhat irregularly distributed on the Continent, but this statement is probably owing to insufficient information. The bird seems to have nested on one or two occasions in England, but even the records of its occurrence are far from numerous.

Miscellaneous Notes.

Ring-Ouzel (*Turdus torquatus*).—On April 7th I saw one of these birds on Berkhamsted Common. It settled on the top of a tree, where I had a good view of it, and I watched it for some time. Mr. Rivers saw one at Sawbridgeworth on April 9th. Most of the former recorded occurrences of this species in Hertfordshire have been in the autumn.

Wood-Wren (*Phylloscopus sibilatrix*).—This bird, which is plentiful in most of the woods in the neighbourhood of Berkhamsted, arrived there very late last spring.

Grasshopper-Warbler (*Locustella nævia*).—This bird occurs plentifully on Berkhamsted Common. When singing it keeps its bill open all the time, showing up very conspicuously the bright fleshy yellow colour of the inside of its mouth.

Great Grey Shrike (*Lanius excubitor*).—In Mr. Rivers' note to the 'Zoologist' about the two-barred crossbill, he also mentions an example of the great grey shrike, which was shot on December

5th, 1890, on Roderick's Farm, near Latton Mill, about 100 yards from the Essex border, while it was sitting on the top of a little oak-tree in a hedgerow. It was a young male. The bird has frequently occurred in Hertfordshire.

HAWFINCH (*Coccothraustes vulgaris*).—This bird has been recorded fairly often in Hertfordshire, but does not appear to have been considered a regular resident. My experience in 1895 makes me think that at any rate in the district around Berkhamsted the hawfinch is not only resident, but is even plentiful. In March I saw several of these birds, and eventually on March 27th I saw a flock of at least fifty hawfinches on the edge of Berkhamsted Common, near the rifle-butts. They utter a note very like the "tit, tit" of a robin, but of course a good deal louder, and, when flying, the white on their wings and tail shows very distinctly. After that date I continually saw hawfinches when I went to likely places, and on May 19th I found a nest with four eggs. It was placed on the branch of an old thorn-tree, and was made of sticks and lichens, with a lining of fine roots and a little grass. In my opinion the hawfinch is a much commoner bird than it really appears to be, as it is often very hard to see on account of its shyness.

GOLDFINCH (*Carduelis elegans*).—I only saw a goldfinch on three occasions in 1895, in the neighbourhood of Berkhamsted. Mr. Rivers mentions its occurrence at Sawbridgeworth in the spring, and I saw some there in August.

SISKIN (*Carduelis spinus*).—Mr. Rivers, in a letter, told me of the occurrence at Sawbridgeworth, about March 12th, of three of these birds, which stayed there for some days. There were two males and a female, and the former sang a good deal. They were very tame, allowing him to go within a few feet of them. Mr. Littleboy mentioned the occurrence of the siskin several times, always in the winter, but since his death it does not seem to have been recorded in the Society's 'Transactions.'

BRAMBLING (*Fringilla montifringilla*).—This bird occurred in vast numbers towards the end of March in the neighbourhood of Berkhamsted. When flying, bramblings look very like chaffinches, but one of their chief distinctions is the white above the tail. I saw many which were assuming the breeding-plumage, their black heads showing up conspicuously. They were usually feeding on the ground under beech-trees, and were always restless, continually fluttering off the ground and settling again. Their principal note seems a long-drawn "chee." On March 20th I noticed one of these birds with a white head. The latest date on which I observed the brambling was April 6th, when I saw a single one at Pendley Manor. "This bird has," according to Mr. Saunders, "very rarely been found nesting in the British Isles, usually retiring further north to breed; but the late Mr. T. H. Booth stated that in June, 1866, while fishing in the river Lyon, in Perthshire, he had occasion to climb a beech-tree to disentangle his line, when he disturbed a female brambling from her nest with three eggs."

Lesser Redpoll (*Linota rufescens*).—On February 10th, 1895, I saw one of these birds feeding on the bank of the canal between Berkhamsted and Boxmoor. It was very tame, and was nearly caught several times. In fact, once I threw my cap over it, but the cap fell over, and the bird escaped. There do not seem to be many records of the lesser redpoll having been observed in Hertfordshire, but it probably occurs frequently, although seldom recorded.

Crossbill (*Loxia curvirostra*).—Mr. Lewis, in his last report, mentioned the occurrence of the crossbill near Berkhamsted and at Tring in the early part of 1895. They were again seen at the former place in March and April. On March 3rd I saw a single bird on the edge of Northchurch Common. On March 10th I heard some in Ockridge Wood, and on March 17th I observed what was evidently a pair at the same place, when I heard the male bird singing. On April 7th I noticed a party of these birds in the same wood feeding on the buds and cones of larch-trees. Some of them uttered a note very like a loud chirp of a cock sparrow. I think it quite possible that some of these birds strayed to breed in Ockridge Wood, although of course their staying so late in the year is no proof of their doing so. The crossbill has on numerous occasions bred in the southern portions of Great Britain, while in some of the more northern parts it breeds plentifully. In the fourth edition of Yarrell, Hertfordshire is mentioned as being one of the counties in which this bird has nested, but there are no details.

Great Spotted Woodpecker (*Dendrocopus major*).—This bird is fairly plentiful in the neighbourhood of Berkhamsted. It also occurs near Sawbridgeworth, for Mr. Rivers saw one there in December.

Lesser Spotted Woodpecker (*Dendrocopus minor*).—This bird is found in some numbers near Berkhamsted, especially in Ashridge Park. Mr. Vaughan Roberts informs me also that it is not uncommon near Watford. Its flight is rather slow, and very undulating.

Tawny Owl (*Syrnium aluco*).—On May 18th I saw a pair of these birds flying in broad daylight in Ashridge Park.

Peregrine Falcon (*Falco peregrinus*).—On March 16th, 1895, when coming home from Tring, I was lucky enough to see a peregrine falcon at Pendley Manor. It made a stoop at a partridge, which, however, it did not succeed in striking. From its size I should say it was a female. In a letter to me Mr. Sainsbury Verey sent the following note: "Mr. Griffin, taxidermist, Rickmansworth, has obligingly shown me a male specimen of *Falco peregrinus*, captured in August, 1895, at Croxley Green." The peregrine falcon has occurred on several occasions in Hertfordshire, and it is a great pity that it should nearly always get shot. It is a bird which might be said to have the highest sporting instincts, as it seldom, if ever, condescends to kill a bird except in full flight.

Cormorant (*Phalacrocorax carbo*).—On October 31st, James Street, the keeper at Tring Reservoirs, saw a bird of this species there. The cormorant has been recorded five times in Hertfordshire, the last time being in October, 1888, when one was seen at the Reservoirs.

COMMON BITTERN (*Botaurus stellaris*).—Mr. Sainsbury Verey has informed me that Mr. Griffin showed him a specimen of the bittern which was shot some thirty years ago in a field immediately opposite his place of business at Rickmansworth. Several occurrences of this bird have been recorded in this county, and in 1849 a nest with four eggs was found at one of the Tring Reservoirs. This is a bird that has become a thing of the past so far as breeding in this country is concerned, and unfortunately the words of the poet who said—

> "No more the screaming bittern, bellowing harsh,
> To its dark bottom shakes the shuddering marsh,"

are only too true. Every year we hear of the slaughter of some of these fine birds; and no doubt if such useless slaughter ceased, we should sometimes have the bittern nesting again in parts of the country suited to it, although many of its former haunts have disappeared before agriculture.

WILD GEESE.—On March 11th Mr. Arthur W. Dickinson saw nearly a hundred wild geese passing eastwards over New Farm, St. Albans, but did not distinguish the species. On November 30th my father saw fifteen wild geese pass over Berkhamsted, but in this case also the species was not distinguished.

SHOVELLER (*Spatula clypeata*).—This handsome duck bred near one of the Reservoirs in 1895. The birds first appeared there on April 6th, and Street found a nest with eggs in a field about two miles from the Reservoirs on May 13th. The young birds were hatched a few days later.

WIGEON (*Mareca penelope*).—This bird occurred in small numbers at the Tring Reservoirs during 1895. One of its notes is a shrill "whew," and, when it is flying, its wings look much more pointed than those of the common wild duck.

POCHARD (*Fuligula ferina*).—This bird was plentiful at the Reservoirs in the early part of the year. Pochards swim very low in the water, and when flying look much shorter in the neck and body than the mallard. They utter a hoarse note, something like that of a carrion-crow, but not nearly so loud nor so prolonged. The female, which is of a dark dusky-grey colour, is very dull in comparison with the male. The latter has a chestnut-coloured head, and a light grey body, which, in the distance, with the sun shining on it, looks nearly white. The first nests were found about May 11th. The pochard lays from seven to fourteen eggs, and the nests, which are usually made of grass and down, are placed amongst the undergrowth by the side of the water. Young pochards have a light patch by the eye, instead of a light eyestreak as young wild ducks have.

TUFTED DUCK (*Fuligula cristata*).—This bird also occurs at the Tring Reservoirs, but not so plentifully as the pochard. These birds nest much later than the last-mentioned duck, laying from eight to twelve eggs. The nest is usually made of grass or sedge and down, and is placed amongst rushes or sedge, most often near the edge of the water.

Goosander (*Mergus merganser*).—On November 25th Street saw two of these birds at the Reservoirs. Two were also shot at the Reservoirs in February, 1885.

Ring-Dove (*Columba palumbus*).—This bird was remarkably plentiful during the winter of 1894–5, vast flocks being seen in the neighbourhood of Berkhamsted and Watford.

Ringed Plover (*Ægialitis hiaticula*).—On August 7th Street saw a ringed plover at the Reservoirs, and on August 30th his son saw several at Wilstone Reservoir. On November 7th I saw one of these birds feeding on the mud at Startop's End Reservoir. In Mr. Littleboy's report for 1887, he mentions that Street thought that this bird bred at the Reservoirs, but I think that possibly this is a mistake, as there does not seem to be a suitable place for it to nest there.

Dunlin (*Tringa alpina*).—On August 31st I saw four of these birds feeding round the Little Tring Reservoir. One of them still retained some of the black feathers of the breeding plumage on the breast. The bird probably occurs annually at the Reservoirs, although not always reported.

Ruff (*Machetes pugnax*).—On August 17th I saw two of these birds at Little Tring Reservoir. By the buff tinge of the plumage on the back, they were probably young birds. When on the wing they flew rather slowly. I saw one of them swimming. Street shot one of these a day or two after I had seen them. This bird has been recorded on two other occasions in Hertfordshire, both at the Reservoirs, namely, in 1884 and 1886; and on the latter occasion two males were procured at a shot. The ruff used formerly to breed in many of the marshy districts of England, but drainage, with other causes, has induced them to become only visitors on the spring and autumn migrations, although possibly a few pairs may still rear their broods in this country.

Green Sandpiper (*Totanus ochropus*).—On the same date as I saw the ruffs, namely, August 17th, I also observed a green sandpiper. It appeared to me to be rather larger than the common species, and also darker in colour, and it did not fly so erratically as that bird. This bird is mentioned in Mr. Littleboy's Register as being a regular spring visitant near Ickleford, and in the same book there are several other records of its occurrence in Hertfordshire.

Common Redshank (*Totanus calidris*).—On October 10th Street saw some redshanks at the Reservoirs. This bird has been obtained three times before in Hertfordshire, the last occasion being in June, 1891, when one was picked up on the Midland Railway between St. Albans and Radlett.

Greenshank (*Totanus canescens*).—On April 6th I observed one of these birds on Little Tring Reservoir. It got up as we approached, and flew across the Reservoir, uttering a loud melodious whistle.

The two narrow light bars on the wings of the bird showed up very plainly while it was flying. Street told me that it usually occurred at the Reservoirs during the spring and autumn migration. On April 7th, and again on April 19th, Street saw one of these birds. The greenshank has been recorded on two former occasions, namely, in 1880 near Watford, and in 1885 at the Reservoirs, when two were shot.

Curlew (*Numenius arquatus*).—One of these birds was seen at the Reservoirs on April 29th, and on August 16th Street saw fifteen of them at Wilstone Reservoir. On December 21st he observed sixteen of these birds, which is the largest number he had ever seen together at the Reservoirs. The curlew has been recorded on several occasions in Hertfordshire.

Black Tern (*Hydrochelidon nigra*).—One of these birds was seen at the Reservoirs by Street on April 17th, and on the 20th I saw one at Marsworth Reservoir. On May 6th Street observed a large party of common terns at Wilstone Reservoir, and amongst them were a few black terns. On August 7th he saw three more, and on August 17th I noticed another. Several of these birds have been obtained in Hertfordshire, and it was thought at one time that some pairs had stayed to nest at the Reservoirs, but the fact has never been proved. This is another bird which formerly bred commonly in the Fen districts, but which has now been banished chiefly by drainage.

Common Tern (*Sterna fluviatilis*).—The common tern occurred on several occasions in 1895 at the Reservoirs, and on one occasion (May 6th) Street saw nearly fifty of them in company with some black terns. This bird, which occurs nearly every year at Tring, has been seen on several occasions at Elstree Reservoir, and in 1881 some were killed in the neighbourhood of Royston.

Lesser Tern (*Sterna minuta*).—On October 10th Street saw three of these birds at the Reservoirs. In 1882 some of these birds were obtained at Royston; while in April, 1886, two were obtained at the Reservoirs by the Hon. Walter Rothschild, and one was also obtained there in 1885.

Common Gull (*Larus canus*).—On August 17th I observed what I took to be a bird of this species at the Reservoirs, and on November 25th Street saw several of them there. It has occurred frequently in Hertfordshire.

Black-backed Gulls.—On June 14th, and again on November 3rd and December 17th, Street saw some black-backed gulls at the Reservoirs, but he did not mention to what species they belonged. The great black-backed gull has occurred on a few occasions in this county, but the lesser black-backed gull has only been procured once.

Kittiwake (*Rissa tridactyla*).—On May 19th I saw a kittiwake flying over Berkhamsted Common. In January, 1885, two were shot at the Reservoirs, and in February in the same year one was picked up at London Colney, near St. Albans. These are the only recorded occurrences in Hertfordshire.

Little Auk (*Mergulus alle*).—A bird of this species was picked up at Sarratt on or about January of last year, and was to have been reported in the 'Field'; but at that time these birds were obtained in such numbers in various parts of the country, that the report was crowded out, and the bird was not recorded in that paper. The little auk has occurred on five former occasions in Hertfordshire, the last being on November 22nd, 1893, when one was picked up between Litlington and Royston.

Great Crested Grebe (*Podiceps cristatus*).—This magnificent bird, now so scarce in most parts of England, is, I am pleased to say, comparatively plentiful at the Tring Reservoirs, where I should think there were from forty to fifty pairs in 1895. They arrived there about the middle of March, coming in the night. I heard several of them utter a kind of croak when I first saw them on March 16th. When they begin building, they fly about a good deal, and are at that time rather noisy. They usually fly very noiselessly, and when flying show a large patch of white on their wings. I examined some of their nests one day, all of which were made of decayed water-weeds, built on a foundation of dead reed-stems, and were placed in the water among the reeds. In all the nests the eggs were either partially or totally covered up with weeds, and the largest number that I found in one nest was four. These birds sometimes catch fish so large that they can scarcely swallow them. Young birds appear to be of a greyish colour striped with brown. The grebes left the Reservoirs about November 6th.

Little Grebe (*Podicipes fluviatilis*).—This bird seems very plentiful on the rivers Gade and Colne. They make a noise very like the laughing note of a kestrel. In the breeding plumage, they have a very bright chestnut-coloured throat. I examined several of their nests. They were always built of decayed water-plants, and were, with one exception, floating nests, that is to say, nests built on the water, but anchored by some weeds. The exception was placed on the bank by the side of the water, which is a very unusual place for this bird to build in. These birds usually cover up their eggs when they leave their nest, using their beak to put the weeds over; these weeds used for covering up the eggs were always fresh and green. They sit very high on the nest, and when driven off quickly return, using their beak to uncover the eggs, and not their feet as one might suppose; when they have returned to their nest they lay the weeds from off the eggs all round the nest, so that they can easily reach them if again disturbed. The largest number of eggs I have found in one nest was five. This bird is, curiously enough, far from plentiful at the Reservoirs.

Arrival and Departure of Migrants.

Summer Migrants.

Species.	Locality.	Date.	Observer.
Ring-Ouzel (*Turdus torquatus*)	Berkhamsted	April 7	A. F. C.
	Sawbridgeworth	,, 12	H. S. Rivers.
Wheatear (*Saxicola œnanthe*)	Tring Reservoirs	Mar. 27	J. Street.
	Sawbridgeworth	April 2	H. S. Rivers.
Whinchat (*Pratincola rubetra*)	Berkhamsted	,, 21	A. F. C.
	Bushey	,, 22	A. F. C.
Stonechat (*P. rubicola*)	Berkhamsted	Mar. 27	A. F. C.
Redstart (*Ruticilla phœnicurus*)	Berkhamsted	April 7	A. F. C.
	Sawbridgeworth	,, 15	H. S. Rivers.
Nightingale (*Daulias luscinia*)	Berkhamsted	,, 12	Mrs. E. Mawley.
	Near St. Albans	,, 17	Arthur Lewis.
	Watford	,, 17	Mrs. Bishop.
	Radlett	,, 17	Miss Lubbock.
	Hatfield	,, 17	J. Brown.
	Hitchin	,, 17	J. E. Little.
	Harpenden	,, 18	J. J. Willis.
	Wormley	,, 18	Miss Warner.
	Sawbridgeworth	,, 18	T. J. Mann.
	Near Tring	,, 19	J. Street.
	Ashwell	,, 19	H. G. Fordham.
	St. Albans	,, 20	Henry Lewis.
Greater Whitethroat (*Silvia cineria*)	Sawbridgeworth	,, 19	H. S. Rivers.
	St. Albans	,, 20	Henry Lewis.
	Berkhamsted	,, 21	A. F. C.
Lesser Whitethroat (*S. curruca*)	Tring Reservoirs	,, 19	J. Street.
	Sawbridgeworth	,, 24	H. S. Rivers.
Blackcap (*S. atricapilla*)	Sawbridgeworth	,, 17	H. S. Rivers.
	Berkhamsted	,, 20	A. F. C.
Garden-Warbler (*S. hortensis*)	Berkhamsted	,, 27	A. F. C.
Chiffchaff (*Phylloscopus rufus*)	Sopwell, St. Albans	Mar. 18	Henry Lewis.
	Radlett	,, 30	Miss Lubbock.
	Berkhamsted	,, 31	A. F. C.
	Sawbridgeworth	April 1	H. S. Rivers.
	New Farm, St. Albans	,, 2	A. W. Dickinson.
	Tring Reservoirs	,, 13	J. Street.
Willow-Warbler (*P. trochilus*)	Sawbridgeworth	,, 10	H. S. Rivers.
	Radlett	,, 13	Miss Lubbock.
	St. Albans	,, 20	Henry Lewis.
Wood-Warbler (*P. sibilatrix*)	Aldbury, Tring	May 12	A. F. C.
Reed-Warbler (*Acrocephalus streperus*)	Tring Reservoirs	April 18	J. Street.
Sedge-Warbler (*A. phragmitis*)	Sawbridgeworth	,, 29	H. S. Rivers.
	St. Albans	May 8	Henry Lewis.
	Great Gaddesden	,, 8	A. F. C.
Grasshopper-Warbler (*Locustella nævia*)	Berkhamsted	April 21	A. F. C.
	Bushey	,, 22	A. F. C.
Yellow Wagtail (*Motacilla Raii*)	Tring Reservoirs	,, 13	J. Street.
	Berkhamsted	,, 19	A. F. C.

Species.	Locality.	Date.	Observer.
Tree-Pipit (*Anthus trivialis*)	St. Albans	April 20	Henry Lewis.
Red-backed Shrike (*Lanius collurio*)	Tring Reservoirs	May 12	J. Street.
	Berkhamsted	,, 15	A. F. C.
	Sawbridgeworth	,, 16	H. S. Rivers.
Spotted Flycatcher (*Muscicapa grisola*)	Hitchin	,, 4	J. E. Little.
	Sawbridgeworth	,, 7	H. S. Rivers.
	Berkhamsted	,, 9	Mrs. E. Mawley.
	Radlett	,, 19	Miss Lubbock.
	Ashwell	,, 21	H. G. Fordham.
	Ashwell (last seen)	Sept. 3	H. G. Fordham.
	Wormley	May 25	Miss Warner.
	Watford	,, 28	Mrs. Bishop.
	St. Albans	,, 30	Miss Moore Smith.
Swallow (*Hirundo rustica*)	Berkhamsted	Mar. 28	Mrs. E. Mawley.
	,, (last seen)	Oct. 14	A. F. C.
	Tring Reservoirs	April 7	J. Street.
	Beaumonts Farm, St. Albans	,, 11	John Boyes.
	Ashwell	,, 11	H. G. Fordham.
	Ashwell (last seen)	Oct. 16	H. G. Fordham.
	Wormley	April 13	Miss Warner.
	Wormley (last seen)	Oct. 20	Miss Warner.
	New Farm, St. Albans	April 14	A. W. Dickinson.
	Watford	,, 15	Mrs. Bishop.
	Watford (last seen)	Oct. 9	Mrs. Bishop.
	Harpenden	April 16	J. J. Willis.
	Radlett	,, 17	Miss Lubbock.
	Near St. Albans	,, 17	Arthur Lewis.
	Sawbridgeworth	,, 17	T. J. Mann.
	St. Albans	,, 20	Henry Lewis.
	Hatfield	,, 21	J. Brown.
House-Martin (*Chelidon urbica*)	Tring Reservoirs	,, 7	J. Street.
Sand-Martin (*Cotile riparia*)	Tring Reservoirs	,, 7	J. Street.
	Sawbridgeworth	,, 20	H. S. Rivers.
Swift (*Cypselus apus*)	Sawbridgeworth	,, 25	H. S. Rivers.
	Tring Reservoirs	,, 29	J. Street.
	St. Albans	May 6	Henry Lewis.
	Berkhamsted	,, 9	A. F. C.
Wryneck (*Iÿnx torquilla*)	Radlett	April 11	Miss Lubbock.
Cuckoo (*Cuculus canorus*)	New Farm, St. Albans	,, 7	A. W. Dickinson.
	Harpenden	,, 8	J. J. Willis.
	The Grange, St. Albans	,, 10	Mrs. Hopkinson.
	Hatfield	,, 10	J. Brown.
	Berkhamsted	,, 11	Mrs. E. Mawley.
	Beaumonts Farm, St. Albans	,, 11	John Boyes.
	Watford	,, 12	Mrs. Bishop.
	Hitchin	,, 14	J. E. Little.
	Sawbridgeworth	,, 14	H. S. Rivers.
	Radlett	,, 17	Miss Lubbock.
	Wormley	,, 17	Miss L. Warner.
	Tring Reservoirs	,, 18	J. Street.

Species.	Locality.	Date.	Observer.
Turtle-Dove	Berkhamsted	April 27	A. F. C.
(*Turtur communis*)	Ashwell	May 2	H. G. Fordham.
	Ashwell (last seen)	Sept. 10	H. G. Fordham.
	Tring Reservoirs	May 4	J. Street.
	Sawbridgeworth	,, 11	H. S. Rivers.
Landrail	Tring Reservoirs	April 20	J. Street.
(*Crex pratensis*)	Berkhamsted	,, 21	A. F. C.
Common Sandpiper	Tring Reservoirs	,, 19	J. Street.
(*Totanus hypoleucus*)			
	Winter Migrants.		
Redwing	Berkhamsted	Oct. 27	A. F. C.
(*Turdus iliacus*)	Sawbridgeworth	,, 27	H. S. Rivers.
Fieldfare	Tring	Nov. 7	A. F. C.
(*T. pilaris*)	Sawbridgeworth (last seen)	April 2	H. S. Rivers.
	(first seen)	Nov. 9	H. S. Rivers.
	Ashwell	,, 11	H. G. Fordham.
	Berkhamsted (last seen)	April 27	A. F. C.
Grey Wagtail	Berkhamsted	Oct. 27	A. F. C.
(*Motacilla melanope*)			
Hooded Crow	Ashridge Park, Tring	,, 27	A. F. C.
(*Corvus cornix*)	Ashwell	Nov. 12	H. G. Fordham.
	Sawbridgeworth	,, 16	H. S. Rivers.
	Berkhamsted (last seen)	April 6	A. F. C.

I should like to mention that it is not only notes upon rare birds that I wish to receive, but also notes on the distribution and habits generally of any birds which occur in Hertfordshire. Our Society does not want to be merely the means of recording the slaughter of rarities, but to be of some assistance in teaching what is the distribution of all birds within the limits of the county, thus contributing to the general knowledge of the birds of Great Britain. This can only be done by means of accurate observers in different parts of the county. With regard to recording all birds, accuracy is strictly necessary. In the case of a rare bird, which has been shot, it should, if possible, be seen before it is skinned, and in that state submitted to some competent authority; but if that cannot be done, it should be produced after it has been preserved, and the person who procured it should be thoroughly cross-examined as to the occurrence. When a bird has only been seen and not shot, such an accurate description should be given by the person who saw it as should easily enable a practical ornithologist to recognize it from such description.

In conclusion, let me thank all those who have been kind enough to send me notes for this paper. I hope they will continue to do so, and will also do what they can to get others to do the same, so that we may hope in time to attain to a good knowledge of the birds of Hertfordshire.

VII.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, DURING THE YEAR 1895.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 21st April, 1896.

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. 86, 87) give the monthly means, etc., of the daily observations in 1895, and the following is the usual summary for the seasons:—

Means for the Seasons from Dec. 1894 to Nov. 1895.

Seasons, 1894-95.	Pressure.	Temperature.		Humidity.	Cloud.	Force of Wind.	Rainfall.	
		Mean.	Daily Range.				Total.	Days.
	ins.	°	°	%	0-10	0-12	ins.	
Winter	29·965	33·4	10·4	84	7·3	1·7	4·77	48
Spring	29·935	47·6	17·2	81	6·3	1·7	3·50	35
Summer.....	29·977	60·4	17·9	72	5·8	1·6	9·46	38
Autumn.....	29·984	50·6	15·4	86	6·0	1·5	7·82	40

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 1895 from Means of 1877-86 at Watford.

Months.	Pressure.	Temperature.		Humidity.	Cloud.	Force of Wind.	Rainfall.	
		Mean.	Daily Range.				Total.	Days.
	in.	°	°	%	0-10	0-12	in.	
January.....	—·302	—5·0	—0·4	=	+1·0	=	—0·09	+ 7
February	+·163	—13·2	+1·9	—16	—1·4	—·3	—2·41	—12
March	—·212	—1·2	+0·2	+ 6	+0·9	—·2	+0·02	+ 5
April	+·052	=	—0·6	+ 6	+0·3	—·4	—1·06	— 2
May	+·147	+2·3	+2·6	=	—1·6	—·3	—1·91	—10
June	+·130	+1·4	+3·2	— 6	—1·4	—·1	—2·47	— 8
July	—·055	—1·0	—0·8	— 1	+0·2	+·2	+2·42	— 1
August	+·004	+0·2	—0·2	=	—1·2	—·2	+1·50	+ 4
September	+·199	+3·5	+5·2	— 2	—2·7	—·4	—1·89	— 9
October	—·060	—3·5	—0·5	— 2	+0·1	—·3	—0·45	— 2
November	+·003	+2·0	—0·4	+ 2	+1·3	=	+1·47	+ 3
December	—·140	+0·9	+0·3	— 1	—0·6	+·1	—0·49	+ 2
Year	—·005	—1·0	+0·8	— 1	—0·4	—·2	—5·36	—23

Results of Meteorological Observations taken at The Grange, St. Albans, in 1895.

Months.	Pressure of the Atmosphere.	Temperature of the Air.										Humidity of the Air.			
		9 a.m.	Means of		Adopted Mean.	Mean Daily Range.	Absolute Min. and Max.				Absolute Range.	Temperature of		Dryness.	Relative Humidity.
			Min.	Max.			Min.	Date.	Max.	Date.		Evaporation.	Dew-point.		
	ins.	°	°	°	°	°	°		°		°	°	°	°	%
January	29·727	31·6	27·8	36·8	32·0	9·0	15·6	27th	50·0	20th	34·4	30·9	29·2	2·4	90
February	30·122	26 6	22·6	34·8	28·0	12·2	10·1	7th	44·8	23rd	34·7	25·4	19·5	7·1	73
March	29·764	39·9	34·6	49·3	41·2	15·0	23·9	3rd	58·0	15th	34·1	38·5	36·8	3·1	88
April	29·928	46·1	39·6	55·4	47·0	15·8	30·5	14th	64·8	17th	34·3	43·7	40 9	5·2	82
May	30·112	54·4	44·2	64·9	54·5	20·7	35·0	17th	82·3	30th	47·3	50·0	45·7	8·7	72
June	30·099	59·9	48·6	69·9	59·5	21·3	38·4	13th	80·5	9th	48·1	54·1	49 0	10·9	67
July	29·897	60·2	52·6	69·0	60·6	16·4	46·1	7th	80·0	8th	33·9	55·6	51·6	8·6	73
August	29·935	61·2	53·1	69·2	61·2	16·1	44·9	25th	79·0	22nd	34·1	57·3	53·9	7·3	77
September	30·170	59·9	50·8	72·3	61·0	21·5	42·2	14th	81·9	27th	39·7	56·8	54·1	5·8	81
October	29·868	44·8	39·2	52·2	45·4	13·0	26·2	24th	71·8	1st	45·6	42·9	40·7	4·1	85
November	29·915	45·0	39·9	51·5	45·4	11·6	30·7	18th	62·5	16th	31·8	43·9	42·6	2·4	91
December	29·826	38·2	33·1	43·5	38·2	10·4	23·8	11th	54·6	5th	30·8	37·0	35·3	2·9	89
Year	29·947	47·3	40·5	55·7	47·8	15·2	10·1	Feb.	82·3	May	72·2	44·7	41·7	5·6	81

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, IN 1895—*(continued)*.

Months.	Rainfall.					Cloud.			Wind.										
	Total Fall.	Max. fall in 24 hours.		No. of days of		Mean Amount, 0-10.	No. of days of		Mean Force, 0–12.	Number of days of									
	Ins.	Ins.	Date.	Rain or Snow.	Snow only.		Clear Sky.	Over-cast.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	2·50	·76	19th	24	17	8·3	1	18	1·7	7	1	2	3	2	4	3	7	2
February	·18	·09	1st	5	5	6·2	7	12	1·4	7	6	3	0	0	1	2	5	4
March	1·68	·36	26th	17	5	7·2	4	14	1·8	2	1	1	2	6	7	7	4	1
April	1·32	·41	25th	13	1	6·8	6	14	1·7	3	6	2	3	4	5	3	1	3
May	·50	·20	23rd	5	1	4·8	11	7	1·6	5	7	5	4	0	0	1	5	4
June	·39	·12	11th	6	0	4·9	6	7	1·5	7	2	1	1	3	4	5	3	4
July	4·95	1·25	18th	14	0	6·7	5	11	1·7	2	1	0	3	4	9	7	3	2
August	4·12	1·08	13th	18	0	5·7	3	7	1·6	0	1	2	3	7	8	9	1	0
September	·72	·66	6th	4	0	3·7	12	4	1·3	1	3	5	3	2	4	6	1	5
October	2·61	·64	5th	15	0	6·6	6	16	1·5	4	2	3	3	3	4	7	3	2
November	4·49	·65	15th	21	1	7·8	3	17	1·8	2	3	5	3	4	3	5	1	4
December	2·14	·40	14, 24	19	6	6·7	3	15	1·7	2	3	6	2	3	3	8	2	3
Year	25·60	1·25	July	161	36	6·3	67	142	1·6	42	36	35	30	38	52	63	36	34

The year 1895 was cold on the whole, but persistently warm throughout the summer, the defect in temperature being almost entirely due to the very cold January and excessively cold February; October, also, was a very cold month, while September was very warm. The mean daily range of temperature was greater than usual, chiefly owing to the high day temperatures in September, and, to a less degree, in June. The mean pressure of the atmosphere was about the average of the ten years 1877–86 at Watford The lowest pressure recorded at 9 a m. was 28·862 ins. on 28th March, and the highest was 30·624 ins. on 2nd May, giving a range of 1·762 in. The rainfall was much below the average of the ten years 1877–86, and a little below a long-period average. The number of wet days was much less than usual. February, May, June, and September were very dry months; July, August, and November were very wet. While the humidity of the air was about the average throughout the year, it was very unequally distributed in the months, February being excessively dry, and July also very dry, while in March and April the air was very moist. The prevailing direction of the wind was westerly. The most memorable feature of the year will be the ten weeks' frost with which it commenced; but more abnormal even than this was the heat of September.

In the winter of 1894–95 (December to February) the mean pressure of the atmosphere was a little below the average, the mean temperature was excessively low, with about an average mean daily range, the air was very dry, the sky of average brightness, and the rainfall very small, but on about the usual number of days. A mild and rather wet December was followed by a cold and wet January, and on the 26th of that month a very cold period set in, continuing throughout the greater part of February, the persistence of the cold weather throughout the greater part of January and February being the most remarkable feature of the winter. Probably in no previous winter has the water-supply been so much interfered with owing to burst service-pipes.

In the spring (March to May) the mean pressure of the atmosphere was about the average, the mean temperature was rather high, with a considerable mean daily range, the air was humid, the sky of average brightness, and the rainfall very small, on a small number of days. The high mean temperature was due to the warmth of the days, the nights not being warmer than usual. On the 30th of May the high maximum of 82°·3 was reached.

In the summer (June to August) the mean pressure of the atmosphere was rather high, the mean temperature was about the average, with a considerable mean daily range, the air was rather dry, the sky very bright, and the rainfall very heavy, but on less than the usual number of days. The average daily rainfall during the last half of the summer was ten times as great as it was during the first half, and seven and a half times as great as it was during the long dry period which lasted from the latter part of the winter to the middle of the summer.

In the autumn (September to November) the mean pressure of the atmosphere was rather high, the mean temperature was high, with a considerable mean daily range, the air was of average humidity, the sky rather bright, and the rainfall rather heavy, but on less than the usual number of days. The high mean temperature of the autumn is due to September being unprecedentedly warm. October and November had identically the same mean temperature, November being about as much warmer than the average as October was colder.

The difference between these seasons and the means of the seasons for 1877–86 at Watford, is shown in the following table. It should be pointed out that the comparison of the rainfall is with an exceptionally wet series of years.

DIFFERENCE IN 1894–95 FROM MEANS OF 1877–86 AT WATFORD.

Seasons, 1894–95.	Pressure.	Temperature. Mean.	Temperature. Daily Range.	Humidity.	Cloud.	Force of Wind.	Rainfall. Total.	Rainfall. Days.
	in.	°	°	%	0-10	0-12	ins.	
Winter	—·019	−4·5	+0·4	— 6	—·2	=	−3·02	— 3
Spring	—·004	+1·2	+0·8	+ 4	—·1	—·3	−2·85	— 7
Summer.....	+·026	+0·1	+0·7	— 3	—·8	=	+1·45	— 5
Autumn.....	+·147	+1·7	+1·5	=	—·5	—·3	—0·87	— 8

NOTES ON THE MONTHS.

JANUARY.—Very cold, with about an average daily range of temperature, an atmosphere of average humidity and low pressure, a cloudy sky, and a heavy rainfall on a very large number of days. Coldest days 27th, mean 23°·7, and 30th, mean 23°·6; warmest day 20th, mean 44°·8. Min. below 32° on 22 days, below 22° on 5 (27th to 31st); max. above 42° on 5 days (16th to 20th). The temperature did not reach freezing-point on the 6th, 10th, 11th, and 28th to 31st. The last six days were the coldest, having a mean temperature of 25°·0 (9 a.m. 23°·9, min. 19°·5, max. 31°·7). Rain (or snow) fell every day but 6th, 8th to 11th, 26th, and 30th.

FEBRUARY.—Excessively cold, with a considerable daily range of temperature, an excessively dry atmosphere of very high pressure, a bright sky, and an exceedingly small rainfall on very few days. Coldest day 7th, mean 16°·4; warmest day 24th, mean 38°·2. Min. below 32° on 24 days, below 22° on 15, below 12° on 3 (6th, 7th, and 8th). The ten days 5th to 14th were the coldest, having a mean temperature of 21°·0 (9 a.m. 18°·2, min. 14°·8, max. 30°·0). This is 16°·5 below the mean for the month for the previous eight years. The minimum reading, 10°·1, is 7°·7 lower than in any previous February, and 1°·7 lower than in any previous winter, during that period. Rain (or snow) fell only on 1st, 2nd, 13th, 18th, and 24th. The month was as remarkable for the extreme dryness of the air as it was for the intense and persistent cold and small rainfall.

MARCH.—Of average temperature, and with an average daily range, a humid atmosphere of low pressure, a rather cloudy sky, and an average rainfall on more than the usual number of days. Coldest day 3rd, mean 30°·0; warmest day 22nd, mean 51°·4. Min. below 32° on 9 days; max. above 42° on 25 days, above 52° on 12. A "partial drought" of 32 days, with a rainfall of 0·17 in., terminated on the 5th. On the 24th, early in the afternoon, there was one of the most destructive gales which has ever passed over Hertfordshire. Many trees were blown down in the neighbourhood of St. Albans and elsewhere nearly all over the county, and other damage was done. An account of this gale has already appeared in the 'Transactions' (Vol. VIII, p. 199).

APRIL.—Of average temperature, and with an average daily range, a humid atmosphere of average pressure, a sky of average brightness, and a rather small rainfall on the usual number of days. Coldest day 4th, mean 38°·4; warmest day 20th, mean 55°·8. Min. below 42° on 19 days, below 32° on 2 (1st and 14th); max. above 52° on 22 days, above 62° on 5 (9th, 17th, 19th, 20th, and 29th). Nearly all the rain fell during the last half of the month, the fall from the 1st to the 15th being 0·10 in. and from the 16th to the 31st 1·22 in. There was a slight fall of snow on the 3rd.

MAY.—A warm month, with a considerable daily range of temperature, an atmosphere of average humidity and high pressure, a bright sky, and a very small rainfall on very few days. Coldest day 17th, mean 41°·1; warmest day 30th, mean 66°·9. Min. below 42° on 10 days; max. above 52° on 25 days (every day but 15th to 20th), above 62° on 20 days, above 72° on 4 (12th, 13th, 29th, and 30th), above 82° on one day (30th). The maximum on this day (82°·3) is the highest temperature which I have recorded in any May. Rain fell only on 1st, 17th, 23rd, 30th, and 31st. There was thus an "absolute drought" of 15 days from 2nd to 16th. On 17th there was a slight fall of snow early in the morning, and on this day the maximum temperature was only 47°·0, giving a range of the maximum of 35°·3 in the month.

JUNE.—Rather warm, with a large daily range of temperature, a very dry atmosphere of high pressure, a bright sky, and a very small rainfall on very few days. Coldest day 15th, mean 51°·5; warmest day 23rd, mean 67°·5. Min. below 52° on 21 days, below 42° on 2 (13th and 15th); max. above 62° on 29 days (every day but 12th), above 72° on 10 days. Rain fell only on 1st, 4th, 11th, 18th, 28th, and 29th. A "partial drought" of 35 days, with 0·33 in. of rain, terminated on the 27th.

JULY.—Of average temperature, and with an average daily range, an atmosphere of average humidity and pressure, a sky of average brightness, and an excessively heavy rainfall on the usual number of days. Coldest day 28th, mean 53°·2; warmest day 8th, mean 67°·1. Min. below 52° on 12 days; max. above 62° on 30 days (every day but 28th), above 72° on 9. Most of the rain fell during the latter part of the month, the fall between the 1st and 17th being 0·51 in., and between the 18th and 31st 4·37 ins. This is the exact amount which fell between the 2nd of March and the 17th of July, or for four and a half months; and from the beginning of February to that date, or for more than five and a half months, only 4·62 ins. fell. There was a very severe thunderstorm at about 1·30 p.m., followed by hail, on Friday the 19th, when a house in St. Albans was struck by the lightning and considerable damage was done.

August.—Of average temperature, with an average daily range, an atmosphere of average humidity and pressure, a bright sky, and a very heavy rainfall on a large number of days. Coldest day 1st, mean 56°·1; warmest day 22nd, mean 69°·0. Min. below 52° on 14 days; max. above 62° on 29 days (every day but 3rd and 13th), above 72° on 6. Rain fell every day but one (9th) from 2nd to 14th, and every day but one (23rd) from 21st to 28th, to the extent of 3·20 ins. in the first period and 0·90 in. in the second. Much of the rain was due to thunderstorms, some of which were of exceptional severity. The first was on the 4th, between 5 and 5.30 p.m. Then came a very severe one, on Saturday the 10th, between 9 and 10.30 p.m., when damage was done in St. Albans to buildings, and to trees in the neighbourhood. Rain fell heavily, flooding the low-lying lands and doing much damage to the crops. Early in the morning of Thursday the 22nd (between 3 and 5 o'clock) there was another very severe thunderstorm, with hail, which did much damage, but St. Albans did not suffer so much as other parts of the county. In the evening the storm was renewed. On the afternoon of Saturday the 24th there was another thunderstorm, but it was not severe at St. Albans.

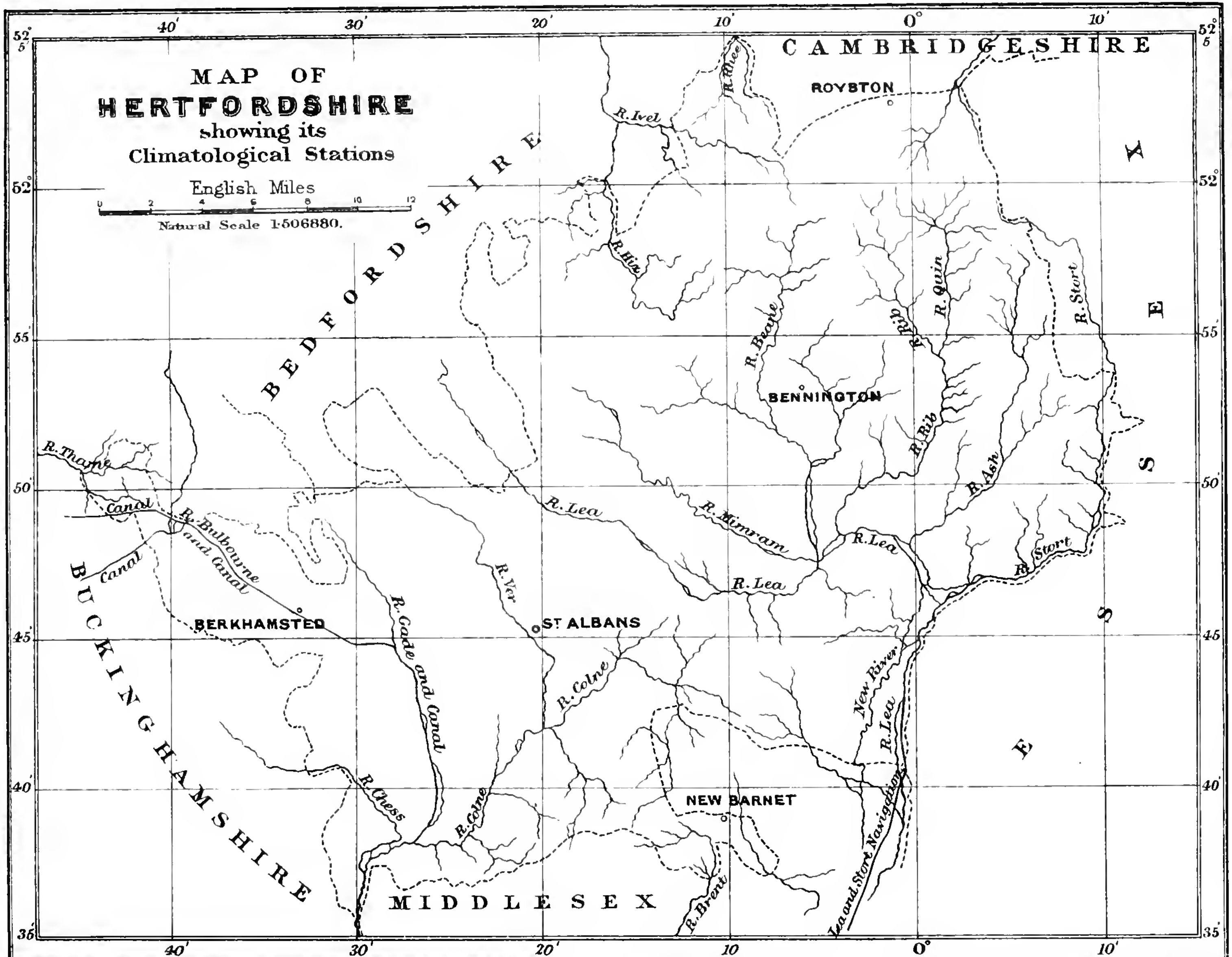
September.—An unprecedentedly warm month, with a very great daily range of temperature, a rather dry atmosphere of very high pressure, an exceedingly bright sky, and a very small rainfall on very few days. Coldest day 21st, mean 52°·6; warmest day 27th, mean 68°·4. Min. below 52° on 14 days; max. above 62° on 29 days (every day but 12th), above 72° on 16 days. Nearly all the rain in the month was due to a thunderstorm early in the morning of Saturday the 7th, 0·66 in. then falling, while only 0·06 fell during the rest of the month, on 10th, 18th, and 19th. The mean temperature of September exceeded the average for any of the three *summer* months for the previous eight years at St. Albans. The last nine days had the very high mean temperature of 64°·4, and on each of these days the sky was absolutely cloudless at 9 a.m.

October.—Very cold, with an average daily range of temperature, a rather dry atmosphere of nearly average pressure, a sky of average brightness, and a little less than the average rainfall on the usual number of days. Coldest day 26th, mean 39°·8; warmest day 1st, mean 62°·3. Min. below 42° on 17 days, below 32° on 7 (24th to 30th); max. above 52° on 17 days, above 62° on 2 (1st and 3rd). The first half of the month was much warmer than the second half, the mean temperature from 1st to 15th being 51°·0

(9 a.m. 50°·3, min. 44°·0, max. 57°·8), and from 16th to 31st 40°·3 (9 a.m. 39°·5, min. 34°·5, max. 47°·0). The week from 24th to 30th was very cold, having a mean temperature of 35°·8, and the minimum in the shade sinking every night to below freezing-point, which is unprecedented for October on so many consecutive nights. Most of the rain fell during the first half of the month, the fall from 1st to 15th being 2·15 ins., and from 16th to 31st 0·46 in.

NOVEMBER.—A warm month, with an average daily range of temperature, a humid atmosphere of average pressure, a cloudy sky, and a very heavy rainfall on a large number of days. Coldest days 18th, mean 38°·1, 24th, mean 38°·2, and 27th, mean 38°·2; warmest day 16th, mean 54°·1. Min. below 42° on 19 days, below 32° on 3 (18th, 19th, and 27th); max. above 52° on 13 days, above 62° on one day (16th). The mean temperature was exactly the same as in October, the month being as much warmer than the average as October was colder. Rain fell daily from 3rd to 15th, to the amount of 2·97 ins. There was a display of the aurora borealis on the evening of the 9th.

DECEMBER.—A rather warm month, with an average daily range of temperature, an atmosphere of average humidity and rather low pressure, a sky of average brightness, and about an average rainfall on a large number of days. Coldest day 11th, mean 30°·0; warmest days 30th, mean 49°·0, and 31st, mean 49°·2. Min. below 42° on 28 days (every day but 6th, 30th, and 31st), below 32° on 12 days; max. above 42° on 18 days, above 52° on 3 (4th, 5th, and 30th). A lunar halo was observed between 5.30 and 6 p.m. on the 1st. There was a gale of wind during the night of the 4th–5th, exceptionally strong early in the morning.



J. Hopkinson del.

E. Weller, lith.

VIII.

CLIMATOLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE IN THE YEAR 1895.

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

Read at Watford, 21st April, 1896.

PLATE II.

THIS is the ninth annual report of observations made at our five Climatological Stations, and comprises the usual series of tables.

The mean temperature of Hertfordshire in 1895, deduced from these observations, was 0°·2 above that of the previous eight years, and 0°·7 below the mean of 1882–86. The year was therefore of about an average temperature. The mean daily range was great, being 1°·3 above the mean of 1887–94, and 1°·0 above that of 1882–86. The extreme range was great, owing to the very low temperature (1°·0) recorded at New Barnet in February. The air was drier and the sky brighter than usual. The rainfall was rather small and on much less than the usual number of days. Royston as usual had the highest temperature and New Barnet the greatest range.

The observations are made at 9 a.m., the maximum temperature and the rainfall being 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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	32·4	27·5	37·2	9·7	16·4	49·1	87	6·8	2·45	21
Feb.	28·2	20·9	35·4	14·5	3·5	45·1	80	5·4	·22	4
March	43·1	34·8	51·4	16·6	23·2	61·1	85	6·9	1·81	16
April	48·8	39·3	58·4	19·1	27·9	69·9	82	5·9	·83	9
May	55·8	43·7	67·9	24·2	32·7	85·9	70	4·8	·66	7
June	60·4	48·0	72·7	24·7	36·1	83·8	75	5·9	·39	6
July	61·7	50·9	72·5	21·6	45·2	84·5	76	6·7	3·84	14
August	63·1	53·0	73·2	20·2	43·3	81·1	81	6·2	5·12	15
Sept.	61·7	50·2	73·2	23·0	36·6	81·2	75	2·6	·79	4
Oct.	46·3	39·3	53·4	14·1	26·1	73·7	85	6·9	1·99	17
Nov.	46·5	40·4	52·6	12·2	28·0	63·1	92	7·0	3·28	19
Dec.	38·7	33·8	43·5	9·7	20·0	55·0	87	7·6	1·52	14
Year	48·9	40·2	57·6	17·4	3·5	85·9	81	6·1	22·90	146

BERKHAMSTED.

(Rosebank.)

Latitude: 51° 45′ 40″ N. Longitude: 0° 33′ 30″ W. Altitude: 400 feet.

Observer: *Edward Mawley, Pres.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	31·7	26·8	36·6	9·8	15·5	49·2	94	8·3	3·12	22
Feb.	27·8	21·0	34·6	13·6	7·5	45·1	76	7·2	·19	4
March	42·4	34·8	49·9	15·1	22·5	63·2	88	7·6	1·64	18
April	47·5	39·1	56·0	16·9	29·2	64·0	80	7·2	1·65	14
May	54·3	43·0	65·6	22·6	35·3	82·9	67	4·3	·54	5
June	58·6	46·8	70·4	23·6	36·4	80·1	65	5·7	·45	8
July	61·0	51·8	70·2	18·4	43·4	80·2	70	7·5	4·53	12
August	61·1	52·2	69·9	17·7	42·7	79·2	75	5·8	3·89	19
Sept.	60·6	48·5	72·7	24·2	35·8	82·2	80	4·8	·91	6
Oct.	45·0	37·2	52·9	15·7	23·7	71·8	88	7·3	2·95	16
Nov.	45·8	40·0	51·5	11·5	26·9	61·8	92	8·3	4·53	19
Dec.	38·5	33·7	43·4	9·7	20·8	54·6	93	8·5	2·22	20
Year	47·9	39·6	56·1	16·5	7·5	82·9	81	6·9	26·62	163

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	32·3	27·8	36·8	9·0	15·6	50·0	90	8·3	2·50	24
Feb.	28·7	22·6	34·8	12·2	10·1	44·8	73	6·2	·18	5
March	41·8	34·3	49·3	15·0	23·9	58·0	88	7·2	1·68	17
April	47·5	39·6	55·4	15·8	30·5	64·8	82	6·8	1·32	13
May	54·5	44·2	64·9	20·7	35·0	82·3	72	4·8	·50	5
June	59·3	48·6	69·9	21·3	34·8	80·5	67	4·9	·39	6
July	60·8	52·6	69·0	16·4	46·1	80·0	73	6·7	4·95	14
August	61·2	53·1	69·2	16·1	44·9	79·0	77	5·7	4·12	18
Sept.	61·5	50·8	72·3	21·5	42·2	81·9	81	3·7	·72	4
Oct.	45·7	39·2	52·2	13·0	26·2	71·8	85	6·6	2·61	15
Nov.	45·7	39·9	51·5	11·6	30·7	62·5	91	7·8	4·49	21
Dec.	38·3	33·1	43·5	10·4	23·8	54·6	89	6·7	2·14	19
Year	48·1	40·5	55·7	15·2	10·1	82·3	81	6·3	25·60	161

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	31·6	27·3	35·8	8·5	17·3	50·2	91	8·6	2·17	22
Feb.	28·2	22·3	34·1	11·8	9·7	44·4	77	7·1	·27	8
March	42·3	34·9	49·7	14·8	23·6	61·1	88	8·5	1·68	17
April	47·5	39·3	55·8	16·5	30·9	64·7	80	7·7	1·11	13
May	53·9	43·3	64·4	21·1	35·8	81·3	69	5·0	·47	6
June	59·0	48·0	70·1	22·1	37·0	81·0	64	6·6	·35	7
July	61·1	52·0	70·1	18·1	44·8	79·9	68	7·4	4·06	15
August	61·1	52·9	69·4	16·5	43·8	79·9	77	5·7	3·37	14
Sept.	61·1	50·5	71·7	21·2	40 9	80·1	78	5·3	·96	5
Oct.	45·6	38 6	52·5	13·9	25·9	72·2	85	7·7	2·10	16
Nov.	45·6	39·9	51·3	11·4	28·7	62·8	90	7·9	3·65	20
Dec.	38·1	33·5	42·8	9·3	21·9	54·5	91	8·1	1·81	17
Year	47·9	40·2	55·6	15·4	9·7	81·3	80	7·1	22·00	160

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	31·9	26·2	37·6	11·4	9·0	52·0	88	7·0	1·89	14
Feb.	27·4	18·6	36·1	17·5	1·0	46·2	78	5·9	·17	3
March	41·9	32·4	51·5	19·1	17·5	63·0	86	6·0	1·64	14
April	47·7	36·9	58·4	21·5	24·8	67·0	81	6·7	1·16	9
May	54·4	40 8	68·0	27·2	31·0	86·8	74	4·5	·40	3
June	59·2	44·7	73·7	29·0	31·8	84·7	72	5·7	·30	4
July	62·2	50·7	73·7	23·0	38·0	83·0	70	6·1	4·03	11
August	61·5	50·5	72·5	22·0	38·0	83·0	76	5·6	3·09	17
Sept.	59·8	45·0	74·7	29·7	32·5	84·5	84	3·1	1·28	2
Oct.	45·0	35·5	54·4	18·9	16·0	74·3	89	6·6	2·66	11
Nov.	45·1	38·3	51·9	13·6	24·0	63·2	87	7·0	4·42	17
Dec.	37 9	32·3	43·5	11·2	17·0	58·0	88	7·3	2·18	14
Year	47·8	37·6	58·0	20·4	1·0	86·8	81	6·0	23·22	119

HERTFORDSHIRE.

Means of Climatological Observations (with extremes of temperature) in 1895, at Royston, Berkhamsted, St. Albans, Bennington, and New Barnet.

Months	Temperature of the Air						Humidity	Cloud, 1–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	32·0	27·1	36·8	9·7	9·0	52·0	90	7·8	2·43	21
Feb.	28·1	21·1	35·0	13·9	1·0	46·2	77	6·4	·21	5
March	42·3	34·3	50·4	16·1	17·5	63·2	87	7·2	1·69	16
April	47·8	38·8	56·8	18·0	24·8	69·9	81	6·9	1·23	12
May	54·6	43·0	66·2	23·2	31·0	86·8	70	4·7	·51	5
June	59·3	47·2	71·4	24·2	31·8	84·7	69	5·8	·38	6
July	61·4	51·6	71·1	19·5	38·0	84·5	71	6·9	4·28	13
August	61·6	52·4	70·9	18·5	38·0	83·0	77	5·8	3·92	17
Sept.	60·9	49·0	72·9	23·9	32·5	84·5	80	3·9	·93	4
Oct.	45·5	38·0	53·1	15·1	16·0	74·3	86	7·0	2·46	15
Nov.	45·7	39·7	51·8	12·1	24·0	63·2	90	7·6	4·07	19
Dec.	38·3	33·3	43·3	10·0	17·0	58·0	90	7·6	1·97	17
Year	48·1	39·6	56·6	17·0	1·0	86·8	81	6·5	24·08	150

Results of Climatological Observations, 1887–94.

Stations.	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Royston	48·6	40·5	56·7	16·2	4·3	93·0	83	6·2	22·08	162
Berkhamsted	47·6	39·9	55·2	15·3	10·8	91·0	83	7·1	25·98	181
St. Albans	47·9	40·7	55·0	14·3	10·9	91·0	83	6·7	26·88	186
Bennington	47·6	40·4	54·8	14·4	10·7	90·9	81	7·3	24·40	190
New Barnet	47·7	38·6	56·9	18·3	4·0	94·5	83	6·2	23·88	144
County	47·9	40·0	55·7	15·7	4·0	94·5	83	6·7	24·64	173

IX.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1895.

By Edward Mawley, Pres.R.Met.Soc., F.R.H.S.,
Phenological Recorder to the Royal Meteorological Society.

Read at Watford, 21st April, 1896.

The only alteration in the list of observing stations since the last report was issued, is the addition of a new one, that at Wormley near Broxbourne, in which locality an observer was then much wanted. At the present time the only parts of the county where observers are still required, in order to make the organization complete, are those in the neighbourhood of Bishop Stortford in the east and of Buntingford in the north-east.

The following table gives the names of the localities represented, their approximate heights above sea-level, and the names of the observers:—

Station.	Height above Sea-level.	Observer.
Watford (The Platts)	240 feet.	Mrs. G. E. Bishop.
Radlett (Newberries)	320 ,,	Miss E. M. Lubbock.
St. Albans (The Grange)	380 ,,	Mrs. J. Hopkinson.
St. Albans (Addiscombe Lodge)	400 ,,	Miss E. F. Smith.
St. Albans (Worley Road)	300 ,,	Henry Lewis.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Harpenden	370 ,,	J. J. Willis.
Broxbourne (Wormley)	120 ,,	Miss L. Warner.
Hatfield (Symonds Hyde)	300 ,,	T. Brown.
Hertford	140 ,,	W. Graveson.
Hitchin	230 ,,	J. E. Little, M.A.
Ashwell (Odsey)	260 ,,	H. G. Fordham.

The Winter of 1894–5.

December proved a very mild winter month, but throughout the rest of the season singularly cold weather prevailed. To give some idea of the persistent character of the cold, it may be mentioned that between the 21st of January and the 21st of February, or for a month, there did not occur at Berkhamsted a single night when the minimum thermometer in shade failed to register a temperature below the freezing-point. The frost, however, was not only continuous, but also, at times, remarkably severe. For instance, on four consecutive nights in February, a thermometer exposed on the surface of the snow showed from 33 to 34 degrees of frost. The ground, although covered with a layer of snow from two to four inches deep during the three

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1895, WITH THE MEAN DATE FOR 1876–1894.

SPECIES.	WATFORD.	RADLETT.	ST. ALBANS.		BERKHAMSTED.	HARPENDEN.	WORMLEY.	HATFIELD.	HERTFORD.	HITCHIN.	ASHWELL.	MEAN, 1876–94.
			The Grange.	Addiscombe Lodge.								
Hazel (*Corylus avellana*)	Feb. 27	Mar. 17	Mar. 5	Mar. 15	Mar. 12	Mar. 14	Mar. 15	Mar. 14	Mar. 3	Mar. 14	Mar. 10	Jan. 27
Coltsfoot (*Tussilago farfara*)	....	Mar. 22	....	(Apl. 8)	Mar. 13	Mar. 25	Mar. 17	Mar. 30	Mar. 10	Mar. 17	Mar. 17	Feb. 25
Wood Anemone (*Anemone nemorosa*)	Apl. 16	Mar. 30	Apl. 7	Apl. 14	Apl. 10	Mar. 31	Mar. 31	Apl. 12	Mar. 24	Apl. 4	....	Mar. 19
Blackthorn (*Prunus spinosa*)	Apl. 3	Apl. 28	Apl. 19	Apl. 17	Apl. 28	Apl. 25	Apl. 23	Apl. 21	Apl. 12	Apl. 23	Apl. 22	Apl. 1
Garlic Hedge-Mustard (*Alliaria officinalis*)	Apl. 15	Apl. 30	Apl. 26	Apl. 27	Apl. 27	Apl. 20	May 1	....	Apl. 18	Apl. 20	....	Apl. 20
Horse Chestnut (*Æsculus hippocastanum*)	(Apl. 11)	May 4	May 2	May 3	May 6	May 7	May 2	May 1	May 3	Apl. 28	....	May 10
Hawthorn (*Cratægus oxyacantha*)	May 2	May 13	May 12	....	May 22	May 20	May 11	May 10	May 9	May 11	....	May 13
White Ox-Eye (*Leucanthemum vulgare*)	(Apl. 29)	May 28	May 23	May 18	May 28	May 26	May 19	May 24	May 16	May 16	....	May 20
Dog Rose (*Rosa canina*)	(May 9)	June 10	June 2	June 9	May 30	June 3	....	....	June 9	May 26	May 29	June 5
Black Knapweed (*Centaurea nigra*)	....	July 5	June 4	June 14	June 20	June 18	June 15	....	June 14	June 6	....	June 21
Harebell (*Campanula rotundifolia*)	July 8	....	July 22	June 18	June 18	July 23	July 5	....	June 23	June 2	....	July 5
Greater Bindweed (*Convolvulus sepium*)	July 6	July 5	July 13	....	June 16	....	June 30	....	July 4	June 29	....	July 9
Ivy (*Hedera helix*)	Oct. 3	....	Sept. 14	....	Sept. 18	....	....	....	Sept. 8	Sept. 9	Sept. 10	Sept. 28

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1895, WITH THE MEAN DATE FOR 1876–1894.

SPECIES.	WATFORD.	RADLETT.	ST. ALBANS.			BERKHAMSTED.	HARPENDEN.	WORMLEY.	HATFIELD.	HITCHIN.	ASHWELL.	MEAN, 1876-94.
			The Grange.	Addiscombe Lodge.	Worley Road.							
BIRDS.												
Song-Thrush (*Turdus musicus*)	Feb. 21	.....	.....	.....	Feb. 19	Feb. 17	Feb. 27	Mar. 7	Mar. 1	.....	.....	Jan. 16
Swallow (*Hirundo rustica*)	Apl. 15	Apl. 17	.....	(Apl. 28)	Apl. 11	Mar. 28	Apl. 16	Apl. 13	Apl. 21	.....	Apl. 11	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 12	Apl. 17	Apl. 10	Apl. 12	Apl. 7	Apl. 11	Apl. 8	Apl. 17	Apl. 10	Apl. 14	.....	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 17	Apl. 18	Apl. 11	Apl. 23	Apl. 17	Apl. 12	Apl. 18	Apl. 18	Apl. 17	Apl. 17	Apl. 19	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	May 28	May 19	.....	May 30	.....	Mar. 9	.....	May 25	.....	May 4	May 21	.....
Swallow (last seen) (*Hirundo rustica*)	Oct. 9	.....	.....	.....	.....	Oct. 14	.....	Oct. 20	.....	.....	Oct. 16	.....
INSECTS.												
Honey Bee (*Apis mellifica*)	.....	Mar. 10	Mar. 12	.....	.....	Mar. 12	Mar. 15	Mar. 14	Apl. 10	.....	.....	Jan. 29
Wasp (*Vespa vulgaris*)	Apl. 13	.....	.....	.....	.....	Mar. 9	Mar. 23	May 5	Apl. 12	.....	.....	Apl. 4
Small White Butterfly (*Pieris rapæ*)	Apl. 10	Mar. 30	Apl. 13	.....	.....	Apl. 12	Apl. 9	Apl. 14	.....	Apl. 14	.....	Apl. 2
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	.....	.....	.....	.....	.....	.....	May 6	May 27	.....	.....	May 7
Meadow-Brown Butterfly (*Epinephile janira*)	.....	.....	.....	.....	.....	.....	.....	June 9	.....	.....	.....	May 17

coldest weeks of the winter, became frozen to a very unusual depth. Even under grass the soil was at one time found to be at a freezing temperature twenty inches beneath the surface.

Owing to the unseasonable mildness and wetness of the late autumn and early winter, there was a plentiful supply of keep on the farms for cattle and sheep until very nearly the end of December; but throughout the prolonged frost that followed, the growth of the grass and young wheat was completely arrested. All the swedes and turnips remaining in the fields were destroyed, also the winter supply of green vegetables in the gardens. Half-hardy shrubs suffered severely; while the commons presented a very forlorn appearance, owing to the winter frosts having killed all the spines upon the gorse, as well as many of the bushes.

Mrs. Mitchell reports that at Watford the laurels and bays were very severely injured; Miss Lubbock that at Radlett the laurestinus and laurel were severely nipped, also beans, oats, etc., where not sufficiently covered by snow; Mr. Henry Lewis that in his garden at St. Albans the green vegetables were nearly all killed, a few wretched remnants of sprouting brocoli only remaining; and Miss L. Warner that at Wormley the gorse had suffered greatly.

The Spring.

This was a very warm and dry season. The most noteworthy meteorological features affecting vegetation were—(1) the absence of anything like severe cold, the exposed thermometer at no time, after the first few nights in March, showing more than eleven degrees of frost, (2) the scanty rainfall, particularly in May, and (3) the remarkable duration of sunshine in that month.

Until the dry weather began to make itself felt in the pastures, this was a very favourable spring indeed for the farmer. The land, owing to the beneficial effect upon it of the prolonged frost, was in splendid working condition. Indeed, seldom have spring corn and other seeds been sown with as little trouble, and on so satisfactory a seed-bed. Towards the end of the season, however, the check caused by the dryness of the soil was beginning to cause serious apprehensions.

For some time after the long winter frost had come to an end the ground remained very cold. It is therefore not surprising to find that all the early spring flowers were singularly late in making their appearance. Our observer at Hertford, Mr. Graveson, regards this retardation of the blossoming of the earliest native plants as "the most remarkable feature of the year." "By the end of March," he says, "I had only observed half as many flowers in bloom as in either of the two previous years at the same time." The average date for the first flowering of the hazel in the previous nineteen years is January 27th, but last year the fertile flowers did not make their appearance until March 11th, or forty-three days late. The coltsfoot was twenty-two days later than the mean date, the wood-anemone seventeen days late, and the black-thorn nineteen days late. From that time, the end of the third week in April, the previous warm weather, although there had been a marked deficiency of sunshine, began at last to increase perceptibly the underground temperature. This is shown by the next plant on the list, the garlic hedge-mustard, which was only four days behind its average time of coming into flower. The horse-chestnut was a week earlier and the hawthorn a day earlier than their respective means, while the white ox-eye was only two days late.

The thrush, taking all the stations reporting upon it, was first heard on February 25th, or forty days behind its average date for the county. All the spring migrants on the list arrived at about their usual time, the swallow being one day late, the cuckoo one day early, and the flycatcher two days late.

The honey-bee was not seen to visit flowers until March 17th, or forty-seven days later than usual. Wasps, however, made their appearance only two days late. The small white butterfly was eight days late, while the orange-tip butterfly, judging by the only two records sent in, was ten days late.

Several observers remark on the very scanty show of blossom on the hawthorn, "some of the bushes," as stated by Miss Warner, "being without a single bud."

My report would not be complete without some mention of the strong gale of March 24th; but, as this has been dealt with in a separate paper by Mr. John Hopkinson,* I will only state here that this gale appears to have been as severely felt in Hertfordshire as in almost any part of the country. The velocity of the wind on that occasion was the greatest that has as yet been recorded by my anemograph since it was first erected at Berkhamsted in the spring of 1885. Mr. Little, writing from Hitchin, states that he saw four trees, all elms, uprooted in a quarter of an hour, and that he counted thirty-six trees (elms, a few poplars, and one ash) which had been blown down within a comparatively small area. He adds that a friend counted fifty-six uprooted trees in the same locality—between Hitchin and Arlesey.

The Summer.

Throughout the first half of the season the weather continued very warm and dry, but during the second half the temperatures were, as a rule, rather low for the time of year, and the rainfall was exceptionally heavy. In order to give some idea as to the trying nature of the drought, which may be said to have lasted from the end of April until the middle of July, to all but deep-rooted plants, I may state that for seven consecutive weeks not a drop of rain-water came through the two and a half feet of soil in either of my percolation-gauges—one containing the heaviest, and the other the lightest soil of the district. Then, as giving some explanation of the surprising nature of the change that took place when the rainy period set in, it should be mentioned

* 'Transactions,' Vol. VIII, p. 199.

that by Midsummer-day—that is to say, only a week after the drought came to an end—ten gallons of water had passed through the gauge containing heavy soil, and 8½ gallons through the light-soil gauge. Both gauges are a yard square.

Owing to the continued dry weather the grass made scarcely any growth. Consequently the crop of hay proved extremely light, but, where cut in good time, of excellent quality. Both on the farms and in the gardens, seeds of all kinds in many cases failed to germinate. The pastures became very dry and bare, and the wheat and other cereals made, as a rule, but little progress. As is usual under such conditions, crops growing on deep and retentive soils fared much better than those on light and shallow ones. The effect of the heavy rains which set in shortly after the middle of July, was almost immediately apparent on the grass lands, which were soon clothed with luxuriant herbage, while the turnips and swedes were also greatly benefited. But the change unfortunately came too late for the corn, although even here some good was also done. The harvest began early, but was frequently interrupted by rain.

Mr. Willis states that at Harpenden "the first ear of wheat was fully out on June 8th." The frost which occurred on the night of June 14th "injured scarlet-runners and potatoes in places at Odsey." Much of the young bracken was also killed on Berkhamsted Common. From two districts reports were received of the foliage of trees being injured by caterpillars. Mr. T. Brown writes that great damage was done in the neighbourhood of Hitchin by caterpillars in some of the woods. "Oak, hornbeam, and hazel were chiefly attacked, while beech is almost uninjured. Some of the oaks are as bare as in midwinter." Miss Warner states that "the hornbeams on Broxbourne Common were nearly bare, and quite brown instead of green, in consequence of the frost."

All the plants on the list which flowered during the summer were in advance of their average dates, the dog-rose being two days early, black knapweed and harebell five days early, and the greater bindweed seven days early.

The Autumn.

Both September and November were unusually warm. On the other hand, during the greater part of October the temperature remained low. There was but little rain in the early part of the season, but November proved exceptionally wet. The record of bright sunshine in September was singularly good.

Harvest operations were greatly hindered by the stormy weather in August, and much of the corn was in consequence gathered in in a more or less unsatisfactory condition. The yield of all the cereals was, moreover, very poor, being lighter than in any recent year with the exception of 1893. In fact, the only satisfactory farm-crop was that of potatoes, which proved abundant. The grass grew rapidly during the rainy period of July and August, and where a second crop of hay was taken the yield was remarkably good. With the exception of the dry period in September, when the grass was beginning to look quite brown again, there was always abundant keep in the pastures until the close of the year.

Apples proved a heavy crop, and there was also a good yield of strawberries, raspberries, and currants, but there were comparatively few pears or plums.

Instances of second flowering and fruiting were very numerous. Mr. Willis, writing from Harpenden, remarks that "a characteristic of this season was the second blossoming of many fruit trees and wild plants. On the same trees were observed ripening apples and blossoms, the wild rose had red berries, flowering buds, and open blooms, and many fully-ripe strawberries were gathered at the beginning of October." Mr. A. E. Gibbs mentions the second blossoming of several spring-flowering perennials at St. Albans, and the unusual circumstance of the Jerusalem artichoke perfecting its flowers. As regards injurious insects, he states that "the winter of 1894–5, though so severe, seems to have had little effect upon insect-life so far, at any rate, as common garden pests are concerned. I have found them more numerous than ever. The dahlias had an exceptionally bad time with the earwigs, while my lawn has been ruined by what I believe to be daddy-long-legs grubs; such soft-bodied things as slugs have been also very numerous and destructive this year." Not only was the tipula grub destructive at St. Albans, but Mr. John Hopkinson, writing on September 25th, remarks that the crane-fly (*Tipula oleracea*) was also unusually abundant there. The same thing was likewise noticed at Berkhamsted about that time.

The ivy, owing no doubt to the great heat of the weather in September, came into flower a fortnight before its usual time.

X.

LIST OF MOSSES COLLECTED IN THE NEIGHBOURHOOD OF HERTFORD.

By Hugh Darton.

Communicated, with an Introduction, by James Saunders.

Read at Watford, 21st April, 1896.

The following list of mosses collected by Mr. Hugh Darton, of Beninghoe, Hertford, forms an interesting addition to our knowledge of the distribution of these plants in Hertfordshire. It shows careful work, especially amongst the minute forms, such as *Pottia* and *Sphærangium*, and also the difficult genus *Barbula*. It contains about twenty species additional to those enumerated in the list furnished to the Society by Mr. A. E. Gibbs, which appeared in Vol. III, Part 2 (1884), of its 'Transactions.' These additions are indicated by an asterisk.

All the specimens on which records are founded have passed through the hands of the writer, and any critical species have been submitted to specialists for an authoritative opinion.

It would appear from an examination of all the lists of Herts mosses known to myself, that the *Sphagnaceæ* are rare in the county. *Sphagnum subsecundum*, *S. contortum*, and *S. cymbifolium* seem to exhaust the list. Mr. Darton writes that the first is still to be found on Hertford Heath, whence Coleman recorded it. It is desirable to obtain confirmations of Webb and Coleman's records for *S. squarrosum* and *S. acutifolium*. As both of these occur in Beds and Bucks, it is highly probable that they also grow in Herts. Those interested in the cryptogamic flora would, no doubt, be amply rewarded by searching for them. Some ten years ago the scrub of Bricket Wood was rich in forms of *S. subsecundum*, but in a recent visit to the spot it was noticed that the bog-mosses were fast disappearing. Those members of the Society who reside near Berry Grove Wood and Little Berkhamsted would find these localities worthy of careful investigation for the *Sphagnaceæ*.

The records sent by Mr. Darton are all for the Lea division of the county. The actual specimens are in his possession, and he will gladly show them to anyone interested in these plants.

Acrocarpi.

Weissia viridula, Brid.—Bank by road to Reformatory, Bengeo, April, '94 (fertile). Bank by footpath between Foxleys Wood and Stapleford Church, April, '94 (fertile). Bank by Hertingfordbury Road, March, '92 (fertile). Bank between Stapleford and Waterford, March, '92 (fertile). Bank by Sacombe Road, March, '92 (fertile).

W. cirrhata, Hedw.—Palings skirting Bayfordbury Park, by Bayford Road, 1888 (fertile). Tree trunk near Baas Hill, Broxbourne, April, '92 (fertile). Palings by footpath between North

Road and Waterford Marsh, near Goldings, March, '92 (fertile). Rotten wood, Mangrove Lane, March, '92 (fertile). Palings by farmyard, Brickendonbury, February, '94 (fertile).

Dicranella varia, Hedw.—Clay soil, Brickendon Lane, March, '92 (fertile). Clay soil, Waterford Marsh, December, '92 (fertile).

**Campylopus pyriformis*, Brid.—Peaty soil in woods bordering Pembridge Lane, April, '87 (fertile).

Pleuridium nitidum, Hedw.—Margin of pond, Bedwell Park, Essendon, October, '94 (fertile). Margin of pond between Pryors Wood and Goldings Wood, Hertford Heath, September, '94 (fertile).

**Sphærangium muticum*, Schreb. — Old ant-heaps, Brickendon Fields, October, '94 (fertile). Fallow field, Chapmore End, January, '94 (fertile).

Pottia minutula, Schwg.—Fallow soil near Molewood Mill, March, '92 (fertile).

**P. cavifolia*.—Hertingfordbury Road, Hertford, February, '94 (fertile).

**P. intermedia*, Turn.—Fallow field by St. John's Wood, Chapmore End, January, '94 (fertile). Fallow soil near Molewood Mill, March, '93 (fertile). Sandy bank by North Road, near "Jacob's Ladder," November, '93 (fertile). Bank between Waterford and Bull's Mill, December, '93 (fertile).

**P. Starkeana*, Hedw.—Fallow field by St. John's Wood, Chapmore End, January, '94 (fertile). Fallow field between Cole Green and Essendon, October, '94 (fertile). Bank between Waterford and Bull's Mill, December, '93 (fertile).

Didymodon rubellus, B. & S.—Tree trunks, Panshanger Park, on slope towards Birch Green, July, '85 (fertile).

**D. sinuosus*, Wils.—Tree trunk between Bengeo Hall and Ware Park, February, '94 (barren).

**Barbula cuneifolia*, Dicks.—Bank by Hertingfordbury Road, December, '93 (barren).

**B. marginata*, B. & S.—Brickwork by bridge over "old" River Rib near Bengeo Gate of Ware Park, February, '94 (fertile).

**B. rigidula*, Dicks.—Wall near Bengeo Cottage, January, '93 (barren).

B. revoluta, Schwg.—Wall in field between "old" and "new" River Rib, Bengeo, March, '93 (fertile).

**B. Brebissoni*, Brid.—Rotting willow stump, osier island, Ware Park Fields, December, '93 (barren).

B. lævipila, Brid.—Stump by "new" River Rib near Westmill, March, '93 (fertile). Tree trunks on slope towards Birch Green, Panshanger Park, July, '85 (barren). Tree trunk near Waterford Hall, March, '92 (barren). Tree trunk near Hertingfordbury Gate, Panshanger Park, March, '92 (barren). Willow trunk, Ware Park Fields, November, '93 (fertile). Tree trunk on right of road to Sacombe near lane to Chapmore End, January, '94 (fertile). Tree trunks, Tewin Water Park, April, '94 (fertile).

**B. latifolia*, B. & S.—Rotting trunks by river Lea outside Woolmers, October, '94 (barren). Rotting trunks by ditch, Ware

Park Fields, February, '94 (barren). Rotting wood by River Rib between Westmill and Bengeo, March, '92 (barren).

Grimmia apocarpa, L.—Stonework of bridge on North Road, near Molewood, July, '86 (fertile). Roof of stable, Molewood Mill, February, '92 (fertile).

**Zygodon viridissimus*, Dicks.—Tree trunk near Bengeo Hall, February, '94 (barren). Stump in hedge, Bayford, January, '94 (barren). Tree trunks, Tewin Water Park, April, '94 (barren).

Orthotrichum affine, Schrad.—Alder trunk, Panshanger Park, July, '85 (fertile). Rotting wood, Waterford Marsh, March, '92 (fertile). Stump in lane between Bramfield and Marden Hill, March, '92 (fertile).

O. Lyellii, H. & T.—Trunks of poplars at Poplar Green, Tewin, in extraordinary abundance, 1887 (barren).

**Ephemerum serratum*, Schreb.—Fallow fields between Bengeo and Chapmore End, October, '94 (fertile).

**Physcomitrella patens*, Hedw.—Mud dredged from affluent of Manifold Ditch, King's Meads, December, '93 (fertile). Mud dredged from ditch, Waterford Marsh, extremely abundant, November, '93 (fertile).

**Funaria fascicularis*, Dicks.—Fallow field between Bengeo and Chapmore End, January, '94 (fertile).

Bartramia pomiformis, L.—Banks by roadside between Bramfield and Bull's Green, nearest the latter, March, '92 (fertile). Bank in Thieves Lane, near Bramfield Road, December, '85 (barren). Sandy bank, Hertford Heath, May, '85 (fertile). Bank by roadside above Stapleford, April, '94 (fertile).

Philonotis fontana.—Near Chadwell, April, '85 (barren).

**Leptobryum pyriforme*, L.—Sandy soil on old willow stump on east side of River Beane below St. Leonards, April, '94 (fertile).

Webera carnea, L.—Clay bank of River Beane near Ware Park Mill, May, '94 (fertile). Clay bank by River Beane, Waterford Marsh, April, '94 (fertile).

Bryum atropurpureum, W. & M.—Lawn at Beninghoe, April, '94 (fertile).

B. pseudo-triquetrum, Hedw.—Ditch between the Lock and River Beane, King's Meads, December, '93 (barren).

Aulacomnium androgynum, L.—Rotting stump between St. Margarets and Hertford Heath, August, '93 (barren). Banks, Broxbourne Woods, April, '92 (barren). Bank in copse between Bengeo Hall and Bengeo Cottage, February, '92 (barren). Rotten wood on trees near Bengeo Gate of Ware Park, March, '92 (barren). Banks by roadside between Bramfield and Bull's Green, March, '92 (barren).

A. palustre, L.—By margin of "Utricularia Pond," Broxbourne Common, April, '92 (barren).

Atrichum undulatum, L., var. *minor*.—Gravelly soil, Foxleys Wood, Stapleford, March, '92 (fertile). Between Bramfield and Bull's Mill, March, '92 (fertile).

Pogonatum aloides, Hedw.—Ditch sides and banks, Hertford Heath, April, '85 (fertile).

AMPHOCARPI.

**Fissidens incurvus*, W. & M.—Brickendon Lane, February, '94 (fertile).

**F. viridulus*, Wils.—Near Bull's Mill, Hertford, December, '93 (fertile).

F. adiantoides, Hedw.—Fallow soil on graves, Tewin Churchyard, April, '94 (barren). Bank in Warren, near St. Leonard's, Bengeo, February, '92 (barren). Chalk slope at Chadwell (? var. *collinus*), December, '93 (barren).

PLEUROCARPI.

Leskea polycarpa, Ehrh.—Bank of River Lea, near Roxford Farm, March, '92 (fertile). Stump by ditch, Waterford Marsh, March, '92 (fertile). Stumps, osier island, Ware Park Fields, December, '93 (fertile). Trees by ditch, Ware Park Fields, February, '94.

Climacium dendroides, L.—King's Meads, on edge of ditch where *Allium vineale* grows, almost extinct, the situation being too dry, December, '93 (barren). Boggy field near Roxford Farm, March, '88 (barren). Island near Poplar Green Gate, Panshanger Park, March, '92 (barren).

Isothecium myurum, Poll.—Stumps, Little Molewood, April, '85 (fertile). Stumps, Broxbourne Woods, April, '92 (barren). Stumps, Brickendon Lane, March, '92 (barren). Hedge-bank, near Bramfield, towards Bull's Green, March, '92 (barren). Tree trunks, slope towards Birch Green, Panshanger Park, August, '85 (fertile). Stumps, Foxley's Wood, Stapleford, March, '92 (barren).

Camptothecium lutescens, Huds.—Gravelly soil by North Road, Hertford, March, '92 (barren). Chalk-pit behind Hertford Union, 1885 (barren). Bank on left of lane to Brickendon, 1887 (barren).

Brachythecium glareosum, B. & S.—Roadside, Gallows Plain, November, '85 (fertile).

B. albicans, Neck.—By footpath, between North Road and Waterford Marsh, near Goldings, March, '92 (barren).

Eurhynchium Swartzii, Turn.—Osier island, Ware Park Fields, March, '92 (barren). Marshy soil by ditch-side between Tewin Water Park and Panshanger Park, May, '90 (barren). By footpath between Waterford Marsh and North Road, near Goldings, 1891 (fertile).

E. pumilum, Wils.—Brickendon Lane, 1887 (barren).

Rhynchostegium confertum, Dicks.—Hedge-bank near Sacombe Road, February, '92 (fertile). Willow by river under Little Molewood, March, '92 (fertile). By roadside, Gallows Plain, 1886 (fertile).

Plagiothecium undulatum, L.—Panshanger Park, between the "House" and Tewin Road Lodge, nearest former, March, '92 (barren).

**Amblystegium irriguum*, Wils.—Rotting woodwork by river, Waterford Marsh, April, '94 (fertile).

Hypnum aduncum, Hedw.—King's Meads, July, '85 (barren). Pond in copse, Mangrove Lane, June, '85 (barren).

**H. aduncum*, var. *Kneiffii*, Bry. Eur.—Ditch between the Lock and River Beane, King's Meads, March, '92 (barren).

H. filicinum, L.—Ditch near Balance House, King's Meads, September, '94 (fertile).

**H. molluscum*, Hedw.—Damp furrows in Brickendon Fields, February, '87 (barren). Bank by road to Brickendon, near Clements, July, '85 (barren).

H. chrysophyllum, Brid.—Chalk slope at Chadwell, December, '93 (barren).

H. stellatum, Schreb.—Damp furrows in Brickendon Fields, April, '87 (barren).

H. cordifolium, Hedw.—Ponds, Pryors Wood, Hertford Heath, February, '87 (barren).

H. Schreberi, Ehrh.—Hertford Heath, August, '93 (barren). Bull's Green, near Bramfield, March, '92 (barren). Roadside near the "Oak," Panshanger Park, March, '92 (barren). Broxbourne Woods, April, '94 (barren). Bedwell Park, Essendon, September, '94 (barren).

Hylocomium splendens, Dill.—Bull's Green, near Bramfield, March, '92 (barren). Island near Poplar Green Gate, Panshanger Park, March, '92 (barren). Broxbourne Woods, April, '92 (barren).

H. triquetum, L.—Fir clump in Brickendon Fields, February, '87 (fertile). By footpath between Waterford Marsh and North Road, near Goldings, March, '92 (barren). Bull's Green, near Bramfield, March, '92 (barren). Chalk slope at Chadwell, December, '93 (barren).

XI.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN THE YEAR 1895.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.

Read at Watford, 21st April, 1896.

Although the number of our rainfall stations is the same as in the last few years, namely 40, there are a few alterations in the staff of observers. The usual return has not been received from Oaklands, Watford, owing to the record being incomplete, and Cheshunt College disappears from our list, the observer there having left the neighbourhood. On the other hand we have a new station at Northchurch, near Berkhamsted, and another at Sawbridgeworth. The latter is an important acquisition, for it is in the river-district of the Stort, which has hitherto been entirely unrepresented. The number of daily records received is 33, which is two less than that for the previous year, but the same as that for the year 1893.

Particulars of the 40 rainfall stations, and the monthly and total rainfall and number of days in the year 1895 on which at least 0·01 inch of rain fell, or, when the measurement is taken to thousandths of an inch, 0·005 inch, are given in Tables I and II, pp. 111–113.

The following supplementary table (Table III) gives six other records of the rainfall in the year. Two of these are the records of additional gauges at Rothamsted, and four are taken from 'British Rainfall, 1894.'

Table III.—Supplementary to Tables I and II.

District.	Station.	Observer.	Gauge. Diameter.	Gauge. Height above Sea.	Rainfall.	Days.
			ins.	feet.	ins.	
4.	Tring—New Mill	R. Leah	5	450	26·90	183
7.	King's Langley	I. Butler	5	283	25·90	
8.	Harpenden—Rothamsted	Sir J. Lawes and	8	420	25·37	140
,,	,, ,,	Sir H. Gilbert	72×87	420	27·16	157
9.	Elstree—Aldenham House	E. Beckett	10	305	24·30	141
12.	Welwyn—Danesbury	A. M. Blake	5	405	25·28	138

The mean rainfall in the county in the year 1895 was 24·91 inches. This is 1·83 inch below the average for the decade 1880–89, and 1·52 inch below that for the half-century 1840–89. The year was, therefore, rather a dry one. The number of wet days was considerably less than usual, the average throughout the county being 11 per cent. less than the mean during the 20 years 1870–89.

The second half of the year is usually wetter than the first half, but this year the difference was very much greater than usual, only 6·84 inches, or $27\frac{1}{2}$ per cent. of the year's rain, falling in the first six months, while 18·07 inches, or $72\frac{1}{2}$ per cent., fell in the last six months. The only season which was wet was the summer, but the first of the three summer months, June, was very dry. November was a very wet month. While the three months, July, August, and November, had excessive rainfall, the three months, February, May, and June, were abnormally dry, the aggregate rainfall in the three wet months being nearly ten times as much as in the three dry ones.

Droughts in 1895.—Accepting as before the definitions of Mr. Symons (in 'British Rainfall') of an "absolute drought" as a period of *more than* 14 consecutive days without any rain, and a "partial drought" as a period of *more than* 28 consecutive days with an aggregate rainfall not exceeding 0·01 inch per day, there were three absolute droughts in 1895, and two partial droughts.

The first absolute drought occurred at 22 out of the 33 stations for which I have the daily rainfall, lasting for

22	days,	February	2	to	February	23,	at	10	stations.
21	,,	,,	2	,,	,,	22	,,	3	,,
21	,,	,,	3	,,	,,	23	,,	1	,,
19	,,	,,	3	,,	,,	21	,,	1	,,
18	,,	,,	6	,,	,,	23	,,	1	,,
16	,,	,,	2	,,	,,	17	,,	2	,,
15	,,	,,	2	,,	,,	16	,,	1	,,
15	,,	,,	3	,,	,,	17	,,	2	,,
15	,,	,,	6	,,	,,	20	,,	1	,,

The second absolute drought lasted for

19	days,	April	28	to	May	16,	at	2	stations.
16	,,	May	1	,,	,,	16	,,	1	,,
15	,,	,,	2	,,	,,	16	,,	9	,,

The third lasted for

20	days,	Sept.	11	to	Sept.	30	at	2	stations.
19	,,	,,	12	,,	,,	30	,,	1	,,
15	,,	,,	20	,,	October	4	,,	1	,,

The first partial drought prevailed at all stations, commencing on the 2nd of February and lasting at most of the stations until the 5th of March, its average duration being about 33 days, and the average rainfall 0·006 in. per diem. It lasted for at least

30	days,	February	2	to	March	3,	at the	33	stations.
32	,,	,,	2	,,	,,	5	,,	29	of these.
35	,,	,,	2	,,	,,	8	,,	2	,, ,,
45	,,	,,	2	,,	,,	18	,,	1	,, ,,
37	,,	January	28	,,	,,	5	,,	4	stations.
40	,,	,,	25	,,	,,	5	,,	3	of these.
42	,,	,,	23	,,	,,	5	,,	1	,, ,,

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1895.

District.	STATION.	OBSERVER.	Diameter of Gauge.	Height of Gauge above Ground.		Height of Gauge above Sea-level.
			ins.	ft.	ins.	ft.†
1.	*Royston	Hale Wortham	8	0	6	269 ⊼
,,	*Odsey	H. George Fordham	5	1	0	256 ⊼
3.	Hitchin—The Firs	William Lucas	5	2	1	238 ⊼
,,	* ,, Bancroft	Francis Ransom	5	0	9	212 T
,,	,, The Maples	William Hill	8	1	1	220 ⊼
,,	* ,, High Down	Joseph Pollard	5	1	1	422 ⊼
4.	*Tring—Elm House	E. J. Le Quesne	5	1	2	460
,,	,, Pendley Manor	J. G. Williams	5	2	0	500 ?
6.	Cowroast	Gordon Thomas	5	3	8	394 L
,,	*Northchurch—The Limes	F. L. Sutton	5	1	0	400 ?
,,	*Berkhamsted—Rosebank	Edward Mawley	8	1	0	401 ⊼
,,	* ,, Fairhill	W. Bonner Hopkins	5	1	0	550 T
7.	*Great Gaddesden Vicarage	Rev. W. T. Drake	8	1	0	427 ⊼
,,	*H. Hempstead—Apsley Mills	J. Dickinson & Co.	24	0	9	260
,,	* ,, Nash Mills	,,	12	3	9	237 ⊼
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	W. Newberry	5	1	0	423 T
,,	* ,, The Grange	John Hopkinson	5	1	0	380 ⊼
10.	*Watford—Frogmore	Arthur P. Blathwayt	5	1	0	182
,,	,, ColneVal.WaterW'ks.	William Verini	5	1	0	220
,,	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340 ⊼
12.	*Welwyn Rectory	Rev. Canon Wingfield	5	0	4	228 T
,,	*Hatfield—Brocket Hall	Lord Mount Stephen	8	1	0	250
,,	*Datchworth Rectory	Rev. J. Wardale	5	1	0	386 T
,,	Hertford—Marden Hill	Richard Hoare	5	0	10	257 T
13.	*Stevenage—Weston Park	M. R. Pryor	5	0	8	470 T
,,	* ,, Bennington House	Rev. Dr. Parker	5	1	0	408 ⊼
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 T
15.	*Much Hadham	T. Woodham Mott	5	1	0	222 B
16.	*Sawbridgeworth—Cowicks	Harry W. Towse	6	1	0	240
17.	*Hertford—Bayfordbury	W. Clinton Baker	8	1	2	250
,,	*Ware—Red House	Joseph Francis	5	0	9	112 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 T
,,	*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 Vol. VII, p. 53.

TABLE II.—RAINFALL IN

River District.			Station.	Jan.	Feb.	Mar.
				ins.	in.	ins.
Ouse	Cam	1. Rhee	Royston	2·45	·22	1·81
			Odsey	2·21	·33	1·55
	Ivel	3. Hiz	Hitchin—The Firs	2·69	·21	1·94
			,, Bancroft	3·04	·31	2·07
			,, The Maples	3·65	·41	1·93
			,, High Down	2·65	·17	1·84
Thames	Thame	4. Up. Thame	Tring—Elm House	2·82	·23	2·03
			,, Pendley Manor	2·99	·21	2·01
	Colne	6. Bulbourne	Cowroast	3·08	·20	1·89
			Northchurch—The Limes	2·98	·19	1·79
			Berkhamsted—Rosebank	3·12	·19	1·64
			,, Fairhill	2·70	·13	1·61
		7. Gade	Great Gaddesden Vicarage	2·95	·21	1·71
			Hemel Hempstead—Apsley Mills	2·44	·17	1·77
			,, Nash Mills	2·35	·06	1·48
		8. Ver	Kensworth—The Grove	3·05	·28	1·89
			Harpenden—Rothamsted	2·11	·18	1·83
			St. Albans—Gorhambury	2·63	·15	1·78
			,, The Grange	2·50	·18	1·68
		10. Lo. Colne	Watford—Frogmore	2·51	·13	1·69
			,, Colne Valley Water Works	2·45	·13	1·65
			Rickmansworth—Moor Park	2·90	·03	1·97
	Lea	12. Mimram	Welwyn Rectory	2·42	·15	1·59
			Hatfield—Brocket Hall	2·13	·16	1·53
			Datchworth Rectory	1·89	·16	1·70
			Hertford—Marden Hill	1·99	·19	1·56
		13. Beane	Stevenage—Weston Park	2·36	·31	2·02
			Bennington House	2·17	·27	1·68
		14. Rib	Therfield Rectory	2·62	·33	1·75
			Throcking Rectory	2·19	·21	1·97
			Buntingford—Hamels Park	2·29	·43	1·92
		15. Ash	Much Hadham	2·16	·24	1·95
		16. Stort	Sawbridgeworth—Cowicks	2·27	·39	1·99
		17. Upper Lea	Hertford—Bayfordbury	2·08	·14	1·61
			Ware—Red House	2·22	·32	1·75
			,, Fanhams Hall	1·98	·14	1·57
		18. Lower Lea	Broxbourne—Stafford House	1·73	·19	1·55
			Cheshunt—Old Nurseries	1·90	·14	1·75
			New Barnet—Gas Works	1·92	·12	1·63
			Southgate—The Lawns	2·38	·17	1·61
Mean for the County				2·47	·21	1·77

HERTFORDSHIRE IN 1895.

APL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.	DAYS.
ins.	ins.	in.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
·83	·66	·39	3·84	5·12	·79	1·99	3·28	1·52	22·90	146
1·01	·86	·46	5·53	5·69	1·00	2·11	3·42	1·65	23·82	162
1·08	·70	·48	4·78	5·03	·92	2·50	3·83	1·79	25·95	151
1·19	·83	·51	4·77	5·26	1·00	2·60	3·92	1·91	27·41	169
1·13	·74	·46	4·68	5·04	·98	2·56	4·03	1·94	27·55	148
1·18	·99	·49	4·50	5·15	·91	2·57	4·30	1·79	26·54	153
1·61	·40	·60	4·15	4·06	·87	2·77	4·55	2·35	26·44	164
1·81	·50	·54	4·43	4·11	·92	3·16	4·81	2·30	27·79	176
1·85	·59	·52	3·94	4·87	·85	2·76	4·54	2·21	27·30	
1·56	·51	·50	4·32	4·29	·95	2·77	4·65	2·12	26·63	134
1·65	·53	·45	4·53	3·89	·91	2·95	4·54	2·22	26·62	162
1·38	·43	·44	4·49	3·71	·92	2·63	4·48	2·02	24·94	160
1·44	·67	·50	5·21	3·78	·90	2·80	4·45	2·19	26·81	153
1·51	·77	·47	4·94	3·47	1·06	3·02	4·68	2·20	26·50	135
1·30	·76	·45	5·01	3·72	·89	3·18	4·28	2·04	25·52	147
1·68	·58	·61	5·80	4·71	1·11	2·84	5·02	2·29	29·86	154
1·44	·65	·43	4·96	3·85	·97	2·51	4·69	2·15	25·77	151
1·37	·49	·50	5·48	3·82	·95	2·88	5·13	2·19	27·37	155
1·32	·50	·39	4·95	4·12	·72	2·61	4·49	2·14	25·60	161
1·76	·20	·50	5·53	2·91	·97	2·17	4·85	2·13	25·35	147
1·69	·13	·59	5·48	2·68	·80	2·52	3·61	2·05	23·78	134
1·78	·21	·49	6·08	3·38	1·00	2·76	5·39	2·80	28·79	137
1·09	·37	·48	4·79	3·73	·93	2·38	4·26	2·17	24·36	131
1·28	·48	·44	4·60	3·38	1·07	2·60	4·37	2·06	24·10	156
1·22	·60	·44	4·00	4·52	·90	3·00	3·95	1·86	24·24	148
1·33	·42	·50	4·73	3·11	·82	3·41	3·43	1·93	23·42	136
1·13	1·19	·69	4·90	5·53	·78	2·37	4·01	1·96	27·25	147
1·11	·47	·35	4·06	3·37	·96	2·10	3·65	1·81	22·00	160
1·03	·78	·51	4·45	6·12	·86	2·38	3·72	1·84	26·39	155
1·24	1·61	·55	4·59	3·97	·74	2·18	3·52	1·73	24·50	165
1·02	·40	·62	4·00	3·18	·97	2·11	3·51	1·94	22·39	124
1·34	·48	·42	4·00	3·44	·62	2·24	3·64	2·21	22·74	148
1·32	·97	·48	4·12	2·97	·81	2·54	3·42	2·49	23·77	152
1·00	·57	·34	3·90	3·17	·67	2·68	3·70	1·94	21·80	133
1·17	·71	·41	3·97	2·93	·61	2·10	3·46	1·93	21·58	125
·91	·44	·32	3·80	2·80	·67	2·57	3·65	1·90	20·75	126
1·34	·33	·46	3·93	2·84	·95	2·18	3·42	2·21	21·13	163
1·17	·37	·42	3·58	2·77	·99	2·28	3·82	2·08	21·27	130
1·16	·40	·30	4·03	3·39	1·01	2·69	4·39	2·18	23·22	
1·22	·47	·63	3·80	2·54	·86	2·85	3·70	2·23	22·46	187
1·32	·59	·48	4·52	3·91	·89	2·58	4·11	2·06	24·91	150

The second partial drought lasted for at least

33	days,	April	28	to	May	30	at	4 stations.
44	,,	,,	28	,,	June	10	,,	3 of these.
51	,,	,,	28	,,	,,	17	,,	2 ,, ,,
35	,,	May	24	,,	,,	27	,,	10 stations.
41	,,	,,	18	,,	,,	27	,,	5 of these.

Distribution of Rainfall throughout the Year.—Of the total rainfall, 19 °/o fell during the winter months (Jan., Feb., and Dec.), 15 °/o during the spring (March to May), 36 °/o during the summer (June to August), and 30 °/o 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, were as follows:—

	Fall.	Diff.		Fall.	Diff.
1st quarter..........	4·45 ins.	—1·18 in.	Winter	4·74 ins.	—1·26 in.
2nd ,, ...	2·39	—3·62	Spring	3·68	—1·84
3rd ,, ...	9·32	+2·00	Summer..............	8·91	+1·93
4th ,, ...	8·75	+1·28	Autumn..............	7·58	—0·35

July, August, and November were excessively wet; scarcely any rain fell in February; and May, June, and September were also very dry. The difference in each month from the mean for the half-century was—

	in.		in.		in.		in.
Jan.	+0·16	April.....	—0·46	July	+2·02	Oct.	—0·36
Feb.	—1·50	May	—1·54	Aug......	+1·53	Nov.....	+1·55
Mar......	+0·16	June	—1·62	Sept......	—1·54	Dec.	+0·08

Thus the fall for the first six months was 4 80 ins. below the mean, and for the last six months 3·28 ins. above the mean; and while three months had over an inch and a half more than the average rainfall, three months had more than an inch and a half less than the average.

The absolute maximum falls in any one day in each month, and the stations recording them, were—

		ins.			ins.
Jan.	19—Kensworth....................	1·06	July	19—Moor Park	1·84
Feb.	24—Red House, Ware.....	0·24	Aug.	21—Kensworth	1·78
Mar.	27—Bancroft, Hitchin.....	0·62	Sept.	6—Brocket Hall	1·01
April	26—Moor Park	0·65	Oct.	8—High Down	0·87
May	12—Sawbridgeworth	0·62*	Nov.	8—Frogmore, Watford	1·16
June	11—Weston Park..............	0·28	Dec.	14—Kensworth	1·01

* Also at Throcking on the 23rd.

The wettest day in each month was—

January 19th at all stations.
February 1st at 22, 24th at 14, 1st and 24th at 4.
March 26th at 18, 27th at 19, 26th and 27th at 3.
April 24th at 1, 25th at 36, 26th at 2, 28th at 1.
May 17th at 24, 23rd at 11, 30th at 2, 31st at 2, 17th and 23rd at 1.
June 1st at 2, 11th at 12, 18th at 9, 28th at 15, 11th and 28th at 2.
July 18th at 18, 20th at 3, 21st at 17, 27th at 2.

August 10th at 1, 13th at 22, 20th at 2, 21st at 11, 22nd at 2, 3rd and 13th at 2.

September 6th at all stations.

October 5th at 14, 8th at 25, 5th and 8th at 1.

November 5th at 20, 8th at 1, 10th at 3, 15th at 13, 22nd at 1, 28th at 1, 29th at 1.

December 12th at 2, 14th at 34, 29th at 2, 14th and 24th at 1, 14th and 29th at 1.

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

Jan. 19th	April 25th	July 18th	Oct. 8th
Feb. 1st	May 17th	Aug. 13th	Nov. 5th
March 27th	June 28th	Sept. 6th	Dec. 14th

The number of wet days in the year (average of 38 gauges) was 150, being 18 below the mean for the 20 years 1870–89. Of the total number there were 41 (or 27 °/₀) in the winter months, 34 (or 23 °/₀) in the spring, 37 (or 25 °/₀) in the summer, and 38 (or 25 °/₀) in the autumn.

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

Jan.	20	+ 5	April	12	—1	July	14	=	Oct.	14	—1
Feb.	4	—10	May	6	—7	Aug.	16	+3	Nov.	20	+4
March	16	+ 3	June	7	—6	Sept.	4	—9	Dec.	17	+1

Distribution of Rainfall throughout the County.—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 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.

TABLE IV.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	2·33	3·01	2·90	2·70	2·15	2·78	2·42
Feb.	·27	·28	·22	·16	·23	·28	·20
March	1·68	1·94	2·02	1·74	1·73	1·86	1·75
April	·92	1·14	1·71	1·55	1·17	1·07	1·36
May	·76	·81	·45	·50	·62	·80	·56
June	·43	·49	·57	·49	·47	·47	·48
July	3·68	4·68	4·29	5·05	4·18	4·35	4·55
August	5·40	5·12	4·08	3·80	3·53	5·20	3·67
Sept.	·90	·95	·90	·93	·85	·93	·88
October	2·05	2·56	2·96	2·74	2·48	2·39	2·62
Nov.	3·35	4·02	4·68	4·63	3·75	3·80	4·17
Dec.	1·59	1·86	2·33	2·20	2·03	1·77	2·15
Year	23·36	26·86	27·11	26·49	23·19	25·70	24·81
Diff. from 1880-89	—0·14	+1·59		—2·48	—2·36	+1·02	—2·34

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

		ins.			ins.
Cam	Rhee	23·36	Lea	Mimram	24·03
Ivel	Hiz	26·86	Lea	Beane	25·62
Thame	Upper Thame	27·11	Lea	Rib	24·43
Colne	Bulbourne	26·36	Lea	Ash	22·74
Colne	Gade	27·15	Lea	Stort	23·77
Colne	Ver	26·64	Lea	Upper Lea	21·38
Colne	Lower Colne	24·03	Lea	Lower Lea	22·02

The total yearly fall ranged from 20·75 inches at Fanhams Hall, Ware, to 29·86 ins. at Kensworth; and the total monthly fall from 0·06 inch at Nash Mills in February, to 6·08 ins. at Moor Park in July. The greatest fall in any one day was 1·84 in. at Moor Park on the 19th of July.

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 ½ inch being styled *considerable*, ¾ inch *very considerable*, 1 inch *great*, 1¼ inch *very great*, 1½ inch *heavy*, and 1¾ inch *very heavy*. There was no *excessive* (2 inches) fall in the year. This analysis only applies to the thirty-three stations for which I have returns of the daily rainfall.

January.—Rainfall a little above the average and on a large number of days, in the form of snow except for a few days about the middle of the month. The 19th was a very wet day at all stations, the fall being *considerable* at nine, *very considerable* at twenty-two, and *great* at Kensworth (1·06 in.) and Moor Park (1·07 in.).

February.—An excessively dry month, with rain or snow on very few days. There was no *considerable* fall at any station.

March.—Rainfall a little above the average and on a rather large number of days. Snow fell only on a few days at the beginning of the month. There was a *considerable* fall of rain at five stations on the 27th.

April.—A rather dry month, with rain on the usual number of days. There was a *considerable* fall at eleven stations on the 25th.

May.—A very dry month, with rain on very few days. There was a slight fall of snow early on the morning of the 17th. On the 12th the fall of rain was *considerable* at one station; on the 17th it was *considerable* at one; on the 23rd it was *considerable* at two (from a thunderstorm); and on the 30th it was *considerable* at one (High Down, Hitchin). This, also, was due to a thunderstorm which passed over the north of the county and was most severe just beyond our borders, in Bedfordshire and Cambridgeshire. At Pirton, a village a little to the north of High Down, Hitchin, a wheat-stack was struck by the lightning and set on fire, and five men who were sheltering under it were struck, one of them being killed on the spot and another very seriously injured. Almost immediately afterwards a cottage in Pirton was struck, and, with three others adjoining it, burned to the ground. Rain fell in torrents when the storm was at its height, and the road between Hitchin and Pirton was in one place about two feet under water, while at Hitchin, three miles off, there was scarcely any rain. At Melbourne, three miles from Royston, a chapel was struck, and a cottage struck and burned down.

JUNE.—A very dry month, with rain on very few days. There was no *considerable* fall at any station.

JULY.—An excessively wet month, but with rain on no more than the usual number of days. On the 18th the fall was *considerable* at three stations, and *very considerable* at two; *great* at Bancroft, Hitchin (1·06 in.); *very great* at Northchurch (1·25 in.), The Grange, St. Albans (1·25 in.), High Down, Hitchin (1·26 in.), Rosebank, Berkhamsted (1·27 in.), and Fairhill, Berkhamsted (1·31 in.); *heavy* at Great Gaddesden (1·56 in.), Nash Mills, Hemel Hempstead (1·58 in.), Frogmore, Watford (1·59 in.), Apsley Mills, Hemel Hempstead (1·69 in.), Kensworth (1·70 in.), and Gorhambury, St. Albans, (1·73 in.); and *very heavy* at Moor Park (1·84 in.). On the 20th the fall was *considerable* at fourteen stations, *very considerable* at four, and *great* at Broxbourne (1·10 in.). On the 21st it was *considerable* at ten stations, and *very considerable* at ten; *great* at Hamels Park, Buntingford (1·06 in.), Bancroft, Hitchin (1·08 in.), and Bennington House (1·15 in.); and *very great* at Throcking Rectory (1·33 in.), and Therfield Rectory (1·45 in.). On the 23rd the fall was *considerable* at eight stations; and on the 27th *considerable* at twenty-one, and *very considerable* at six. Most of these heavy falls of rain were due to thunderstorms. At St. Albans, and probably elsewhere, there was one in the night of the 18th–19th (really early in the morning of the 19th), to which the rain of the 18th was due, and another in the afternoon when a house in St. Albans was struck and much damaged; considerable damage was also done to fruit-trees by hail. On the afternoon of Sunday the 21st there was a thunderstorm of great violence in the neighbourhood of Welwyn. Trees were struck by the lightning, and glass and crops were damaged by hail. The hailstones were very large, measuring two inches in circumference.

AUGUST.—Also a very wet month, and with rain on rather more than the usual number of days. On the 3rd the fall was *considerable* at nine stations, and *very considerable* at two; on the 4th it was *considerable* at one; and on the 5th it was *considerable* at five. On the 10th it was *considerable* at seven, *very considerable* at two, and *great* at Weston Park (1·18 in.) and Odsey (1·24 in.). On the 13th it was *considerable* at three stations, and *very considerable* at seventeen; *great* at Royston (1·01 in.), Gorhambury, St. Albans (1·05 in.), Moor Park (1·07 in.), The Grange, St. Albans (1·08 in.), High Down, Hitchin (1·09 in.), Therfield Rectory (1·11 in.), and Apsley Mills, Hemel Hempstead (1·14 in.); and *very great* at Nash Mills, Hemel Hempstead (1·28 in.), Weston Park (1·31 in.), and Moor Park (1·35 in.). On the 21st it was *very considerable* at four stations; *great* at Northchurch (1·02 in.); *very great* at Elm House, Tring (1·31 in.), Royston (1·33 in.), and Bancroft, Hitchin

(1·42 in.); *heavy* at Odsey (1·52 in.), and High Down, Hitchin (1·52 in.); and *very heavy* at Kensworth (1·78 in.). On the 22nd the fall was *considerable* at five stations, and *very considerable* at two. Several of these falls were due to thunderstorms, which were even more prevalent than in July. I have thunderstorms recorded at St. Albans on the 4th (5 to 5.30 p.m.), 10th (9 to 10.30 p.m.), night of 21st–22nd (early morning) with hail, and also evening of 22nd, and afternoon of 24th. The storm of the night of Saturday the 10th was very severe in the north of the county, and seriously interfered with harvest-work; at St. Albans a building was struck and several trees were damaged by the lightning. The storm of Thursday morning the 22nd was most severe, but of this a separate account is appended, so it need not be further alluded to here.

September.—A very dry month, with rain on very few days; in fact nearly all the rain in the month fell in the night of the 6th–7th, making the 6th appear a very wet day at all stations. The rain entered to this day was *considerable* at seven stations, *very considerable* at twenty-five, and *great* at Brocket Hall (1·01 in.). This was due to a thunderstorm, some of the effects of which are mentioned in an appendix. There was also a thunderstorm on Tuesday evening the 3rd, with no rain, and in fact in bright sunshine. At Therfield some cottages were struck by the lightning and the roof and walls shattered to pieces which were sent flying in all directions.

October.—A wet month as usual, but with rather less than the average amount of rain, on about the usual number of days. On the 5th the fall was *considerable* at fifteen stations, and *very considerable* at three; on the 8th it was *considerable* at ten, and *very considerable* at five; and on the 10th it was *considerable* at one (Datchworth Rectory).

November.—A very wet month, with rain on a large number of days. On the 5th the fall was *considerable* at sixteen stations, *very considerable* at five, and *great* at Elm House, Tring (1·01 in.), and Kensworth (1·07 in.); on the 8th it was *considerable* at one station (Moor Park), and *great* at Frogmore, Watford (1·16 in.); on the 10th it was *considerable* at nine stations; on the 15th it was *considerable* at thirteen, and *very considerable* at three; on the 28th it was *considerable* at three; and on the 29th it was *considerable* at ten stations.

December.—Rainfall a little above the average, and on a considerable number of days. The 14th was a very wet day at all stations, averaging over 0·40 in., but only reaching 0·50 in. at two stations, the fall being *considerable* at one station (Moor Park), and *great* at Kensworth (1·01 in.).

APPENDIX.

The Thunderstorms of the 22nd of August and the 7th of September.—The summer and early autumn of 1895 have been remarkable for the number of thunderstorms which have occurred, doing much damage in various parts of the country, and Hertfordshire suffering severely. In several of these storms there have been only one or two casualties, but in two of them considerable damage was done throughout a great part of Hertfordshire. Both storms occurred in the early morning, a rather unusual time.

The storm of Thursday, the 22nd August, was accompanied by heavy hail, by which most of the damage was done. It appears to have lasted from 2 to 5 a.m., being most severe between 3 and 4. In the neighbourhood of Berkhamsted, Hemel Hempstead, Redbourn, and Harpenden the destruction of property was due to hail, the hailstones being variously estimated as from the size of walnuts to that of bantams' eggs. About Redbourn and Harpenden some of the houses had not a sound piece of glass left in their windows, and in one street in Harpenden nearly 300 window-panes were broken, while the glass in conservatories was in some cases completely demolished. At Harpendenbury Farm turkeys were killed by the hailstones. In the centre of the county the hailstorm was less severe, but there were casualties from the lightning. At Hertford, between 2 and 5 a.m., the thunder and lightning were incessant, the heavens being one continuous sheet of flame. In Panshanger Park a wych-elm was struck and two bullocks were killed by the lightning, one sheltering under this tree, and the other under a clump of trees not far off. On Lawrence End Farm seven young pedigree beasts met with a similar fate.

The rainfall during this storm was very unevenly distributed over the county, being very heavy in the north, light in the south-west, and erratic in the east. In the Ouse river-basin it averaged 1·45 inch, ranging only from 1·32 in. to 1·52 in.; in the northern portion of the Colne it averaged 1·10 inch, ranging from 0·81 in. to 1·78 in.; but in the southern portion of this river-basin it only averaged 0·22 inch, ranging from 0·10 in. to 0·36 in. In the Lea river-basin the average was 0·41 inch, and the range from 0·10 in. to 0·94 in.

The storm was renewed for a short time at 8 o'clock in the morning, and again in the evening at the same hour, when vivid forks of lightning played on an almost continuous sheet-lightning. Shortly after 8 p.m. two Alderney cows and a heifer were killed on Townsend Farm, St. Albans, and cattle were also killed at about the same time at Panshanger and elsewhere.

The storm of Saturday, the 7th of September, was very severe in the south-west of Hertfordshire. At Rickmansworth it is stated to have been one of the heaviest which has been known for several years. It lasted from 3 to 5 a.m. The rain fell in torrents, flooding some of the houses in High Street and others in the low-lying parts of the town. At Watford, at about 4.30, a house was struck and the stack of chimneys crashed through the roof. In the centre of the county it was most severely felt in the neighbourhood of Codicote, where houses were flooded, and at Potters Heath a cottage was struck by the lightning, the slates being torn off part of the roof, and the joists set on fire. In the east of Hertfordshire the storm was terrific How it behaved at Hoddesdon was thus described in the 'Hertfordshire Mercury' of the 14th of September:—"In the early hours of Saturday morning there was a terrific thunderstorm, accompanied by very vivid lightning and a deluge of rain. About 4 a.m. there were some extremely vivid flashes of lightning, followed by a tremendous crash of thunder and other noises, which very much alarmed the inhabitants of Briscoe Road; and later in the morning it was found that Crofton Villa had been struck by lightning. A stack of chimneys was shattered, and the tiles of the whole of the roof were loosened, whilst one side of the wall was bulged out and shivers of the woodwork were driven into the brick wall. After striking the chimney the lightning appears to have passed down the roof, scorching the verge-board and pulverizing the face of the bricks. It then spent itself down the waterpipe at the side, which is broken. Hundreds of bricks and tiles (whole and in pieces) were scattered over the garden and the adjacent gardens, and sent flying to a distance of many yards. Inside the house the chimney-wall was cracked all the way down to the fireplace in one of the upstair rooms, the stove and its surroundings being forced out into the room. In the front sitting-room, underneath it, the marble mantel was broken to pieces. There is quite a large hole in the roof, and at 10 a.m. there was a strong smell of sulphur very perceptible along the front of the house." There seems to have been only one other case of structural damage in the east of the county. The windmill near Much Hadham was struck, and several of the sails were torn off.

During this storm heavy rainfall was general all over the county. In the Ouse river-basin the fall averaged 0·82 inch, ranging from 0·73 in. to 0·90 in.; in the Colne it averaged 0·83 inch, ranging from 0·66 in. to 0·94 in.; and in the Lea it averaged 1·78 inch, ranging from 0·54 in. to 1·01 in.

XII.

ON SOME OVERLOOKED RECORDS OF HERTFORDSHIRE PLANTS.

By B. Daydon Jackson, Sec. L.S., Hon. Memb. Herts Nat. Hist. Soc.

Read at Watford, 21st April, 1896.

Having recently come upon certain records of Hertfordshire plants which seem to have escaped the notice of the late Mr. A. R. Pryor, I thought the Society which published his 'Flora' would like to have the same laid before it, which I now have the honour of doing.

In 1892 Mr. J. Lucas published a translation of part of Kalm's 'Travels,' which relates to his visits to England in 1748 and 1751: a copy of this work having lately been added to the library of the Herbarium of the Royal Gardens at Kew, I looked into it, and soon found much to arrest my attention.

Pehr Kalm was born in Finland in the year 1715, studied botany under Linnæus at Upsala, and, as he showed marked acuteness as a botanist, was sent to North America to collect plants. He spent six months in England whilst on his outward voyage, and about five weeks on his homeward way, laden with so ample a store of new plants, that Linnæus was cured of a fit of the gout by the excitement of their arrival.

Kalm reached England on the 17th of February, 1748, and left our shores for America on the 11th of August of that year. During the interval he paid two visits of some extent—(1) to Woodford, which does not immediately concern us, and (2) to Little Gaddesden, which directly appeals to us. The visit to our county was accomplished at the desire and at the cost of Baron Bielke, a Swedish nobleman, to see and report on the farming practice of William Ellis, a man who enjoyed a great reputation in rural economy, but still more for his writings on that subject. With Lars Jungström, a gardener and fellow-countryman, Kalm spent from 25th March to 15th April in the neighbourhood of Little Gaddesden, and recorded all the operations which came under his observation which seemed to differ from the farming processes carried on in Sweden, evincing close observation and shrewdness. He learned more from the neighbours of Ellis than from that person himself, who seems to have shown himself very "close" and jealous of imparting any information gratuitously. His land is described as being the worst cultivated of any round about, a fact which goes far to confirm the account of Ellis which is given below.

Kalm anticipated some modern developments, by examining certain haystacks to discover the constituents of the hay. One was in Ashridge Park, and although it may not have been of purely Herts growth, yet, as the plants mentioned are of very wide distribution and very common, I have included them. The second stack was well within our borders, namely at Hudnall. In most cases Kalm cites the names given in Linnæus's 'Flora Suecica,' ed. 1 (1745), to which he had contributed information.

These records, amounting to 58, naturally escaped attention so long as they existed only in their original form, as part of 'En resa till Norra America . . . af Pehr Kalm,' . . . Stockh. 1753–56.

The foregoing statement induced me to refer to the account of Ellis which is given by Mr. James Britten in the English Dialect Society's volume for 1880, p. 30, where it forms part of a treatise on old farming words, including names of plants. As I expected, I found many weeds and well-known plants mentioned, all under their vernacular names, which I have included in the following list, under the determination given by Mr. Britten, checking them occasionally with the reductions afforded by Messrs. Britten and Holland in their 'Dictionary of English Plant Names,' issued by the same Society, in 1878–86. There is one alteration I have made where *Narthecium ossifragum*, Huds., a plant not recorded for the county, is cited as the equivalent of Ellis's "moor-grass": in this case I have taken the more likely reduction of Messrs. Britten and Holland, *Eriophorum angustifolium*. The description given by Ellis of a certain poisonous weed, undoubtedly belongs to *Mercurialis perennis*, although Mr. Britten fails to identify the plant.

I extract the following account of Ellis from Mr. Britten's remarks in the volume already cited:—"Ellis was a farmer at Little Gaddesden, in Hertfordshire, during the last century. Very little is known about him, but from his 'Modern Husbandman' we gather incidentally that he had been fifty years a resident in the locality, which makes it probable that he was born there; that he had travelled both in England and on the Continent; that he had a wife and six children, the latter of whom he took pains to train in agricultural pursuits. . . . . It is clear that he was a man of much intelligence, although he refers to his 'illiterature': his writings have a strong local colouring, and record for the most part his experience as a Hertfordshire farmer" (p. viii). Again, quoting from his posthumous 'Husbandry abridged,' 1772, Mr. Britten continues—"His education was something not much superior to that of the general run of common farmers, but he inherited from nature strong and active parts, which enabled him to rise into a sphere superior to his brethren. . . . . Any person in Great Britain might send for him, on paying for his time and expenses. . . . . Having engaged for larger quantities of MSS. than his materials of real excellence would allow, all his pieces are nearly equal in being filled with trash. This did his reputation so much mischief, and at last injured him so much with the public, that he no longer found any pecuniary advantage in writing, but stuck to his farm, and very wisely depended on that alone . . . . instruments, he procured them, and sold them to any persons. . . . . Ellis made a traffick, sometimes profitably, of ploughs, drill-ploughs, horsebreaks, etc. This induced him to be very voluminous in their description and very hyperbolical in their praise" (pp. xii, xiii).

In Kalm's pages will be found additional light on the character of this striking personage, but I cannot stay to dwell on it.

By inspection of the list it will be seen that nearly 100 common plants, which were for the most part supposed to be recorded for the first time as natives of Hertfordshire about the year 1838, are now vouched for about ninety years earlier.

The arrangement and nomenclature are the same as in Pryor's 'Flora of Hertfordshire.' I have cited the authority and the date for the earlier records, together with the date which appears in the Flora itself.

Clematis Vitalba, *L.*	Ellis,	1750	1838
Ficaria verna, *Huds.*	Kalm,	1748	,,
Ranunculus repens, *L.* (*vel* R. acris ?)	Ellis,	1750	,,
——— Flammula, *L.*	,,	1749	,,
——— arvensis, *L.*	,,	1750	,,
Raphanistrum innocuum, *Medic.*	,,	,,	,,
Nasturtium officinale, *R. Br.*	Kalm,	1748	,,
Alliaria officinalis, *Andrz.*	Ellis,	1750	,,
Brassica campestris, *L.*	,,	,,	1839
Sinapis arvensis, *L.*	,,	1749	1838
Erophila vulgaris, *DC.*	Kalm,	1748	,,
Capsella Bursa-pastoris, *Moench*	Ellis,	1750	,,
Silene Cucubalus, *Wibel*	,,	,,	,,
Githago segetum, *Desf.*	,,	,,	1839
Cerastium vulgatum, *L.*	Kalm,	1748	1838
Linum catharticum, *L.*	,,	,,	,,
Acer campestre, *L.*	,,	,,	,,
Ilex Aquifolium, *L.*	,,	,,	,,
Ulex europæus, *L.*	,,	,,	,,
Ononis arvensis, *L.*	Ellis,	1750	,,
Anthyllis Vulneraria, *L.*	Kalm,	1748	,,
Medicago lupulina, *L.*	Ellis,	1736	,,
Trifolium pratense, *L.*	Kalm,	1748	,,
——— repens, *L.*	,,	,,	,,
Lotus pilosus, *Beeke*	,,	,,	,,
—— corniculatus, *L.*	Ellis,	1750	,,
Lathyrus pratensis, *L.*	Kalm,	1748	,,
Vicia Cracca, *L.*	,,	,,	,,
—— sativa, *L.*	Ellis,	1750	,,
Ervum hirsutum, *L.*	,,	,,	,,
Prunus avium, *L.*	Kalm,	1748	1815
——— spinosa, *L.*	,,	,,	1838
Spiræa Ulmaria, *L.*	Ellis,	1750	,,
——— Filipendula, *L.*	Kalm,	1748	1846
Rubus "fruticosus" (ulmifolius, *Schott* ?)	,,	,,	1849 ?
—— cæsius, *L.*	Ellis,	1750	1838
Fragaria vesca, *L.*	Kalm,	1748	,,

Rosa rubiginosa, *L.*	Kalm,	1748	1815
—— canina, *L.*	,,	,,	1849
Sorbus Aria, *Crantz.*	Ellis,	1750	1846?
Cratægus oxyacantha, *L.*	Kalm,	1748	1838
Sedum vulgare, *Link.*	Ellis,	1750	1838?
Scandix Pecten-Veneris, *L.*	,,	,,	,,
Anthriscus silvestris, *Hoffm.*	,,	,,	,,
Hedera Helix, *L.*	Kalm,	1748	,,
Galium verum, *L.*	Ellis,	1750	,,
——— Aparine, *L.*	,,	,,	,,
Senecio Jacobæa, *L.*	,,	,,	,,
Achillea Millefolium, *L.*	Kalm,	1748	,,
Chrysanthemum segetum, *L.*	Ellis,	1750	,,
Leucanthemum vulgare, *Lam.*	Kalm,	1748	,,
Bellis perennis, *L.*	,,	,,	,,
Tussilago Farfara, *L.*	,,	,,	,,
Cirsium lanceolatum, *Scop.*	Ellis,	1750	,,
Serratula tinctoria, *L.*	Kalm,	1748	1815
Centaurea nigra, *L.*	,,	,,	1838
Taraxacum officinale, *Weber*	,,	,,	,,
Hieracium umbellatum, *L.*	,,	,,	,,
Helmintia echioides, *Gaertn.*	Ellis,	1759	,,
Calluna Erica, *DC.*	Kalm,	1748	,,
Fraxinus excelsior, *L.*	,,	,,	,,
Calystegia sepium, *R. Br.*	Ellis,	1750	,,
Cuscuta europæa, *L.*	,,	,,	1839
Echium vulgare, *L.*	,,	,,	1838
Verbascum Thapsus, *L.*	,,	1736	,,
Veronica agrestis, *L.*	Kalm,	1748	,,
Rhinanthus minor, *Ehrh.*	Ellis,	1750	,,
Prunella vulgaris, *L.*	Kalm,	1748	,,
Lamium purpureum, *L.*	,,	,,	,,
Thymus Serpyllum, *L.*	,,	,,	,,
Primula vulgaris, *Huds.*	,,	,,	,,
Plantago media, *L.*	,,	,,	,,
Rumex Acetosa, *L.*	,,	,,	,,
Polygonum amphibium, *L.*	Ellis,	1750	,,
Daphne Laureola, *L.*	Kalm,	1748	1815
Mercurialis perennis, *L.*	Ellis,	1750	1838
Urtica dioica, *L.*	Kalm,	1748	,,
Humulus Lupulus, *L.*	Ellis,	1750	,,
Ulmus campestris, *L.*	Kalm,	1748	,,
Quercus pedunculata, *Ehrh.*	,,	,,	,,
Carpinus Betulus, *L.*	,,	,,	,,
Corylus Avellana, *L.*	,,	,,	,,
Populus alba, *L.*	Ellis,	1750	1843
——— tremula, *L.*	,,	,,	1838
Salix Caprea, *L.*	,,	,,	,,
Alnus glutinosa, *Gaertn.*	,,	,,	,,
Narcissus pseudo-Narcissus, *L.*	Kalm,	1748	1815

Allium vineale, *L.*	Ellis,	1750	1838
Eriophorum angustifolium, *Roth.*	,,	1749	,,
Anthoxanthum odoratum, *L.*	Kalm,	1748	,,
Alopecurus myosuroides, *Huds.*	Ellis,	1750	,,
Phleum pratense, *L.*	Kalm,	1748	,,
Cynosurus cristatus, *L.*	,,	,,	,,
Agrostis vulgaris, *With.*	,,	,,	,,
Holcus mollis, *L.*	,,	,,	,,
Arrhenatherum avenaceum, *Beauv.*	Ellis,	1750	,,
Avena pratensis, *L.*	Kalm,	1748	1843
Dactylis glomerata, *L.*	,,	,,	1838
Bromus secalinus, *L.*	Ellis,	1736	1843
Festuca elatior, *L.*	Kalm,	1748	1838
——— rubra, *L.*? (*vel* F. ovina, *L.*, 1843)	,,	,,	1880
Briza media, *L.*	,,	,,	1838
Poa pratensis, *L.*	,,	,,	,,
Lolium temulentum, *L.*	Ellis,	1750	1813
——— perenne, *L.*	Kalm,	1748	1838
Equisetum arvense, *L.*	,,	,,	,,
Pteris Aquilina, *L.*	,,	,,	,,

Two plants mentioned by Ellis are doubtful, the "sedge, or round rush," which is probably a common species of *Juncus*, and "white bennet," as to the identity of which I can hazard no conjecture.

In conclusion I may append a short list of Ellis's works from which the foregoing notices have been drawn: for a fuller account of them I must refer inquirers to Mr. Britten's volume previously cited (pp. ix–xi).

(*a*) 1736. 'New Experiments' (incorporated in (*e*)).
(*b*) 1738. 'Timber Tree Improved' (reissued in (*e*)).
(*c*) 1749. 'Shepherd's Guide.'
(*d*) 1750. 'Country Housewife.'
(*e*) ,, 'Modern Husbandman,' in eight parts, some of which probably were issued in advance of the date on the title-page.
(*f*) 1759. 'Practical Farmer,' ed. v (incorporated in (*e*)). The previous editions must have come out very early in the literary career of Ellis, but I have not succeeded in seeing them.

XIII.

NOTES OF THE OBSERVATION OF SWALLOWS.

By A. Sainsbury Verey, Memb. Brit. Orn. Union.

Read at Watford, 21st April, 1896.

(Abridged.)

The training of the Swallows in the art of flight commences from their earliest infancy. So soon as the wings are little more than mere flappers, the young birds leave their nests, and then, small huddled-up bunches of feathers, sit perched upon rails or fences, taking their first glimpses of the world. I have never yet been able to ascertain how the little birds become aware of the approach of their parent with food. Often, as I have watched them, long before I could distinguish the particular bird from others of its kind flying about, the inert little heaps would display unusual animation; then suddenly one would rise perpendicularly in the air, when the parent, descending in the same line, transferred the food to its mouth. The old birds always feed their young in the air in this manner, for were they to meet in a horizontal direction there would be danger of collision, and it would be difficult also to transfer the food.

Later on in their lives swallows seem to establish training-grounds. About midsummer some favourable spot is selected, and there in the evening a school of the birds assembles, and then, high in air, with screams and mad gambols and in wanton delight, they combine business with pleasure. I have often observed them, and felt the better for it. There is one such playing-field (if, indeed, the term can be at all properly applied to anything in the realm of air) near the Vicarage at Mill End, Rickmansworth.

There is no better method of studying much that takes place in Swallowland than by walking through a country village. Upon the lowly tenement of the labourer no costly decorations have been lavished, so Nature herself has stepped in to adorn it, and its walls and eaves, no longer bare, are embellished with Nature's homes, and the swallow sings—for swallows do sing—from the chimney-top above. Who has not entered into the spirit of the wild chase when the parent swift is leading its screaming young through every devious way? Who, also, when a river runs close to the village, has failed to see the sand-martin come flying in, and then, making two or three rapid courses up and down the length of the street, hasten back again to the flowing stream of his watchful care? The swift, however, does not belong to the swallow family, but now takes its place in classification in company with the nightjar among the Picariæ or woodpeckers. Nevertheless, he still displays a marked predilection for assimilating his habits to that of his old friends the swallows.

I now come to a very interesting phase of Swallowland, one, too, that I have repeatedly met with since my first observation.

As, one day early in September, I was walking across an old common, my attention was attracted by the notes of the swallow, which I found proceeded from some twenty or thirty birds clustering round a small fir-tree, upon the branches of which several of them had already perched. Approaching them very closely, I sat down to watch them, and was somewhat surprised to observe that they appeared to be all young birds, for in none of them could I discover those two long tail feathers which are so characteristic of the adult swallow. At length all had settled upon the tree, when suddenly there sounded the cry of a swallow from some distance off on the common, and instantly the birds were again in motion, rising with one accord into the air and quickly betaking themselves in the direction whence the cry proceeded. I thought that I had seen the last of them, but in a short space of time back they all came, straggling in two and three at a time, fatigued, seemingly, for they settled immediately on the tree, and then, for the first time, I could perceive an adult bird. He was a grand specimen, and, as he flew over my head at a height of only a few feet, seemed rather to court the admiration his power of flight demanded. Not for long did he leave the young birds to themselves, which at his call directly rose and followed him, to return in time to rest once more; and again and again did I see this repeated.

The only conclusion I could arrive at was, that the bird actually was training the younger ones for the migration they shortly would have to make, and marvellously, patiently, and well did he perform the duty. As I have already said, I have frequently seen the same thing happen since.

It often used to puzzle me why the swallow should have those two elongate tail-feathers, and at length I concluded that it may be for this reason. In the young birds these feathers do not extend much beyond the others, and their tails are wedge-shaped. But then, young swallows do not obtain their food in quite the same manner as the old birds. They frequent open spaces, and catch their prey by hawking after it in the air. The adult swallows, on the other hand, as often, and with exceedingly swift flight, traverse hedgerows, lanes, and other narrow ways thickly obstructed by trailing boughs and branches, and by projecting twigs and sprays. Now if we watch a swallow swiftly approaching us as we saunter along those country lanes we all love so well, we notice that the bird is bearing directly down upon us without altering its course, and, indeed, there seems to be a risk of its colliding with us. But observe it carefully, and just at that very moment when collision appears inevitable, one wing is suddenly thrown up and then so forcibly brought down again as instantaneously to change the course sufficiently to avoid us, and the little bird, flashing past, almost brushing us as it does so, has demonstrated to us such a knowledge of dynamic force, and the power of controlling it, as might put on their mettle even the navigators of our "ocean greyhounds." But now, if we turn round, we see that one powerful stroke has upset the equilibrium of the delicate fabric, and yonder goes the swallow, oscillating violently from side to side, the lateral motion, however, being at once checked by the elongate feather on one side. By this sudden arrest the body of the bird is sent rebounding upon the opposite feather, only in turn to be stopped by it; and thus the bird continues swaying from side to side, until, the disturbance gradually subsiding, equilibrium is restored. And this, I think, may be an explanation of what would otherwise appear strange to us, for the swallow is the only one of the family possessed of this peculiar tail.

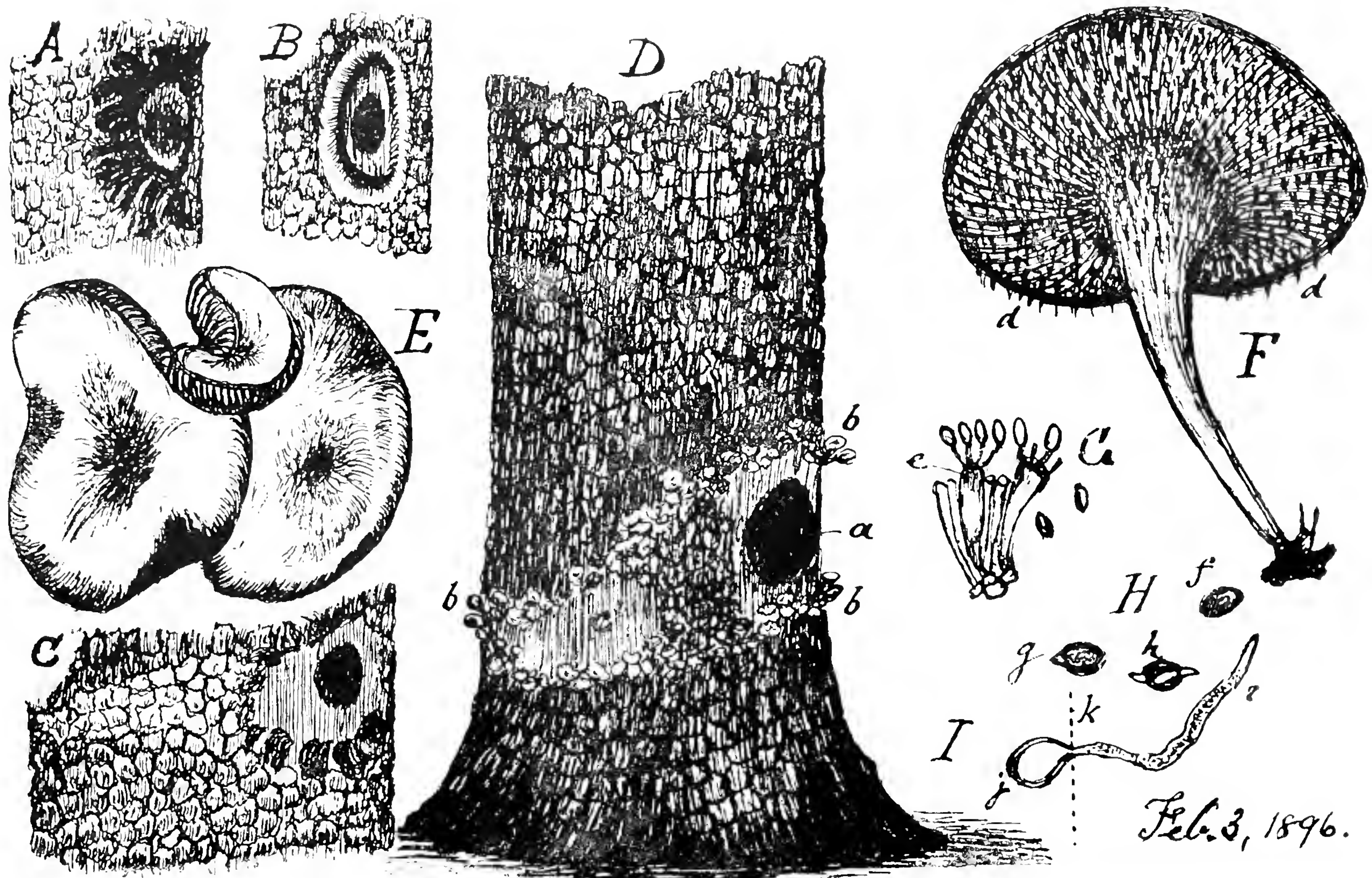
A fascinating question is: Do swallows hibernate? But I must touch upon it only briefly. The belief that they do so is, I think, more firmly held in America than in our own country.

Certain it is, that for some time after the departure of the main body of swallows, barely-fledged young birds are commonly to be seen, and these again as suddenly disappear. What becomes of them? It is difficult to suppose that they can in any way fit themselves in time for a supplementary migration, for their insect food is daily becoming scarcer, and, on the other hand, to argue on insufficient data that they must all die, is to pay no very high compliment to the prudence and foresight of nature. The difficulty which has always confronted us is that no bird, so far as I am aware, has ever been found in a state of hibernation. But I will mention a fact that is very helpful to us, for indeed it takes us very far on the way.

My old and very dear friend, the late Dr. Henry Thornton Wharton, used often to relate to me how well he recollected that, when a boy at Mitcham Rectory, as he stood one Christmas Day in a room but seldom used, in which a fire had just been lighted, he saw two swallows in a semi-torpid condition come tumbling down the chimney.

In the early morning of Lord Mayor's Day, in the year 1878, I saw from the carriage of a train stopping at Godalming Station, six or seven martins. A bright, cheerful sun had risen upon a cold, frosty morning, and the birds were endeavouring to gain some warmth from it; poor benumbed things, very feeble in their flight and very unlike the swallows of summertime, yet there they were unmistakably.

We can only hope to elucidate the mystery by patient wanderings in Swallowland.



FUNGI DESTROYING AN ELM-TREE AT ST. ALBANS.

XIV.

ON THE DESTRUCTION OF AN ELM-TREE BY FUNGI AT ST. ALBANS.

By George Abbey.

Communicated by A. E. Gibbs, F.L.S., F.E.S.

Read at Watford, 8th December, 1896.

PLATE III.

The pair of elm-trees at the intersection of Victoria Street with Upper Lattimore Road are the oldest, and until this year were the finest, arboreal specimens belonging to the Corporation of St. Albans. There are several elms of the same age in various parts of the city, namely, on land for sale off Beaconsfield Road, on private ground on the east side of Hatfield Road, at the north boundary of Clarence Park, on the St. Peter's Park estate, and on St. Germain's Farm, St. Michael's, within the walls of the ancient city of Verulamium. There are many others outside the city boundary, as on the north side of Hatfield Road near the Cemetery, at St. Stephen's, and on the Redbourn side of St. Albans.

All these trees appear to have at one time been hedgerow timber, planted simultaneously by the lords of Gorhambury and Althorpe—the Earl of Verulam and Earl Spencer, K.G. There are trees of the same age on the south-east boundary of the lawn at Porter's Park, Shenley, which, I have been informed, were planted by the celebrated English Admiral, Earl Howe, during his possession of that delightful estate. Probably Earl Howe prompted the owners of neighbouring estates to plant timber trees. Be that as it may, it is a remarkable circumstance that all the English elms (*Ulmus campestris*) of stateliness and grandeur in the city of St. Albans and its environs appear to be of the same age. There are also some elm-trees of the same age on the Marshall'swick estate, and in the hedgerows on Beaumont's Farm, but those in the "Avenue" belong to a more recent date.

Earl Howe—one of the highest of the great sea-captains of Britain—was born in 1725, and died in 1799. During his residence at Porter's Park he added a morning-room to the mansion, in imitation of a captain's cabin, with a southern and western outlook, and on the south-east of the lawn he planted the elm-trees, which, from their size and other characteristics, appear to be contemporaneous with others at Newberries, Radlett; with the two in Victoria Street; and with those mentioned on the estates of the Earl of Verulam and Earl Spencer. The age, therefore, of these trees, is not more than 150 years, even from the seed. Few of the trees exceed twelve feet in circumference, or about four feet in diameter, at three feet from the ground. All the trees, except the one which has just perished, are remarkably healthy and vigorous.

not nearly at their best by another 150 years, hence the loss of this one is the more lamentable.

Elms thrive singularly well on the soil of St. Albans and its neighbourhood, which is calcareo-siliceous in some places and calcareo-argillaceous in others. The ancient Britons and Romans took care to pitch their habitations where the soil was capable of producing "the staff of life," where rich pasturage was abundant and there was a plentiful supply of pure water. And the monks, with their learning, the Abbots of St. Albans in particular, always kept an eye on the good things of the earth: hence they farmed the best lands, and, with the barons, occupied the best situations. Elms and nettles, both belonging to the natural order Urticaceæ, grow on good land, their whipcord-like roots taking a deep hold (with a wide range) of the soil, and therefore the elms derive abundant nutrition from the siliceous and argillaceous drift beds overlying the Chalk, and pump up moisture, or absorb that which is supplied to them by capillarity, from great depths, so that they are but little inconvenienced by droughty weather.

The soil of St. Albans (and the same may be said of that of Watford) is essentially suitable for elm-trees, as shown by their making more rapid growth than any other tree, except perhaps poplars. The elm, however, is not a desirable town tree, for the limbs are liable to be broken by high winds, and the tree itself sometimes snaps off bodily near the ground. But this scarcely applies to the St. Albans elms, for, owing to the peculiar nature of the soil, they build up their structures solidly, yet with remarkable elasticity. The elm also bears pollarding well; consequently when the trees get too large, and may possibly endanger the public safety by the falling of branches or the downfall of the tree, the head may be cut off with the certainty that it will form another quite as fine or finer, and thus make a more suitable town tree.

The mischief to the elm-tree in Victoria Street commenced by horses biting the bark, but this was not broken through until the winter of 1892–93, when the tree was run into and abraded by some heavily-laden vehicle. The bark around the wound, as shown at *A* in the accompanying plate (Plate III), dried up in shreds, and no callus was formed around the wound in the following summer, as would be the case under normal conditions, the tree striving to cover the wound by occlusion, as represented at *B*, and making a special effort in that direction by the growth of cellular tissue around the circumference of the injured area. In the following year (1894) it was noticed that the bark surrounding the wound had become of a pale colour, as shown at *C*.

The malady being evidently due to a fungoid growth, observation was kept on the tree for the appearance of the fungi. They were anticipated to appear in the autumn, and to be *Polyporus sulphureus*, as several fine specimens of this species were found on two elm-trees in Beaumont's Avenue, and the spores were supposed to have come from there in 1893. They did not appear in 1895, but the bark became pale in colour all round the tree, and it was inferred that the mycelial hyphæ of some fungus were located in the alburnum and inner bark, living on the cambial layers and epidermal cells, and by destroying them cutting off the supply of sap to the parts above, the tree meanwhile being outstripped in growth by its companion on the opposite side of Upper Lattimore Road. This difference in growth during three years indicates the impoverishing power of the invading fungus, and shows the rate at which elm-trees increase in height and circumference.

At last, in the early months of 1896, certain fungoid growths appeared at the circumference of the wounds, for the stem had been still further bitten by horses through the bark down to the wood. They were of an irregular tuberculous or lobed character, and yellowish in colour. As some of the outgrowths were knocked off, and I dreaded not having another opportunity, I made a sketch of the lower part of the tree by lamplight on the 3rd of February. *D* is a facsimile, the scar and cause of the mischief being shown at *a*, the fungus at *b*, and the recent abrasure of bark at *c*, the last-mentioned being of no consequence, as this part had been traversed by the mycelial hyphæ of the parasite. This by its presence had offered an inducement to the hungry animals, for it was not only on the side next Victoria Street, but also at the back, that it was eaten off more or less, and nowhere but overlying the fungal hyphæ. A cluster of the fungus showing the upper part of the pileus, natural size, is represented at *E*. As there were no teeth, or very few, on the upper surface, it was concluded to be *Hydnum ochraceum*, Pers., especially as the club-like processes characteristic of *Hydnum diversidens*, Fries., were wanting or very indefinitely present on the margin. Eventually, however, a fairly representative specimen, shown at *F*, natural size, was secured, and from its regular spines, awl-shaped and three lines long, proved to be *H. diversidens.* Probably both forms were present, that is *H. ochraceum* and *H. diversidens,* for there is frequently a strange consortism amongst fungi, rendering it extremely difficult to pitch upon the right delinquent. In this case, however, I consider that the enemy was *H. diversidens*, as shown at *F* on the under-side. The pileus is thick and fleshy, and probably edible, while that of *H. ochraceum* is thin and coriaceous, and this species is certainly not the active agent in the destruction of trees. The spores are shown at *G*, highly magnified. They are borne in fours on the basidia (*e*), and, being very minute, are readily dispersed by wind, and those which happen to alight on the wounded surface of a suitable host, germinate at once. At *H* the spores are shown still more highly magnified. In the wound of the tree the spore (*f*), by the stimulus of moisture and the nutrition of the sap, develops a germ-tube from one end (*g*), or both ends (*h*), and this germ-tube grows into the crevice formed by the separation of the bark of the tree from the wood, due to the wound. It then emits a ferment, breaks down the living cell-walls, abstracts and appropriates their contents, and continues to enlarge and multiply its hyphæ or mycelium. As shown at *I*, the contents of the original cell forming the spore are absorbed by the growing germ-tube, now called a hypha (*i*), and the cell (*j*) is emptied of the protoplasm transmitted from the parent. The spore itself never enters the tissue of the tree, but remains outside in the wound, as shown by the dotted line *k*. It is the hypha alone which enters the living tissues, and now by its own efforts maintains its existence independent of the parent cell. Though lost to view it grows and multiplies, forming a mycelium or bundle of hyphæ, and producing a white-rot in the wood. In due course the fungus prepares for reproduction, the hyphæ thickening and pushing from their outward ends white sporophores into the air, which thus appear above the surface as incrustations or brackets, as shown in the figure *D* at *b*. The hymenium or fruit-producing surface is disposed on downward-directed spines, as seen in the figure *F* at *d*, of unequal length, and the basidia with their four slender processes termed sterigmata, from each of which a spore is developed. These spores when ripe are disseminated far and wide by the wind.

Such is a brief outline of the life-history of the fungus *Hydnum diversidens*, a parasite on beech, birch, elm, hornbeam, and oak trees. It always enters its host by a wound, never through the unbroken cortex.

Whence came the spores which attacked this particular tree is unknown, for there are no other trees in the neighbourhood of St. Albans known to be infested by the same species. This neighbourhood is, however, singularly rich in parasitic fungi, no finer specimens of witches'-broom existing than on the hornbeams near the lodge of Sopwell, and on birch at Cunninghame Hill Farm.

The dead tree in Victoria Street has had its limbs lopped, but it ought to be bodily carted away for the sake of those which are left, for both above and below where the once grand specimen has been girdled, the bark is very light-coloured, evidence that its organized substance is still being fed upon, and still fostering fungi, some of the spores of which may be carried by the wind to wounds on other elm-trees and do like damage. Its near neighbour, the noble elm on the opposite side of Upper Lattimore Road, ought also to be protected by a strong iron guard, else it may share a similar fate.

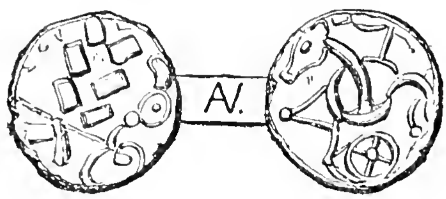
[March, 1897.—The tree has now been felled and removed.—Ed.]

XV.

ON AN ANCIENT BRITISH COIN FOUND NEAR WATFORD.

By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc.

Read at Watford, 8th December, 1896.



The gold coin, of which a figure (slightly less in diameter than the original) is given above, was found during the autumn of 1895 by a man who was excavating for the foundations of a house at Callow Land or New Watford, about a mile from Watford Station in a northerly direction. From the finder it came into the hands of Messrs. Spink & Son, from whom I obtained it. It may be described as follows:—

Obv.—Portions of a rude imitation of the laureate head of Apollo on the Macedonian Philippus; the leaves of the wreath run in opposite directions from a faint transverse line; in front are some curved lines and pellets, a crescent-shaped protuberance, and a somewhat oval ring ornament; behind are some very faint traces of ornamentation.

Rev.—Disjointed horse l., the off fore-leg bent to an acute angle at the knee, the near leg slightly bent in front of a wheel with four spokes, from the rim of which a line runs to the knee of the horse; above, a reversed T-shaped figure between two slight protuberances; the head of the horse is large and its outline formed by raised lines.

AV. 81½ grains.

This coin is uninscribed, and differs in several respects from any that have been published. In general character, however, it closely approximates to coins usually found in Yorkshire and in the adjoining counties to the south, such as those inscribed VEP CORF. (Evans, 'Ancient British Coins,' pl. xvii, figs. 5–7). The reverse is much like that of some uninscribed coins from the Yorkshire district, such as Ev., pl. xvii, figs. 10, 11, but differs in giving the wheel and the bent fore-leg of the horse. The open character of the horse's head bears much analogy to that of the head of the animal on the reverse of the coins reading DVMNOCOVEROS, etc.

There can, therefore, be little doubt that this coin was struck at some place considerably to the north of Hertfordshire. Its extremely degenerate types, and its light weight, 81½ grains—precisely the same as that of the uniface coin, Ev., pl. xvii, fig. 11—assign the coin to a very late place in the ancient British coinage, and not improbably to a time when the southern part of this island was already under Roman rule. Coins of this class have indeed been found associated with Roman denarii struck but a year or two before the invasion of Claudius in A.D. 43.

It is useless to speculate on the way in which this northern coin found its way into Hertfordshire. It was, however, dug up not far from what seems to be a Roman road, leading from Watford to Verulamium, and there is a strong temptation to suggest that it may have been part of the spoil of some Roman soldier returning from the conquest of the territory of the Brigantes by Petilius Cerealis in A.D. 71.

[Reprinted from the 'Numismatic Chronicle,' 3rd series, vol. xvi, p. 183.]

XVI.

THE RÖNTGEN OR "X" RAYS.

By Thomas Mansell, F.R.M.S., F.R.P.S.

A Lecture delivered at Watford, 26th January, 1897.

(Abridged.)

In the history of science there has never been so much research concentrated on one particular field of investigation as at the present time, when in all the principal physical laboratories of Europe inquiries are being made into the effects and causes of the new species of radiation called by one of the early discoverers "X" rays, the name having been given by Professor Röntgen because their nature is unknown, and in mathematical problems X represents the unknown quantity.

We all know that any ordinary source of electricity, whether a battery, dynamo, or friction machine, has two terminals, called positive and negative. When these are connected by means of a wire we form what is called a circuit. If we even cut the wire the current still tries to pass, and tends to leap across the gap in the form of sparks. This is called the "spark-gap," and the length of spark is a rough measure of the voltage or pressure of electricity.

If when we are producing the spark it is surrounded by a partial vacuum, the electric force is more easily able to pass. To make such a vacuum we have to fuse wires into the opposite ends of a closed tube of glass and exhaust the air by means of an air-pump. As the exhaustion proceeds, the sparks pass so rapidly that one thinks there is a continuous string of light through the tube. On further exhaustion the string of light widens until it appears like a luminous glow; and in the end the light in the tube almost disappears, while the tube itself commences to shine with a fluorescent light.

Many years ago Professor William Crookes showed that, when the exhaustion in a vacuum-tube becomes about one-millionth of an atmosphere, the molecules of the residual gas have a free path in which they can move, without causing a visible glow in the tube. At this stage the molecules are attracted to the negative pole or "cathode." According to Professor Lodge, if we reduce the atmospheric pressure to one-hundred millionth of an atmosphere, there still remains in every cubic inch of the tube something like 1,540 billion complete molecules. We call this radiant matter "cathode" rays, and it will be seen that when the current is turned on through a vacuum-tube and a magnet is brought near the tube, the beam will be deflected, that is to say, the cathode rays are deflected by magnetism. This deflection of the cathode rays is one of the peculiarities which distinguish them from the "X" rays of Röntgen.

I have no doubt that many of my audience do not know the difference between "Crookes tubes" and "Geissler tubes"; and I therefore show some of both Crookes' and Geissler's tubes, so that it may be understood more exactly what happens when these photographs are taken.

The chief difference between Geissler tubes and Crookes tubes is this: In a Geissler tube the exhaustion is very much less than in a Crookes tube, the light which we see in the Geissler tube being due to the luminescence of the residual gas.

The one now shown is a Geissler tube with a fancy pattern of glass tubing inside, and a small amount of air; when the current is turned on, it will be seen that this will light up in different colours, due to the different qualities of glass which have been used in the making of the tube.

In a Geissler tube with different fluid substances surrounding the inner tube through which the current is passed, although by the ordinary electric light these substances appear to be of the same colour, when the current is passing they will fluoresce with different colours. If the Geissler tube be further exhausted, a different phenomenon will be obtained—that of Crookes. If the current be turned on through a Crookes tube, it will be observed that the tube is not so strongly illuminated as was the case in the Geissler tube, but owing to radiation which takes place from the large terminal, the flat piece of mica inside the tube coated with calcium-sulphide will become intensely luminescent.

The discovery of the "X" rays by Professor Röntgen was due, as is so often the case, in some measure to an accident. He was experimenting with a Crookes tube wrapped in an opaque material, and on his bench he had laid a piece of sensitive paper, on which he found, after a powerful current had passed through the tube, that a black mark had been formed.

Retracing our steps we have, first, a tube in which the gas is luminescent; then one in which the gas loses most of its luminosity; and lastly, one containing a solid substance upon which the cathode rays from the negative electrode play, rendering it luminescent.

The cathode rays, as shown by Lord Kelvin in his works, are due to the residual gas particles contained in the tube being electrified. The real work done is not by these cathode rays inside the tube, but by the invisible or "X" rays outside the tube, and when we come to Röntgen Photography we have to some extent ceased to have to do with the cathode rays.

We are unable at the present time to decide what these rays on the outside of the tube are. Is it that the cathode rays, after being filtered through the glass, become converted into something else, or is it that the cathode rays, beating on one side of the glass, set up some form of vibration on the other side of the glass? Some say that they are very long waves, corresponding to infra-red light; others say that they are short, corresponding to ultra-violet light. My conclusion is that they are short waves, and correspond to ultra-violet light.

The essential differences and similarities between the cathode rays and Röntgen's "X" rays are:—

"X" rays are not deflected by magnets, cathodic rays are; "X" rays are not absorbed or diffused so readily as cathodic rays; "X" rays will traverse several inches of wood and even several inches of aluminium or glass, while cathodic rays fail to pass through any but thin films of glass and aluminium; "X" rays excite fluorescence, and give shadowgrams at a distance of eighty inches from the tube, whilst cathodic rays are absorbed or diffused at a distance of fifty inches.

The main points of similarity between the two are their powerful action on photographically sensitive films, and their rectilinear propagation as shown by the sharply-defined shadows.

In a darkened room, paper covered on one side with barium platino-cyanide lights up with brilliant fluorescence when brought into the neighbourhood of the Crookes tube; and, with its aid, paper is very transparent; objects can be seen through a book of over 1,000 pages, two packs of cards, and a thick block of wood. A sheet of aluminium 15 mm. thick still allows these "X" rays to pass; water, and several other fluids, are very transparent to them; salts of metals, either solid or in solution, behave as a rule as the metals themselves.

Barium platino-cyanide is not the only fluorescent substance acted on by the "X" rays. Calcium sulphide, uranium-glass, rock-salt, and Iceland-spar exhibit fluorescence just as well, and have the advantage of being much cheaper.

The tubes must be constructed of glass which is of sufficient thickness to withstand the heat; otherwise, as in the case of those made with lead glass, they easily crack. To avoid such an accident we are obliged to give intervals of rest during the exposure, which is a great drawback in the case of a surgical shadowgraph.

Some workers have suggested that the rays proceeded in direct lines from the cathode through the sides of the tube, and not from the surface of the tube itself. I exposed a plate in front of the tube (opposite the cathode) and another at the side of the tube, its surface parallel with the main axis of the rays, if proceeding, as suggested, in a direct line from the cathode. The results, developed together, gave every sign of equal exposure.

Lenard, in his investigations on cathode rays, has shown that they belong to the ether, and can pass through all bodies, and "X" rays behave in the same manner.

Professor Thompson has shown that a photographic plate enclosed in a vacuum-tube is not acted upon by the cathode rays produced in the tube. This is no doubt due to the absence of oxygen on the plate.

The discovery of Pratt and Bennett that the rays have killed certain bacteria, viz., those of cholera, anthrax, pneumonia, diphtheria, and others, is, if true, of great interest to the medical profession.

Little now remains to say, except that it must appear to everyone that this discovery is of great importance, especially for surgery, because it gives one a means of seeing the interior of the body.

The amount of knowledge that has been acquired during this century upon scientific subjects is very much greater than in all previous centuries put together. I do not wish for a moment to lessen the credit due to Röntgen in connection with the discovery of which I have had the pleasure of showing some illustrations this evening, but we must remember that Röntgen simply worked upon a foundation laid by Lenard, Crookes, Hertz, Clerk Maxwell, Faraday, and others, and the most important thing which he discovered was that bone was much less transparent than flesh to the "X" rays.

We know that knowledge, and the discoveries that make knowledge, do not proceed from single brains, but are subject, as is everything else, to the law of evolution, and are the result of the cumulative workings of many minds.

[Numerous experiments were made by Mr. Mansell, and skiagraphs taken at the commencement of his lecture were developed, and lantern-slides made from them by Mr. F. Downer were shown on the screen at the conclusion of the lecture, with many other lantern-slides illustrating the subject.]

XVII.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN THE YEAR 1896.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 23rd March, 1897.

For several years the number of our rainfall stations has been 40. This number is now increased to 44. One station, Brocket Hall, disappears from our list, owing to Lord Mount Stephen's gardener who took the observations having left, and none of his other gardeners having been instructed to continue them. On the other hand, there are five stations added to the list—Bulbourne, near Tring; Offside Cottage, Cowroast; Laurel Bank, King's Langley; Bone Hill, St. Albans; and Aldenham House, Elstree, on the Upper Colne. Hitherto one station, Odsey, has been outside the county boundary, in Cambridgeshire, but almost surrounded by Hertfordshire; now there are two similarly circumstanced, Bulbourne being just over our border in Buckinghamshire, at the extremity of a spur of that county which projects into Hertfordshire. This latter station is on the water-parting between the river basins of the Thame and the Bulbourne, but the ground on the Bulbourne side seems to rise a little higher than that in the direction of the Thame, and therefore it is placed in that district, notwithstanding its name.

The number of daily records which has been received is 35, which is two more than for the previous year, but the same number as that for the year 1894.

Particulars of the 44 rainfall stations, and the monthly and total rainfall and number of days in the year 1896 on which at least 0·01 inch of rain fell, or, when the measurement is taken to thousandths of an inch, 0·005 inch, are given in Tables I and II, pp. 141–143.

The mean rainfall in the county in the year 1896 was 26·70 inches. This is 0·04 inch below the average for the decade 1880–89, and 0·27 inch above that for the half-century 1840–89. The year was, therefore, one of about average rainfall. The mean number of wet days in the year was exactly the average for the twenty years 1870–89.

In the distribution of the rainfall between the two halves of the year there is not much difference between 1895 and 1896. In the former year 27½ per cent. of the year's rain fell in the first six months, and 72½ per cent. in the last six months; in 1896 the fall in the first half of the year was 7·91 inches, or 30 per cent. of the whole, and the fall in the second half was 18·79 inches, or 70 per cent. of the whole year's fall. The autumn was much the wettest season, having 11·14 inches of rain, or 42 per cent. of the year's fall in one quarter of the year. September was an excessively wet month.

Droughts in 1896.—Accepting as usual Mr. Symons' definitions of an "absolute drought" as a period of *more than* 14 consecutive days without any rain, and a "partial drought" as a period of *more than* 28 consecutive days with an aggregate rainfall not exceeding 0·01 inch per day, there was one absolute drought in 1896, and one partial drought.

The absolute drought occurred at 24 out of the 35 stations for which I have the daily rainfall, its average duration being 22 days. It lasted for

34	days,	April 17	to	May	20,	at 1	station.
33	,,	,, 17	,,	,,	19	,, 2	,,
32	,,	,, 17	,,	,,	18	,, 1	,,
29	,,	,, 17	,,	,,	15	,, 1	,,
25	,,	,, 17	,,	,,	11	,, 2	,,
25	,,	,, 23	,,	,,	17	,, 1	,,
20	,,	,, 30	,,	,,	19	,, 1	,,
18	,,	,, 30	,,	,,	17	,, 2	,,
20	,,	May 1	,,	,,	20	,, 2	,,
19	,,	,, 1	,,	,,	19	,, 3	,,
17	,,	,, 1	,,	,,	17	,, 3	,,
17	,,	,, 2	,,	,,	18	,, 2	,,
16	,,	,, 2	,,	,,	17	,, 1	,,
15	,,	,, 2	,,	,,	16	,, 2	,,

The partial drought prevailed at all stations, commencing on the 17th of April and lasting at most of the stations until the 3rd of June, its average duration being 45 days, and the average rainfall 0·007 in. per diem. It lasted for at least

33	days,	April 17	to	May	19,	at the 35	stations.
34	,,	,, 17	,,	,,	20	,, 33	of these.
46	,,	,, 17	,,	June	1	,, 27	,, ,,
47	,,	,, 17	,,	,,	2	,, 26	,, ,,
48	,,	,, 17	,,	,,	3	,, 25	,, ,,

Distribution of Rainfall throughout the Year.—Of the total rainfall, 19 °/ₒ fell during the winter months (Jan., Feb., and Dec.), 17 °/ₒ during the spring (March to May), 22 °/ₒ during the summer (June to August), and 42 °/ₒ 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, were as follows:—

	Fall.	Diff.		Fall.	Diff.
1st quarter..........	4·76 ins.	—0·87 in.	Winter	5·06 ins.	—0·94 in.
2nd ,, ...	3·15	—2·86	Spring	4·58	—0·94
3rd ,, ...	10·37	+3·05	Summer..............	5·92	—1·06
4th ,, ...	8·42	+0·95	Autumn..............	11·14	+3·21

September was excessively wet; March, October, and December were also very wet; and August was rather wet. February and May were exceedingly dry; January and April were also very dry; and July and November were rather dry. The aggregate

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1896.

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 ⊼
,,	*Odsey	H. George Fordham	5	1	0	256 ⊼
3.	Hitchin—The Firs	William Lucas	5	2	1	238 ⊼
,,	* ,, Bancroft	Francis Ransom	5	0	9	212 T
,,	,, The Maples	William Hill	8	1	1	220 ⊼
,,	* ,, High Down	Joseph Pollard	5	1	1	422 ⊼
4.	*Tring—Elm House	E. J. Le Quesne	5	1	2	460
,,	,, Pendley Manor	J. G. Williams	5	2	0	500 ?
,,	* ,, Bulbourne	Gordon Thomas	5	2	3	401
6.	Cowroast	Gordon Thomas	5	3	8	394 L
,,	* ,, Offside Cottage	Richard Leah	5	1	4	420 ?
,,	*Northchurch—The Limes	F. L. Sutton	5	1	0	400 ?
,,	*Berkhamsted—Rosebank	Edward Mawley	8	1	0	401 ⊼
,,	* ,, Fairhill	W. Bonner Hopkins	5	1	0	550 T
7.	*Great Gaddesden Vicarage	Rev. W. T. Drake	8	1	0	427 ⊼
,,	*H. Hempstead—Apsley Mills	J. Dickinson & Co.	24	0	9	260
,,	* ,, Nash Mills	,,	12	3	9	237 ⊼
,,	Kg.'s Langley—Laurel Bank	Isaac Butler	5	1	0	283 ⊼
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	W. Newberry	5	1	0	423 T
,,	* ,, The Grange	John Hopkinson	5	1	0	380 ⊼
,,	* ,, Bone Hill	H. J. T. Broadwood	5	1	0	336 ⊼
9.	* Elstree—Aldenham House	Edwin Beckett	10 sqr.	4	9	305
10.	*Watford—Frogmore	Arthur P. Blathwayt	5	1	0	182
,,	,, ColneVal.WaterW'ks.	William Verini	5	1	0	220
,,	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340 ⊼
12.	*Welwyn—Bridge House	B. Wilfred Thomas	5	0	6	228 ?
,,	*Datchworth Rectory	Rev. J. Wardale	5	1	0	386 T
,,	Hertford—Marden Hill	Richard Hoare	5	0	10	257 T
13.	*Stevenage—Weston Park	M. R. Pryor	5	0	8	470 T
,,	* ,, Bennington House	Rev. Dr. Parker	5	1	0	408 ⊼
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 T
15.	*Much Hadham	T. Woodham Mott	5	1	0	222 B
16.	Sawbridgeworth—Cowicks	Harry W. Towse	6	1	0	240
17.	*Hertford—Bayfordbury	W. Clinton Baker	8	1	2	250
,,	*Ware—Red House	Joseph Francis	5	0	9	112 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 T
,,	*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 explanation of these symbols see Vol. VII, p. 53.

TABLE II.—RAINFALL IN

River District.			Station.	Jan.	Feb.	Mar.
				in.	in.	ins.
OUSE	Cam	1. Rhee	Royston	·81	·49	3·27
			Odsey	·72	·41	3·20
	Ivel	3. Hiz	Hitchin—The Firs	·70	·37	3·08
			,, Bancroft	·77	·45	3·32
			,, The Maples	·76	·36	3·30
			,, High Down	·73	·45	3·38
THAMES	Thame	4. Up. Thame	Tring—Elm House	·83	·38	3·30
			,, Pendley Manor	·96	·41	3·45
			,, Bulbourne	·84	·42	3·18
	Colne	6. Bulbourne	Cowroast	1·12	·38	3·32
			,, Offside Cottage	1·10	·38	3·24
			Northchurch—The Limes	1·05	·39	3·51
			Berkhamsted—Rosebank	·97	·38	3·52
			,, Fairhill	1·00	·41	3·60
		7. Gade	Great Gaddesden Vicarage	1·08	·50	3·93
			Hemel Hempstead—Apsley Mills	·90	·50	3·82
			,, Nash Mills	·74	·34	3·28
			King's Langley—Laurel Bank	·87	·44	3·88
		8. Ver	Kensworth—The Grove	1·21	·59	3·80
			Harpenden—Rothamsted	1·06	·56	3·62
			St. Albans—Gorhambury	·91	·47	3·76
			,, The Grange	·79	·46	3·62
			,, Bone Hill	·84	·47	3·93
		9. Up. Colne	Elstree—Aldenham House	·84	·50	3·62
		10. Lo. Colne	Watford—Frogmore	·78	·39	3·47
			,, Colne Valley Water Works	·81	·39	3·32
			Rickmansworth—Moor Park	1·19	·51	4·27
	Lea	12. Mimram	Welwyn—Bridge House	·78	·39	3·76
			Datchworth Rectory	·69	·42	3·14
			Hertford—Marden Hill	·76	·35	3·42
		13. Beane	Stevenage—Weston Park	·72	·48	3·76
			Bennington House	·66	·47	3·34
		14. Rib	Therfield Rectory	·86	·44	3·30
			Throcking Rectory	·69	·54	3·40
			Buntingford—Hamels Park	·80	·48	3·60
		15. Ash	Much Hadham	·86	·48	3·68
		16. Stort	Sawbridgeworth—Cowicks	·98	·69	4·10
		17. Upper Lea	Hertford—Bayfordbury	·56	·44	3·15
			Ware—Red House	·59	·44	3·23
			,, Fanhams Hall	·58	·44	3 06
		18. Lower Lea	Broxbourne—Stafford House	·60	·39	3·78
			Cheshunt—Old Nurseries	·54	·36	3·15
			New Barnet—Gas Works	·79	·37	3·47
			Southgate—The Lawns	·70	·41	3·19
Mean for the County				·83	·44	3·49

Hertfordshire in 1896.

Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Days.
in.	in.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
·85	·30	2·02	·65	2·38	5·25	2·96	1·05	3·06	23·09	169
1·03	·32	2·12	·85	2·16	6·68	2·82	0·99	2·46	23·76	181
·75	·32	1·59	1·01	2·38	5·85	3·36	1·10	3·21	23·72	178
·86	·36	1·84	1·19	2·43	5·85	3·34	1·17	3·40	24·98	179
·78	·31	1·64	1·06	2·35	5·75	3·42	1·12	3·29	24·14	161
·75	·40	1·21	1·30	2·42	6·46	3·19	·93	3·15	24·37	164
·74	·36	2·03	·88	3·52	6·88	3·34	1·18	4·13	27·57	183
·82	·42	1·90	1·10	3·50	7·08	4·04	1·41	4·50	29·59	210
·91	·39	2·00	·86	3·14	5·91	3·51	1·20	3·99	26·35	164
·79	·40	1·71	·87	2·69	7·22	3·83	1·31	4·28	27·92	
·81	·38	1·74	·89	2·78	7·13	3·87	1·34	4·25	27·91	181
·69	·28	2·04	·72	2·68	6·70	3·30	1·31	4·15	26·82	154
·70	·26	2·19	·81	2·79	6·54	3·50	1·33	4·31	27·30	165
·77	·28	2·16	·79	2·85	6·25	3·23	·81	4·18	26·33	178
1·19	·32	1·95	1·19	2·77	6·73	3·49	1·36	3·89	28·40	170
·94	·42	1·62	1·60	2·67	6·54	3·57	1·40	4·69	28·67	161
·70	·28	1·60	1·42	2·69	6·65	3·57	1·15	4·13	26·55	154
·86	·35	1·48	1·49	2·77	6·74	3·64	1·34	4·58	28·44	
·92	·47	2·31	1·29	3·36	6·19	3·82	1·27	3·89	29·12	169
·88	·45	2·09	1·21	2·78	7·66	3·87	1·29	4·05	29·52	171
·83	·34	1·74	1·06	2·56	6·80	3·82	1·31	4·24	27·84	172
·87	·34	1·60	·90	2·42	6·69	3·46	1·49	4·16	26·80	178
·72	·30	1·79	·96	2·71	6·33	3·22	1·44	3·76	26·47	159
·58	·10	2·18	·96	3·16	6·02	2·74	1·34	3·50	25·54	
·49	·27	1·41	1·53	3·60	7·29	2·96	1·36	3·89	27·44	158
·54	·30	1·71	1·21	2·85	7·13	2·95	1·32	3·76	26·29	160
·74	·27	1·68	1·41	3·32	7·97	3·72	1·50	4·79	31·37	171
·70	·35	2·11	·97	2·13	6·62	3·63	1·31	3·82	26·57	176
·58	·24	1·86	·71	2·32	6·46	3·11	1·10	3·46	24·09	148
·68	·24	2·40	·85	2·48	6·37	2·89	1·34	3·61	25·39	156
·82	·36	2·51	1·21	2·71	6·40	3·62	1·44	3·24	27·27	163
·64	·25	2·34	1·20	2·98	6·26	3·43	1·29	3·61	26·47	170
1·13	·40	2·64	·96	2·47	5·59	3·33	1·12	3·30	25·54	181
·93	·31	2·18	1·17	3·00	5·92	3·39	1·59	3·48	26·60	177
·73	·39	2·41	·92	2·87	5·80	3·52	1·21	3·58	26·31	151
·70	·39	2·87	·81	3·25	5·49	3·19	1·27	3·82	26·81	168
1·12	·43	2·94	1·34	3·76	7·44	3·92	1·08	3·67	31·47	165
·59	·24	2·36	·79	2·96	6·30	2·74	1·21	3·71	25·05	163
·58	·28	3·35	1·16	2·86	8·07	2·85	1·22	3·29	27·92	150
·57	·31	3·08	1·75	3·31	6·20	3·34	1·80	4·10	28·54	159
·63	·23	2·38	·67	3·37	6·24	3·37	1·24	3·34	26·24	170
·65	·27	2·02	·70	2·83	6·13	3·33	1·25	3·25	24·48	177
·54	·23	1·91	·98	2·44	6·79	3·07	1·19	4·02	25·80	
·56	·28	1·92	·98	1·93	6·13	3·14	1·17	3·80	24·21	185
·77	·32	2·06	1·05	2·81	6·51	3·37	1·26	3·79	26·70	168

rainfall in the four very wet months was about seven and a quarter times that in the four very dry ones. The difference in each month from the mean for the half-century was—

	in.		in.		in.		in.
Jan.	—1·48	April.....	—1·01	July	—1·45	Oct.	+0·43
Feb.	—1·27	May	—1·81	Aug.	+0·43	Nov.	—1·30
Mar.	+1·88	June	—0·04	Sept.	+4·08	Dec.	+1·81

Thus the fall for the first six months was 3·73 ins. below the mean, and for the last six months 4·00 ins. above the mean; and while one month had more than four inches above the average, no other month deviated as much as two inches from the average, and only three months more than an inch and a half from it.

The absolute maximum fall in any one day in each month, and the stations recording them, were—

	in.		ins.
Jan. 24—Kensworth...................	0·40	July 26—Apsley Mills, Hemel Hempstead	1·15
Feb. 20—Moor Park, Rickmansworth	0·22	Aug. 31—Sawbridgeworth.....	1·08
Mar. 18—Broxbourne	0·97	Sept. 12—Odsey	1·76
April 10—Great Gaddesden	0·48	Oct. 6—Gorhambury	0·97
May 21—Kensworth	0·34	Nov. 7—Moor Park	0·59
June 24—Fanhams Hall, Ware	1·33	Dec. 4—Pendley, Tring	0·92

The wettest day in each month at 43 stations was—

January 24th at 37, 25th at 6.

February 8th at 15, 12th at 1, 20th at 16, 29th at 10, 8th and 20th at 1.

March 17th at 21, 18th at 3, 20th at 18, 22nd at 1.

April 4th at 10, 10th at 24, 11th at 4, 12th at 2, 16th at 1, 4th and 10th at 1, 12th, 14th, and 16th at 1.

May 18th at 2, 20th at 1, 21st at 40.

June 7th at 2, 10th at 33, 24th at 8.

July 7th at 3, 16th at 1, 25th at 2, 26th at 37.

August 9th at 2, 10th at 5, 19th at 9, 25th at 8, 31st at 18, 10th and 31st at 1.

September 1st at 2, 4th at 5, 10th at 7, 12th at 10, 23rd at 1, 24th at 18.

October 6th at 35, 12th at 1, 15th at 3, 19th at 4.

November 7th at 34, 14th at 8, 7th and 14th at 1.

December 2nd at 2, 4th at 41.

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

Jan. 24th	April 10th	July 26th	Oct. 6th
Feb. 20th	May 21st	Aug. 31st	Nov. 7th
March 17th	June 10th	Sept. 24th	Dec. 4th

The number of wet days in the year (average of 40 gauges) was 168, being exactly the same as the mean for the 20 years 1870–89. Of the total number there were 41 (or 24 °/ₒ) in the winter months, 39 (or 23 °/ₒ) in the spring, 35 (or 21 °/ₒ) in the summer, and 53 (or 32 °/ₒ) in the autumn.

The average number of wet days in each month, and the deviation from the mean for the 20 years 1870–89, were as follows—

Jan.	10	— 5	April	11	—2	July	9	— 5	Oct.	20	+5
Feb.	8	— 6	May	4	—9	Aug.	16	+ 3	Nov.	10	—6
March	24	+11	June	10	—3	Sept.	23	+10	Dec.	23	+7

Distribution of Rainfall throughout the County.—The following table (Table III) 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.

TABLE III.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	·77	·74	·88	·96	·72	·75	·85
Feb.	·45	·38	·40	·45	·45	·41	·45
March	3·23	3·27	3·31	3·64	3·44	3·26	3·50
April	·94	·81	·82	·78	·71	·85	·76
May	·31	·35	·39	·32	·31	·34	·32
June	2·07	1·57	1·98	1·83	2·43	1·74	2·11
July	·75	1·14	·95	1·13	1·01	1·01	1·06
August	2·27	2·39	3·39	2·86	2·80	2·35	2·86
Sept.	5·79	5·98	6·62	6·81	6·37	5·97	6·61
October	2·89	3·33	3·63	3·48	3·29	3·18	3·41
Nov.	1·02	1·08	1·26	1·31	1·28	1·06	1·30
Dec.	2·76	3·26	4·21	4·14	3·59	3·09	3·90
Year	23·43	24·30	27·84	27·71	26·40	24·01	27·13
Diff. from 1880-89	—0·07	—0·97		—1·26	+0·85	—0·47	—0·02

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

District	Sub-district	ins.
CAM	Rhee	23·43
IVEL..........	Hiz............................	24·30
THAME.....	Upper Thame.........	27·84
COLNE	Bulbourne	27·26
	Gade	28·01
	Ver	27·97
	Upper Colne	25·54
	Lower Colne	28·37
LEA................	Mimram	25·35
	Beane	26·87
	Rib	26·15
	Ash	26·81
	Stort	31·47
	Upper Lea..........	27·17
	Lower Lea..........	25·18

The total yearly fall ranged from 23·09 inches at Royston to 31·47 ins. at Cowicks, Sawbridgeworth; and the total monthly fall from 0·10 inch at Aldenham House, Elstree, in May, to 8·07 ins. at the Red House, Ware, in September. The greatest fall in any one day was 1·76 inch at Odsey, on the 12th of September.

Distribution of the 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 ½ inch being styled *considerable*, ¾ inch *very considerable*, 1 inch *great*, 1¼ inch *very great*, 1½ inch *heavy*, and 1¾ inch *very heavy*. There was no *excessive* fall (2 inches) in the year. This analysis only applies to the thirty-five stations for which I have returns of the daily rainfall.

JANUARY.—A very dry month, with no snow, the rain falling on two-thirds the average number of days. There was no considerable fall of rain at any station.

FEBRUARY.—An exceedingly dry month, having little more than half the rainfall of January, with scarcely any snow, and rain on little more than half the average number of days. As in January there was no considerable fall of rain at any station.

MARCH.—A very wet month, the rainfall being more than double the average and on a large number of days, with occasional falls of snow. On the 17th the fall of rain was *considerable* at twenty-six stations, and *very considerable* at one; on the 18th it was *considerable* at two; on the 20th *considerable* at thirteen and *very considerable* at five; and on the 22nd it was *considerable* at one.

APRIL.—A very dry month, with rain on a rather small number of days. A partial drought commenced on the 17th and lasted at all but a few stations to about the end of the following month. There was no *considerable* fall of rain.

MAY.—An exceedingly dry month, having even less rain than February, and on a very small number of days, being less than a third the average. The rainfall was about one-seventh the average, and only just over the amount which would have constituted the month one of partial drought throughout the whole county. There was no *considerable* fall of rain.

JUNE.—Rainfall about the average, nearly all falling within the first ten days, and the number of wet days being small. On the 7th the fall was *considerable* at four stations; on the 10th *considerable* at seventeen, *very considerable* at twelve, and *great* at Weston Park (1·03 in.); and on the 24th (on the east of the county only) *considerable* at five stations, *very considerable* at one, and *very great* at the Red House, Ware (1·32 in.), and at Fanhams Hall, Ware (1·33 in.).

JULY.—A dry month, the rainfall being less than half the average and on about two-thirds the usual number of days. On the 7th the fall was *considerable* at one station and *very considerable* at one; and on the 26th it was *considerable* at eight stations, *very considerable* at two, and *great* at Apsley Mills, Hemel Hempstead (1·15 in.). During a violent thunderstorm on the 7th a "remarkably brilliant thunderbolt" is reported to have fallen near Dunstable.

AUGUST.—A rather wet month, with rain on rather more than the usual number of days. On the 9th the fall was *considerable* at one station, and on the 10th at five; on the 19th it was *considerable* at eight and *very considerable* at one; on the 25th it was *considerable* at four; and on the 31st it was *considerable* at ten and *very considerable* at four.

SEPTEMBER.—An excessively wet month, the rainfall being nearly three times the average and greater than in any previous month since these reports were commenced more than twenty years ago, the only near approach to it being in October, 1891, when the average rainfall throughout the county was 6·24 inches. There were nearly twice as many wet days as usual. There were two days on which the rainfall was at least *considerable* at all the stations in the county, the 4th and the 24th, although the greatest fall at any one station occurred on the 12th. On the 1st the fall was *considerable* at thirteen stations, *very considerable* at nine, and *great* at Odsey (1·03 in.) and Therfield (1·07 in.). On the 4th it was *considerable* at five stations, *very considerable* at twenty-eight, and *great* at Weston Park (1·04 in.) and Royston (1·07 in.). On the 5th it was *considerable* at one station and *very considerable* at one; and on the 8th it was *considerable* at four and *very considerable* at one. On the 10th it was *considerable* at thirteen, *very considerable* at thirteen, *great* at Datchworth (1·15 in.), and *very great* at the Red House, Ware (1·36 in.). On the 12th it was *considerable* at ten stations, *very considerable* at sixteen, *great* at Frogmore, Watford (1·00 in.), Bayfordbury, Hertford (1·00 in.), Southgate (1·05 in.), Northchurch (1·07 in.), Bancroft, Hitchin (1·09 in.), Offside Cottage, Cowroast (1·13 in.), and New Barnet (1·19 in.), and *very heavy* at Odsey (1·76 in.). On the 13th it was *very considerable* at one station (Red House, Ware); on the 17th it was *considerable* at one station; and on the 22nd it was *considerable* at twenty-one stations and *very considerable* at one. The heavy falls of rain in this remarkable month closed on the 24th, when the fall was *considerable* at four stations, *very considerable* at twenty-two, and *great* at Offside Cottage, Cowroast (1·00 in.), The Grange, St. Albans (1·01 in.), Welwyn (1·01 in.), Bayfordbury, Hertford (1·02 in.), the Red House, Ware (1·02 in.), Great Gaddesden (1·04 in.), Elm House, Tring (1·07 in.), Gorhambury, St. Albans (1·10 in.), and Moor Park, Rickmansworth (1·15 in.). During a thunderstorm on the 8th rain fell at Rosebank, Berkhamsted, for five minutes at the rate of two inches per hour, and for ten minutes at the rate of an inch and a half per hour.

October.—A very wet month, although the rainfall was not much above the average, this usually being the wettest month in the year. The number of wet days, however, was one-third more than usual. On the 6th the fall was *considerable* at eighteen stations and *very considerable* at eight; and there was a *considerable* fall at four stations on the 12th, at one on the 15th, and at eight on the 19th. There were several thunderstorms.

November.—A dry month, the rainfall being about half the average, and on a small number of days. Nearly all the rain fell during the first half of the month, and the only *considerable* fall was on the 7th at seven stations.

December.—A very wet month, the rainfall being about double the average, and on half as many more days than usual. On the 2nd the fall was *considerable* at five stations; on the 4th it was *considerable* at twenty-six stations, and *very considerable* at eight; and on the 24th it was *considerable* at six.

XVIII.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1896.

By Alan F. Crossman, F.L.S.

Read at Watford, 23rd March, 1897.

I have not many notes to report on birds which have actually occurred in our county in 1896, inasmuch as I find the greatest difficulty in obtaining correspondents. Most people appear to think that I only want records of rare birds. This, however, is not the case, as I am only too glad to get notes on any birds, whether rare or common, that are seen in Hertfordshire. A thorough knowledge of the avifauna of the county can only be obtained by such assistance, as it is impossible for one man to carefully study every district.

To try to make up for such shortcomings with regard to birds observed in 1896, I have been searching various books with a view to bringing before the Society old records of birds formerly seen in Hertfordshire, but which have never been recorded in our 'Transactions.' Amongst other books I studied 'The Birds of Berks and Bucks,' by the late Captain Clarke Kennedy; and 'The Birds of Middlesex,' by Mr. J. E. Harting, who is an honorary member of this Society. From the former I gained much information about birds which had up to the date of publication of the book—viz. 1868—occurred at the Tring Reservoirs; and from the latter, which was published in 1866, I obtained a few records of birds which had been found at Elstree Reservoir. All the information taken from these two books, and from any others which I have examined, I have incorporated in my present paper. It seems to me that a recorder to a Natural History Society should do his best to bring before such Society not only records of recent events or discoveries, but should also from time to time endeavour to search up all old records which have not appeared in the 'Transactions' of the Society, in order that if anyone in time to come should wish to bring out a fauna of the county, he would have before him all the materials for doing so without having also the trouble of searching through a vast amount of literature and obtaining possibly very small results. This is what I have been endeavouring to do, and I only hope that my efforts may be of assistance to some future author of a book on the birds of Hertfordshire.

Although I have no record of any bird new to our county list having been obtained in 1896, I have the pleasure of directing your attention to four birds, which, although they occurred or are reported to have occurred in Hertfordshire some years ago, do not appear to have been mentioned in our 'Transactions.' I can give very little information about these birds, except the fact that they or their eggs have been seen. Three out of the four occurred at the Tring Reservoirs, and no doubt is likely to attach to the reports of them, inasmuch as the vast expanse of water there would be a very likely spot for them. With regard to the fourth, however, I hesitated very much at first as to whether I should make any mention of it, but eventually I decided to bring the record before the Society for what it is worth. The finding of the eggs of the bird referred to was recorded by a man who was one of the first field naturalists of his day. I refer to the late Mr. F. Bond, but of course there is the chance of his having been falsely informed.

Following the usual order observed in former reports, I will first state what I know about the birds new to the county list, and will then proceed to give such notes on any other birds as appear to me to be of sufficient interest to introduce into this report.

1. Great Reed-Warbler (*Acrocephalus turdoides*).—Mr. A. G. More, in his excellent paper on "The Distribution of Birds in Great Britain during the Nesting Season," which appeared in the 'Ibis' for 1865, stated that the late Mr. F. Bond told him that he had seen three eggs of this bird which were taken in Hertfordshire. Unfortunately, no particulars are given either as to locality or date. I should think from what I have heard about the great reed-warbler that the only place suitable for it in this county would be one of the Tring Reservoirs, but this, of course, is only a surmise. I can get no further information about these eggs, and, as Mr. Bond died in 1889, it is improbable that any more will ever be forthcoming. This bird has only occurred on a few occasions in Great Britain, and hence it seems curious that no other details were mentioned in this instance. It is a bird which cannot be mistaken, and furthermore it is bold and is very conspicuous from its large size and its loud harsh song. Mr. Howard Saunders states that south of the Baltic the reed-warbler is abundant in summer in suitable localities throughout Europe as far south as the Mediterranean; he also mentions that it breeds annually as near to us as Calais, and is common in Belgium and Holland. In the breeding-season it need only be looked for in reed-beds. The nest he describes as being a compact cup-shaped structure some five inches deep, composed of dry reeds and grass with a lining of the finer portions and the flowers of the same, the whole being closely bound to and suspended from several upright reed stems. The eggs, four, five, or six in number, are pale greenish-blue, botched and speckled with ash-grey, russet-brown, and dark olive.

2. White-fronted Goose (*Anser albifrons*).—Captain Clarke Kennedy stated that he was informed by the Rev. H. H. Crewe that this species had been observed at the Tring Reservoirs. Until I went thoroughly into the old records of the birds of Hertfordshire, for the purpose of preparing this paper, I was under the impression that this bird had already been recorded in our 'Transactions,' but I find that this is not the case, and that therefore it is an addition to our county list. It is, however, unfortunate that there is not

more information in 'The Birds of Berks and Bucks' about this and the two following species. The white-fronted goose is only an annual winter visitor to the British Islands, its chief nesting-grounds being in Siberia.

3. Gadwall (*Anas strepera*).—The gadwall is also stated, on the authority of Mr. Crewe, to have been occasionally killed at the Reservoirs. This duck, according to Mr. Howard Saunders, is uncommon except in Norfolk and one or two spots in the Midlands. In Norfolk, however, on certain estates, it breeds in large numbers, and I would refer anyone desiring further information on the subject to Stevenson's 'Birds of Norfolk.'

4. Velvet Scoter (*Œdemia fusca*).—Mr. Crewe also mentioned that this bird had occurred on two occasions at Tring, but gave no further details. The velvet scoter, which may easily be distinguished from the common scoter by its larger size and its wing, is far less numerous on our coasts, but one or two pairs may often be observed with almost every flock of the common bird on certain parts of our coasts. The late Mr. Booth believed that a few pairs breed in parts of the Northern Highlands, but this has never been actually proved.

Miscellaneous Notes.

Blackbird (*Turdus merula*).—Amongst the information I obtained from Captain Clarke Kennedy's book on the 'Birds of Berks and Bucks,' was the statement that several black and white birds of this species were observed in Ashridge Park during the year 1862.

Ring-Ouzel (*Turdus torquatus*).—On 8th May, 1896, my brother saw one of these birds near a little pond on Berkhamsted Common. Mr. Latchmore informs me that ring-ouzels are seen regularly every spring at Ickleford, near Hitchin; and Mr. Lucas states that his father used frequently to see these birds on his lawn at the latter place, but that they have not appeared there in recent years. On looking through the past records of this bird in Hertfordshire, I find that between 1877 and 1886 it was reported nearly every year, and that, with two exceptions, all the examples were seen in the autumn. From 1886 to 1895 I can find no records of this bird in the 'Transactions,' but I was able to report its occurrence in two localities in the latter year during the spring migration. A striking feature about the appearance of the ring-ouzel in this county is the late date on which it has so often occurred, several of the records being in November, and one being so late as December 12th, on which date in 1882 the late Mr. Littleboy saw two or more at Caldecott. In the 'Zoologist' for 1879 there is an interesting article by Mr. Harting on the occurrence of this species in the British Isles during the winter, in which he enumerates several well-authenticated instances of the bird remaining so late with us.

Stonechat (*Pratincola rubicola*).—I observed the stonechat on Berkhamsted Common on 25th and 27th December, 1896. It is probable that it remained with us on account of the unusually mild weather which lasted up to the end of the year.

REDBREAST (*Erithacus rubecula*).—Captain Clarke Kennedy states in his book that in the summer of 1862 he found in a lane near Berkhamsted a robin's nest containing four pure white eggs, which, however, appeared pink before they were blown. In Vol. VIII of our 'Transactions' Mr. Lewis mentions some apparently white eggs of this bird, but on closer examination very faint markings could be observed.

WOOD-WREN (*Phylloscopus sibilatrix*).—The wood-wren was rather late in arriving near Berkhamsted in 1896. In two woods at least, where I observed it in 1895, it did not appear at all, while, on the other hand, I heard it on June 20th at Ockridge Wood, where I did not notice it in the previous year. I heard the bird singing as late as July 5th, near Aldbury, and on the following day in Frithsden Copse. On May 31st I found in a wood above Aldbury a nest belonging to this species containing seven eggs. It was placed amongst a lot of undergrowth, and was extremely difficult to find; in fact, I only discovered it after a long search by following and watching the hen bird. Young birds were eventually hatched from this nest. In the wood in question the wood-wren was fairly plentiful, and one could see several pairs there in an afternoon. Mr. Harting, in the 'Birds of Middlesex,' states that this bird used to occur in the neighbourhood of Bushey.

GRASSHOPPER-WARBLER (*Locustella nævia*).—This bird was very plentiful on Berkhamsted Common in 1896. I also heard it singing on King's Langley Common. The latest date on which I heard one singing was July 7th, on Berkhamsted Common.

COAL-TITMOUSE (*Parus britannicus*).—Captain Clarke Kennedy mentions in his book that he once found a nest of this species built in a haystack at Little Gaddesden. This seems a very unusual situation for this bird to build in, but the tits are famous for choosing curious nesting-sites.

MARSH-TITMOUSE (*Parus palustris*).—Mr. Rivers informs me that he found a marsh-tit's nest with young birds in a hole in the wood of an orchard-house. He does not state whether the hole was dug out by the bird itself, but this species very often digs out a hole in a rotten post or stump for its nest. A noticeable fact about the marsh-tit is that, when it does dig out its own nesting-hole, as a rule no chips are to be found on the ground below, proving clearly that the bird carries them away.

PIED WAGTAIL (*Motacilla lugubris*).—This bird appeared to stay with us during the whole of the winter of 1895–96, and I also saw it in December, 1896, near Berkhamsted. Mr. Rivers tells me that he found a nest of this species in the yew-hedge, in nearly the same place as the nest containing twelve eggs which he found in 1895, and which I mentioned in my report for that year under the head of the next species. Later on in the season he found a second nest in nearly the same spot.

White Wagtail (*Motacilla alba*).—I saw this wagtail on several occasions near Berkhamsted in 1896, but could obtain no actual proof of its nesting in the neighbourhood.

Grey Wagtail (*Motacilla melanope*).—This bird remained with us in 1896 until nearly the end of March, and appeared again about the middle of September, which was nearly a month earlier than the date on which I first saw it in 1895.

Meadow-Pipit (*Anthus pratensis*).—I saw one or two pairs of meadow-pipits on Berkhamsted Common during the summer, but could not discover whether they were actually nesting there. The bird appears to nest in the neighbourhood of Royston, but there does not seem to be any other place in the county where the fact of its nesting has been actually proved.

Great Grey Shrike (*Lanius excubitor*).—Mr. F. Sutton informed me that he shot a male of this species at Hill Farm, Northchurch, in January, 1886. It was sitting on a high tree, and when shot fell off into the snow, and on account of its colour could not at first be found. He has the specimen in his possession now. Mr. Latchmore states that he has one of these birds which was shot on Norton Common, near Baldock, and Mr. Lucas tells me that specimens have been seen from time to time near Hitchin. This bird has been obtained in Hertfordshire on about a dozen occasions since 1880.

Pied Flycatcher (*Muscicapa atricapilla*).—A specimen of this species was seen in Hitchin by Mr. Lucas in the summer of 1896, and was eventually shot and preserved. Mr. Latchmore also mentions that the pied flycatcher has occasionally been seen in the neighbourhood of Hitchin. Only three examples of this bird have been previously recorded in Hertfordshire, the last of the three being shot at Stevenage in May, 1887.

Hawfinch (*Coccothraustes vulgaris*).—The hawfinch was fairly plentiful in the Berkhamsted district in 1896, although I did not notice it in such large numbers as in 1895. On June 21st I saw three of these birds in our garden at Berkhamsted feeding on a cherry-tree; so far as I could see, they were a female and two young birds. Mr. Rivers informs me that this species is resident in the neighbourhood of Sawbridgeworth, and he mentions Pishiobury as a place where he thinks they nest, although he has not had an opportunity of actually verifying the fact. He also says that one or two families may sometimes be seen during the summer feeding together on the peas in his garden. Mr. Lucas states that he has observed this bird in the neighbourhood of Hitchin, while Mr. Nunn informs me that within the last three years the hawfinch has established itself in the parish of Therfield, very much to the annoyance of gardeners there. In the 'Zoologist' for 1849 there is a note from the late Rev. H. H. Crewe, in which he mentions that a male hawfinch had been killed at Berkhamsted about six years previously, and that in April, 1849, he had observed a pair in a wood near Tring, and he then wrote as if this species was at that time a comparatively rare bird in the north-west portion of Hertfordshire. I am glad to be able to say that this is not now the case, but that the fine bird may now be considered as a fairly plentiful and increasing resident.

Goldfinch (*Carduelis elegans*).—The goldfinch has been reported to me as having been seen on several occasions in the district around Berkhamsted during the latter part of 1896, both in small parties and singly. In April of that year I found a nest of this species containing young birds in a small fir spinney just outside the borders of the county; it was placed at the end of a bough of a small pine, and was built of moss and lined with what appeared to be catkins. Although this nest was not actually in Hertfordshire, it is interesting to know that a bird which is in some districts becoming very scarce still nests at least near to our county. Mr. H. S. Rivers tells me that he frequently saw goldfinches about near Sawbridgeworth in 1896, and that he is almost certain that a pair nested in his garden, although he could not actually discover the nest.

Tree-Sparrow (*Passer montanus*).—This bird, according to Mr. Harting, used occasionally to be observed in small flocks at Elstree during the winter-time. Mr. Nunn tells me that during the last few years the tree-sparrow has commenced to nest in the neighbourhood of Royston, where in former times it was only a winter visitor.

Mealy Redpoll (*Linota linaria*).—Mr. Harting, in his book on the 'Birds of Middlesex,' states that a pair of these birds were obtained near Elstree in 1866, and further that he had been informed that the bird might be procured there in most years. This bird has only been recorded in Hertfordshire on one other occasion, when one was taken by a bird-catcher on the north-western border of the county, towards Ivinghoe. According to Mr. Howard Saunders the mealy redpoll is a regular winter visitor to the north of the British Isles, but becomes less plentiful further south.

Lesser Redpoll (*Linota rufescens*).—Mr. Lucas informs me that he has observed this species in the neighbourhood of Hitchin, and he also says that he possesses some eggs which were taken in that locality. Mr. Rivers states that on 29th July, 1896, he saw a lesser redpoll on a birch-tree in his grounds at Sawbridgeworth. This is the first occasion on which he has observed the bird in that district.

Cirl-Bunting (*Emberiza cirlus*).—Mr. More, in the 'Ibis' for 1865, mentions that on 4th June, 1864, the Rev. H. H. Crewe found near Tring a nest of the cirl-bunting containing three eggs. The chalk hills of Hertfordshire are mentioned by Mr. Howard Saunders in his 'Manual' as one of the breeding-places of this species, and in Vol. VIII of our 'Transactions' it is mentioned as having been very plentiful around Tring in 1894.

Jackdaw (*Corvus monedula*).—Mr. Silvester informs me that on 10th March, 1896, his ploughman, who was rolling a meadow on Hedges Farm, St. Albans, about ten o'clock in the morning, saw a flock of rooks attack three jackdaws, two of which they killed, the third managing to escape for a time. As soon, however, as they had despatched the two, the rooks started full cry after the survivor, and although the man did not see the finish, he had no doubt that it shared the same fate as the others. This is a most curious circumstance, and one would very much like to know the reason of this apparently unprovoked assault.

NIGHTJAR (*Caprimulgus europæus*).—I saw the nightjar on several occasions near Berkhamsted. They seemed particularly plentiful on the Common, and could be heard there on most evenings during the summer. When disturbed they usually fly only quite a short distance, and then settle again. A young bird of this species was shot near Northchurch on October 6th. Mr. Lucas mentions the bird as occurring at Wain Wood, near Hitchin, and Mr. Latchmore states that it is very common in certain localities in that district.

WRYNECK (*Iÿnx torquilla*).—The wryneck was fairly plentiful in the Berkhamsted district in 1896. The latest date on which I saw one was September 5th, at Northchurch. I was particularly struck with its flight, which reminded me of that of a red-backed shrike, for which, indeed, I mistook the bird at first. Mr. Rivers reports this bird from Sawbridgeworth, and Mr. Lucas has observed it in the neighbourhood of Hitchin. Mrs. Bishop informed Mr. T. Vaughan Roberts that the bird is observed annually in her garden at Watford.

GREAT SPOTTED WOODPECKER (*Dendrocopus major*).—This bird was very plentiful in West Herts during the year 1896. I saw several holes in a wood called Frithsden Beeches, which were apparently tenanted by this species, and under one of them I found egg-shells from which young birds had been hatched. The bird occurs near Hitchin, and Mr. Rivers has frequently observed it around Sawbridgeworth.

LESSER SPOTTED WOODPECKER (*Dendrocopus minor*).—Mr. Harting, in the 'Birds of Middlesex,' mentions this bird as having been observed near Elstree. Mr. Latchmore and Mr. Lucas both inform me that they have seen it near Hitchin, and it also occurs near Sawbridgeworth. I myself saw several of these birds near Berkhamsted in 1896.

KINGFISHER (*Alcedo ispida*).—The kingfisher was fairly plentiful along the Canal and River Bulbourne, near Berkhamsted, in 1896. On the other hand, Mr. Latchmore states that in the neighbourhood of Hitchin this species is nearly extinct, owing to the way in which it is destroyed there by birdcatchers, who hang a silk net over the arch of a bridge, and then drive the birds up or down stream, as the case may be; in this way they are easily caught. He suggests that the kingfisher should be protected all the year round in Hertfordshire, which, if possible, would be a very good thing to do.

LONG-EARED OWL (*Asio otus*). — In 'The Birds of Berks and Bucks,' Ashridge Park is mentioned, on the authority of the Rev. Dr. Jenks, as a regular breeding-place of this bird.

TAWNY OWL (*Syrnium aluco*).—A curious circumstance is mentioned in the 'Field' of 18th May, 1895, by Mr. Naylor, of

Amwellbury, Ware. He stated that on May 12th of that year he found a young bird of this species nearly fledged, having evidently fallen out of the nest, which, however, he could not discover. He carried it into the shade. Towards evening it became much livelier, and managed to climb upon a railing about eighty yards from the house. On going to look at it about 8 p.m., and while still some ten yards away from it, one of the old birds swooped down on him from a neighbouring tree unseen, striking him a heavy blow on the ear and cheek and drawing blood with claws and beak. The blow was almost a knock-down one, but the bird passed on immediately.

Hen-Harrier (*Circus cyaneus*).—Mr. Lucas tells me that he once saw a hen-harrier near Hitchin. About the year 1845 a pair of these birds were shot in the parish of Sandon. They were preserved by the late Mr. Norman, and were in the possession of the late Mr. Henry Fordham at the time of his death. The only other record that I can find of this bird in Hertfordshire is of one that was killed near Weston Manor, Stevenage, on 28th October, 1883.

Peregrine Falcon (*Falco peregrinus*).—A female of this species was killed on 6th August, 1896, on Mr. Sutton's premises at Northchurch, by a boy with a stick, while it was attacking some fowls. It is now in the possession of Mr. W. Sutton. On December 20th in the same year a fine specimen was shot on the very borders of the county near Brockley Hill, by Mr. Arthur Wilshin. Mr. Latchmore mentions that this bird has occasionally been obtained in the neighbourhood of Hitchin, but gives no further information. Mr. Nunn informs me that a pair were shot by a keeper in Newnham plantation, not far from Baldock, about the year 1878, and were formerly in the possession of Mr. Simpson. In my report for 1895 I mentioned two other occasions on which the peregrine had occurred in that year in Hertfordshire.

Hobby (*Falco subbuteo*).—Mr. Latchmore has in his possession some eggs of this hawk which were taken at Stevenage. Mr. Nunn informs me that when he went to reside in the parish of Kelshall in 1847, the hobby was fairly plentiful in that neighbourhood, but that in 1849 the last bird obtained in that parish was shot from the nest. The bird is now in his possession. The hobby has been recorded as nesting in Hertfordshire on one other occasion. A nest with four eggs was found in Moor Park by a keeper in 1881.

Merlin (*Falco æsalon*).—Mr. Thompson, of Elstree, informs me that a merlin was observed near there in December, 1896, and Mr. Lucas states that it has been seen at times near Hitchin. This bird has only been recorded as having been shot in this county on five other occasions. One was shot at Hitchin, but no date is given, and it is probably one of those mentioned by Mr. Lucas. The other four were obtained at Tring, two being shot there in February, 1886, and two in January, 1887.

Osprey (*Pandion haliaëtus*).—In the 'Ibis' for 1865 there is a letter from the Rev. H. H. Crewe about a pair of ospreys which frequented the Tring Reservoirs during the month of September,

1864. On the 30th of that month the female was shot while devouring a fish. The male continued in the neighbourhood for some time and then disappeared. This species has been recorded in our 'Transactions' on several occasions, the most recent record being of one that was seen fishing in the River Lea, near Wheathampstead, in September, 1887.

LITTLE BITTERN (*Ardetta minuta*).—In the 'Birds of Middlesex,' Mr. Harting mentions a male of this species in good plumage, then in the collection of Mr. Bond, which was obtained at Elstree Reservoir in 1840. There is one other record of this bird in Hertfordshire. On 17th October, 1884, one was shot near the Carthagena Weir near Broxbourne.

BITTERN (*Botaurus stellaris*). — Mr. Lucas informs me that a bittern was heard near Hitchin in 1894, and Mr. Latchmore states that one, now in the possession of Mr. William Hill, was shot near there some years ago.

WHOOPER (*Cygnus musicus*).—The Rev. H. H. Crewe informed Captain Clarke Kennedy that this bird was an occasional visitor to the Tring Reservoirs. From our 'Transactions' I find that in the winter of 1875–76 a pair of whoopers frequented a piece of water in Great Gaddesden parish, and that in 1892 thirty were seen flying over Hertford, one of them being afterwards shot at Woodhall.

COMMON SHELDRAKE (*Tadorna cornuta*).—This bird is also mentioned as an occasional visitor to the Tring Reservoirs. In December, 1896, one was also observed at Elstree Reservoir, where another is recorded as having been shot in 1883. The only other record of this species in Hertfordshire is of one seen at Tring in 1888.

PINTAIL (*Dafila acuta*).—The pintail formerly occurred at Tring every winter, but in recent years it has only been recorded on two occasions in this county, both being at Tring.

TEAL (*Querquedula crecca*).—I observed this species at the Tring Reservoirs on several occasions in 1896, and Mr. Thompson tells me that the keeper at Elstree Reservoir also saw it there occasionally.

WIDGEON (*Mareca penelope*).—The widgeon used formerly to occur plentifully at Tring during the winter, but is now usually seen there only in small parties. Street saw five there on 5th January, 1896. The bird is also frequently seen at Elstree.

SCAUP (*Fuligula marila*).—The scaup is mentioned in 'The Birds of Berks and Bucks' as being an occasional visitor to the Reservoirs at Tring. In recent years it has only been recorded in Hertfordshire on two occasions, viz., one at Easneye, near Ware, in 1881, and one at Tring in 1884.

GOLDEN-EYE (*Clangula glaucion*). — This bird appears to have always been a fairly regular winter visitor to Tring, and the year 1896 was no exception in this way, as Street saw nine there on January 6th. It is only very rarely that drakes in full plumage are seen there, the annual visitors being usually females and young birds. In 1849, at the beginning of the year, a fine male in full plumage was obtained.

Common Scoter (*Œdemia nigra*).—In the 'Birds of Berks and Bucks' the scoter is mentioned as having been observed at Tring. Within recent times it has occurred at Bushey Heath, a pair having been seen there in 1881, and at Tring, where a female was shot in October, 1884.

Goosander (*Mergus merganser*). — Small parties of goosanders used occasionally to visit the Tring Reservoirs in former years, but of late they have been less frequent. In January, 1896, however, Street saw two there.

Redbreasted Merganser (*Mergus serrator*). — This bird also appeared at the Tring Reservoirs there at times, but does not seem to have done so recently. At Munden House, near Watford, there is a pair of these birds which were obtained there between 1840 and 1850.

Stock-Dove (*Columba œnas*).—Captain Clarke Kennedy, in his book, states that the stock-dove formerly nested in large numbers in Ashridge Park, and I can bear witness to their being fairly plentiful there at the present time.

Quail (*Coturnix communis*). — Mr. Sainsbury Verey informed me that he heard a quail near Heronsgate early in June, 1896. Mr. Lucas gives this as one of the birds observed near Hitchin, and Mr. Latchmore states that it breeds in that neighbourhood every year.

Spotted Crake (*Porzana maruetta*).—Mr. Latchmore has a spotted crake which was killed by flying against the telegraph-wires near Hitchin in November, 1893, and has seen others obtained in that locality. He also states that one was found dead in August, 1896, at Offley. Mr. Lucas informs me that one was procured in the Hitchin district during the past winter.

Stone-Curlew (*Œdicnemus scolopax*).—In the 'Birds of Berks and Bucks,' Captain Clarke Kennedy mentions, on the authority of the Rev. H. H. Crewe, that this bird was formerly very common in the neighbourhood of Tring. Mrs. Ashby, of Norcott Hill Farm, has in her possession a stuffed specimen which was obtained some twenty years ago, at Dudswell, between Berkhamsted and Tring. This is a very light-coloured bird. Mr. Lucas states that the stone-curlew is still fairly plentiful in the neighbourhood of Hitchin, and Mr. Latchmore informs me that it breeds near Hexton. On the other hand, Mr. Nunn tells me that he has known of no eggs having been found in the Royston district since 1894. This bird, which frequents much the same sort of country as the great bustard used formerly to do, seems, I am sorry to say, to be gradually disappearing from our county. I should be very glad of any notes on the habits and distribution of the bird in Hertfordshire, in order that, in times to come, our descendants may not be without some information about it, as is unfortunately the case with us with reference to the great bustard, which disappeared from the county without any record at all having been kept even as to when the last one was seen.

Dotterel (*Eudromias morinellus*).—Mr. Latchmore informs me that the dotterel comes every spring to the hills near Royston, resting there a few days on its way north, and appearing there again in the autumn. He also tells me that he has seen some very fine specimens which were obtained by a farmer at Wallington, near Baldock. In the 'Birds of Berks and Bucks' there is mention made of a male obtained by one of Lord Brownlow's keepers on 14th August, 1862, on the very borders of the county, in a cornfield near Ivinghoe.

RINGED PLOVER (*Ægialitis hiaticula*).—This bird occurs at the Tring Reservoirs every year on migration.

GOLDEN PLOVER (*Charadrius pluviatilis*).—Large parties of golden plovers appeared at Tring in December, 1896.

GREY PLOVER (*Squatarola helvetica*).—I am informed that in the spring of 1893 a female of this species was found at Royston, having come in contact with the telegraph-wires. The only other specimen of this bird recorded in Hertfordshire was shot near the Tring Reservoirs in 1885.

OYSTER-CATCHER (*Hæmatopus ostralegus*).—An oyster-catcher was killed at Elstree Reservoir early in April, 1866. The only other specimen recorded in Hertfordshire was also shot at Elstree; this was in February, 1868.

GREAT SNIPE (*Gallinago major*).—In the 'Birds of Middlesex' Mr. Harting mentions a bird of this species as having been obtained at Bushey Heath, but gives no particulars. This bird appears to have occurred on one other occasion in this county, an albino specimen having been obtained at Tring.

DUNLIN (*Tringa alpina*).—This bird is mentioned by Mr. Harting as frequenting Elstree Reservoir during the winter. It is also an annual visitor to Tring, where Street saw some in August, 1896.

RUFF (*Machetes pugnax*).—A reeve was obtained at Chisfield Park, near Stevenage, about fourteen years ago, and is now in the possession of Mr. C. Poyntz Stewart. In my report for 1895 I mentioned the various occasions on which this bird has occurred in Hertfordshire.

COMMON SANDPIPER (*Totanus hypoleucus*).—Mr. Latchmore informs me that a nest of this bird was found by the miller of Hyde Mill, near Hitchin; it was placed under a high bank at the sluice-pit. Mr. Latchmore says that he himself used frequently to flush the birds from the place, but never thought of looking for a nest. No actual date can be given by the miller as to when he found the nest. This is the first time that this bird has been recorded as nesting in Hertfordshire.

GREEN SANDPIPER (*Totanus ochropus*).—This bird occurs annually at the Tring Reservoirs and also in the neighbourhood of Hitchin.

REDSHANK (*Totanus calidris*).—On September 19th Street saw two birds at Tring, presumably, from his description, of this species. In my last report I enumerated the various instances of the occurrence of the redshank in Hertfordshire.

GREENSHANK (*Totanus canescens*).—The greenshank occurred at

Tring during the autumn migration. It may now, I think, be considered an annual visitor there.

COMMON CURLEW (*Numenius arquatus*).—In April, and again in August, some birds of this species were observed at Tring.

BLACK TERN (*Hydrochelidon nigra*).—This bird appeared in large numbers at Tring during the summer of 1896, as many as sixty having been seen there together on May 11th.

COMMON TERN (*Sterna fluviatilis*).—This species was also fairly plentiful at Tring in 1896. Mr. Rivers informs me that on August 18th and again on September 27th he saw a bird presumably of this kind at Sawbridgeworth.

ARCTIC TERN (*Sterna macrura*).—The Rev. H. H. Crewe informed the author of 'The Birds of Berks and Bucks' that the Arctic tern used occasionally to visit the Tring Reservoirs. The only recent record, however, of this bird in Hertfordshire, is of one shot at Tring in the spring of 1886.

LESSER TERN (*Sterna minuta*).—Street informs me that he saw two lesser terns at Tring on 17th October, 1896. Some were seen there about the same time in 1895, as I mentioned in my report for that year.

BLACK-HEADED GULL (*Larus ridibundus*).—A few birds of this species were observed at Tring at various times in 1896. On March 15th Mr. Rivers observed one sailing about at Sawbridgeworth.

COMMON GULL (*Larus canus*).—Street mentions the occurrence of certain gulls at various times, which he speaks of as common gulls. Though probably these were not all "*Larus canus*," some of them were most likely of that species. In 1896 small parties of these so-called common gulls appeared at Tring nearly every month. Mr. E. W. Arnold mentioned to Mr. Hopkinson that two gulls were seen flying over Redbourn about the first week in February.

BLACK-BACKED GULL (*Larus fuscus* vel *marinus*).—Street also informs me of the occurrence of black-backed gulls at the Reservoirs occasionally, but he does not state whether they were lesser or great black-backed gulls.

LITTLE AUK (*Mergulus alle*).—In my report for 1895 I mentioned the occurrence of a little auk at Sarratt, but could give no date. I have since ascertained that the actual date was January 25th. Mr. Nunn informs me that in the autumn of 1894 a little auk, which is now in the possession of Mr. D. H. Nash, stuffed, was brought to him alive at Royston. Mr. Latchmore also tells me that in the winter of 1895–96 little auks were picked up dead at Hitchin, Welwyn, and Ashwell.

GREAT NORTHERN DIVER (*Colymbus glacialis*).—Captain Clarke Kennedy mentions that an immature specimen of this bird was obtained at one of the Tring reservoirs in December, 1841. This species has only been recorded in this county on four other occasions—two being obtained at different times at Elstree Reservoir, one being shot in January, 1887, and another being seen in February of the same year at Tring.

Arrival and Departure of Migrants.

Summer Migrants.

Species.	Locality.	Date.	Observer.
Ring-Ouzel (*Turdus torquatus*)	Berkhamsted	May 8	A. Crossman.
Wheatear (*Saxicola œnanthe*)	Tring Reservoirs	Mar. 30	J. Street.
Whinchat (*Pratincola rubetra*)	Sawbridgeworth	April 28	H. S. Rivers.
(Last seen)	Berkhamsted	Sept. 7	A. F. C.
Redstart	Sawbridgeworth	April 28	H. S. Rivers.
(*Ruticilla phœnicurus*)	St. Albans	,, 29	H. Lewis.
Nightingale	Watford	,, 18	C. Worte.
(*Daulias luscinia*)	Hitchin	,, 19	J. E. Little.
	Berkhamsted	,, 20	Mrs. Mawley.
	St. Albans	,, 21	H. Lewis.
	Ashwell	,, 23	H. G. Fordham.
	Hatfield	,, 24	T. Brown.
	Wormley	,, 25	Miss Warner.
	Sawbridgeworth	,, 25	H. S. Rivers.
	Harpenden	,, 28	J. J. Willis.
Common Whitethroat	Watford	,, 24	C. Worte.
(*Silvia cinerea*)	St. Albans	,, 25	H. Lewis.
	Sawbridgeworth	,, 26	H. S. Rivers.
(Last seen)	Berkhamsted	Sept. 5	A. F. C.
Lesser Whitethroat (*Silvia curruca*)	Sawbridgeworth	April 28	H. S. Rivers.
Blackcap	Sawbridgeworth	Mar. 24	H. S. Rivers.
(*Silvia atricapilla*)	Watford	April 19	C. Worte.
Garden-Warbler (*Silvia hortensis*)	Watford	,, 26	C. Worte.
Chiffchaff	Berkhamsted	Mar. 20	A. F. C.
(*Phylloscopus rufus*)	Sawbridgeworth	,, 21	H. S. Rivers.
	Radlett	,, 27	Miss Lubbock.
(Last seen)	Berkhamsted	Sept. 18	A. F. C.
Willow-Wren	Sawbridgeworth	April 18	H. S. Rivers.
(*Phylloscopus trochilus*)	St. Albans	,, 25	H. Lewis.
(Last seen)	Berkhamsted	Sept. 7	A. F. C.
Wood-Wren (*Phylloscopus sibilatrix*)	Watford	April 27	C. Worte.
Reed-Warbler	Tring Reservoirs	,, 17	J. Street.
(*Acrocephalus streperus*)	Watford	,, 25	C. Worte.
Sedge-Warbler	Watford	,, 22	C. Worte.
(*Acrocephalus phragmitis*)	Sawbridgeworth	,, 25	H. S. Rivers.
Grasshopper-Warbler (*Locustella nævia*)	St. Albans	,, 26	H. Lewis.
Yellow Wagtail (*Motacilla Raii*)	Tring Reservoirs	,, 9	J. Street.
Tree-Pipit	St. Albans	,, 19	H. Lewis.
(*Anthus trivialis*)	Sawbridgeworth	,, 22	H. S. Rivers.
(Last seen)	Berkhamsted	Sept. 5	A. F. C.
Red-backed Shrike (*Lanius collurio*)	Berkhamsted	May 6	A. F. C.
Spotted Flycatcher	Berkhamsted	April 20	Mrs. Mawley.
(*Muscicapa grisola*)	Sawbridgeworth	May 14	H. S. Rivers.
	Ashwell	,, 17	H. G. Fordham.
	St. Albans	,, 31	H. Lewis.
Swallow	Berkhamsted	April 11	Mrs. Mawley.
(*Hirundo rustica*)	St. Albans	,, 12	H. Lewis.

Species.	Locality.	Date.	Observer.
Swallow	Watford	April 14	Mrs. Bishop.
(*Hirundo rustica*)	Sawbridgeworth	,, 15	H. S. Rivers.
	Tring Reservoirs	,, 16	J. Street.
	Hitchin	,, 17	J. E. Little.
	Hatfield	,, 22	T. Brown.
	Wormley	,, 24	Miss Warner.
	Ashwell	,, 25	H. G. Fordham.
	Harpenden	,, 26	J. J. Willis.
	Radlett	,, 28	Miss Lubbock.
(Last seen)	Watford	Oct. 18	Mrs. Bishop.
	Sawbridgeworth	,, 19	H. S. Rivers.
	Ashwell	,, 23	H. G. Fordham.
	Berkhamsted	,, 24	Mrs. Mawley.
House-Martin	Watford	April 20	C. Worte.
(*Hirundo urbica*)	St. Albans	,, 27	H. Lewis.
	Sawbridgeworth	,, 28	H. S. Rivers.
(Last seen)	Berkhamsted	Oct. 13	A. F. C.
	Sawbridgeworth	Nov. 1	H. S. Rivers.
Sand-Martin	Watford	April 6	C. Worte.
(*Cotile riparia*)	Tring Reservoirs	,, 10	J. Street.
	Sawbridgeworth	,, 25	H. S. Rivers.
(Last seen)	Berkhamsted	Oct. 13	A. F. C.
Swift	Sawbridgeworth	May 9	H. S. Rivers.
(*Cypselus apus*)	Watford	,, 9	C. Worte.
	St. Albans	,, 10	H. Lewis.
(Last seen)	Berkhamsted	Aug. 14	A. F. C.
	St. Albans	,, 15	A. F. C.
	Sawbridgeworth	Sept. 3	H. S. Rivers.
Nightjar (Last seen)	Northchurch	Oct. 6	J. Bunker.
(*Caprimulgus europæus*)			
Wryneck	St. Albans	April 17	H. Lewis.
(*Iÿnx torquilla*) (Last seen)	Northchurch	Sept. 5	A. F. C.
Cuckoo	St. Albans	April 12	Mrs. Hopkinson.
(*Cuculus canorus*)	Tring Reservoirs	,, 17	J. Street.
	Wormley	,, 17	Miss Warner.
	Watford	,, 19	C. Worte.
	Hitchin	,, 19	J. E. Little.
	Hatfield	,, 20	T. Brown.
	Sawbridgeworth	,, 20	H. S. Rivers.
	Berkhamsted	,, 20	Mrs. Mawley.
	Radlett	,, 21	Miss Lubbock.
	Harpenden	,, 22	J. J. Willis.
	Ashwell	,, 26	H. G. Fordham.
Turtle-Dove	Watford	,, 27	C. Worte.
(*Turtur communis*)	Sawbridgeworth	May 17	H. S. Rivers.
(Last seen)	Berkhamsted	Sept. 18	A. F. C.
Landrail	Watford	April 24	C. Worte.
(*Crex pratensis*)			
Common Sandpiper	Tring Reservoirs	,, 27	J. Street.
(*Totanus hypoleucus*)	Sawbridgeworth	May 10	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 1	H. S. Rivers.

Winter Migrants.

Redwing (Last seen)	Sawbridgeworth	Mar. 11	H. S. Rivers.
(*Turdus iliacus*) (First seen)	Sawbridgeworth	Oct. 18	H. S. Rivers.
	Berkhamsted	,, 20	A. F. C.
Fieldfare	Radlett	,, 9	Miss Lubbock.
(*Turdus pilaris*)	Berkhamsted	,, 20	A. F. C.
	Sawbridgeworth	Nov. 6	H. S. Rivers.

Species.		Locality.	Date.	Observer.
Grey Wagtail *(Motacilla melanope)*	(Last seen)	Berkhamsted	Mar. 25	J. G. Crossman.
	(First seen)	Berkhamsted	Sept. 17	A. F. C.
		Sawbridgeworth	Oct. 3	H. S. Rivers.
Hooded Crow *(Corvus cornix)*	(Last seen)	Sawbridgeworth	Mar. 22	H. S. Rivers.
	(First seen)	Sawbridgeworth	Oct. 17	H. S. Rivers.
		Ashwell	,, 22	H. G. Fordham.
		Odsey	,, 22	H. G. Fordham.

I should like to ask members of this Society, when they see stuffed birds preserved in houses in Hertfordshire, to inquire whether such birds were obtained in the county, and if they were, to obtain further particulars about them, and to let me have such particulars, and also to inform me of the whereabouts of any such specimens. By this means much information might possibly be obtained about birds which have been procured in our county in former times. With reference to birds mounted in cases, I would remind you that very often some particulars are written on the back of the case, and that such particulars may be the means of bringing to light the history of the bird. I should like to get correspondents from the central parts of the county, such as the districts around Hertford, Hatfield, and Buntingford, and also from the eastern side of the county where it borders on Essex, in which part I have at present only one correspondent—Mr. Rivers, of Sawbridgeworth. It would be of great assistance to me if members living in those districts which I have just mentioned, would, if not interested in ornithology themselves, try to get some friend to send me notes on the birds of their neighbourhood every year. I have received some most useful information from Hitchin and Royston. The notes from the latter place include so much of the history of the avifauna of the district, that it is proposed to read them before the Society as a separate paper.

In conclusion, I beg to thank all my correspondents most heartily for their assistance in supplying me with materials for this paper, and I only hope that they will be kind enough to continue their efforts in that way through many years to come.

XIX.

NOTES ON THE BIRDS OF NORTH HERTFORDSHIRE.

By Joseph P. Nunn.

Communicated by Alan F. Crossman, F.L.S.

Read at Watford, 30th April, 1897.

Up to the close of the first half of the present century the northern part of Hertfordshire had a fairly good avifauna, but by the introduction of the gamekeeper and the modern gunner it was soon stript of its feathered inhabitants, and to ever expect a return of our lost birds to our woods and fields is as hopeless as a return to the good old times when agriculture was remunerative.

It must be understood that the following remarks refer to the locality of Royston, Therfield, Kelshall, and Sandon, the last three parishes having large open fields to the north, backed up by hills and woods on the south.

In the Forties the great plover was fairly common all along the open fields, but as agriculture improved it gradually became scarce, and it is now very sparingly represented. I have heard of none breeding in the neighbourhood since 1894, when I found a pair of eggs on my land just over the border in Cambridgeshire. The dotterel (*Eudromias morinellus*) always appeared at the time of the spring migration, but now it is a very rare visitor. It is quite twenty years since I have seen any: I then saw about sixty in one pack, which is the greatest number I have ever seen together. I could not have been mistaken, for I walked quite on to them, and although I put many of them up, they did not leave the field; on the following day, however, they had taken their departure.

The wheatear in those days (the Forties) nested very freely on Royston Heath, but now only a few may occasionally be seen on migration. The only local eggs I have in my collection I took, about forty years ago, from a nest on our heath.

Wildfowl were always seen in considerable numbers passing south during the winter in days gone by, but they no longer have a line of flight over this district.

The larks are to the present day always seen passing south at the commencement of severe weather, but they now take their line either east or west of the town of Royston, and are never seen passing directly over as they did in former days: indeed, it is quite the exception to see even a small flock passing directly over the town. The nightjar was never common. I have but one local egg in my cabinet, which I obtained in the year 1845. I have not heard of one being found since. Goldfinches used to breed within a few yards of the house in which I now reside in the town of Royston, but ere the Fifties arrived they had departed, and are scarcely ever now seen in a wild state. The Royston or hooded crow was a constant visitor, and in considerable numbers during the winter, but of late years we have seen very few of them. They generally used to arrive about October 18th.

Before leaving the Forties I may say that a woodchat shrike (*Lanius pomeranus* *) was shot at Sandon, and came into the possession of the late Mr. John Norman, but I am unable to give any more particulars. About the same time (1845) a pair of hen-harriers (*Circus cyaneus*) were shot in Sandon. They were preserved by the late Mr. John Norman, and were in the possession of the late Mr. Henry Fordham at the time of his death.

In the year 1847 I went to reside in the parish of Kelshall, the upper part of which was then almost a forest in its primeval state. I found the rooks and jackdaws breeding in the village, and the carrion-crow, sparrow-hawk, kestrel, hobby, magpie, white and long-eared owls, and jay in undisturbed possession of the woods, but when a keeper was installed in this El Dorado, most of these birds were cleared off. The carrion-crow (*Corvus corone*) was the first to disappear; then followed the beautiful hobby (*Falco subbuteo*), the last of which was shot from the nest in the breeding season of 1849, and is now in my possession. I have never heard of another being seen. The owls kept losing ground, and, at the time of my leaving Kelshall in 1870, they were quite rare birds: however, as they lost ground on the hills, they established themselves in the plantations on the northern border, and now breed there. The long-eared owl is a terrible enemy to our small birds, and there is a most decided falling-off of all the small birds in the plantations referred to, which are commonly known as The Fox Covert or Church Hill Plantations.

The short-eared owl is occasionally seen in our turnip-fields in the autumn. The kestrel still lingers in the open fields called Odsey Heath. A few years back a nest with eggs was found on the top of a wheat-stack, but, needless to say, the eggs were destroyed.

The magpie, which was common over all this district, is now extinct. The jay, on the other hand, has held its own against all comers, and is fairly numerous.

The woodpeckers were never common, although the whetile (the local name for the green woodpecker) was frequently heard. I never, however, met with it breeding. In the spring of 1893 a pair of the lesser spotted woodpecker (*Picus minor*) were shot about a mile south of Royston. The nightingale never paid us a visit in the woodlands, but the whitethroat was exceedingly plentiful. The strong and beautiful hawfinch never visited us, but, curious to relate, it has within the past three years established itself in the village of Therfield, very much to the annoyance of the gardeners. I have never seen but one of these birds in its wild state near Royston.

* [This is probably the woodchat referred to in the 'Zoologist' for 1892, p. 348, as having been shot near Baldock in the spring of 1856, although the date mentioned by Mr. Nunn is somewhat earlier.—A. F. C.]

Since the cold winter of 1894 the common (now uncommon) linnet has disappeared, and on the west side of Royston is a rare bird; it would not be possible to find a pair of them.

The swift in the Forties was quite a rare bird at Royston; now it breeds there freely. On the other hand, in those days it was a constant visitor to Kelshall and Sandon, and bred there, but in the Sixties it was scarcely ever seen at either of these places.

The plovers—golden plover (*Charadrius pluvialis*) and green plover (*Vanellus cristatus*)—appear to be rather erratic in their movements. In the Forties thousands of golden plovers used to visit the neighbourhood of Odsey Heath during the autumn. In the Fifties they discontinued their visits, but now they have appeared again in very considerable numbers in our fields on the extreme northern borders of Herts, and during the winter of 1895–96 both the green and golden plovers were to be seen in numbers never before witnessed. It was truly a most wonderful sight when they were all on the wing together, the whole country being full of them: the plovers stayed with us until the 4th of March, 1896, on which day the lapwings took their departure, not even a stray bird being left to tell the tale, and the golden plovers left the next day. Both kinds returned during the closing days of October, 1896, but left as soon as the snow came, about Christmas, reappearing about the middle of February, though not in their former numbers.

In the spring of 1893 that rare bird the grey plover (*Squaterola helvetica*) was found here (Royston), having come in contact with the telegraph-wires. The specimen, which was a female, came into the possession of the late Mr. W. Norman, who brought it to me. I have no other record of this bird having been seen here.

In the autumn of 1894 a little auk was brought to me alive: it is now in the possession of Mr. D. H. Nash, of Royston.

I have never met with the tawny owl in Hertfordshire, although it has been found nesting a couple of miles over the border in Cambridgeshire.

During my twenty-three years on the hills in North Herts, I never met with the tree-sparrow (*Passer montanus*), but within the last five years I have received the eggs from that district. This bird, although having always been a constant visitor during the winter to the immediate locality of Royston, has only very recently stayed to nest, but now I find it breeding freely on my farms. It is exceedingly curious how little is known of the tree-sparrow, very few people being aware of its existence.

In former times I used to hear the grasshopper-warbler, but I have never heard of its nest having been found. The kingfisher used occasionally to pay a visit to our ponds, but never stopped to nest. The red-backed shrike (*Lanius collurio*) may be seen nearly every year along the borders of Hertfordshire and Cambridgeshire, but I have never met with it on the hills.

The peregrine (*Falco peregrinus*) is occasionally seen in our open fields. The last pair of these birds I have any recollection of having been shot were killed by the keeper in the Newnham Plantation, not far from Baldock, about the year 1878. They were a fine pair, and are or were in the possession of Mr. Simpson.

I may state that the foregoing remarks, with a few exceptions, apply chiefly to the hilly and wooded districts, while the following refer to the district around Royston, which I regret to say is rapidly becoming a birdless region. It is true we have a sample avifauna, but no birds—not even *Passer domesticus*—in bulk. The wryneck is a lost bird: I cannot say that of the nuthatch, having never seen but one in the district. All the ordinary tits breed here, and also the goldcrest. The nightingale is found in numbers, and nearly all the general run of common birds. As we have no water, I have no aquatic birds to report beyond a water-rail (*Rallus aquaticus*) caught in the town, having come in contact with the telegraph-wires, which are responsible for the lives of very many birds.

The main causes of the decrease of birds are: (1) the cats, which are far too numerous and utterly useless; (2) the gardeners; (3) the modern gunner. "The Boy" is not in it, for birdsnesting is not carried on as it was formerly.

XX.

NOTES ON SOME PLANTS COLLECTED IN HERTFORDSHIRE BY MISS MARIA RANSOM, 1838–1840.

By James Saunders.

Read at Watford, 23rd March, 1897.

The small herbarium formed by Miss Maria Ransom, of Hitchin, afterwards Mrs. R. Marsh, of Luton, is now in the possession of her son, Mr. Marsh, at present residing at Bedford. The collection was lent to the writer that it might be seen if there were any records of sufficient interest to be preserved in the 'Transactions' of the Society. The few that are so regarded are enumerated below.

The specimens are still in good condition, and exhibit great care in pressing and mounting. They were originally intended for exhibition at some flower-shows at Hitchin. Those for the first occasion, about forty species, were mostly of the commoner kinds, while those for the second included the rarer forms.

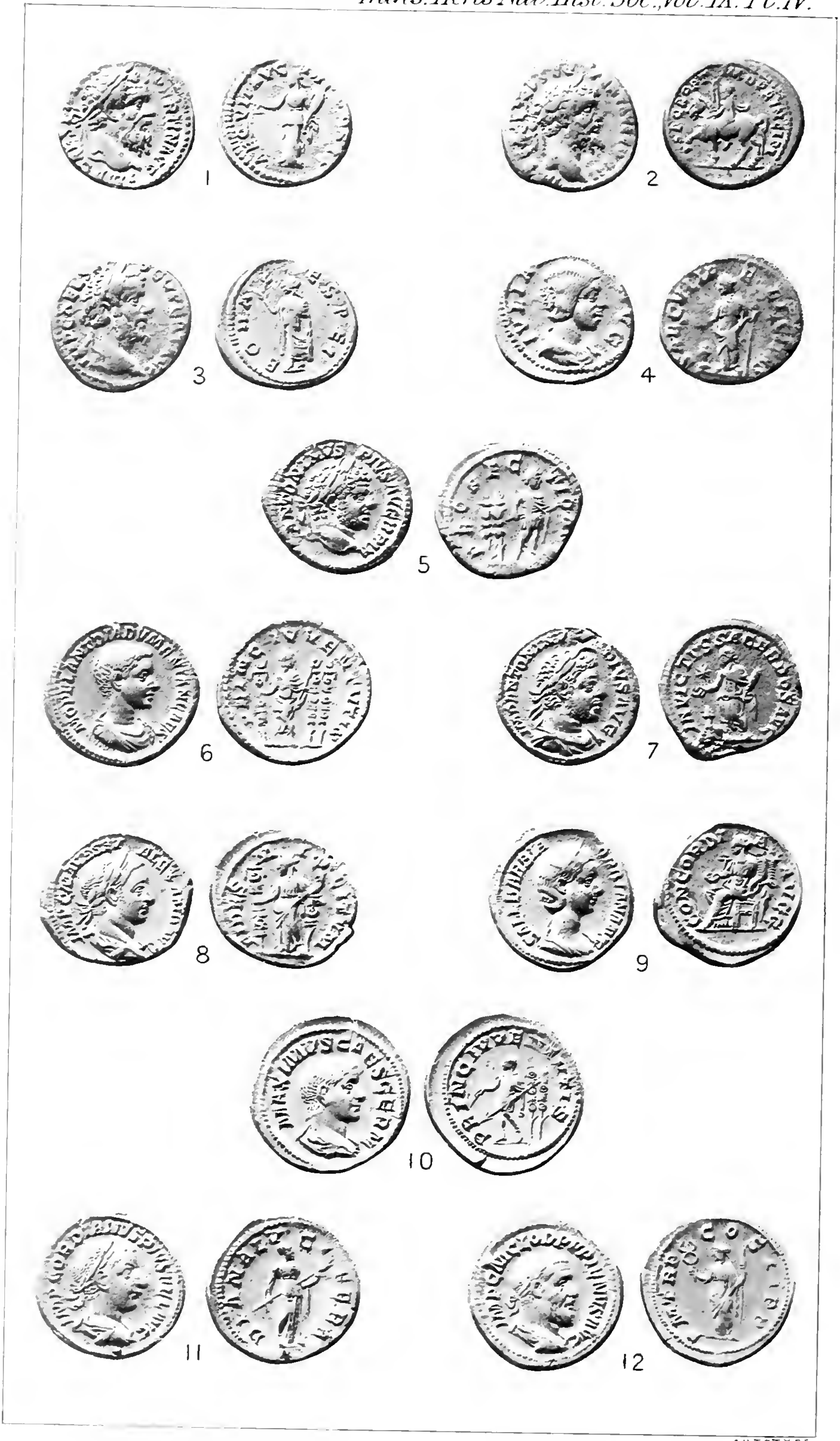
Miss Ransom had the advantage of the acquaintance and assistance of the late Mr. Isaac Brown, an honorary member of the Society, and also of the late Mr. William Dawson, both of whom resided at Hitchin at this period, which no doubt accounts in some measure for the general accuracy of the names. Except in one or two instances they are correct, and in these cases the specimens probably have not been seen by either of them. It is possible that some of the specimens were given to Miss Ransom by Mr. Brown, as the stations for them are the same as appear in Webb and Coleman's 'Flora' with his authority.

The most noteworthy omission of a locality for a specimen is that for *Drosera anglica*, which is the true plant, and just such as one might find in the New Forest. This is unfortunate, as there is no record known to the writer of the occurrence of this species in Hertfordshire, although it is recorded by Abbott as growing in Ampthill Bogs, in Bedfordshire, *circa* 1798, a specimen being preserved in his herbarium at Turvey Abbey. In the absence of any evidence of Miss Ransom's specimen having been found in Hertfordshire, the species is omitted from this list.

The original arrangement was that of the Linnean system, but the sequence and nomenclature here adopted is that of Pryor's 'Flora of Hertfordshire,' published by this Society.

Myosurus minimus, *L.* Ivel.—Ippollitts.
Ranunculus parviflorus, *L.* Ivel.—Ickleford Road, Hitchin.
Batrachium trichophyllum, *F. Schultz.*, var. Godroni, *Gren.* Ivel.—Bearton Closes, Hitchin. (First record.)
B. hederaceum, *Gray.* Ivel.—West Mill, Ickleford.
Helleborus fœtidus, *L.* Lea.—Hoddesdon.

Aquilegia vulgaris, *L.* Ivel.—Wellbury, Hitchin.
Alyssum calycinum, *L.* Ivel.—Oughton Head, Hitchin.
Parnassia palustris, *L.* Ivel.—Oughton Head Common, Hitchin.
Dianthus Armeria, *L.* Lea.—Fairlands Farm, Stevenage.
Sagina (=Spergula) nodosa, *Fenzl.* Ivel.—Walsworth Common, Hitchin.
Geranium columbinum, *L.* Lea.—Hertford.
Astragalus danicus, *Retz.* (= A. hypoglottis, *L.*). Lea.—Lilley Hoo. (Still there in 1895.—J. S.)
Lathyrus Nissolia, *L.* Lea.—Hertford.
Vicia sylvatica, *L.* Ivel.—Wain Wood, Hitchin.
Chrysosplenium oppositifolium, *L.* Lea.—Hoddesdon.
Bupleurum rotundifolium, *L.* Ivel.—Near Grove Mill, Hitchin. (First record.)
Adoxa moschatellina, *L.* Lea.—Near Lilley Hoo.
Galium cruciatum, *With.* Ivel.—Hexton.
Dipsacus pilosus, *L.* Lea.—Near Hertford.
Campanula Trachelium, *L.* Ivel.—High Down Wood, Hitchin.
Blaxtonia (=Chlora) perfoliata, *Huds.* Ivel.—Hexton.
Cuscuta europæa, *L.* Ivel.—In a bean-field at Bearton Napp, Hitchin.
Lycopsis (=Anchusa) arvensis, *L.* Ivel.—Near Highbury, Hitchin.
Lithospermum officinale, *L.* Ivel.—Cadwell, Ickleford.
Melampyrum cristatum, *L.* Ivel.—Chapelfoot, Ippollitts.
Orobanche minor, *Sm.* Ivel.—Hitchin Hill. (First record.)
Samolus Valerandi, *L.* Ivel.—Oughton Head Common, Hitchin.
Anagallis tenella, *L.* Ivel.—Oughton Head Common.
Hottonia palustris, *L.* Ivel.—Walsworth Common, Hitchin.
Daphne Laureola, *L.* Ivel.—Cadwell, Ickleford.
Triglochin palustre, *L.* Lea.—Hoddesdon. (First record.)
Potamogeton densus, *L.* Ivel.—Norton Common, Baldock.
Herminium Monorchis, *R. Br.* Ivel.—In a chalk-pit on the Preston Road, Hitchin.
Fritillaria Meleagris, *L.* Lea.—Hoddesdon.
Asplenium Adiantum-nigrum, *L.* Ivel.—Near Ippollitts.



AUTOTYPE

ROMAN COINS FOUND AT
BRICKENDONBURY, HERTFORD.

XXI.

ON SOME ROMAN COINS FOUND AT BRICKENDONBURY, HERTFORD.

By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., etc.

Read at Watford, 23rd March, 1897.

PLATE IV.

In excavating at Brickendonbury, the seat of Mr. George Pearson, about a mile and a half south of the town of Hertford, the workmen came upon a small hoard of Roman denarii, for the most part of base metal. The excavation was for a sunk flower-bed, ten yards east of the house. The coins lay in a small recess cut in the virgin clay and covered with eight inches of clay and natural soil, and upon the old surface there lay about eighteen inches of made-up ground derived from an ancient moat close at hand when in course of construction. This shows no disturbance since its first deposition.

The following is a summary of the coins which I have examined, with the names of the Emperors, Empresses, and Cæsars represented in the hoard:—

Commodus	1
Pertinax	1
Septimius Severus	33
Julia Domna	15
Caracalla	20
Plautilla	2
Geta	8
Diadumenianus	2
Elagabalus	67
Julia Paula	5
Aquilia Severa	2
Julia Soæmias	15
Julia Mæsa	23
Severus Alexander	144
Sallustia Barbia Orbiana	3
Julia Mamæa	30
Maximinus	19
Maximus	1
Gordianus III	25
Pupienus	1
Philippus I	9
Philippus II	1
Trajanus Decius	2
Herennia Etruscilla	2
Herennius Etruscus	1
	432

There must have been in the deposit rather more than 450 coins in all, the greater number of which came into the possession of Mr. Pearson, who kindly placed them in my hands for examination. I am indebted to Mr. R. T. Andrews, of Hertford, not only for calling my attention to the coins, but also for making a preliminary arrangement of them. In describing them I have referred for details to Cohen's '*Médailles Impériales.*'

Full particulars of the various types of these coins are given in the 'Numismatic Chronicle' (3rd series, vol. xvi, pp. 192–201), and it would be needless to reproduce them here. As might be expected in the case of so extensive a deposit, there are several scarce varieties present, some of them being of Emperors whose coins are but seldom found in Britain, and others presenting rare reverses of those whose coins are as a rule common.

It will be well to say a few words with regard to some of these scarcer pieces. The coins of Pertinax, in any metal, are of extremely rare occurrence in Britain, and none were present in the Lime Street hoard found in 1881,* the coins in which cover nearly the same period as those in the hoard now under consideration. Although the reign of Pertinax lasted rather less than the first three months of A.D. 193, a considerable variety of his coins was struck, and Cohen enumerates 59 types in gold, silver, and copper. The denarius with the type of Æquitas is among the more common of his silver coins (Pl. IV, Fig. 1). The same type was used on some of his other coins, both in gold and bronze. It became a favourite device among the succeeding emperors, the moneyers probably regarding it as complimentary to their justice in making the coins of full weight.

Among the coins of Severus some few call for remark. One with P. M. TR. P. VI. COS. II. P. P., and Fortune standing to the left, holding a rudder placed on a globe, and a cornucopiæ on the reverse, does not occur in Cohen with IMP. X on the obverse. More interesting is a coin with the Emperor on horseback on the reverse, and the legend S. P. Q. R. OPTIMO PRINCIPI (Pl. IV, Fig. 2). This type occurs also in gold and bronze, in the latter case with the addition of S. C. to the legend, showing that it was struck in the Senatorial mint. Those in gold and silver were apparently struck in the Imperial mint, and as they all belong to the early part of the reign of Severus, they seem to indicate some decree of the Senate expressing its satisfaction at his having overcome his rivals Pescennius Niger and Clodius Albinus.

A coin with VICTOR. IVST. AVG. (Cohen, 738) is also worthy of notice. This, too, belongs to the year A.D. 193, or the beginning of the reign of Severus. The legend expanded would appear to be VICTORIAE IVSTI AVGVSTI. The title of Justus was assumed by Pescennius Niger, from whom Severus must have borrowed it. There are indeed silver coins of Pescennius with precisely the same type and legend.

* 'Num Chron.,' 3rd series, vol. ii, p. 57; vol. iii, p. 278.

A BONAE SPEI reverse is also one of those of Pescennius, whose hopes, however, were not so satisfactorily realized as those of Severus. The coin bearing it is scarce, and the Brickendonbury specimen differs from that in Cohen in not having II. CO. on the obverse (Pl. IV, Fig. 3).

The coins of Julia Domna, the wife of Severus, present but little novelty. One, however, with the legend SAECVLI FELICITAS, presents the type of the Empress sacrificing at an altar, as on the large brass coin with the same legend (Cohen, 178), and thus constitutes a variety not given by Cohen among the silver coins of Domna (Pl. IV, Fig. 4).

Among the scarcer coins of Caracalla are some with MARTI VLTORI and VOTA SVSCEPTA X, but they can hardly be regarded as rare. One with PROFECTIO AVG. is somewhat rarer. It belongs to the year A.D. 213, and appears to refer to his expedition into Gaul (Pl. IV, Fig. 5). A coin of the fourteenth year of his Tribinutian Power differs from Cohen, who gives the type for his thirteenth year only.

The coins of Plautilla, the wife of Caracalla, and of Geta, his brother, though somewhat scarce, do not require any comment.

Diadumenianus, the son of Macrinus, is represented in the hoard by two coins, both of some degree of rarity, though the types are of an ordinary character. A specimen, with the PRINCEPS IVVENTVTIS reverse, was present in the Lime Street hoard (Pl. IV, Fig. 6).

The coins of Elagabalus are among the most numerous in the hoard, and present several of the devices commemorative of the worship of the Syrian sun-god, from whose name that commonly given to this Emperor has been adopted. On one of the coins, with the legend INVICTVS SACERDOS AVG., the Emperor is represented with what would appear to be a horn upon his head on the obverse, probably as an emblem of power. On the reverse another horn is sometimes shown at his feet, but the Hertford example varies somewhat from Cohen's description * (Pl. IV, Fig. 7). For a notice of this rare coin Cohen may be consulted. The horned head of the Emperor occurs on a few coins of other types.

The only other coin of Elagabalus to which attention may be called is one reading P. M. TR. P. V. COS. IIII. P. P., with Providentia standing to the left holding a wand and cornucopiæ; at her feet a globe. This is not described by Cohen, but the type of the reverse is the same as that of the large brass coin No. 212.

The coins of Julia Paula, though by no means common, present types already well known. Those of Aquilia Severa, another of the wives of Elagabalus, are of greater rarity, but in that case also there is no novelty about the device.

Those of Julia Soæmias, the sister of Julia Domna and daughter of Julia Mæsa, are fairly numerous in the hoard, though hardly common coins.

Those of Julia Mæsa, the clever grandmother of Elagabalus, are more numerous still, but require no comment.

* '*Méd Imp.*,' 2nd edition, vol. iv, p. 329.

A third of the hoard consists of coins of Severus Alexander, with a great variety of reverses, but among them none that can be classified as rare. Perhaps the most scarce is one with FIDES EXERCITVS (Cohen, No. 49). Of those with the legend FIDES MILITVM there were three examples, one with Fides seated and two with Fides standing (Pl. IV, Fig. 8).

The coins of his wife, Sallustia Barbia Orbiana, are certainly rare, but three specimens, with the reverse CONCORDIA AVGG., were present (Pl. IV, Fig. 9). There were none in the Lime Street hoard.

The coins of Julia Mamæa, the mother of Alexander, are numerous in the deposit, but none exhibit rare reverses.

The coins of Maximinus I are all of a common character, but that of his son Maximus is of considerable rarity, though it bears a device trite on the coins of the Cæsars, PRINC. IVVENTVTIS (Pl. IV, Fig. 10).

The reverses on the coins of Gordianus Pius are for the most part common, but that of DIANA LVCIFERA is scarce, and seems more fitting for a coin of an empress than for one of an emperor (Pl. IV, Fig. 11). One with FIDES MILIT. presents a variety not given in Cohen.

The coin of Pupienus, the colleague of Balbinus, whose reign lasted but three months in A.D. 238, is rare, and, moreover, the coins of this Emperor but seldom occur in Britain, though two were present in the Lime Street hoard, already frequently mentioned (Pl. IV, Fig. 12).

The coins of Philippus I are common, though those recording the Sæcular Games on the thousandth anniversary of the foundation of Rome, with the wolf and twins, and what may be regarded as a *miliarium* rather than a *cippus*, are highly interesting.

The coin of Philippus II is rather scarce, but very well known. Those of Trajanus Decius, relating to his campaigns in Dacia and Pannonia, are interesting, but not rare, and those of his wife Etruscilla and his son Herennius close the list. They bear but ordinary devices upon them.

The coin of Herennius must have been struck in the year A.D. 249 or 250, as it gives his title as Cæsar. He received the title of Augustus in A.D. 251, and together with his father was killed in battle near Abricium, in Thrace, in that year.

The probability, therefore, is that the Brickendonbury hoard, which, so far as I know, includes no coins of Trebonianus Gallus, was deposited about A.D. 250 or 251. It consequently seems to have been buried at about the same time as that which was found in Lime Street, the coins in which extended from the days of Commodus to those of Trajanus Decius.* In describing that hoard I remarked that "of what was taking place in Britain at the period when Decius, Gallus, Volusian, Æmilianus, and Valerian successively wore the purple, we know but little. This country

* 'Num. Chron.,' 3rd ser., vol. ii, p. 60.

was, however, in all probability cut off from all connection with any central authority, and its inhabitants left much under their own government, such as it may have been."

But though history is silent, my friend Mr. Haverfield, of Christ Church, Oxford, has called my attention to the testimony of inscribed stones found in Britain, and from the inscriptions on milestones—which, by the way, seem to have been altered from time to time, so as to bear the name of the reigning emperor—the isolation does not appear to have been so complete as I supposed. The names of Gallus and Volusian * occur together on milestones at Bittern, near Southampton, and at Gretabridge, Yorkshire, and together with that of Decius on a stone at Castleford † in the same county. Those of Gallus and Volusian are also recorded together in inscriptions on the Roman wall, ‡ and those of Valerianus, Gallienus, and Valerianus Cæsar are found in an inscription at Caerleon. ||

It would seem, then, that the government of Britain must have been carried on in the normal manner, until the revolt of Postumus, in A.D. 258, severed Gaul, and with it probably Britain, from the rest of the Roman Empire, and paved the way for the advancement of Victorinus, Marius, and the Tetrici, of whose reigns so many numismatic and other monuments still exist among us.

At the same time the correspondence in date between the Lime Street and the Brickendonbury hoards may be significant of the setting in of disturbances in Britain and of those "twenty years of shame and misfortune" to the Roman Empire, of which Gibbon § speaks, having already commenced in this country.

Nor are similar indications wanting in Northern Gaul. At Jupille,¶ near Liége, in Belgium, in June, 1895, a still larger hoard of denarii than that of Brickendonbury was unearthed. Though a few of the earlier coins go back to the time of Nero and Vitellius, nearly half of them were struck under Severus Alexander, Maximinus, and Gordianus III, the latest examined being of Philippus and Otacilia. The date assigned by Dr. Simonis for the deposit of this hoard is between A.D. 244 and 249, but there is no reason why it might not have been a year or two later.

Another hoard found near Luzy** (Nièvre) must be of nearly the same date, the last coins in it being of Philippus I and Otacilia.

A complete list of the coins will be found in the article in the 'Numismatic Chronicle' already referred to (3rd ser., vol. xvi, p. 191).

* '*Corp. Insc. Brit.*,' pp. 1148, 1182.
† Ephemeris, vol. viii, pp. 1104, 1105.
‡ '*C.I.B.*,' pp. 646, 949.
|| '*C.I.B.*,' p. 107.
§ 'Decline and Fall,' chap. x.
¶ '*Rev. Belge de Num.*,' 1896, p. 128.
** '*Rev. Arch.*,' vol. xxxi, 1876, p. 436.

Explanation of Plate IV.*

Fig.

1. *Pertinax.* AEQVIT. AVG. TR. P. COS. II. Equity standing l.
2. *Septimius Severus.* S. P. Q. R. OPTIMO PRINCIPI. Emperor on horseback l.
3. *Septimius Severus.* BONAE SPEI. Hope walking l. Without II. CO. on obv.
4. *Julia Domna.* SAECVLI FELICITAS. Empress at altar.
5. *Caracalla.* PROFECTIO AVG. Caracalla standing r., two standards behind.
6. *Diadumenianus.* PRINC. IVVENTVTIS. Cæsar standing—three standards.
7. *Elagabalus.* INVICTVS SACERDOS AVG. Elagabalus horned l., at altar.
8. *Severus Alexander.* FIDES MILITVM. Fides standing between two standards.
9. *Sallustia Barbia Orbiana.* CONCORDIA AVGG. Concord seated l.
10. *Maximus.* PRINC. IVVENTVTIS. Maximus standing l., two standards behind.
11. *Gordianus III (Pius).* DIANA LVCIFERA. Diana standing r.
12. *Pupienus.* P. M. TR. P. COS. II. P. P. Felicity standing l., with caduceus.

* Reprinted from the 'Numismatic Chronicle,' 3rd ser., vol. xvi.

XXII.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, DURING THE YEAR 1896.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at St. Albans, 6th April, 1897.

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 1896, and the following is the usual summary for the seasons:—

Means for the Seasons from Dec. 1895 to Nov. 1896.

Seasons, 1895-96.	Pressure.	Temperature. Mean.	Temperature. Daily Range.	Humidity.	Cloud.	Force of Wind.	Rainfall. Total.	Rainfall. Days.
	ins.	°	°	%	0-10	0-12	ins.	
Winter	30·182	38·7	10·9	90	7·4	1·6	3·39	39
Spring	30·084	48·4	15·8	78	6·4	2·1	4·83	43
Summer.....	30·020	61·0	18·2	72	6·4	1·6	4·92	35
Autumn.....	29·902	46·4	11·5	88	6·4	1·8	11·67	56

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 1896 from Means of 1877–86 at Watford.

Months.	Pressure.	Temperature. Mean.	Temperature. Daily Range.	Humidity.	Cloud.	Force of Wind.	Rainfall. Total.	Rainfall. Days.
	in.	°	°	%	0-10	0-12	in.	
January.....	+·345	+3·0	−0·1	+ 1	+0·4	−·1	−1·80	− 6
February	+·389	−1·5	+2·6	+ 2	−0·1	−·3	−2·13	− 8
March	−·145	+3·4	−1·9	+ 2	+1·2	+·4	+1·96	+14
April	+·289	+1·8	−1·4	− 1	−0·5	−·2	−1·51	− 3
May	+·292	+0·8	+1·4	+ 1	−1·3	=	−2·07	−10
June	−·005	+3·2	+0·3	− 3	+0·2	=	−1·26	− 4
July	+·098	+1·8	+3·9	− 5	−1·0	+·2	−1·63	− 6
August	+·116	−2·8	−1·2	+ 1	−0·3	−·2	−0·20	+ 2
September	−·187	−0·7	−4·7	+ 4	+0·5	=	+4·08	+11
October	−·174	−3·5	−1·2	+ 2	−0·1	+·3	+0·40	+ 4
November	+·246	−3·3	−1·5	=	−0·6	−·2	−1·53	− 7
December	−·170	+0·6	−0·6	+ 3	−0·2	+·2	+1·53	+ 7
Year	+·093	+0·3	−0·4	=	−0·1	=	−4·16	− 6

Results of Meteorological Observations taken at The Grange, St. Albans, in 1896.

Months.	Pressure of the Atmosphere.	Temperature of the Air.										Humidity of the Air.			
		9 a.m.	Means of		Adopted Mean.	Mean Daily Range.	Absolute Min. and Max.				Absolute Range.	Temperature of		Dryness.	Relative Humidity.
			Min.	Max.			Min.	Date.	Max.	Date.		Evaporation.	Dew-point.		
	ins.	°	°	°	°	°	°		°		°	°	°	°	%
January	30·374	39·7	34·9	44·2	39·6	9·3	26·7	23rd	51·2	17th	24·5	38·6	37·2	2·5	91
February	30·347	37·3	32·3	45·2	38·3	12·9	20·9	26th	56·7	12th	35·8	36·3	34·9	2·4	91
March	29·831	44·3	38·1	51·0	44·5	12·9	29·5	15th	63·3	24th	33·8	42·3	39·9	4·4	85
April	30·165	48·4	40·1	55·1	47·9	15·0	32·0	24th	64·8	27th	32·8	44·7	40·6	7·8	75
May	30·257	52·9	43·1	62·6	52·9	19·5	34·0	2nd	75·1	12th	41·1	48·6	44·3	8·6	73
June	29·964	62·3	52·2	70·6	61·7	18·4	37·7	1st	81·1	15th	43·4	56·8	52·1	10·2	70
July	30·050	63·1	52·4	73·5	63·0	21·1	45·3	29th	84·3	14th	39·0	57·5	52·7	10·4	69
August	30·047	58·1	50·7	65·8	58·2	15·1	43·8	27th	72·7	13th	28·9	54·4	51·1	7·0	78
September	29·784	55·5	50·0	61·6	55·7	11·6	38·3	21st	68·9	8th	30·6	53·6	51·7	3·8	87
October	29·754	44·0	39·0	51·3	44·8	12·3	27·9	28th	61·5	3rd	33·6	42·7	41·1	2·9	89
November	30·168	38·0	33·8	44·3	38·7	10·5	25·3	30th	49·8	21st	24·7	36·8	35·1	2·9	89
December	29·796	37·8	33·2	42·7	37·9	9·5	24·5	24th	50·7	26th	26·2	37·0	35·9	1·9	93
Year	30·045	48·5	41·7	55·7	48·6	14·0	20·9	Feb.	84·3	July	63·4	45·8	43·1	5·4	82

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE GRANGE, ST. ALBANS, IN 1896—(*continued*).

Months.	Rainfall.					Cloud.			Wind.										
	Total Fall.	Max. fall in 24 hours.		No. of days of		Mean Amount, 0–10.	No. of days of		Mean Force, 0–12.	Number of days of									
	Ins.	Ins.	Date.	Rain or Snow.	Snow only.		Clear Sky.	Over-cast.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	·79	·26	24th	11	1	8·0	1	17	1·6	5	2	3	3	4	5	5	2	2
February	·46	·13	20th	9	0	7·5	4	18	1·4	3	2	4	2	4	4	2	4	3
March	3·62	·66	20th	26	3	7·5	2	15	2·4	3	1	1	2	6	8	5	3	2
April	·87	·26	10th	12	0	6·4	3	8	1·9	2	2	0	1	2	5	9	8	1
May	·34	·20	21st	5	0	5·1	8	7	1·9	10	5	1	1	1	1	1	10	1
June	1·60	·48	10th	10	0	6·5	4	13	1·6	2	4	1	4	6	4	5	3	1
July	·90	·50	26th	9	0	5·5	4	12	1·7	3	2	2	4	5	6	6	2	1
August	2·42	·55	25th	16	0	6·6	2	9	1·6	6	4	0	1	2	6	7	5	0
September	6·69	1·01	24th	24	0	6·9	3	10	1·7	3	2	1	6	7	5	3	3	0
October	3·46	·95	6th	21	0	6·4	6	14	2·1	5	1	0	1	5	9	3	5	2
November	1·49	·44	7th	11	0	5·9	7	13	1·6	6	5	3	0	2	2	5	3	4
December	4·16	·75	4th	24	4	7·1	4	18	1·8	2	3	4	3	5	6	4	2	2
Year	26·80	1·01	Sept.	178	8	6·6	48	154	1·8	50	33	20	28	49	61	55	50	19

The year 1896 was rather warm, except towards the end of the summer and throughout the autumn, October and November being especially cold months; on the other hand, January, March, and June were very warm. The mean daily range of temperature was less than usual, chiefly owing to the abnormal character of the weather in September, the days being much colder and the nights warmer than usual in that month. The mean pressure of the atmosphere was much above the average. It was very high throughout January and February, and especially so for the seven days from 29th January to 4th February, the mean then being 30·744 inches (reduced to 32° and to sea-level). The lowest pressure recorded at 9 a.m. was 28·687 ins. on 4th December, and the highest was 30·925 ins. on 30th January, giving the unusually large range of 2·238 ins. The rainfall was about the average of a long period, but considerably below the average of the ten years 1877–86. There were about as many wet days as usual. Nearly three times as much rain fell in the second half of the year as in the first half, the fall from January to June being 7·68 ins., and from July to December 19·12 ins. March, October, and December were very wet months, and September was excessively wet, being the wettest month for the ten years during which my observations have been taken at St. Albans, and wetter than any month at Watford in the previous ten years during which I took observations there, the nearest approach to it being in October, 1882, when 6·10 ins. of rain fell. The humidity of the air was about the average, but it varied greatly during the year, June and July having a very dry atmosphere, while in September and December it was very moist. Thunderstorms were less frequent than usual, and there were no very severe ones.

In the winter of 1895–96 (Dec. to Feb.) the mean pressure of the atmosphere was very high, the mean temperature was above the average, with a considerable mean daily range, the relative humidity and amount of cloud were about the average, and the rainfall was very small and on very few days. January was warmer than either December or February. The fertile flowers of the hazel were open on the 16th of January, and the catkins were then shedding; wasps appeared on the 19th of January, and the honey-bee first visited flowers on the 8th of February.

In the spring (March to May) the mean pressure of the atmosphere was high, the mean temperature was considerably above the average, with nearly the average mean daily range, the relative humidity and amount of cloud were about the average, and the rainfall was rather small, but on about the usual number of days. March had three times as much rain as April and May together, and was much more humid and cloudy than those months. A partial drought commenced on the 17th of April and at the end of May had lasted forty-five days, with 0·37 inch of rain. The cuckoo was heard on the 10th of April, and the nightingale on the 23rd. The hawthorn well merited its name of "may," coming into flower on May Day.

In the summer (June to August) the mean pressure of the atmosphere was rather high, the mean temperature was a little above the average, with a considerable mean daily range, the air was very dry, the sky rather bright, and the rainfall very small, being but little more than half the average and on a small number of days. A very dry period of four months' duration terminated about the beginning of August, having little more rain than fell in March, and little more than half as much as fell in September.

In the autumn (September to November) the mean pressure of the atmosphere was a little below the average, the mean temperature was very low, with a very small daily range, the air was rather moist, the sky rather bright, and the rainfall very heavy, and on a large number of days. The very low temperature is almost entirely due to the coldness of October and November, while the excess in the rainfall is more than accounted for by the very wet September.

The difference between these seasons and the means of the seasons for 1877–86 at Watford is shown in the following table, the comparison of the rainfall being with an exceptionally wet series of years.

DIFFERENCE IN 1895–96 FROM MEANS OF 1877–86 AT WATFORD.

Seasons, 1895–96.	Pressure.	Temperature.		Humidity.	Cloud.	Force of Wind.	Rainfall.	
		Mean.	Daily Range.				Total.	Days.
	in.	°	°	%	0–10	0–12	ins.	
Winter	+·198	+0·8	+0·9	=	—0·1	—0·1	—4·42	—12
Spring	+·145	+2·0	—0·6	+ 1	=	+0·1	—1·62	+ 1
Summer.....	+·083	+0·7	+1·0	— 3	—0·2	—0·2	—3·09	— 8
Autumn.....	—·082	—2·5	—2·4	+ 2	—0·1	+0·1	+2·98	+ 8

NOTES ON THE MONTHS.

JANUARY.—Very mild, with about an average daily range of temperature, an atmosphere of average humidity and very high pressure, a very cloudy sky, and a small rainfall on less than the average number of days. Coldest day 23rd, mean 32°·8; warmest day 17th, mean 45°·8. Min. below 32° on eleven days; max. above 42° on twenty-one days.

FEBRUARY.—Rather warm, with a considerable daily range of temperature, a rather humid atmosphere of very high pressure, a sky of average brightness, and a very small rainfall on less than the average number of days. Coldest day 26th, mean 27°·1; warmest days 9th, mean 45°·6, and 29th, mean 45°·8. Min. below 32° on thirteen days, below 22° on one day (26th); max. above 42° on eighteen days, above 52° on five. The only really cold period was from 23rd to 27th, the mean temperature of these five days being 32° (9 a.m. 30°·5, min. 25°·7, max. 39°·7). This is 8°·7 below the mean for the three winter months.

March.—Very warm, with a small daily range of temperature, a rather humid atmosphere of rather low pressure, a cloudy sky, and a very heavy rainfall on a large number of days. Coldest day 13th, mean 37°·3; warmest day 22nd, mean 53°·4. Min. below 42° on twenty-three days, below 32° on four (13th, 15th, 19th, and 28th); max. above 52° on twelve days, above 62° on one day (24th). There were not two days together without rain, which fell on every day but 3rd, 10th, 12th, 19th, and 24th.

April.—Rather warm, with a small daily range of temperature, a rather dry atmosphere of considerable pressure, and a small rainfall on less than the usual number of days. Coldest day 2nd, mean 40°·3; warmest day 26th, mean 56°·8. Min. below 42° on nineteen days; max. above 52° on twenty-one days, above 62° on five. Nearly all the rain fell during the first half of the month, there being only 0·03 in. after the 16th, on two days.

May.—Of average temperature, with a rather large daily range, an atmosphere of average humidity and considerable pressure, a bright sky, and a very small rainfall on very few days. Coldest day 1st, mean 42°·8; warmest day 12th, mean 60°·5. Min. below 42° on thirteen days; max. above 52° on twenty-nine days (all but 1st and 2nd), above 62° on sixteen, above 72° on three (12th, 14th, and 29th). Rain fell only on 12th, 18th, 20th, 21st, and 22nd, and from 17th April to 19th May inclusive only 0·06 in. fell on four days.

June.—Very warm, with about an average daily range of temperature, a very dry atmosphere of average pressure, a sky of average brightness, and a small rainfall on a rather small number of days. Coldest day 26th, mean 56°·8; warmest day 16th, mean 70°·2. Min. below 52° on twelve days, below 42° on one day (1st); max. above 62° on twenty-eight days (all but 7th and 10th), above 72° on ten. Between the 3rd and 10th 1·35 in. of rain fell on six days, and for the rest of the month only 0·25 in. fell on four days. There were several thunderstorms during the wet period, the most severe commencing about 10 p.m. on the 4th. On this night the lightning struck an outbuilding at the St. Albans Union workhouse, damaging the roof, wrenching a door from its fastenings, throwing it to the ground, and loosening part of the brickwork.

July.—Rather warmer than June, but not so much above the average in temperature, with a large daily range, a dry atmosphere of rather high pressure, a bright sky, and a very small rainfall on a small number of days. Coldest day 16th, mean 54°·5; warmest day 21st, mean 69°·9. Min. below 52° on fourteen days; max. above 62° on twenty-nine days (all but 1st and 16th), above 72° on eighteen days, above 82° on two (14th and 21st). The high mean temperature of the month is entirely due to the warmth of the days, the nights being of the average temperature while the days were several degrees warmer than the average. There was a thunderstorm on the 7th accompanied by only 0·05 in. of rain.

August.—A rather cold month, with a small daily range of temperature, an atmosphere of average humidity and rather high pressure, a rather bright sky, and about the average rainfall on the usual number of days. Coldest day 26th, mean 52°·2; warmest day 13th, mean 64°·8. Min. below 52° on twenty days; max. above 62° on twenty-eight days (all but 8th, 9th, and 26th), above 72° on one day (13th). There was an unusual absence of thunderstorms, but the rather heavy falls of rain on the 19th (0·42 in.) and 25th (0·55 in.), and the smaller fall on the 31st (0·23 in.), were due to thunder-showers in storms which did not reach St. Albans.

SEPTEMBER.—Of nearly average temperature, with a very small daily range, a very humid atmosphere of low pressure, a rather cloudy sky, and an excessively heavy rainfall on a very large number of days. Coldest day 21st, mean 47°·4; warmest day 9th, mean 62°·6. Min. below 42° on four days; max. above 52° every day, above 62° on twelve days. The rainfall was about three times the average and on nearly twice the usual number of days, and as before stated the month was the wettest on my record for twenty years (ten at Watford and ten at St. Albans). The only days without rain were the 6th, 15th, 16th, 23rd, 29th, and 30th. The fall exceeded half an inch on six days, three-quarters of an inch on two of these, and one inch on one of these. Thunderstorms were frequent, and severe in the early part of the month.

OCTOBER.—A cold month, with a rather small daily range of temperature, a humid atmosphere of low pressure, a sky of average brightness, and a heavy rainfall on a considerable number of days. Coldest day 28th, mean 35°·6; warmest days 3rd, mean 57°·0, and 4th, mean 56°·8. Min. below 42° on twenty-one days, below 32° on four (19th, and 28th to 30th); max. above 52° on eleven days. Rain fell every day from 2nd to 20th, and on 24th and 25th. There were slight thunderstorms on 14th and 24th, which, however, were heavy in some parts of the county.

NOVEMBER.—Also a cold month, with a small daily range of temperature, an atmosphere of average humidity and high pressure, a bright sky, and a small rainfall on a small number of days. Coldest day 30th, mean 31°·0; warmest days 12th, mean 43°·5, and 22nd, mean 43°·7. Min. below 42° every day, below 32° on nine days; max. above 42° on twenty-three days. The 7th was also a very cold day, mean 34°·0, and the last eight days were very cold, having a mean temperature of 35°·5 (9 a.m. 34°·6, min. 32°·5, max. 39°·4).

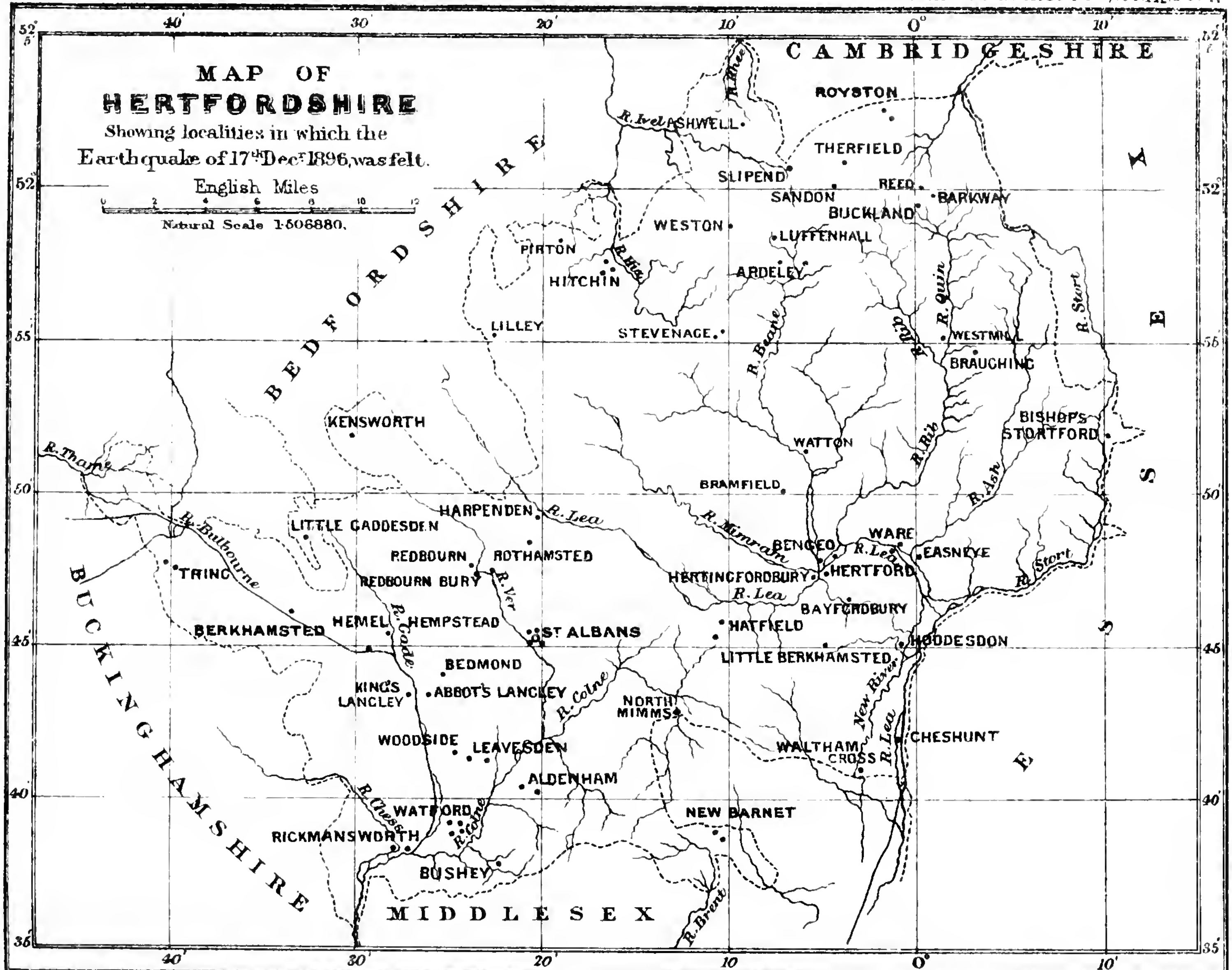
DECEMBER.—Of about average temperature, with a small daily range, a humid atmosphere of low pressure, a sky of average brightness, and a very heavy rainfall on a large number of days. Coldest days 17th, mean 29°·6, and 18th, mean 29°·3; warmest day 26th, mean 43°·8. Min. below 42° every day but one (31st), below 32° on fourteen days; max. above 42° on nineteen days. The only cold period was from 16th to 24th, the mean temperature of these nine days being 31°·5 (9 a.m. 31°·2, min. 28°·0, max.

35°·4). Rain or snow fell every day but 7th, 15th, 16th, 18th, 22nd, 23rd, and 25th. Snow fell on the 17th, 19th, 20th, and 21st, but the total precipitation was only equivalent to 0·12 inch of rain.

Appendix to Report on the Rainfall in 1896.

The following table gives six records of the rainfall in the year 1896 supplementary to the forty-four monthly records on pp. 141–143 of the above Report. Two of these are the records of additional gauges at Rothamsted, and the remaining four are taken from 'British Rainfall, 1896,' published since my Report was printed.

District.	Station.	Observer.	Gauge. Diameter.	Gauge. Height above Sea.	Rainfall.	Days.
			ins.	feet.	ins.	
8.	Harpenden—Rothamsted	Sir J. Lawes and Sir H. Gilbert.....	8	420	28·98	161
,,	,, ,,		72×87	420	31·33	180
10.	Watford—Oaklands	E. Harrison	5	273	29·24	172
,,	,, St. Alban's Road	H. Ruddle.............	5	250	26·94	117
12.	Welwyn—Danesbury	A. M. Blake..........	5	400	26·51	164
13.	Bennington	Miss C. Nihill	5		27·53	181



J.H.&H.G.F del.

R. Weller, lith.

XXIII.

THE EARTHQUAKE OF THE 17TH OF DECEMBER, 1896, AS IT AFFECTED THE COUNTY OF HERTFORD.

By HERBERT GEORGE FORDHAM.

Read at St. Albans, 6th April, 1897.

PLATE V.

INTRODUCTION.

THE effects of earthquakes such as we experience in the British Isles are commonly so slight and insignificant, as compared with those which occur in other parts of the world, that it can hardly be expected that any deductions of direct scientific value can be obtained from their consideration.

Nevertheless, in the aggregate of knowledge no fact, or collection of facts, is to be despised, and we should not be doing our duty in Hertfordshire were we to fail in recording all that is known of even so trifling a shock as that of the 17th of December, 1896, as its effects were felt within the county and on its borders. We may hope that, although no substantial addition to our information on the subject of earthquakes can be expected from what is recorded in the following pages, the results of this inquiry may yet help in a small way to the building up of knowledge, and in the accumulation of that mass of minor details upon which important advances in information are based.

Having, on a former occasion, undertaken to deal with phenomena which, at first attributed to terrestrial movement, ultimately turned out to owe their origin to a very different cause,* I have now been asked to collect such information as may be available as to the earthquake of the 17th December. Accordingly, I have, through the public Press and the monthly circulars of our Society, appealed generally to the public, and especially to our members and correspondents, for information as to the localities at which the shock was experienced in the early morning of Thursday, 17th December, 1896, and as to its effects and character. A similar inquiry, extending to the whole kingdom, has been undertaken by Mr. Charles Davison, Sc.D., F.G.S., of 373, Gillott Road, Birmingham, Secretary of the British Association Seismological Investigation Committee.

A Committee on Earthquakes was first appointed at the Leeds meeting of the British Association (1890), but with a somewhat limited reference (that of establishing instruments for the systematic recording of earth tremors in this country). Five Reports of the Committee have been presented to the Association, dealing mainly with the preliminary question of the instruments available for recording earth tremors. During fifteen years up to 1895, another

* See "The Meteorite of the 20th of November, 1887" ('Trans. Herts Nat. Hist. Soc.,' Vol. V, p. 33).

Committee of the British Association had been investigating the seismic phenomena of Japan, and at the Ipswich Meeting (1895) these two committees were amalgamated under the title of "The Committee on Seismological Observations," and the new Committee presented its first Report at last year's meeting at Liverpool.*

In view of future shocks it is very desirable that the class of facts which may be usefully noted by observers should be widely known, and I think therefore that no apology is needed for reprinting here the set of queries published by Dr. Davison in the newspaper press under date of the 19th of December, 1896, and which may be referred to by persons noticing any vibration or movement of the earth, and who may wish to record their sensations shortly.

"1.—Name of the place where the earthquake was observed.

"2.—Time at which it was felt, if possible to the nearest minute.

"3.—(*a*) What was the nature of the shock? (*b*) Did the shock consist of two distinct parts, separated by an interval of a few seconds? (*c*) If so, which part was the stronger, and how long was the interval between the two parts?

"4.—How many seconds did the shock last, not including the accompanying sound?

"5.—Was the shock strong enough (*a*) to make doors, windows, fire-irons, crockery, etc., rattle; (*b*) to cause the chair, etc., on which the observer was resting to be perceptibly raised or moved; (*c*) to make chandeliers, pictures, etc., swing, or to stop clocks?

"6.—(*a*) Was the shock accompanied by any unusual rumbling sound; and, if so, what did it resemble? (*b*) Did the beginning of the sound precede, coincide with, or follow, the beginning of the shock, and by how many seconds? (*c*) Did the end of the sound precede, coincide with, or follow, the end of the shock, and by how many seconds?"

My investigation of the causes of the disturbance experienced on 20th November, 1887, extending over a very considerable area in the South Midlands of England, showed conclusively that what was in the first instance attributed to an earthquake, was really due to the passage of a bolide or meteorite through the atmosphere across the district, and its explosion at various points on its course.

So far as I am aware, the series of facts collected in that case present the only fairly complete study we have (in this country, at all events) of such an occurrence. They are of interest in themselves, but perhaps their value really lies in their assisting, in some measure, to establish the distinctions between the effects of earth tremors and aërial shock on individuals and objects on the surface

* 'Report of the British Association for the Advancement of Science,' Liverpool, 1896, p. 180. (London: John Murray, 1896.)

of the earth, while they also mark certain characteristics common to both kinds of disturbance, which may lead (and probably have actually led in the past) to a confusion of the two sources. Indeed, with our present knowledge, we may be permitted to suspect that some, at least, of the older statements purporting to relate to earthquakes may really refer to the effects of concussion of the air produced by explosions at high altitudes in the air itself.

But, however this may be, there can be no doubt that the shock recorded in the south of England on 17th December is attributable solely to a movement of the earth.

Although some observers speak of movement of the air, and of noise which might be associated with aërial shock, there can be no doubt that the passage of an explosive meteorite through the atmosphere at night would light up, and probably very brilliantly, a great expanse of country. At half-past five in the morning on 17th December, the moon, though nearly full, was very low on the horizon, and it is hardly possible that such a light as must have been caused, had a bolide passed across the south of England at that time, would have escaped the notice of the many persons who are abroad during the night.

It will be remembered, perhaps, that the bolide of the 20th November was (so far as I could ascertain) actually seen by two persons only, one at Hertford and the other at Solihull near Birmingham; but in that case the time was 8.20 a.m., and therefore in broad daylight, and the weather was dull and foggy.

An explosive bolide may, however, be distinctly seen in broad daylight, and even in bright sunlight when very near the surface of the earth, though this is very uncommon. In Switzerland on the 20th June, 1890, fragments of a luminous falling mass, which had probably broken up very high in the atmosphere, were seen in the afternoon in bright sunlight at three different points many miles apart by different observers, of whom I had the good fortune to be one.*

Apart from these considerations, it will be seen, on looking through the various statements I have collected from Hertfordshire, that the shock felt on 17th December, 1896, is generally described as of a different character from that of 1887. Even a slight comparison of the statements printed in Vol. V of our 'Transactions,' p. 35 *et seq.*, with those incorporated in this paper, will establish this distinction in the mind of the reader.

I propose to deal with my materials very much as I did with those I obtained in 1887, that is to say, to let observers speak for themselves and in their own language. If this language is not always scientific it is at all events natural, a characteristic of the first importance in such matters as we have under examination. It will be convenient to add a short general summary.

Before proceeding to set out the statement of observers, I should

* See "Note sur le bolide du 20 Juin, 1890," par H. G. Fordham ('Bull. Soc. Vaud. Sc. Nat.,' 3e série, vol. xxvii, p. 220); and "A Meteorite observed in Switzerland" ('Trans. Herts Nat. Hist. Soc.,' Vol. VI, p. 193).

like to draw attention to the Report on the East Anglian Earthquake of 1884, published by the Essex Field Club,* as a model of what may be achieved in this branch of scientific investigation by a local scientific society. It is perhaps the only monograph extant of a modern British earthquake. Complete and exhaustive as it is, and highly valuable as a record, it is also well worth study as an example of an inquiry, and as a guide to systematic observation and to the collection of facts in an investigation of great extent and difficulty.

I cannot pass from this general and introductory portion of my work without thanking the Editors and Proprietors of the various local newspapers for the assistance they have so readily given to me in obtaining information; and I must also record my thanks to all those who have taken the trouble to communicate to me their impressions and experiences, as well as to Dr. Davison, who has been good enough to let me look through his letters from Hertfordshire. The information I have taken from the communications made to Dr. Davison I have distinguished by an asterisk (*).

The geographical order of the observations and notices given below is generally from west to east. The plans in the text are drawn, as nearly as the information given me allows, on a scale of about $\frac{1}{120}$, or 10 feet to an inch.

Observations and Notes.

Tring.—I was awoke on the morning in question by a shaking or rocking of my bed. I was alone at the time, and my impression was that something or somebody was under the bed. I got up, and the impression was so strong that I looked under the bed and then at the time, which was about 5.30.—*J. G. Williams, Pendley Manor, Tring.*

* I distinctly felt my bed, a *large* heavy iron one, tremble and shake beneath me. I was sound asleep, when I awoke suddenly and felt wide awake. Then I felt a strange but distinct shaking; but shaking is not quite the word, it [the bed] seemed to move to and fro under me. In the High Street, two sisters living together say that their house shook, windows rattled, and they thought someone was trying to wake them by violently shaking their front door. One friend felt as if someone was shaking the bed violently.—*Wilhelmina* [Mrs. S. G.] *Foulkes, Grove Lodge, Tring.*

Berkhamsted.—At Berkhamsted many people thought that the foundations of their houses had given way.—*Herts Mercury*, 19 *Dec.*, 1896.

I was from home at the time of the earthquake, but on my return the next day, could not find the slightest sign of the disturbance of the pencils or pen of any of my self-recording meteorological instruments, not even on the trace of the self-recording rain-gauge, which is sunk more than a foot deep in the

* 'Report on the East Anglian Earthquake of April 22nd, 1884,' by Professor R. Meldola and William White ('Essex Field Club Special Memoirs,' vol. i, 8vo, pp. 224. London: Macmillan, 1885). See also 'Trans. Herts Nat. Hist. Soc.,' Vol. IV, p. 23.

ground.—*Edward Mawley* [Pres. R. Met. Soc., F.R.H.S.], *Rosebank, Berkhamsted.*

*LITTLE GADDESDEN.—The shock was rather slight, of two distinct parts, first a rumbling noise, then a rattling, the interval between being only a second or two. My cupboard doors were thrown open, although locked for certain at night; my bed was slightly lifted, my windows rattled very much. The sound resembled that of a traction-engine moving heavily along. It followed the shock by about a few seconds. Time, 5.30.—[Fräulein] *M. A. Haftslein, Little Gaddesden House, Berkhamsted.*

KENSWORTH.—5.35 a.m. Sharp shock of earthquake. Furniture and crockery, etc., shaken and rattled.—[Miss] *S. Grace Jones, The Grove, Kensworth.*

*HEMEL HEMPSTEAD.—In bed on first floor. Awakened by the noise, as of the fall of some heavy body, or of an explosion at some little distance. A slight rocking of the bed felt. Time, about 5.45.—[Sir] *John Evans* [K.C.B., D.C.L., Treas.R.S., etc.], *Nash Mills, Hemel Hempstead.*

RICKMANSWORTH.—I was staying in Rickmansworth in a house near the cemetery. I was awake early and had just put out my candle, when I felt a very gentle trembling of the bed; there was no wind, no one moving in the house. The trembling was repeated—then a third time—and immediately it seemed as if someone raised the bed and tried to *twist* it. It made me feel giddy, although it was soon over, and I knew then what it was. The whole room seemed to be twisted, and to resist and creak. I looked at my watch and found it 5.30. My maid, sleeping in a room opposite, was greatly alarmed, and she, too, felt the bed and room twisted. It was a very different movement from any I had felt before, in some far stronger and longer shocks, in the extreme north of Scotland. It did not, however, wake another person in the same house.—*Sophie D.* [Mrs. Clarence] *Fry, Rough Down, Northwood, Middlesex.*

* The observer was indoors, in bed, on first floor. Time, 5.25. The duration of the shock one or two seconds; it was strong enough to make windows, doors, fire-irons, etc., rattle. Several persons in the town say that it caused beds to be perceptibly moved. In several houses crockery was thrown down. There was no particular sound, except that of a concussion, just as if some huge van or traction-engine had been overturned in the street close by. The shock was felt with more or less intensity in nearly all the towns and villages near. — *A. E. Northey* [Vicar of Rickmansworth], *The Vicarage, Rickmansworth.*

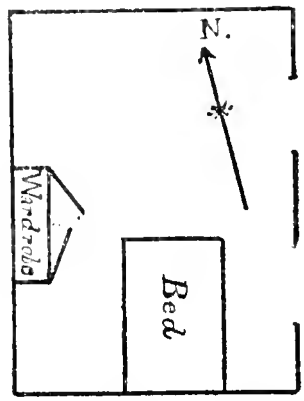
KING'S LANGLEY; ABBOTS LANGLEY; BEDMOND; LEAVESDEN ASYLUM. — Oscillations of beds and jarring of ornaments experienced.—*Watford Observer*, 19 *Dec.*, 1896.

LEAVESDEN.—The earthquake was felt at this cottage by three old people, about half-past five in the morning, two feeling as though the bed was lifted up, the other was shaken.—[Mrs.] *K. Kentish, Rose Cottage, Woodside, Leavesden.*

* I was suddenly awakened by my bed rocking backwards and forwards. I cannot say how many seconds it had been doing so, but I had time to light a lamp by my bedside before it stopped. I concluded something very heavy had fallen in one of the rooms, though I was at a loss to account for the prolonged and exaggerated result of such an occurrence. I cannot truthfully say that I was awakened by any sound, but for some time afterwards I lay awake listening to the unusual crackings that went on in the brickwork of the chimney. I looked at my clock when I woke and noticed it was just about 5.30 a.m. No one else in the house had been awakened, but most of the inhabitants of the village had similar tales to tell of their beds shaking. In one house a short distance off, a cousin of mine was awake all night, and heard curious sounds in the air "like rushing water." She also experienced the same rocking sensation, and heard plaster, etc., give way in the house, which caused her alarm.—*E. Peach, Learesden Green, Watford.*

WATFORD.—Hundreds of people in Watford were awakened from their sleep by the movement of their beds and the loud rattling of crockery. There was first a rumbling noise, and then a shaking of the earth, occasioning the jarring of window-sashes, doors, picture-frames, and even the movement of furniture. Professor Attfield, F.R.S., favours us with the following particulars:—"The effects of the earthquake this (Thursday) morning were felt by me in my private house, 'Ashlands,' at 5.34, Greenwich time. They lasted for twenty seconds. The first effect noticed was the noisy vibration of a nearly empty 150-gallon cistern in a north attic of the second floor. That was followed, within ten seconds, by the moderate rattling of the window-sashes in my bedroom on the first floor and at the south corner. The whole house shook slightly. Other inmates were not awake. I was already awake. By subsequent comparison of watches, I find that the effects were experienced at Sudbury, Middlesex, by Mr. T. J. Hamp, at practically the same time."—*Watford Observer*, 19 *Dec.*, 1896.

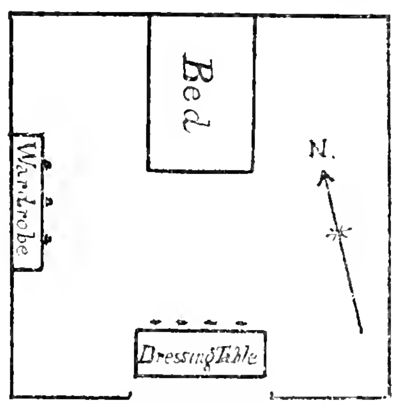
I was suddenly awakened, and that thoroughly, either by the first shock, if there were two, or by some concussion, my first impression being that an explosion had occurred. Immediately afterwards the windows of the room rattled violently, the bed heaved perceptibly, the sensation being that a wave had passed under it, and the doors of a large wardrobe swung open. The shock lasted sufficiently long for me to call my wife's attention to the fact that the jugs on the washstand were vibrating considerably, which they continued to do for some seconds after I had spoken. My son, who was sleeping in a room overhead, was aroused in a similar manner, and he described the oscillation and vibration as so violent that he came downstairs thinking there had been an explosion in the house. The time, as nearly as possible, was 5.25 a.m. Neighbours opposite seem to have had a similar experience, while some on either side knew nothing of the shock. I annex a ground plan of room, showing position of wardrobe and bed. My impression was that the wave passed under the bed longitudinally, from S. to N., or *vice versâ*, though I think the former. The opening of the wardrobe doors would indicate a wave



Plan No. 1.—Denham Lodge, Watford.

E. or W., although one from N. or S. would affect them, as they do not fit very closely and were not secured in any way.—*Sidney Martin, Denham Lodge, Watford.*

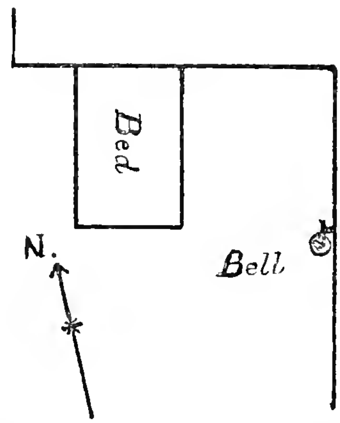
I was awake early that morning and my husband and I both heard first a sort of thud, and then directly afterwards the brass handles of our bedroom furniture (hanging handles) rattled noisily, but we did not feel any movement of bed or room. The time was either just before or just after 5.30 a.m. had struck, but I cannot now [6 Jan., 1897] remember which; probably the latter, I think. I subjoin a rough plan of my room. It faces almost due S. As



Plan No. 2.—Mayfield, Upton Road, Watford.

the handles would swing backwards and forwards, not from side to side, I suppose their movement was E. and W. The dressing-table also has drop-handles; if they had been the ones to swing, it would have been a N. and S. movement, and I cannot, of course, say certainly which handles they were, but as the sound seemed to come from the wardrobe we took for granted it was so.—*Janet* [Mrs. A.] *King Smith, Mayfield, Upton Road, Watford.*

We felt the earthquake here. This house is of three stories, and it was only felt in the top one by my son and daughter who occupy the two bedrooms on that floor. The former was awakened by what appeared to him to be a loud noise. He fancied that a picture on the wall must have fallen down, and when called later on asked the servant whether what he fancied had taken place. This is about all he can say with any certainty. My son fancied that he heard the crockery on his washing-table shaking, but of this he is not absolutely certain. No picture actually fell. At the same time my daughter was awakened by a shaking of her bed from side to side and by a bell on the wall of her room ringing. She was a good deal frightened. The bed lies [see rough plan]



Plan No. 3.—Verulam House, Watford.

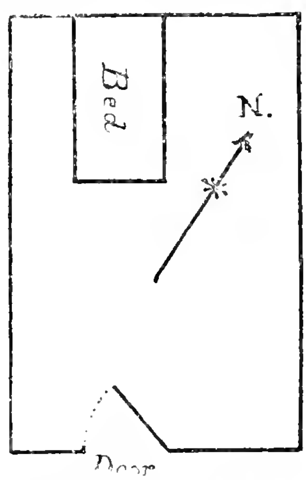
almost N. and S. The bell is on the wall forming the eastern boundary. When the bell is rung by pulling the string the clapper would move N. and S.; it might be made to sound if the bell were shaken in any direction, but it only swings naturally as shown on the plan from N. to S.—*T. Vaughan Roberts, Verulam House, Watford.*

* My house is situated at the S.E. end of Watford and about 50 yards from the River Colne on low-lying ground. The time at which the shock was felt was between 5.33 and 5.34 a.m. Both my mother and myself were awakened by the shaking of the beds. My bed appeared to be shaken as if by a succession of waves following one another fairly rapidly (say about three per second). It was a regular motion, and I could not hear the slightest noise. The duration of the shock was from four to six seconds. On feeling the peculiar motion I immediately thought it was an earthquake, and listened intently for a rumbling sound which I expected, but could hear absolutely no noise whatever, neither from the effects of the shock nor accompanying it. I made a thorough examination of the house afterwards and could find nothing displaced, with the exception of one picture in my room slightly tilted. Only one shock was felt. The wave-like motion appeared to pass from WSW. to ENE., as my bed lies in that direction, and the movement seemed to commence at my feet and pass away towards my head; and this is borne out by my mother, whose bed appeared to rock from side to side, the direction of her bed being at right angles to mine.—*Geo. H. Haywood, 287, High Street, Watford.*

BUSHEY.—The earthquake was felt here.—*Watford Observer*, 19 *Dec.*, 1896.

ALDENHAM.—The earthquake was felt here. There was no noise accompanying it. Beds seemed to be lifted up and then to fall gently down again. My manservant told me about it when he called me at 7.30, before any of the household had seen anyone outside. The time by my man's watch was 5.35; both he and his wife were greatly alarmed. I did not wake at all, and none of my cottagers felt anything. This house is about three-quarters of a mile from any other; it is on the bank of the River Colne, upon the Chalk just outside the edge of the London Clay.—*S. Taprell Holland, Otterspool, Aldenham.*

This place is between Radlett and Aldenham, and on the morning of Dec. 17, at 5.30, I was awakened by my door being burst open, and it seemed as if some heavy person had come into the room and was raising the bed, which seemed to be rocking. I called out "Who is there?", lit a candle and shut the door, and it again burst open and the walls cracked all round the room. Such was my impression. I should say the rocking was certainly on the W. side of the room, and I should think the second opening of



Plan No. 4.—The Folly, Aldenham.

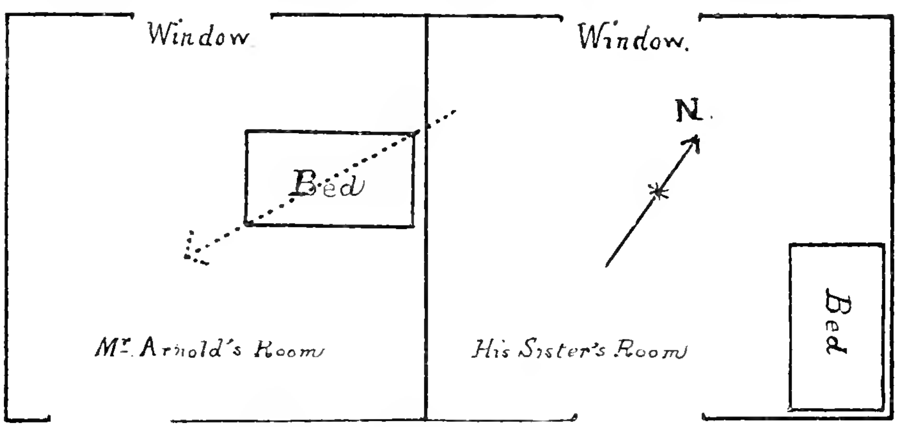
the door was within (say) three minutes. The time was 5.30.—[Miss] *Emily Brunner, The Folly, Aldenham.*

REDBOURN.—Our Redbourn correspondent writes:—"Many of the inhabitants here were considerably alarmed on Thursday early morn (about 5.30) by a shock of 'earthquake,' which was felt all over the village. Some maintain that their beds swayed, others that the bedrooms and house shook and trembled, while crockery jingled together in unearthly fashion. The heavier sleepers were inclined to be sceptical, but the general experience was convincing. It is thirty-four years ago last October that a similar shock was felt, so asserts an old inhabitant."*—*Herts Advertiser*, 19 *Dec.*, 1896.

* This refers, probably, to the earthquake of 6 Oct., 1863, about 3.22 a m., which was felt in the Midland and Southern Counties of England and in Wales and Ireland. If so, the interval is 33 and not 34 years.

Mr. E. W. Arnold, Redbourn Bury, St. Albans, felt the shock, and knew it to be an earthquake. He therefore looked at his watch, and found the time to be 5.35. That is the time of the principal shock, but that was preceded by a slighter tremor lasting about half a minute. Crockery in his room rattled, and he felt his bed lift up, first at one corner, he thought, and then at another, at the end of the tremor. His sister, in a room a little distance off, felt her bed shake, but sideways, not up and down. The house has only two floors, and both these rooms are on the upper floor. At Little Mill (formerly called Do-Little Mill) a rumbling noise was heard preceding the principal shock. This mill is about half-way between Redbourn and Redbourn Bury. Both places are on the River Ver, within a few yards of the river and about level with it.—*Letter from John Hopkinson* [F.L.S., F.G.S., F.R.Met.Soc.], *The Grange, St. Albans.*

I enclose a rough sketch of both my room and my sister's. With regard to my sister, she felt her bed rock *from side to side*, but could not tell which side started first, being asleep when the movement began. With regard to my own sensations, which were very



Plan No. 5.—Redbourn Bury, St. Albans.

distinct, being well awake all through it, I should say the feeling was similar to being in a boat, but a much rougher motion. The head of my bed rose first, and went on diagonally across as I have shown; after that a good many things in the room rattled, but I cannot say that I heard any noise, though one or two people living not far off told me afterwards that they did. I do not know whether the situation of our house was in any way the cause of the shock being felt so distinctly, for we are on rather low ground close to the River Ver.—*E. W. Arnold, Redbourn Bury, St. Albans.*

Harpenden.—Whilst in bed, I experienced a vibratory motion which thoroughly woke me up; a few seconds afterwards a severe shaking occurred (apparently from undulatory movement) followed by a very distinct upheaval—my bed feeling as if lifted 3 or 4 inches. I concluded it was an earthquake, and at once struck a light and noted the time, about 5.35 a.m. One of my servants thought part of the house had fallen, and got up; whilst dressing she thought there was another shaking, but slight. The ceiling of a detached room over an open porch was cracked, as also was a pane of glass in a conservatory on the opposite side of the house. This house is situated on high ground, about 427 feet above the sea.—*Edward Durnford, Lieut.-Colonel, Rothamsted Lodge, Harpenden.*

At Harpenden several persons complained of having felt the shock, and all give about the same time—from 5.30 to 5.45 a.m. Several report that they felt their beds shake, and others that they heard articles in the rooms shake about.—*Herts Advertiser*, 19 *Dec.*, 1896.

ST. ALBANS.—Mr. F. A. Campion, of Netria, Bricket Road, St. Albans, told me that he found most of the pictures hanging on the walls of his house out of position after the shock. Questioning him closely as to this, I ascertained that the pictures on the east and west walls were more disturbed than those on the north and south walls, that they were on the average half an inch out of position, and that most of them were raised on the east, and lowered on the west. I then looked at mine and found that in my dining-room all the lighter pictures on the east and west walls were slightly raised on the east, some being quite half an inch out of square and others rather less. On the same walls there is one very heavy picture which remained in its proper position, and so did all on the north and south walls. I feel sure that all were nearly horizontal on the previous day. They are oil-paintings and heavier than the water-colours in my drawing-room. These also were askew on all the walls, but with no regularity, which I attribute to the fact that they more easily swing backwards and forwards. Mr. Campion, who is Engineer to the Great Northern Railway Company, says that the point of suspension of his pictures was altered, but I cannot be certain that this was the case with mine. You will see what is the position, height above the sea, etc., of my house from one of my meteorological papers which I send you.* For east and west walls I should have said ESE. and WNW. true (=S E. and N.W. magnetic, nearly). Mr. Campion's house is more nearly true N. and S., etc. It is to the S.E. of mine and overlooks my meadow, and is about 50 feet lower than mine. It is modern and thinly built, while mine is 180 years old and has one *inner* wall two feet thick. Although the shock did not awaken me, one of my servants felt it. She first thought that a man was walking heavily across her room, and then she felt her bed lift up and go down again. She looked at a clock in the room and found that it was 5.35. It is a large room at the opposite end of the house to mine, and three servants sleep in it. The two others were asleep, but this one, our housemaid, told the others when they awoke what a fright she had had. I have heard of two other servants in the town, in different houses, who had just the same experience, first thinking that a man was in the room, and then feeling their bed go up and down. One of Mr. Campion's servants heard a chair rattle as if it had been dropped upon the floor, and

* Long. 0° 20′ 7″ W.; lat. 51° 45′ 9″ N.; height above sea-level, 380 feet.

one gentleman in St. Albans heard the flap of a small table in his bedroom move up and down several times, the flap knocking against its support. From all this it seems that the vibration or oscillation was an up-and-down one, eventually if not at first. The time is variously given here as between 5.30 and 5.35—I believe the latter is most likely to be correct—and the duration of the shocks as about half a minute, from which, knowing how apt we all are to underrate that interval, I should think it most probable that it was about a quarter of a minute.—*John Hopkinson, The Grange, St. Albans.*

I was lying awake at the time, so I am able to say that there was no noise either preceding or accompanying [the shock]. The movement was a vibration, or shaking, lasting perhaps as much as half a minute, and causing the china on a washstand in the room to rattle very audibly. There was no feeling of the bed being raised, nor of a wave of shock such as I have felt on one previous occasion. The time was, as near as I could tell, 5.30 a.m. My house has only cellars, ground floor, and *first floor*, on which are the *bedrooms.*—[Miss] *Eleanor A. Ormerod* [F.R.Met.Soc.], *Torrington House, St. Albans.*

The impression produced on the mind of a correspondent at St. Albans was that someone had tilted his bed upward from beneath him.—*Herts Mercury*, 19 *Dec.*, 1896.

In St. Albans the "wave" caused no little consternation, as in other parts of the country. The motion was experienced at about 5.30 a.m. Several of the wakeful citizens assert that they felt the oscillation quite distinctly, while others were aroused from their slumbers by the unusual tremors, the jingling of crockery, and the slamming of doors. Some seemed to think that an explosion had occurred, while others state that they experienced a movement such as that caused by the heavy traffic near their dwelling, unaccompanied, however, by any of those familiar sounds. The vibration lasted several seconds.—*Herts Advertiser*, 19 *Dec.*, 1896.

New Barnet.—About 5.27 or 5.30 a.m. on 17th Dec., Mrs. Fryer and myself were awakened by a noise as of heavy pictures or furniture falling in the dining-room below, and almost immediately we felt our beds rock with a decided movement from E. to W. I then noticed a sort of creaking of the outer wall as after a severe strain. The whole shock did not appear to last more than three or four seconds.—*A. Ellen Coles, Beaufort Lodge, New Barnet.*

Oscillations were experienced at Barnet.—*Herts Mercury*, 19 *Dec.*, 1896.

Hatfield.—On the occasion of the recent earthquake, bottles piled up in my cellars here were thrown down and strewed about the floor. They were all secure at night.—*C. Butler* [F.S.A.], *Warren Wood, Hatfield.*

An engine-driver on the Great Northern Railway declares that after passing Hatfield the line practically rocked, and he feared that either the permanent way had subsided or that his train had become derailed.—*Herts Mercury*, 19 *Dec.*, 1896.

*North Mimms.—I felt it very distinctly where I live, which is sixteen miles north of London, and four miles from Hatfield. I occupy a room at the top of the house (third floor) facing N.E. I was awake at the time, but was so startled that I did not look at my clock at once; when I looked it was 5.35. No tremulous motion was felt. I cannot say for how many seconds the vibration lasted. It was quickly over. I only felt one vibration. I did not notice any tremulous motion after the vibration. The movement gradually increased in intensity, then died away. The shock was not strong enough to cause doors, etc., to rattle, but the bed was perceptibly moved, neither was it strong enough to stop clocks, etc. The shock was accompanied by an unusual rumbling sound, and it seemed as though everything in the house was falling down. The beginning of the sound preceded the shock.—*A. M. Dales, Hawkshead House, Hatfield.*

Lilley.—I was at Putteridge Bury, about half awake, and thought there was a big dog in the room scratching himself hard and shaking the floor rhythmically, and making the washhand-stand clatter. As I knew the dogs in the house, and did not mind their being in the room, I paid no further attention, but at daybreak I found there was no dog and the door was shut.—*M. R. Pryor* [M.A., F.Z.S.], *Weston, Stevenage.*

Pirton.—A lady friend of mine tells me she was awoke by feeling her bed rock, and herself rocked or thrown or jerked from side to side, E. to W., and that she heard a noise directly after that appeared to be a long way off; that would be about the time [of the earthquake] as reported in the '[Herts] Express.' Her father and mother did not feel it, although they sleep in the same house, but her room and the kitchen under her form a kind of lean-to to the house, which may account for it. The person referred to was *awake* (instead of being awoke) when the shock was felt, and had been for some time previous to its being felt. I have learned since that in a cottage erected three or four years ago, about thirty yards from the place where the other house stands, the timepiece on the mantelpiece was found to have been stopped—time half-past five or twenty-five minutes past five (I forget now exactly which), and a vase was found leaning against the said timepiece. The timepiece stood on the mantelpiece facing nearly due N., and the vase stood on the W. side of and fell to the timepiece; thus it fell E.—*William Hare, Pirton, Hitchin.*

*Hitchin.—Was in bed on the second floor of house. Shock recognized, and time taken at once—5.34 a m. No tremulous motion. Three main vibrations lasting two or three seconds. Self and wife happened to be awake. We were lying heads W., feet E. (nearly); we were moved in bed with three distinct movements, the first rolling us very gently to the N., the second to the S., and the third back to N. The movements were very distinct and easy, nothing jerky or violent. There was no perceptible vertical motion. The windows shook and the bed-hangings moved distinctly. No other movement noticed. No damage to buildings in this neighbourhood. No sound noticed.—*William Hill* [F.G.S.], *The Maples, Hitchin.*

We were awakened about 5.30 on the morning of the 17th December. We felt our beds rock, and one sister who was sleeping on a higher floor than the rest felt the furniture shake and thought a wardrobe would fall on to her bed. My mother heard a prolonged noise, as of plaster and bricks falling, and my brother heard distinct knocks, as of hammering, and, thinking burglars were getting in, we partially dressed and went round the house, but could see nothing. In the morning we discovered two cracks in the dining-room walls, from floor to ceiling. The room had been enlarged about ten years before, and it was probably a weak place in the building. The servants sleeping in another wing were not disturbed and heard nothing.—*Grace Lucas, Tile House, Hitchin.*

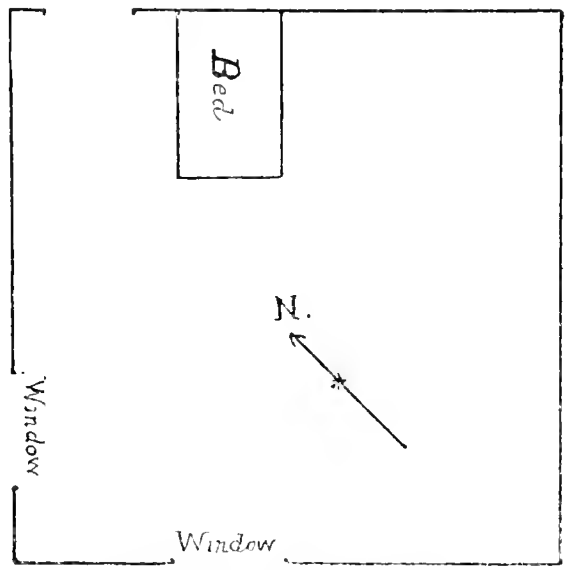
Our correspondent states that a sharp shock was felt in Hitchin and neighbourhood at 5.35, and many people were awoke by the movement of the furniture in their houses, but no damage was caused.—*Herts Mercury*, 19 *Dec.*, 1896.

The shock of earthquake which was felt over such a large part of the country on Thursday morning was noticed by a good many people in this neighbourhood, some of them being roused by the movement of furniture in their bedrooms. The time, as near as can be ascertained, was between twenty-five and twenty-six minutes to six. Mr. William Ransom, writing from Fairfield, Hitchin, says:—" With the view of eliciting further reports in this district, I will describe in a few words what I felt sure was the shock of an earthquake. Whilst lying awake on my back in bed, the first indication I noticed was an instantaneous motion by being turned from one side to the other and back again, the motion being very similar to that experienced when driving in a carriage over a depression in the road. Immediately afterwards, the two windows in my room chattered, and likewise the glass in the wash-stand. A noise resembling the discharge of a distant fog-signal followed. I then lighted a candle, and, looking at my watch, noted the time to be twenty minutes to six o'clock."

While in most respects the descriptions of the occurrence given by different people almost exactly agree, the widest discrepancy exists between the causes to which those who felt the shock attributed their sensations at the moment. The passing of a steam-roller was the explanation which occurred to many; while not a few appear to have jumped to the more alarming conclusion that burglars were at the bottom of the disturbance—were, some supposed, under the shaken or upraised beds!—and we hear of one house in Hitchin having been searched from top to bottom for the imaginary intruders, while in other instances startled sleepers were afraid to speak or stir lest they should become the objects of the burglars' attention.—*Herts Express*, 19 *Dec.*, 1896.

The position of my bedroom is as under, on the first floor of the house. On the washstand against the N.W. window the glasses and basin rattled considerably. The N.W. window rattled most.

The S.W. window, which might have been more tightly fastened, not so much. The height of Fairfield is 276 feet above the sea,



Plan No. 6.—Fairfield, Hitchin.

and to the first bedroom floor 287 feet 6 inches. The windows are sash windows.—*William Ransom* [F.S.A., F.L.S.], *Fairfield, Hitchin.*

* Stevenage.—Time about 5.25 a.m. House felt as though it was about to fall. Only one shock. The bed was raised and shook violently. Everything rattled in the room, and the dogs downstairs barked. There was a loud rumbling, like a heavy train passing.—*W. Brudenell Rooke, The Firs, Stevenage.*

About 5.30 on 17th Dec., I was awoke quite suddenly by the violent shaking of my bed. The shock was so violent that it sent me nearly out of bed. I got up at once and went into the next ward, where there was a patient under treatment. . . . Nothing had been felt by Mrs. Mardell in the room under mine, though she was quite awake, or by Ada Chalkley, the patient, who was sound asleep when I went into the ward to see if anything were wrong, but the shake I felt I shall never forget.—*Charles Mardell, Caretaker, Isolation Hospital, Pin Green, Stevenage.*

In a subsequent letter Mr. Mardell states that his bed stood E. and W., and that the movement came from the N.—[H. G. F.]

Weston.—My eldest daughter, sleeping at the top of this house, felt a strange vibration.—*M. R. Pryor, Weston, Stevenage.*

Ardeley.—My daughters were sleeping in separate bedrooms (adjoining), and both were awake at the time and distinctly [felt] the shock. Their beds were raised and went back with a thud. The shock consisted of two distinct parts, if not three, with an interval of a few seconds; they think the second part the stronger. The time was about 5.35 a.m. They heard no sound, only the moving motion. A grey parrot we have (the cage standing on a table) screamed vociferously as though much frightened, a thing she had never been known to do before in the night. A cottager living a short distance from us also felt the shock in the same way. We understand at about two miles from us a cottager had some ornaments shaken from his mantelpiece.—*Sarah Darby, White Hall Farm, Luffenhall, Ardeley, Stevenage.*

* Time, 5.30 a.m. Bed shook and furniture, also basin on the washhand-stand, etc. Did not notice any interval. The duration of the shock was three or four seconds. A rustling sound, like birds in the chimney, was heard. The sound was heard first, then the furniture shook, and then the bedstead. The motion *seemed* to travel from S.E. to N.W.—Observers: [Miss] *Mary H. Young*, and [Mrs.] *Mary Ann Wright, Moor Hall, Ardeley.*

* Locality, five and a half miles W. of Stevenage. The observer was in bed asleep on the first floor. Time, about 5.30 a.m. The shock was just like the approach of a very heavy goods train, and the consequent gradual sensation of noise. Its duration was thirty seconds. The window, crockery, fire-irons, etc., rattled, and the bed shook violently. The sound became gradually louder, and then died away.—*Maude Josephine Scott, Ardeley Bury.*

WATTON.—I was one of those aroused by the earthquake, and as very few people in our district felt it, I think it worth while to mention it to you. The shock was not very severe, but was strong enough to make the windows, etc., rattle, and lasted a few seconds. I cannot really give a more accurate account, as by the time I was thoroughly awake it was all over. I confess I was one of the foolish persons to whom the idea of burglars occurred in the first instance; but having felt the earthquake about fifteen years ago,* I soon realized what it was.—*Abel H. Smith* [M.P.], *Watton Rectory, Hertford.*

BRAMFIELD.—The shock of the recent earthquake was felt at "Green Hill Farm," which is situated a mile from the village. The house stands alone, on rather high ground, and being very much exposed has often been felt to shake when the wind is rough, but never to *rock* in the peculiar manner experienced on the morning in question. The occupants of two bedrooms distinctly felt the beds rock to and fro, and the sensation experienced thereby was novel, puzzling, and ever-to-be remembered. An unusual, indistinct, and indescribable sound preceded the movements, which were followed by a perfect silence and calm. One of our men, on his way to work through the woods which surround our fields, states that the pheasants and [other] birds suddenly made a loud cry and flutter as though greatly agitated. The time was about half-past five in the morning. I was wide awake at the time, half lying and partly sitting in bed, my head resting on the back of the bedstead, hesitating to face the unpleasant but inevitable duty of getting up. The position was excellent for *feeling* and hearing all that occurred. —*J. Salmon, Green Hill Farm, Bramfield, Hertford.*

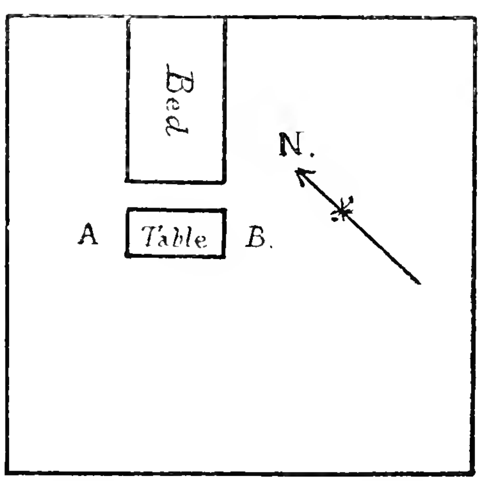
* Probably the East Anglian earthquake of 22nd April, 1884.

* LITTLE BERKHAMSTEAD.—I find only one person in this village who perceived the earthquake, and that slightly.—*G. Gibson, Rector, The Rectory, Little Berkhamstead, Hertford.*

HERTINGFORDBURY.—Mr. W. E. Topham, of Hertingfordbury, states that he was awakened by the bed being violently shaken, and the rings on the curtain poles jingling together, and he could also hear the pheasants in Panshanger Park crowing and calling in an excited manner. Another member of the family had similar experiences; but as this is the third shock felt there since 1880, Mr. Topham at once guessed the cause of it, and found the time to be exactly 5.30.—*Herts Mercury*, 19 *Dec.*, 1896.

* BAYFORDBURY.—Observer in doors, on the first floor, awake, in bed. The time was 5.32 a.m. There was no tremulous motion either before or after the principal vibrations. Of the latter there were about twelve (probably more), lasting about fifteen seconds. The movement increased in intensity up to about the ninth vibration and then died away. The doors and windows, etc., rattled violently, and the bed was perceptibly moved. No clocks were stopped or ornaments overthrown, and there was no structural damage to buildings. No sound was heard and there was no wind at the time. Position of bed N.E. and S.W., and the apparent course of the shock was across it—S.E. to N.W. The oscillations were purely horizontal—a rocking motion. Windows began to rattle at about the eighth vibration.—*W. Clinton Baker* [F. R. Met. Soc.], *Bayfordbury, Hertford.*

BENGEO.—I distinctly felt the earthquake here on the 17th ultimo [17th December]. The time was about 5.30 a.m. I was perfectly aware of what was happening, having been in earthquake



Plan No. 7.—Bengeo Hall, Hertford.

countries, and consequently accustomed to shocks of the kind. My bed shook with apparently a side-to side motion, and the flaps of a table in my room chattered while the shock lasted. The room I was occupying is on the second floor. Aspect towards the N.E. Head of bed against the N.E. wall, as shown in rough plan. The flaps of the table were at either end where marked A and B. Of course the flaps of the table were hanging down. My house is on rising ground in the valley of the River Rib.—*Hellier R. H. Gosselin, Bengeo Hall, Hertford.*

* HERTFORD.—A shock was felt at 4.20 a.m. by my daughter, who was woke up by it, and got out of bed directly and looked at the time, and also out of doors to see if it could be anything outside. I did not feel this shock, but must have awoke soon after, as at 4.35½ a m. my bed was shaken up and down and slightly in the direction of N.E. and S.W. for two seconds, not more. Neither of us felt anything that is said to have happened at 5.35. I am sure as to my observation of the time, and so is my daughter. There was a distinct lifting of the bed at 4.20.—*R. T. Andrews, 25, Castle Street, Hertford.*

A Hertford correspondent says:—"Two distinct shocks of earthquake were experienced early on Thursday morning in the town and neighbourhood. The one generally felt was at 5.35, but in one case, at least, an earlier shock was felt, between four and five o'clock. The rattling of crockery was noticed, but no harm was done."—*Herts Express*, 19 *Dec.*, 1896.

The shock was felt by several persons in Hertford and the neighbourhood. Mr. Leonard McMullen, of Sele Cottage, North Road, informs us that he experienced two shocks, the first one between four and five o'clock, and the second one at 5.35, when there was a distinct shaking of the bedroom and a jingling of the glasses on the washstand. Mr. W. P. Willson, who lives close by, states that the shock was rather severely felt at his house at 5.35 a.m. In one of the rooms the bed was shaken sideways, the shock appearing to come from north to south; while in other rooms, where the beds are placed in a different position, the head and foot of the bedsteads seemed to be lifted up. The shock appeared to last quite half a minute. Similar occurrences were noted in different parts of the town and at Bengeo. One lady informs us that she felt her bed tremble, and the walls appeared to be shaking.—*Herts Mercury*, 19 *Dec.*, 1896.

WARE.—At Ware the shock was also experienced, the time being taken as 5.35.—*Herts Mercury*, 19 *Dec.*, 1896.

Two gentlemen living close to Ware distinctly felt the shock of the earthquake on 17th Dec., at 5.30 a.m., although unable to account for it until reading next day's paper.—*George Price, Ware.*

The earthquake was felt at 5.30 a.m by our servants sleeping on the second floor of this house—so much so that they got up and lighted a candle, thinking there might have been a gas-explosion. They reported what they had felt, and said it must have been either an earthquake or an explosion. No one sleeping on the first floor was disturbed.—*T. Fowell Buxton, Easneye, Ware.*

HODDESDON.—Mr. F. M. Campbell [F.L.S., F.Z.S.] of Rose Hill, Hoddesdon, reports that the earthquake was felt at Hoddesdon, but not by him.—H. G. F.

* WALTHAM CROSS.—Time about 5.35 a.m. In one room on the second floor one shock was felt; in another room on the same floor two shocks were felt, with scarcely any interval. In the former case the bed was raised with some force, considerably shaking the occupant who was already awake. In the latter case the bed was slightly raised twice, waking the occupant, in both cases giving the impression that there was some one under the bed; no rumbling or other noise was heard.—*E. M. Gower, Theobalds, Waltham Cross.*

* CHESHUNT.—The observer was in bed fast asleep on the second floor, the house being three stories high above basement. Time, 5.30 a.m. There was a violent shaking of the bed, apparently not vertical. The bed was very distinctly moved, waking up both the observer and his wife with alarm, but nothing was overthrown. *F. F. Lambert* [Vicar], *Cheshunt Vicarage.*

* ASHWELL.—I was sleeping in my own house, The Bury, Ashwell, when for a drowsy moment I fancied I was in my berth on board ship and that that ship was rolling heavily. The windows and door rattled. I lit a match, realizing the cause, and found it was 5.35 by my watch.—*Wolverley A. Fordham* [*The Bury, Ashwell, Baldock*].

Miss Mabel Fordham, Elbrook House, was awakened and frightened, and got out of bed and went to the nurse's room, saying her bed was shaking. She was afraid to go to bed again and got up and dressed.—H. G. F.

Whether I was asleep or not I cannot tell, but all at once there was a most terrific gust of wind, apparently blowing through the trees at the corner of the house and scattering the leaves in all directions, and I could not understand it because I knew there [were] no leaves on the trees. It appeared like two gusts following quickly one on the other, and then all was quiet again.—*Moses Humphry, Stipend, Ashwell.*

SANDON.—I must give you my version of that commotion a fortnight ago last Thursday, about 35 minutes past five o'clock a.m. I had been lying awake, I may say, for an hour. It made me think more of an *air*-quake than an *earth*-quake. I heard it distinctly for about 30 seconds. It appeared like a rushing mighty wind, about twelve feet from the ground. The sound with it was like boys sliding on rough ice, with hobnails in their shoe-soles. Sound travelling from west to east, very rapidly, into space.—*W. H. Lees* [*C. C.*], *Sandon Bury.*

[Mr. Lees tells me also that the sound was peculiar and he was startled by it, that the house did not shake, and that it was dark and no light was seen.—H. G. F.]

THERFIELD.—The earthquake shock of last week was noticed in this village. At the residence of Mrs. Francis we understand that the sensation was felt as if someone had hold of the bedstead and was shaking it. Mr. Shackleton, churchwarden, also noticed it, but attributed the noise at the time to horses kicking in the stables adjoining.—*Herts & Cambs Reporter*, 24 *Dec.*, 1896.

Royston.—I was awakened, as near as I can tell, about half-past five by a most peculiar rumbling and grating sound, appearing to come in a south-westerly direction. By the time I had done speculating as to its cause, the window of my room loudly rattled, and I expected to hear a sound of wind with it, but nothing more was heard by me.—[Mrs.] *A. E. Hughes, High Street, Royston.*

On Thursday, 17th Dec., 5.30, upon retiring to my bed I was very much alarmed, owing to a violent shaking, lasting, of course, only a few seconds. On inquiring next day I found nothing otherwise than normal.—*W. L. Farnham, Limes, The Warren, Royston.*

Reed.—About 5.35 on the 17th Dec., I felt my bed rock from north to south for three or four seconds very distinctly, and the shaking of a partition gave me a fright.—*John Wilson, Goodfellow Farm, Reed.*

Buckland.—First it was like gusts of wind, and then as though the house was all falling down, and the bedsteads shook as though someone was shaking them, and then all was quiet.—*William Jarman, Hodenhoe Farm, Buckland, near Buntingford.*

Barkway.—Mr. J. J. Balding, of Barkway, told me in conversation that his bed shook as if a traction-engine was passing in the road. He thought it was an earthquake. Also that two ladies, in different houses in the High Street, Barkway, 200 yards apart, felt the shocks, and that one of them got up.—H. G. F.

Westmill, Buntingford.—I felt the earthquake of 17th December distinctly in this house. I had been awake some time, and was just falling asleep when I was startled by feeling my bedroom heave gently up and down. The bed-curtains rustled and the curtain-rings rattled. There were no other sounds, and the night was very still. I did not look at my watch, so cannot fix the time, except that it was early morning.—*Louisa R. Greg, Coles, Buntingford.*

* Braughing.—Shocks were felt by my wife, sons, and daughter, in bed on first and second floors, about 5.30 a.m. I slept through it. They say they all felt the bed shake considerably for some time, but they cannot give any exact account either of their sensations or of the duration. Nothing was thrown down. I fancy some fresh cracks were made in ceilings, but no plaster fell. I do not think any sound was heard here, but a good many people in the neighbourhood were disturbed by the motion.—*P. G. Ward,* [Vicar], *Braughing Vicarage, Ware.*

Bishop's Stortford.—On Thursday morning, between half-past five and six o'clock, an inhabitant of Bishop's Stortford was aroused by the peculiar movement of the bed. It, and the room in which it stood, shook so much that under ordinary Stortford circumstances it would have occasioned no little alarm; but the occupant, reflecting that the town was now the happy possessor of a steam-roller, and that it was doubtless rumbling along on its way to some early rendezvous, turned contentedly over and peacefully went to sleep again. The shock was distinctly felt in many parts of Hertfordshire, and as far east as the borders of Essex. It was noticed at Bishop's Stortford by several persons.—*Herts & Essex Observer*, 19 *Dec.*, 1896.

It [the earthquake] was scarcely noticed in the district generally. —*Mardon Bros.*, *Herts & Essex Observer*, *Bishop's Stortford.*

I add a few notes relating to localities in adjoining counties.

Bedfordshire.

LUTON.—At Luton two or three distinct shocks are stated to have been felt, and several persons allege that their houses trembled for fully thirty seconds, causing many articles of furniture to be shifted. —*Herts Mercury*, 19 *Dec.*, 1896.

SHILLINGTON.—The shock was felt here.—*William Hare, Pirton, Hitchin.*

BIGGLESWADE. — The earthquake was distinctly felt here at 5.30 a.m. Persons living near the Market Place were aroused, and thought the old Shambles had fallen; and on the Station Road houses and beds were shaken.—*Herts Express*, 26 *Dec.*, 1896.

Huntingdonshire.

HUNTINGDON.—The Earthquake —Several people assert that they were awakened from their sleep by hearing a noise, and through the shaking which took place, but it does not appear to have been very marked. On the other hand, there were many people up at the time, and they heard or felt nothing.—*Cambridge Independent Press*, 24 *Dec.*, 1896.

Cambridgeshire.

CAMBRIDGE.—[The Observatory.]—We have no special instruments for recording seismic disturbances. Mercury readily transmits tremors, and the earthquake of 1884* was detected here by means of the circular trough of mercury under the transit instrument. However, as the earthquake of 17th December occurred so early in the morning there was no chance of any of the observers being fortunate enough to detect it in that way.

The corrections for the transit instrument are obtained with great exactness, and any slight shift of the telescope would at once have been detected by means of the star reductions. However, the corrections have been carefully scrutinized, and, as far as can be made out, there is no indication whatever of any shift of the instrument.—*Letter from Miss A. Walker, The Observatory, Cambridge.*

The seismic disturbance which passed over England on Thursday morning was felt between 5.34 and 5.35 a.m. by Mr. Howell Pain, of Sidney Street, who was awakened by the shock.—*Cambridge Independent Press*, 18 *Dec.*, 1896.

ELY.—The Earthquake.—The following letter appears in a London contemporary:—Sir, I see no notice in this morning's

* "Mr. H. Todd, writing from the Cambridge Observatory, states that at the time of the earthquake, observations for the determination of the level of the transit instrument were in progress, and the mercury was so disturbed that the observer had to wait some time, thinking that it arose from some waggon passing along the road."—'*The East Anglian Earthquake of* 1884,' p. 128.

paper of the earthquake having been felt in the East of England, so it may be interesting to mention that three people in different rooms in this house distinctly felt it. Two were awakened by the shock, and the third, already awake, with a candle lighted, saw that it was half-past five a.m. They spoke of it when they came down, and it was suggested that it might have been caused by a passing traction-engine, but the motion was described as quite of a different kind—not a quick vibration, but rocking.—I am, Sir, your obedient servant, Florence [Lady Alwyne] Compton, The Palace, Ely, 18th Dec.—*Cambridge Independent Press*, 24 *Dec.*, 1896.

Summary and Conclusions.

It will be seen from the foregoing notes and communications that the earthquake was more or less definitely felt over the whole area of the County, seventy-three observations distributed over forty-seven distinct localities having been recorded, leaving no part of the County of any considerable extent untouched.

The shock was more marked on the western than on the eastern side of the County, and I cannot learn that it extended into Essex.

There seems to be no clear difference in its recorded effects as between localities at various altitudes above the sea, or between those situated on different rock-formations, or on superficial clays and gravels as compared with those on the bare chalk. Had the movement been more pronounced and striking in its effects, no doubt classification would have been possible on such lines.

Nor is there any special deduction of scientific interest to be obtained from the experiences of observers relative to the character or duration of the earth-movement. My information comes almost entirely from persons who were in bed at the time of the earthquake, and their sensations are generally expressed in much the same terms; a lifting or rolling movement of the bed is almost universally spoken of. Opinions vary as to the direction to be ascribed to the movement, and the ideas of persons suddenly awoke from sound sleep, as occurs in many cases, would necessarily be vague. The position and structural arrangements of the building in which an observer is placed, seem to affect the local movement, and may, in some cases, seriously deflect a horizontal tremor. At best a human being is a very unsatisfactory instrument for recording with any exactness the effects of terrestrial vibrations.

As to inanimate objects, we have a few scattered details. They relate to the movement of pictures suspended on the walls of houses (St. Albans); to the stopping of a clock and the falling of a vase (Pirton); to the ringing of a bell (Watford); the swinging of the handles of furniture (Watford), and of the flaps of a table (Bengeo); the opening of doors (Little Gaddesden, Watford, and Aldenham); the throwing down of bottles piled up in a cellar (Hatfield); the swaying of bed-hangings (Hitchin and Westmill); and the falling of ornaments from a mantelpiece (Ardeley). The rattling of windows and of crockery and other light articles of furniture was pretty-generally noticed.

Structural damage to buildings is, where recorded (and that in three instances only), of the very slightest character. At Rothamsted Lodge, Harpenden (a house situated on high ground, 427 feet above the sea), Colonel Durnford states that the ceiling of a detached room over an open porch was cracked, as also was a pane of glass in a conservatory on the opposite side of the house. At Hitchin (Tile House) two cracks were made in the wall of a dining-room, extending from floor to ceiling. Cracks in a ceiling are reported, but doubtfully, from Braughing.

As to the character of the movement, there is a very general agreement. Undulations or swaying as of a ship at sea, or of a carriage driven over a depression in a road, are spoken of by observers who were awake prior to the movement and were thus well able to record their impressions. Several of my correspondents thought their beds had been lifted up by a person underneath, many speak of the bed being lifted, others of a rocking motion. An engine-driver on the Great Northern Railway near Hatfield, the only outdoor observer whose experiences have been noted, felt the line rock. Various terms are used in the descriptions given by observers of their sensations—"slight rocking," "trembling," "rocking backwards and forwards," "bed heaved as if a wave had passed under it," "wave-like motion," "rolling motion," "turned from one side to the other," "beds raised and went back with a thud," "rock to and fro," "violently shaken," "rocking, horizontal motion," "side-to-side motion"—occur in the accounts transcribed, and represent the general impression of the forty or so persons who speak distinctly on this point.

The result seems to indicate pretty clearly that a terrestrial undulation took place, the movement being variously translated according to the position and structure of the buildings in which the observers were at the moment, but being generally comparable as regards the observers to that of a ship at sea under which a wave or more than one wave passes.

There is a conflict of evidence as to accompanying sounds. In a large number of cases a rumbling sound is recorded. The following are representative examples of the expressions used by observers:—Like a traction-engine moving heavily along (Little Gaddesden); fall of a heavy body, or explosion at a distance (Hemel Hempstead); concussion as of a van or traction-engine overturned (Rickmansworth); a sort of thud; a loud noise (Watford); a rumbling noise (Redbourn); as of heavy furniture falling (New Barnet); unusual rumbling noise (North Mimms); noise a long way off (Pirton); prolonged noise; like discharge of distant fog-signal (Hitchin); loud rumble, like heavy train (Stevenage); like heavy goods train (Ardeley); rumbling and grating (Royston); unusual sound (Braughing).

On the other hand, some very competent observers speak positively as to the absence of noise, and these reports come from various districts:—Watford (Mr. G. H. Haywood); Aldenham (Mr. S. T. Holland); St. Albans (Miss Ormerod); Hitchin

(Mr. W. Hill); Ardeley; Bayfordbury (Mr. W. Clinton Baker); Waltham Cross; and Buntingford.

A possible explanation of this discrepancy may be found in the difficulty in discriminating between sound-vibration accompanying or produced by the earth-movement itself, and the noise of moving objects, which would be purely local. That there was no general aërial wave seems clear, several notes from various parts of the County expressly stating that there was no wind; but in one district, or rather on one narrow line of country, stretching in a N.W. and S.E. direction, three of my correspondents agree in speaking of strong gusts of wind (Slipend, Sandon, Buckland). Whether this was a collateral circumstance or a variety in the impressions received from the terrestrial movement, I cannot say; the former seems the more probable conclusion.

A few instances are cited of the effect of the shock on wild and domestic animals. As has been often observed, any unusual aërial or terrestrial disturbance has a terrifying influence on the higher classes of animals; a thunderstorm, an explosion, or an earthquake, are equally noticed by them. In the present instance at Stevenage dogs barked in a house, at Ardeley a parrot screamed, and from Bramfield and Hertingfordbury we have reports that pheasants called out.

On the duration of the general movement and the number of distinct tremors we have a variety of notes. In the majority of cases only one movement is spoken of, no distinction being made between the minor shocks or vibrations which by some persons are recorded. At Little Gaddesden two distinct parts to the shock, with an interval of only a second or two, are reported. Three gentle tremblings of the bed, and then a lifting and twisting motion, are noted at Rickmansworth. Mr. G. H. Haywood, of Watford, experienced a succession of waves following one another fairly rapidly (say about three per second?) during four to six seconds. Miss Brunner, The Folly, Aldenham, writes of a door opening twice at an interval estimated at three minutes. At Redbourn the principal shock was preceded by a slight tremor lasting about half a minute. Colonel Durnford (Rothamsted Lodge) was awakened by a vibratory motion, which was followed in a few seconds by a severe shaking. Miss Ormerod (St. Albans) gives the duration of the disturbance as "perhaps as much as half a minute." At Hitchin Mr. Hill noticed "three main vibrations, lasting two or three seconds." At Stevenage one shock only is recorded by Mr. W. Brudenell Rooke and Mr. Chas. Mardell. From Ardeley we have various accounts:—a "shock consisting of two distinct parts, if not three, with an interval of a few seconds" (Luffenhall); shock, with no interval, lasting three or four seconds (Moor Hall); movement lasting thirty seconds (Ardeley Bury). Mr. W. Clinton Baker, of Bayfordbury, says there was no tremulous motion either before or after the principal vibrations. The latter he describes as "about twelve vibrations (probably more) lasting about fifteen seconds," and increasing in intensity up to the ninth. At Hertford "quite half a minute" is given (Mr. W. P. Willson). Two shocks, with scarcely any interval, were felt near Waltham Cross. Mr. John Wilson writes of a movement lasting three or four seconds at Reed.

It will be seen that the duration of the movement as a whole is variously estimated from one or two or a few seconds only up to fifteen seconds (Bayfordbury), twenty seconds (Dr. John Attfield, F.R.S., Watford), thirty seconds (Ardeley Bury), to "quite half a minute" (Hertford), and even to three minutes (Aldenham).

As to the time, very little satisfactory and exact information is available. Unfortunately no recording instruments of any kind help us on this point. Mr. Mawley's meteorological instruments at Berkhamsted show no trace of any disturbance, and at the Cambridge Observatory, where the East Anglian earthquake of 1884 was (almost accidentally) noticed, the shock that we are now considering passed unobserved.

Many observers, however, note the time, and there are (as might be expected) considerable variations. Out of 47 notes, three are as early at 5.25, one as late as 5.45. Between these two extremes the largest number (23) give 5.30, and 13 give 5.35 as the time. In general we may take it that these are round figures.

Exact observations appear to be given by:—Mr. Sidney Martin, Watford, 5.25 "as nearly as possible"; Miss Ormerod, St. Albans, 5.30 "as near as I could tell"; Mr. W. Clinton Baker, Bayfordbury, 5.32; Mr. G. H. Haywood, Watford, 5.33 to 5.34; Mr. W. Hill, Hitchin, 5.34; Dr. Attfield, Watford, 5.34 "Greenwich time"; Miss Grace Jones, Kensworth, 5.35; Mr. E. W. Arnold, Redbourn Bury, 5.55; and, on the whole, the balance of probability seems in favour of 5.34 as being the nearest minute, for the western side of the County at all events.

Finally, some materials have accumulated pointing to the direction of propagation of the undulatory or wave-like movement which seems to have traversed Hertfordshire in the superficial crust of the earth. The sketch-plans incorporated in the text are principally published as helping to elucidate this point. The results, however, are by no means clear. Where there are personal observations as well as the movements of inanimate objects in the same locality, they do not always agree. For instance, it will be seen on referring to Plan No. 1, p. 189, that while the observer thought that the movement was from S. to N., the wardrobe doors were opened by a motion which, it would seem, must have been approximately from W. to E., or E. to W. At Watford also the observer was shaken from W. to E., but the bell which was rung, if it swung as it would naturally swing, would move on a north-and-south line. It appears, however, that the bell could be made to ring if shaken in any direction. It is possible to bring into harmony the movement experienced by Miss Brunner at Aldenham with the opening of the door reported by her, by assuming a movement from a south-westerly direction, though the door would apparently be most liable to be affected in the way stated by a movement from the south (see Plan No. 4, p. 191). The sensations of two persons in adjoining rooms at Redbourn Bury do not altogether agree. The one speaks of movement from E.N.E., the other of one from N.N.E., but the discrepancy here is not considerable. The swaying of pictures at St. Albans does not establish any well-marked line of direction. At Pirton, in the north of the County, the stopping of a clock, the fall of a vase, and the personal sensation of an observer, all point to an E. and W. movement; and at Bengeo, as shown on the plan (Plan No. 7, p. 199), the movement of the bed and of the flaps of the table standing at its foot coincides in direction.

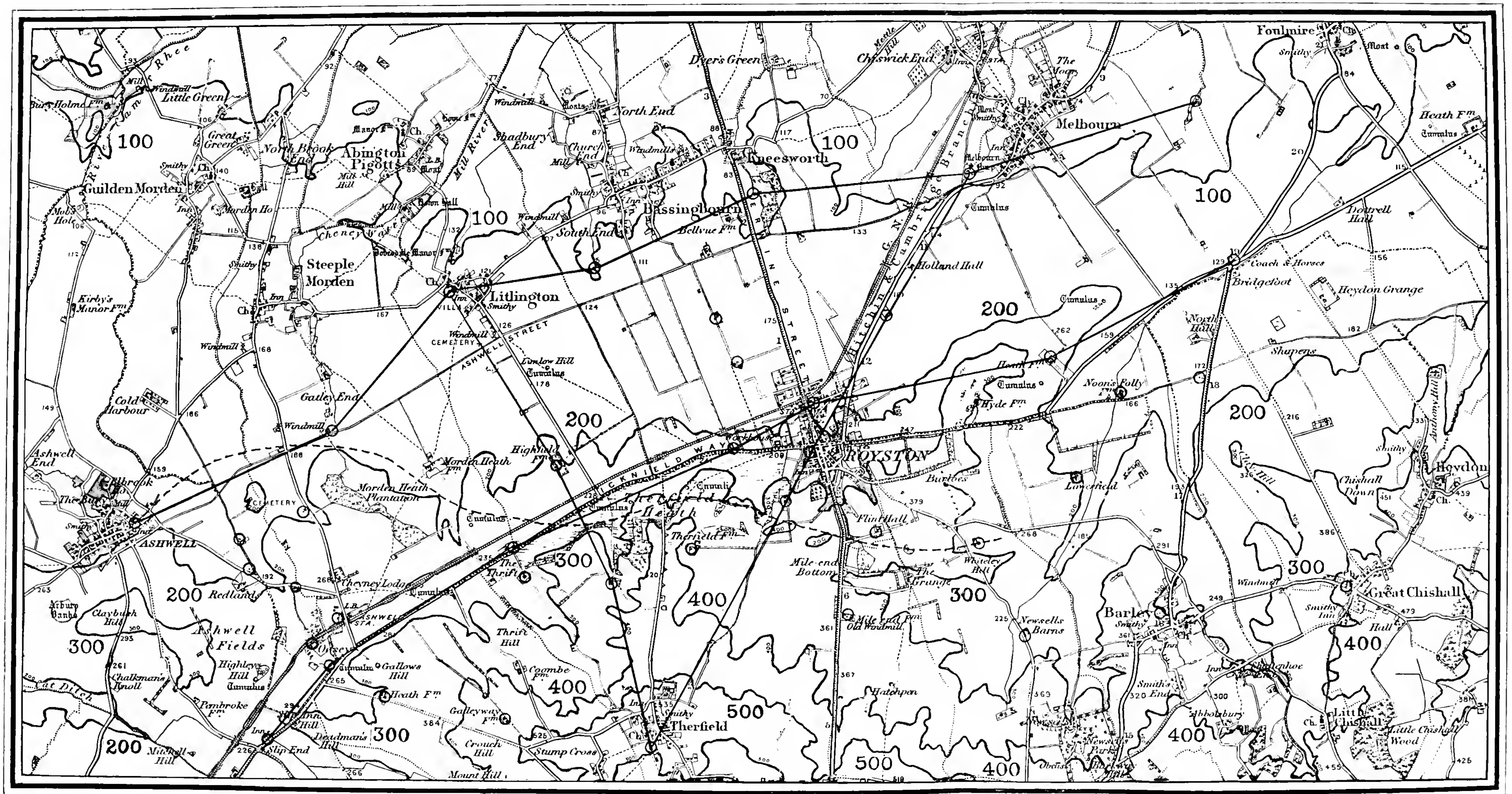
It may be said that of the eight cases in which inanimate objects can be appealed to, a westerly and easterly movement is either definitely indicated or can at least be inferred as possible.

Sixteen personal impressions are recorded. Of these, one refers to a movement from S. to N., three from N. to S., three from S.E. to N.W., and one N.W. to S.E. Six speak of the movement as coming from the W. or from a westerly point, and two from the opposite quarter. Thus the balance of numbers is clearly in favour of a movement on a W. and E. line, which seems the probable general direction of the movement. Deviations from that general direction must, if this be accepted, be accounted for by reference to local circumstances, either relating to the character of the deep-seated or superficial geological formations, or to the structure and position of buildings.

It remains to notice the earlier shocks which are reported from Hertford. Mr. R. T. Andrews, of Castle Street, who did not notice the movement between five and six, gives a distinct account of a shock he felt at 4.35½, and mentions that his daughter was awakened by a yet earlier shock at 4.20. Mr. Leonard McMullen, of Hertford, also felt a shock between four and five, and there can be no doubt of the fact, although, curiously enough, these vibrations have not been recorded elsewhere in the county.

I have now endeavoured to sum up, as shortly as possible, in the above few pages, the results and more salient features of the detailed observations previously printed. For more minute particulars students will, no doubt, study the detailed observations themselves; but the more casual reader will probably be content with the summary.

The scientific results of my inquiry, as I have previously hinted, are not large or important. They are nevertheless not devoid of interest. As a matter of county record I hope they are fairly complete. They may be more interesting when read into and with the elaborate study of this earthquake now in the hands of Dr. Davison. Until that work sees the light mine must speak for itself.



MAP OF THE COUNTRY AROUND ROYSTON.

SCALE: 1 INCH = 1 MILE

XXIV.

WATER-LEVELS IN THE CHALK NEAR ROYSTON.

By Harold Warren, Assoc. M. Inst. C.E.

Communicated by H. G. Fordham.

Read at St. Albans, 6th April, 1897.

PLATE VI.

I have been asked to bring before the Society the results I have obtained by taking the water-levels in several of the wells and springs in the north-east of Hertfordshire and south-west of Cambridgeshire. The district embraced, as shown on the map, is about sixty square miles in extent, with Royston nearly at its centre, and Ashwell at its extreme west. This includes the whole breadth of the Chalk escarpment, which here reaches its highest point at Therfield, and throws out at its base the magnificent line of springs which feed the River Rhee or western branch of the Cam.

This being a bare chalk area, the plane of saturation almost invariably rises beneath high ground, the springs below increasing or decreasing according to the hydrostatic pressure behind them, thus maintaining a general balance. The variation of level due to rainfall is, of course, felt in the wells on the higher grounds more than in the shallower wells and streams in the valley.

The wells in which these water-levels were taken all derive their water-supply from the Middle and Lower Chalk, only those at Therfield and Great Chishall being sunk through a few feet of Upper Chalk, while the springs in the valley, as is well known, are thrown out by the Totternhoe Limestone, which everywhere overlies the Chalk Marl in this district.

For the sake of comparison with other years I show on a table the monthly rainfall at Odsey and Therfield for 1895, and also

1895.	Rainfall.		Depth of water in Therfield well.		1895.	Rainfall.		Depth of water in Therfield well.	
	Odsey.	Therfield.				Odsey.	Therfield.		
	ins.	ins.	ft.	ins.		ins.	ins.	ft.	ins.
Jan.	2·21	2·62			July	3·53	4·45		
Feb.	·33	·33	23	3	August	5·69	6·12	26	9
March	1·55	1·75	28	0	Sept.	1·00	·86		
April	1·01	1·03	31	4	October	2·11	2·38		
May	·86	·78	32	9	Nov.	3·42	3·72		
June	·46	·51	32	0	Dec.	1·65	1·84	20	9

a somewhat broken record of the depth of water in the well at Therfield Rectory for the same period, taken at the end of each month

The levels, with one or two exceptions, were taken between the 30th of December, 1895, and 10th of January, 1896, at about which time the winter rise of level usually commences in this area. This is shown in the records given by Mr. Fordham in his papers on the Barley and Odsey wells (see 'Transactions,' vol. v, p. 20; vol. vi, p. 31).

On the map will be seen the surface-contours, and I have also attempted to show in dotted lines the subterranean contour of saturation where it is 145 feet above Ordnance Datum, but it is difficult to plot this with accuracy as the wells are in some cases few and far between. The small circles on the map show the position of the wells and springs in which levels have been taken.

I have prepared four typical sections, showing the hydrostatic gradients in this district. I do not think these need much comment beyond a short description of their direction (shown on the map).

Section No. 1 is taken through the line of springs which rise at the base of the Chalk outcrop from Ashwell to Shepreth. It will be seen that with the exception of the Upper Gatley Spring, which is only about 3 ft. 9 ins. lower than that at Ashwell, there is an almost uniform gradient throughout. From Ashwell Spring (145·9 ft. O.D.) to Shepreth Spring (71·8 ft. O.D.) there is a fall of 74 feet, giving an average gradient of nearly 5 feet per mile.

Section No. 2 is taken higher up the escarpment nearly parallel to the above, that is, in an E.N.E. direction, from the "Hare and Hounds" Inn near Odsey, through Royston, to the "Coach and Horses" Inn on the Newmarket Road. There appears to be a slight depression under Royston, but I do not think this is due to any permanent lowering of the line of saturation by pumping.

Section No. 3 is taken across the outcrop from Therfield Rectory to Litlington Spring. The levels shown in this section were taken on the 30th of March of this year, and must not be confused with the others, which were all taken on the dates before mentioned. It will be seen that the well at Therfield is actually over the ridge separating the Cam and Lea basins.

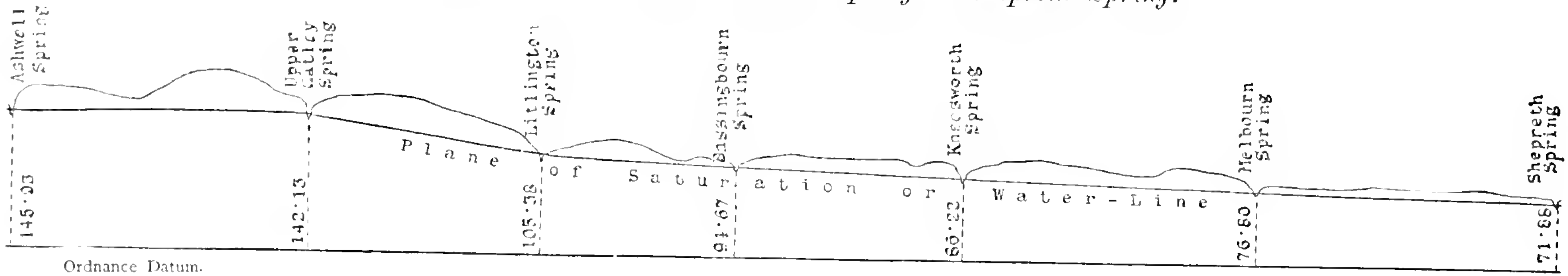
I had hoped to have got some levels in other wells near here, in order to ascertain how nearly the underground parting-line corresponds with the surface-ridge, but unfortunately I have been unable to do so. I think, however, there is little doubt but that this well does drain towards the Cam valley, as, the outlet being comparatively near, there would be an easier passage for the water in this direction than there would be towards the Lea valley.

From Therfield Rectory (284·2 ft. O.D.) to Litlington Spring (105·3 ft. O.D.) there is a fall of 179 feet, giving an average gradient of 45 feet per mile from the top of the ridge to the outlet spring at the bottom.

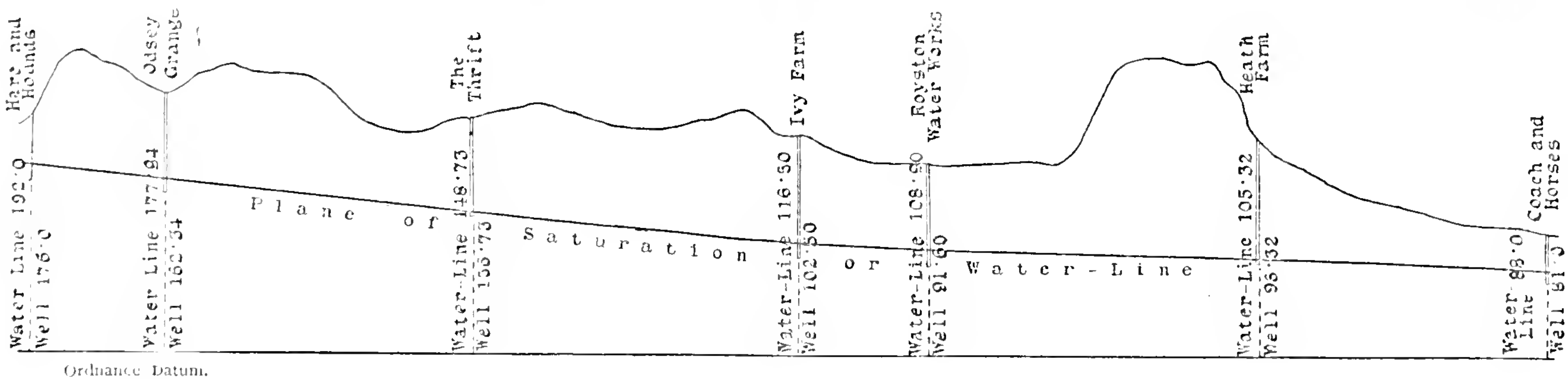
Section No. 4 is another cross-section from Therfield Rectory through Royston and out at Melbourn Spring. This gives a fall of 177 feet and a gradient of 35½ feet per mile.

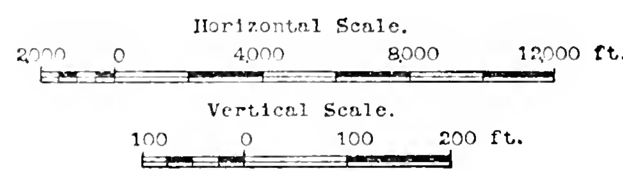
The following is the list of wells, giving level at the surface, which is generally the well-coping, the water-level, the level of

Section No. 1.—*From Ashwell Spring to Shepreth Spring.*



Section No. 2.—*From the "Hare and Hounds" near Odsey, to the "Coach and Horses" on the Newmarket Road.*



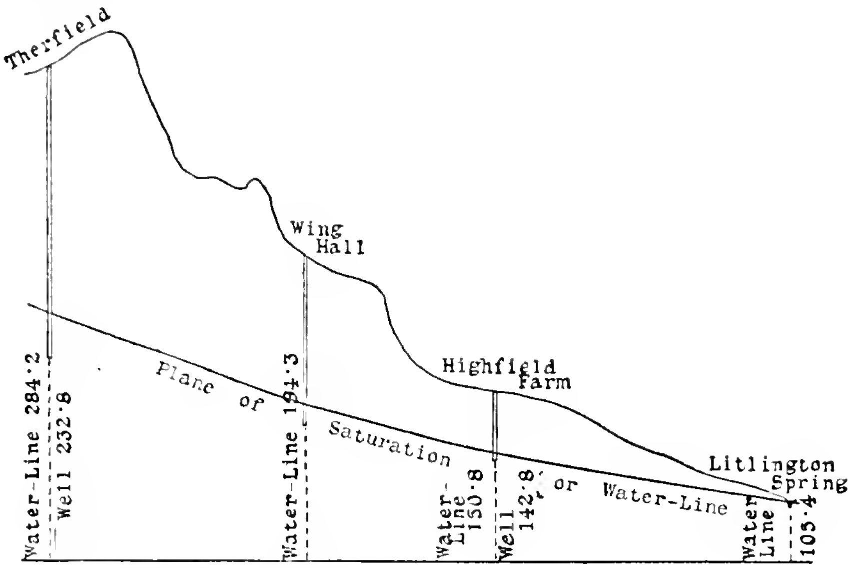


the bottom of the well, date when levelled, and where levelled from. *B.M.* indicates that the levels were taken from an Ordnance Bench Mark; *Road mark* that they were taken from an Ordnance road-level as marked on the 6-inch plans. The wells are taken as nearly as possible in order from west to east.

WELLS.

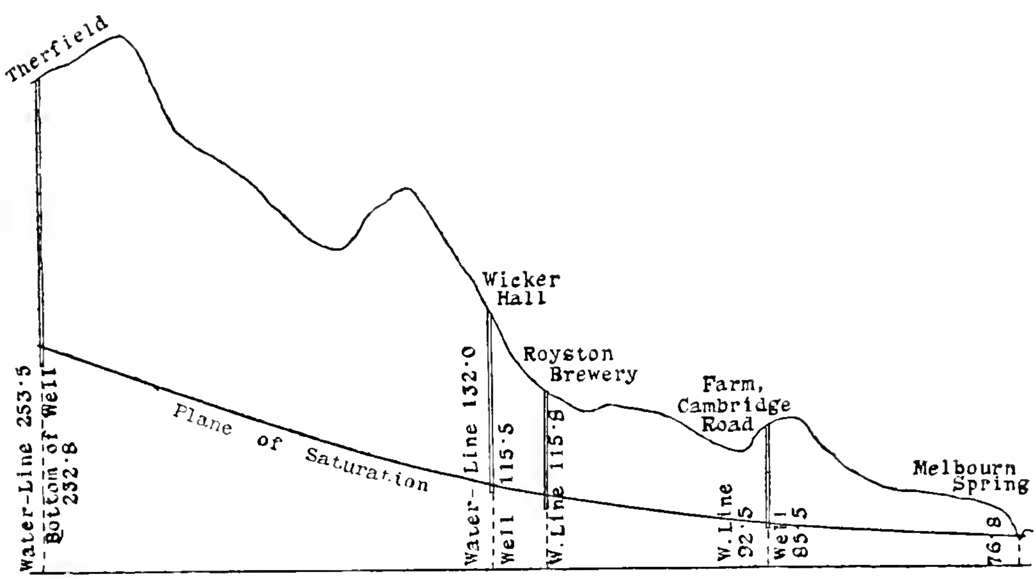
	Surface-level.	Water-level.	Bottom of well.	When levelled.	Where levelled from.
	ft.	ft.	ft.		
Harepark Farm (Royston and Baldock Road)	272·1	195·1	166·1	3/1/96	Road mark.
"Hare & Hounds" P.H. (near Odsey)	238·9	191·9	175·9	,,	B.M.
The Sinks, Ashwell	190·9	157·9	152·9	,,	B.M.
Cottages on Morden Rd. (1 mile from Ashwell Station)	188·9	148·9	141·9	,,	B.M.
Hill Farm, Odsey	222·5	158·0	152·5	31/12/95	Road mark.
"Travellers' Rest" P.H. (Ashwell Station)	279·0	156·5	148·0	3/1/96	B.M.
Odsey—No. 1 well	255·9	174·9	159·8	31/12/95	B.M.
,, No. 2 well	243·1	164·1	152·1	,,	B.M.
Odsey Grange	265·8	177·8	162·3	,,	B.M.
Heath Farm, Odsey	310·9	196·4	172·9	,,	B.M.
"Horse & Groom" P.H. (The Thrift)	240·7	148·7	136·7	6/1/96	B.M.
Thrift Farm	252·8	153·3	139·8	,,	B.M.
Highfield Farm	204·1	150·8	142·8	30/3/97	B.M.
Wing Hall	331·1	194·3		,,	B.M.
Therfield Rectory	509·2	253·9	233·2	31/12/95	B.M.
,, ,, ...	,,	284·2	,,	30/3/97	B.M.
Ivy Farm, Royston	224·5	116·5	102·5	4/1/96	B.M.
The Hoy Farm	146·6	99·1	94·1	30/12/95	B.M.
Barn near the Hoy	159·2	100·2	95·2	,,	B.M.
Royston Waterworks	196·2	108·9	91·6	4/1/96	B.M.
Royston Brewery	208·8	115·8		,,	B.M.
Wickes Hall	339·0	132·0	115·5	7/1/96	B.M.
Mill End Farm	352·9	193·6	162·9	9/1/96	B.M.
Flint Hall	390·1	141·3	123·8	7/1/96	B.M.
Farm on Cambridge Road	177·7	92·5	85·5	10/1/96	B.M.
Burloes Farm	298·3	123·8	114·3	7/1/96	B.M.
Heath Farm		146·2	126·7	8/1/96	Road mark.
Newsells Barns	245·1	176·1	156·1	,,	B.M.
Noons Folly Farm	162·6	118·1	104·4	,,	B.M.
Barley (Mr. Wilkinson).	304·1	167·1	139·1	9/1/96	B.M.
King's Building	174·2	117·8	104·5	8/1/96	Road mark.
Heath Farm (Newmarket Road)	219·8	105·3	96·3	10/1/96	B.M.
"Coach & Horses" P.H. (Newmarket Road)	129·5	88·0	81·0	8/1/96	B.M.
Great Chishall (Cottages near Church)	432·8	181·8	149·8	9/1/96	B.M.

Section No. 3.—*From Therfield Rectory to Litlington Spring.*

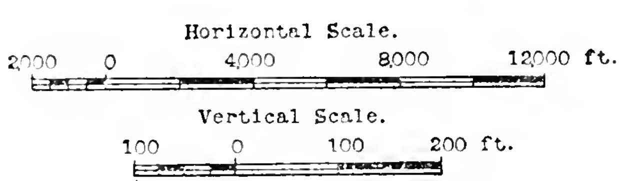


50 ft. above Ordnance Datum.

Section No. 4.—*From Therfield Rectory to Melbourn Spring.*



50 ft. above Ordnance Datum.



Springs.

	Water-level.	Date.	Where levelled from.
	ft.		
Ashwell Spring, Herts	145·9	3/1/96	B.M.
Ruddery Spring ,, ...	152·3	,,	Road mark.
Upper Gatley Spring, Cambs	142·1	,,	B.M.
Litlington Spring ,, ...	105·3	30/3/97	B.M.
Bassingbourn Spring ,, ...	94·6	30/12/95	Road mark.
Kneesworth Spring ,, ...	86·2	10/1/96	B.M.
Melbourn Spring ,, ...	76·8	30/12/95	B.M.
Shepreth Spring ,, ...	71·8	10/1/96	B.M.

XXV.

THE CLIMATE OF ST. ALBANS,

DEDUCED FROM METEOROLOGICAL OBSERVATIONS TAKEN DURING THE TEN YEARS 1887–1896.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst.C.E.

Read at St. Albans, 6th April, 1897.

Four years ago I communicated to the Society a paper on "The Climate of Watford, deduced from Meteorological Observations taken during the ten years 1877–1886." This paper was published in the 'Transactions' of the Society for November, 1893 (Vol. VII, pp. 219–232). The observations, commenced at Watford in 1876, have been continued at St. Albans from 1887 to the present time, and the general results have been printed annually in the 'Transactions.'

The present communication is an attempt to deduce the chief elements of the Climate of St. Albans from these observations. In the former paper it was stated that 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. It is generally admitted that with an increase of elevation with places similarly situated in other respects the mean temperature will be lower. The level of the ground at my thermometer-screen at St. Albans is 157 feet higher than it was at Watford: the mean temperature at St. Albans for the ten years 1887–1896 was 0°·3 lower than it was at Watford for the previous ten years. Again, with an increase of elevation the extreme range of temperature is usually reduced: the extreme range at St. Albans during the last ten years was 4°·4 less than it was during the previous ten years at Watford. The range, however, is likely to vary more from one period to another than is the mean, and I do not place much reliance upon this test of the value of ten years' observations. The slight difference in altitude between Watford and St. Albans is not likely to affect the humidity of the air or the amount of cloud: the mean of both of these for the last ten years at St. Albans was exactly the same as it was for the previous ten years at Watford. With regard to rainfall it was stated in the previous paper that 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. The true mean rainfall at St. Albans is not likely to be greatly different from that at Watford, but at the higher altitude there should be rather more rain: the mean annual rainfall at St. Albans for the ten years 1887–96 was, however, 4·22 inches less than it was for the ten years 1877–86 at Watford. This is because the earlier period was an exceptionally wet one in this part of England. Any difference, therefore, between the two places in these elements of climate is traceable to known causes, and the rainfall appears to be the only element affected by the shortness of the periods of observation.

In the former paper were given the reasons for the sequence of the tables which revealed the climate of Watford. As the same sequence is followed here, these reasons may be repeated. "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."

Some information will first be given as to the locality where the observations have been made, the instruments used, and the method of observation and reduction. This will be followed by a discussion of the general results obtained.

Situation of Station.

The Grange, St. Albans.—Latitude, 52° 45′ 9″ N.; longitude, 0° 20′ 7″ W. (of Greenwich). Centre of St. Albans (the Town Hall) 170 yards WSW.; Parish Church (St. Peter's) 340 yards NNE. Ground-level at thermometer-screen 380 feet above mean sea-level (Ordnance Datum) and at rain-gauge 379 feet; cistern of barometer 388 feet above Ordnance Datum.

The situation is very open and well elevated above the valley of the Ver. The ground slopes downwards slightly towards the south for a short distance and then much more steeply in the same direction. It also falls on either side of this main gradient, so that the contour is convex, being made up of a south-westerly slope to the River Ver, which is half a mile distant, and of a south-easterly slope to the River Colne, distant about three miles. The ground rises to about 410 feet half a mile to the north-east, and falls to about 250 feet half a mile to the south. The distances given above indicate the position of the thermometer-screen and rain-gauge; the barometer is 200 feet to the west-north-west; part of the increase in its altitude is due to the slope of the ground and part to the height of the ground-floor of the house above the ground-level and the height of the barometer above the floor. The elevations were ascertained by levelling from a bench-mark (384·3 ft.) on the wall by one of my own gate-posts about 40 feet from the barometer.

The subsoil is gravel on chalk, and there is a considerable depth of surface-soil, but this, having very little clay in its composition, soon transmits the rain which falls upon it to the pervious gravel underneath. The natural level of the plane of saturation in the chalk is about 130 feet beneath the surface, but it is lowered by pumping at the waterworks about one-third of a mile to the north-north-east. It rises very slightly from the river, close to which there is another pumping-station.

There are a few large trees on the north and east of the rain-gauge and thermometer-screen, but they are sufficiently distant to have no appreciable effect on either the temperature or the rainfall recorded. The wind-vane, when first erected, was rather too near them, but it was removed to above the roof of the house in 1890.

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 on a pole erected on the top of the house, with nothing to interfere with the free action of the wind upon it, the nearest objects of equal height being some trees about 100 feet to the east.

Observations taken at 9 a.m. (or a little before that hour). Readings of minimum thermometer entered to the day of observation, of maximum thermometer and rain-gauge to the previous day. Readings corrected for index-errors of instruments, and barometer-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 from tables in the Royal Meteorological Society's 'Hints to Meteorological Observers,' by William Marriott (2nd and 3rd editions).

During the whole of the ten years there has been no intermission in any of the observations except in the reading of the barometer, the observations during my absence from home having been taken by others. Barometer-readings have been supplied by calculation from the readings at other stations in Hertfordshire for each day on which they have been omitted.

GENERAL RESULTS AND INFERENCES.

All the more important elements of the climate of St. Albans being given in the tables, it is only necessary to state here some of the general results which may be arrived at from their examination, and inferences which may be drawn from their study, the tables giving the information, and these remarks being merely a commentary upon them. Occasionally, however, a fact may be stated which is neither shown in the tables nor can be deduced from them. Such of the values given as are considered to be approximately correct elements of the climate of St. Albans are usually expressed in the present tense.

In dividing the year into seasons, the months of March, April, and May are considered as spring; June, July, and August as summer; September, October, and November as autumn; and December, January, and February as winter.

Pressure of the Atmosphere (Tables I–III, p. 219).—The mean pressure was the same (29·990 ins.) during each half of the period. The year of lowest pressure was not the wettest, nor was the year of highest pressure the driest, in the series. Both these years were in the second half of the period.

Pressure was considerably above the mean in the first and the last year of the series, appreciably below the mean in three years, and the mean or very near it in five years. The average annual deviation from the mean was 0·023 in. Whilst the lowest and the highest mean annual pressures deviated almost equally from the mean for the whole period, the lowest pressure recorded deviated 0·517 in. more from the mean than did the highest pressure, and the mean of the lowest pressures deviated from it 0·441 in. more than the mean of the highest pressures.

The extreme range of pressure was 2·387 inches, being from 28·538 inches on 11th November, 1891, to 30·925 inches on 30th January, 1896.

On the average, pressure is low in spring and autumn, a little higher, but still below the mean, in summer, and considerably above the mean in winter. It is lowest in October and highest in February. The season with the lowest mean pressure was the spring of 1890 (29·856 ins.), and that with the highest the winter of 1890–91 (30·226 ins.). The months with the lowest mean pressure were February, 1893 (29·700 ins.), and October, 1889 (29·703 ins.); the month with the highest mean pressure was February, 1891 (30·488 ins.). This was the month of least rainfall.

Temperature of the Air (Tables IV–VI, p. 221).—The second half of the period was about a degree warmer than the first half, the mean temperature during the first five years being 47°·46, or 0°·53 below the mean for the period (47°·99), and during the second five years, 48°·52, or 0°·53 above the mean, the difference therefore being 1°·06. Both the coldest and the warmest year occurred during the later period, 1892 being the coldest and 1893 the warmest, and giving an extreme annual range for the whole period of 3°·3. No other years differ from each other in their mean temperature so much as two degrees, and the annual average deviation from the mean is 0°·65, the temperature being below the mean in five years, above it in four, and equal to it in one year.

The coldest year had no other special characteristics, but if the 9 a.m. temperature be taken into consideration, 1888 comes out as the coldest, and that had the least daily range of temperature, the most cloudy sky, much the fewest days of clear sky, and much the largest number of days of overcast sky. The warmest year had the greatest daily range of temperature, the driest atmosphere, the clearest sky, the greatest number of days of clear sky, and much the smallest number of days of overcast sky.

The extreme range of temperature was 80°·9, the absolute minimum being 10°·1 on 7th February, 1895, and the absolute maximum 91°·0 on 18th August, 1893.

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.
1887	30·034	28·820	Nov. 3	30·860	Feb. 7	2·043
88	29·967	28·837	Mar. 28	30·742	Jan. 10	1·905
89	29·985	28·975	Mar. 20	30·713	Jan. 4	1·728
90	29·984	28·712	Jan. 23	30·717	Feb. 23	2·005
91	29·978	28·538	Nov. 11	30·338	Feb. 18	1·800
92	29·967	29·136	Feb. 18	30·601	Mar. 31	1·465
93	30·001	28·753	Feb. 21	30·750	Dec. 30	1·997
94	29·990	29·150	Nov. 14	30·642	Dec. 27	1·492
95	29·947	28·862	Mar. 28	30·624	May 2	1·762
96	30·045	28·687	Dec. 4	30·925	Jan. 30	2·238
Mean	29·990	28·848		30·691		1·843

TABLE II.—*Seasonal Pressure at 9 a.m.*

Season.	Mean.	Min. seasonal pressure.		Max. seasonal pressure.		Range.
	Ins.	Ins.	Year.	Ins.	Year.	Ins.
Spring	29·966	29·856	1890	30·137	1893	0·281
Summer	29·979	29·903	1888	30·096	1887	0·193
Autumn	29·968	29·888	1891	30·058	1890	0·170
Winter	30·046	29·932	1892–93	30·182	1895–96	0·250

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	30·055	29·727	1895	30·374	1896	0·547
February	30·101	29·700	93	30·488	91	0·788
March	29·919	29·615	88	30·147	93	0·432
April	29·973	29·750	89	30·165	96	0·415
May	30·006	29·803	91	30·257	96	0·454
June	30·040	29·947	88	30·212	87	0·265
July	29·941	29·746	88	30·064	87	0·218
August	29·957	29·825	91	30·050	93	0·225
September	30·040	29·784	96	30·179	88	0·395
October	29·900	29·703	89	30·119	90	0·416
November	29·965	29·710	87	30·231	89	0·581
December	29·982	29·796	96	30·205	89	0·409
Year	29·990	29·615	1888	30·488	1891	0·873

The annual mean daily range of temperature, 14°·4, varied from 13°·0 in 1888 to 16°·6 in 1893.

Autumn is warmer than spring by 1°·2, almost entirely owing to the colder nights in spring; but the excess of the temperature of summer over that of winter is more due to the warm days in summer than to the cold nights in winter. Spring is 10°·8 warmer than winter, and summer 12°·2 warmer than spring; autumn is 11°·0 colder than summer, and winter 12°·0 colder than autumn. Thus winter passes more slowly into spring than does spring into summer, while summer passes rather more slowly into autumn than does autumn into winter.

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 spring and least in winter, and greater in autumn than in summer. The nights are much colder in spring than in autumn, while the days have very nearly the same temperature in each season; in summer they are not nearly so much warmer than in autumn as are the days.

January is on the average the coldest month, and July the warmest. The temperature increases from January to July, and decreases from July to January, as follows:—

Increase:		°	Decrease:		°
Jan.	to Feb.	1·0	July	to August	0·6
Feb.	to March	4·0	August	to Sept.	3·5
March	to April	5·2	Sept.	to Oct.	9·2
April	to May	6·3	Oct.	to Nov.	4·5
May	to June	6·4	Nov.	to Dec.	5·4
June	to July	1·6	Dec.	to Jan.	1·3

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 much the most rapid during the months of September and October.

Both the days and the nights are coldest in January and warmest in July.

The mean daily range of temperature is least in January and greatest in June. The increase and decrease are as follows:—

		°			°
Jan.	to Feb.	+1·4	July	to August	—0·5
Feb.	to March	+2·4	August	to Sept.	—0·8
March	to April	+3·0	Sept.	to Oct.	—2·1
April	to May	+0·7	Oct.	to Nov.	—2·7
May	to June	+0·6	Nov.	to Dec.	0·0
June	to July	—1·7	Dec.	to Jan.	—0·3

Thus the mean daily range increases in the early part of the year (January to June) more rapidly than it decreases in the rest of the year (June to January). The greatest increase (March to April) is due to the cold nights (not to warm days) in April.

Temperatures below freezing-point (32°) have occurred in every month but the three months of summer and the first month of autumn—June to September. Only once has the temperature been

Table IV.—*Mean and Extreme Temperature in each Year.*

Year.	Mean.	Means of Min.	Means of Max.	Mean daily Range.	Absolute Min.	Day.	Absolute Max.	Day.	Absolute Range.
	°	°	°	°	°		°		°
1887	47·2	39·7	54·7	15·2	13·7	Jan. 2	86·0	July 3	72·3
88	47·0	40·5	53·5	13·0	18·4	Feb. 25	83·8	Aug. 10	65·4
89	47·7	41·1	54·4	13·3	16·8	Feb. 13	80·0	Aug. 1	64·0
90	48·0	40·7	55·2	14·5	12·7	Dec. 23	78·1	Aug. 5	65·4
91	47·4	40·4	54·4	14·0	11·8	Dec. 24	79·6	Sept. 11	67·8
92	46·9	39·7	54·0	14·3	16·1	Dec. 29	79·8	June 10	63·7
93	50·2	41·9	58·5	16·6	14·7	Jan. 5	91·0	Aug. 18	76·3
94	48·8	42·0	55·6	13·6	10·9	Jan. 6	81·6	July 6	70·7
95	48·1	40·5	55·7	15·2	10·1	Feb. 7	82·3	May 30	72·2
96	48·6	41·7	55·7	14·0	20·9	Feb. 26	84·3	July 14	63·4
Mean	48·0	40·8	55·2	14·4	14·6		82·7		68·1

Table V.—*Mean and Extreme Seasonal Temperature.*

Season.	Mean.	Means of Min.	Means of Max.	Mean daily Range.	Absolute Min.	Year.	Absolute Max.	Year.	Absolute Range.
	°	°	°	°	°		°		°
Spring	47·6	38·4	54·8	16·4	15·8	1890	82·3	1895	66·5
Summer....	59·8	51·2	68·3	17·1	34·8	95	91·0	93	56·2
Autumn.....	48·8	42·2	55·3	13·1	18·6	87	81·9	95	63·3
Winter	36·8	31·3	42·2	10·9	10·1	95	65·3	91	55·2

Table VI.—*Mean and Extreme Monthly and Annual Temperature.*

Month.	Mean.	Means of Min.	Means of Max.	Mean daily Range.	Absolute Min.	Year.	Absolute Max.	Year.	Absolute Range.
	°	°	°	°	°		°		°
Jan.	36·0	30·8	41·1	10·3	10·9	1894	57·6	1888	46·7
Feb.	37·0	31·2	42·9	11·7	10·1	95	65·3	91	55·2
March	41·0	34·0	48·1	14·1	15·8	90	66·5	90	50·7
April	46·2	37·7	54·8	17·1	26·3	87	77·7	93	51·4
May	52·5	43·6	61·4	17·8	29·1	92	82·3	95	53·2
June	58·9	49·7	68·1	18·4	34·8	95	86·1	93	51·3
July	60·5	52·2	68·9	16·7	40·6	88	86·0	87	45·4
Aug.	59·9	51·8	68·0	16·2	42·4	91	91·0	93	48·6
Sept.	56·4	48·6	64·2	15·4	35·3	87	81·9	95	46·6
Oct.	47·2	40·6	53·9	13·3	26·2	95	71·8	95	45·6
Nov.	42·7	37·4	48·0	10·6	18·6	87	62·5	95	43·9
Dec.	37·3	32·0	42·6	10·6	11·8	91	55·8	88	44·0
Year	48·0	40·8	55·2	14·4	10·1	1895	91·0	1893	80·9

below freezing-point in May—on the 7th of May, 1892. The average number of frosty nights (not including ground-frosts) has been as follows:—

Jan.	16	April	3	July	0	Oct.	3
Feb.	15	May	0	August	0	Nov.	6
March	11	June	0	Sept.	0	Dec.	15

Temperatures above 62° have occurred in every month but the three months of winter. Only twice has the temperature been above 62° in November—on the 1st of November, 1894, and on the 16th of November, 1895. The average number of days on which the maximum temperature has exceeded 62° has been as follows:—

Jan.	0	April	5	July	28	Oct.	2
Feb.	0	May	14	August	27	Nov.	0
Mar.	1	June	25	Sept.	18	Dec.	0

The minimum temperature has been below 12° on five nights during the whole period—24th December, 1891, 6th January, 1894, and 6th, 7th, and 8th February, 1895. The maximum has been above 82° on 26 days in all—on one day in May (30th May, 1895), seven days in June, nine days in July, and nine days in August; fifteen of these 26 days were in 1893.

The minimum temperature of the year has occurred three times in January, four times in February, and three times in December; the maximum has occurred once in May, once in June, three times in July, four times in August, and once in September.

Temperature, Humidity, and Cloud at 9 a m. (Tables VII–IX, p. 223).—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 about 9 a.m. is on the average 0°·5 lower than the mean of the minimum and maximum temperatures; in no year has the difference exceeded 0°·8. (The observations have as a rule been taken a few minutes before nine, which probably accounts in some measure for the discrepancy of about half a degree between these and the Watford observations.)

From January to April, and from September to December, the temperature at about 9 a.m. is appreciably lower than the mean of the mimimum and maximum; in May it is a little higher, and from June to August (the three summer months) it is about the same. 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 maximum alone. If this be the case the mean diurnal temperature in the first and last four months in the year is probably rather lower than that given in Table VI, and in May rather higher, the mean being true for the summer months, while for the year it would be 47°·8.

TABLE VII.—*Temperature, Humidity, and Cloud, in each Year, at 9 a.m.*

Year.	Temperature of Air.	Temperature of Evaporation.	Temperature of Dew-point.	Dryness.	Relative Humidity.	Short of Saturation.	Cloud, 0–10	Days of Clear Sky.	Days of Overcast.
	°	°	°	°	%	%			
1887	46·7	43·7	40·7	6·0	81	19	6·5	61	144
88	46·2	44·0	41·5	4·7	84	16	7·4	38	199
89	47·1	45·2	43·1	4·0	86	14	7·0	57	179
90	47·4	45·1	42·6	4·8	84	16	7·0	52	150
91	47·0	44·9	42·6	4·4	85	15	7·0	47	165
92	46·6	43·9	40·9	5·7	81	19	6·2	76	152
93	49·7	46·3	42·7	7·0	79	21	5·9	79	124
94	48·2	45·7	43·1	5·1	82	18	6·7	57	162
95	47·3	44·7	41·7	5·6	81	19	6·3	67	142
96	48·5	45·8	43·1	5·4	82	18	6·5	51	154
Mean	47·5	44·9	42·2	5·3	82	18	6·7	59	158

TABLE VIII.—*Seasonal Temperature, Humidity, and Cloud, at 9 a.m.*

Season.	Temperature of Air	Temperature of Evaporation.	Temperature of Dew-point.	Dryness.	Relative Humidity.	Short of Saturation.	Cloud, 0–10	Days of Clear Sky.	Days of Overcast.
	°	°	°	°	%	%			
Spring ...	46·2	43·1	39·7	6·5	79	21	6·4	16	37
Summer...	59·7	55·4	51·6	8·1	73	27	6·4	12	32
Autumn...	48·2	46·4	44·5	3·7	87	13	6·7	16	40
Winter ...	35·8	34·8	33·1	2·7	89	11	7·1	14	48

TABLE IX.—*Monthly and Annual Temperature, Humidity, and Cloud, at 9 a.m.*

Month.	Temperature of Air.	Temperature of Evaporation.	Temperature of Dew-point.	Dryness.	Relative Humidity.	Short of Saturation.	Cloud, 0–10	Days of Clear Sky.	Days of Overcast.
	°	°	°	°	%	%			
Jan.	35·4	34·5	33·0	2·3	91	9	7·6	3	18
Feb.	35·6	34·4	32·3	3·4	87	13	7·0	5	14
March ...	39·9	38·0	35·5	4·4	84	15	6·6	6	14
April	45·7	42·4	38·7	7·0	77	23	6·4	5	12
May	52·9	48·8	44·8	8·1	74	26	6·3	5	11
June	58·7	54·4	50·3	8·4	74	26	6·4	5	11
July	60·6	56·0	52·0	8·6	74	26	6·6	4	11
Aug.	59·8	55·9	52·5	7·3	77	23	6·2	3	10
Sept.	56·0	53·4	50·9	5·1	83	17	6·4	5	10
Oct.	46·4	44·8	43·0	3·4	88	12	6·4	7	14
Nov.	42·0	40·9	39·5	2·5	91	9	7·3	4	16
Dec.	36·5	35·6	34·0	2·5	90	10	6·8	6	16
Year	47·5	44·9	42·2	5·3	82	18	6·7	58	157

The spring and summer half of the year is much drier than the autumn and winter half, having 12 per cent. less mean relative humidity. Summer is drier than spring by 6 per cent.; autumn is drier than winter by 2 per cent. Spring and summer are the brightest seasons; winter is the most cloudy one; autumn having the mean amount of cloud of the year. Summer and winter have fewer days of clear sky than spring and autumn; spring and autumn have nearly the same number of days of overcast sky; summer has much the fewest, and winter has much the greatest number.

The air is driest in May, June, and July, and most humid in November, December, and January, the humidity decreasing each month from January to May, and increasing each month from July to November. Although as a rule the colder months are the more humid, the air is much drier in comparison with the temperature in the spring than it is in the autumn; thus April is much drier than September although its temperature is about the same.

Force and Direction of the Wind at 9 *a.m.* (Tables X–XII, p. 225).—Although the force of the wind is arrived at, in the absence of an anemometer, in the same way as is the amount of cloud, that is by estimation, it is much easier to estimate the proportion of cloud to clear sky when the whole sky is in sight, than it is to estimate the proportionate force of the wind when there is nothing to compare the force with at any time but a vague recollection of what it has been at other times. It is even difficult to say sometimes whether the air should be considered calm or as having the force 1 on Beaufort's scale. Again, as we never experience the force 12 (a hurricane) in this country, it is difficult to say how near this is approached in a severe gale. The greatest force, on this scale, at which I have estimated the wind at 9 a.m. on any occasion, is 6: this has occurred several times in some years and in others not once. The greatest estimated mean force in any month is 2·8 (in March, 1891); the least in any month is 1·2 (in January, 1887, November, 1892, and September, 1893). The mean annual force has varied from 1·6 to 1·9. The wind is strongest in spring, lightest in summer, and the mean force of the year in autumn and winter, but the seasonal variation is very slight. It is strongest in March and lightest in June.

With regard to direction, S.W. winds are much the most prevalent, and are followed in frequency by W. winds; E. and S.E. winds are the least frequent. The wind has been S.W. on as many as 78 days in the year, and it has been E. and S.E. on as few as 16. S.W. winds prevail most in summer and least in spring, and are more prevalent in autumn than in winter; N.E. winds are prevalent in spring, and W. winds in summer. There is no great preponderance of winds from any other quarter in any season. S.W. and W. winds prevail most in August; N.E. winds most in April. There are very few E. winds in August and October. Calms occur most often in December; much the least often in March, April, and July.

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.
1887	1·7	45	55	21	16	29	57	39	60	43
88	1·9	51	53	21	23	46	55	47	44	26
89	1·9	50	49	25	25	47	53	49	47	20
90	1·9	31	47	32	25	28	78	62	38	24
91	1·9	46	37	16	21	38	78	56	45	28
92	1·7	40	50	34	26	18	71	49	42	36
93	1·9	37	39	27	33	44	69	63	27	26
94	1·7	36	38	32	36	51	71	47	33	21
95	1·6	42	36	35	30	38	52	63	36	33
96	1·8	50	33	20	28	49	61	55	50	20
Mean	1·8	43	44	26	26	39	64	53	42	28

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..	1·9	12·7	15·9	9·0	6·3	7·7	13·6	11·8	10·5	4·5
Summer	1·7	10·1	9·1	4·9	5·8	11·3	19·9	15·7	9·9	5·3
Autumn	1·8	11·0	9·6	5·4	7·0	9·7	16·3	12·1	11·3	8·6
Winter..	1·8	9·0	9·1	7·0	7·2	10·1	14·7	13·4	10·6	9·2

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	3·6	2·1	1·6	2·7	3·5	5·6	4·3	4·3	3·3
Feb.	1·9	3·4	4·3	2·5	1·9	2·1	3·9	4·3	3·3	2·6
March..	2·1	3·0	4·2	2·7	1·8	3·5	5·9	5·1	3·8	1·0
April	1·9	4·7	6·2	3·4	1·8	1·8	4·4	3·6	2·7	1·4
May	1·8	5·0	5·5	2·9	2·7	2·4	3·3	3·1	4·0	1·9
June	1·6	4·5	4·6	2·0	2·0	3·6	4·8	4·0	2·6	2·0
July	1·8	3·1	2·6	1·8	2·2	4·0	6·7	5·1	3·5	1·4
Aug.	1·8	2·5	1·9	1·1	1·6	3·7	8·4	6·6	3·8	2·2
Sept	1·7	3·0	3·9	2·1	2·1	3·0	5·5	4·1	4·1	3·2
Oct.	1·8	4·2	2·5	0·8	1·9	3·7	6·2	3·9	4·6	3·2
Nov.	1·8	3·8	3·2	2·5	3·0	3·0	4·6	4·1	2·6	3·2
Dec.	1·7	2·0	2·7	2·9	2·6	4·5	5·2	4·8	3·0	3·3
Year	1·8	42·8	43·7	26·3	26·3	38·8	64·5	53·0	42·3	27·6

Rainfall (Tables XIII–XV, p. 227).—There could scarcely have been a better decade than 1887–96 from which to form an idea of the rainfall of St. Albans, for the mean rainfall throughout the county has been very nearly the average of a long series of years. In the fifty-seven years ending 1896 the mean annual rainfall at all the stations in Hertfordshire was 26·33 inches. In this determination no adjustment has been made for the disparity of distribution of the rainfall-stations. The rainfall increasing from east to west, and there being a larger number of stations for the area in the west than in the east, the mean value derived from all the stations requires a deduction in order to arrive at the true mean for the county, which is probably about 26 inches. How this value has been arrived at will be seen on referring to pp. 37 and 38 of the present volume of our 'Transactions.' The mean annual rainfall at all the stations in Hertfordshire for the ten years 1887–96 was 25·21 inches. This requires a slight deduction for disparity of distribution of the stations, and we may fairly consider that the true mean was about 25 inches. Whether the values arrived at be thus adjusted or not, the rainfall during the last ten years will be found to have been a little under 4 per cent. below the mean for the last fifty or sixty years. In such a very varying element of climate as rainfall this is a very slight difference, and it may be neglected for all practical purposes. Applying the correction, however, the mean annual rainfall at St. Albans for the last ten years, 26·74 inches, would be raised to 27·81 for the last half-century, but if we wished to arrive at the probable value for the last *century* a deduction would have to be made, and the true mean value would be between 27 and 27½ inches.

For the last half-century the following was probably the approximate mean monthly and seasonal rainfall:—

March	2·15	June	1·86	Sept.	2·25	Dec.	2·23
April	1·37	July	3·27	Oct.	3·44	Jan.	1·88
May	1·98	Aug.	3·03	Nov.	3·09	Feb.	1·26
Spring	5·50	Summer	8·16	Autumn	8·78	Winter	5·37

Winter and spring have each 20 per cent. of the year's rainfall, summer has 29 per cent., and autumn has 31 per cent. Spring has 23 per cent. of the year's wet days, summer has 24 per cent., autumn has 26 per cent., and winter has 27 per cent.

The fall of rain varies on the average most in summer and least in autumn, and more in winter than in spring, the mean deviation from the average fall for each season having been as follows:—In spring 1·54 in., in summer 1·78 in., in autumn 1·49 in., and in winter 1·65 in. The extreme deviation, however, has been greatest in spring and least in winter, the wettest spring (1889) having had five times as much rain as the driest (1893), and the wettest winter (1892–93) only twice as much rain as the driest (1887–88); and it has been rather greater in summer than in autumn.

February and April are much the driest months; July and October are the wettest, followed closely by August and November.

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.	Ins.	Date.	Rain.	Snow.
1887	19·84	·64	Feb.	3·40	Nov.	·68	Nov. 3	162	25
88	28·29	·72	Sept.	4·70	Nov.	2·40	June 26	194	24
89	29·45	1·14	Nov.	5·36	July	2·95	July 12	186	29
90	23·27	·59	Sept.	4·17	July	2·00	July 17	188	25
91	31·13	·05	Feb.	6·35	Oct.	1·35	Aug. 20	201	23
92	25·84	·87	April	4·23	Oct.	1·55	Aug. 27	179	36
93	25·00	·14	April	5·07	Oct.	2·02	Oct. 9	170	22
94	32·20	1·86	Feb.	4·81	Nov.	1·42	Aug. 24	212	14
95	25·60	·18	Feb.	4·95	July	1·25	July 18	161	36
96	26·80	·34	May	6·69	Sept.	1·01	Sept. 24	178	8
Mean	26·74	·65		4·97		1·66		183	24

TABLE XIV.—*Seasonal Rainfall.*

Season.	Mean.	Min. seasonal fall.		Max. seasonal fall.		Max. in 24 hours.		Days of	
	Ins.	Ins.	Year.	Ins.	Year.	Ins.	Year.	Rain.	Snow
Spring .	5·29	2·30	1893	6·96	1894	1·38	1889	41	6
Summer	7·85	2·60	87	11·45	88	2·95	89	43	0
Autumn	8·44	4·62	90	11·64	96	2·02	93	49	2
Winter..	5·16	3·39	95–96	6·85	93–94	1·40	94	50	16

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.	Ins.	Year.	Rain.	Snow.
Jan.	1·81	·79	1896	2·94	1890	·76	1895	19	7
Feb.	1·21	·05	91	3·36	93	·50	94	13	5
March ...	2·07	·51	93	3·62	96	·92	94	16	5
April	1·32	·14	93	2·47	89	·41	95	13	1
May	1·90	·34	96	4·51	89	1·38	89	12	0
June	1·79	·39	95	3·79	88	2·40	88	11	0
July	3·15	·88	87	5·36	89	2·95	89	16	0
Aug.	2·91	1·07	87	4·29	91	1·55	92	16	0
Sept.	2·16	·59	90	6·69	96	1·01	96	13	0
Oct.	3·31	1·01	88	6·35	91	2·02	93	18	1
Nov.	2·97	1·14	79	4·81	94	1·40	94	18	1
Dec.	2·14	·66	90	4·16	96	·81	91	18	4
Year	26·74	·05	1891	6·69	1896	2·95	1889	183	24

The least fall of rain in any season was 1·61 in. in the spring of 1893, the least in any month was 0·05 in. in February, 1888; the greatest fall of rain in any season was 11·14 ins. in the autumn of 1896, the greatest in any month was 6·69 ins. in September, 1896; the greatest fall in any day (of 24 hours ending 9 a.m. on the following day) was 2·95 ins. on the 12th of July, 1889.

Falls of rain exceeding one inch in 24 hours have occurred on eighteen occasions, averaging 1·47 inch each fall.

Absolute droughts (periods of more than fourteen consecutive days without rain) have occurred on ten occasions, their average duration being 20 days. The longest was 29 days, from 18th March to 15th April, 1893; the next in duration was 27 days, from 7th June to 3rd July, 1887.

Exceptional Phenomena.—Only a few of the more remarkable meteorological phenomena which have occurred at St. Albans are here enumerated, in chronological order. The references are to my accounts of the phenomena in the Society's 'Transactions.'

The year 1887 was very dry, the rainfall being 26 per cent. below the average for the ten years. In 1888 there fell in nine hours in the night of 26th–27th June, 2·40 inches of rain, being at the rate of 0·27 inch per hour. In 1889 there fell on 12th July, 2·95 inches of rain, and on the following day 0·23 inch, making 3·18 inches in two days. The great frost of 1890–91 lasted for the eight weeks from 26th November to 20th January, the mean temperature during this period being 29°·3, or 2°·7 below freezing-point (VI, 172). In February, 1891, only 0·05 inch of rain fell. In 1892 the minimum shade temperature on 7th May was 2°·9 below freezing-point; there was a white frost on 15th June and 18th September; and on 24th October the minimum shade temperature was 5°·5 below freezing-point. There was a severe thunderstorm on the night of 28th–29th June (VII, 180, 212). The year 1893 was exceptionally warm, and had several very severe thunderstorms in July, August, and November; a violent gale and heavy snowstorm on 18th November; and a still more furious gale, which did much damage, on 12th December (VIII, 41–44, 63–64). In 1894 there were 8·33 inches of rain in October and November together, causing serious floods (VIII, 141–146). In 1895 occurred the great frost of ten weeks' duration which did so much damage to water-pipes, and, by their leaky condition during the dry weather which succeeded it in the spring, helped to cause the water-famine in the east of London. The frost was most severe between 26th January and 14th February (IX, 88, 89). In March occurred a gale which blew down many trees (VIII, 199–202). September was exceedingly warm (IX, 91). In 1896 September was excessively wet, 6·69 inches of rain falling, and in October 3·46 inches, more than half as much rain thus falling in two months as fell in the whole of the year 1887.

XXVI.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1896.

By Edward Mawley, Pres. R. Met. Soc., F.R.H.S.,
Phenological Recorder to the Royal Meteorological Society.

Read at Watford, 30th April, 1897.

The list of observing stations remains the same as in the previous report. The only localities where new observers are at the present time still greatly needed are those in the neighbourhood of Bishop's Stortford in the east, and Buntingford in the north-east. If these gaps in the distribution of the stations could only be filled up, the organization for the county might be regarded as sufficiently complete.

The following table gives the names of the observers, the districts they represent, and the approximate height of the stations above sea-level:—

Station.	Height above Sea-level.	Observer.
Watford (The Platts)	240 feet.	Mrs. G. E. Bishop.
Radlett (Newberries)	320 ,,	Miss E. M. Lubbock.
Broxbourne (Wormley)	120 ,,	Miss L. Warner.
St. Albans (The Grange)	380 ,,	Mrs. J. Hopkinson.
St. Albans (Addiscombe Lodge)	400 ,,	Miss E. F. Smith.
St. Albans (Worley Road)	300 ,,	Henry Lewis.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hatfield (Symonds Hyde)	300 ,,	T. Brown.
Hertford	140 ,,	W. Graveson.
Harpenden	370 ,,	J. J. Willis.
Hitchin	230 ,,	J. E. Little, M.A.
Ashwell (Odsey)	260 ,,	H. G. Fordham.

The Winter of 1895–96.

Taken as a whole this was a very warm winter, the only other recent winter with as high a mean temperature being that of 1893–94. Not only did the weather continue unseasonably warm, as a rule, but there also occurred very few really cold nights. Only towards the end of February did the thermometer exposed on my lawn at Berkhamsted show more than 13 degrees of frost, and even then the lowest reading registered by it was only 17 degrees below the freezing-point. In December there was nearly a seasonable quantity of rain, but taking January and February together, the fall was lighter than for the same two months in any of the previous 41 years, which is as far back as the Berkhamsted rainfall records extend. Although this winter

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1896, WITH THE MEAN DATE FOR 1876–1895.

SPECIES.	WATFORD.	ST. ALBANS. The Grange.	ST. ALBANS. Addiscombe Lodge.	RADLETT.	BERKHAMSTED.	HARPENDEN.	WORMLEY.	HATFIELD.	HERTFORD.	HITCHIN.	ASHWELL	MEAN, 1876–95.
Hazel (*Corylus avellana*)	Jan. 22	Jan. 16	Jan. 28	Feb. 10	Feb. 20	Jan. 18	Jan. 12	Feb. 9	Jan. 13	Jan. 19	Jan. 19	Jan. 29
Coltsfoot (*Tussilago farfara*)	....	....	Feb. 13	....	Feb. 19	Mar. 13	Feb. 29	Mar. 23	Feb. 9	Feb. 7	Mar. 4	Feb. 26
Wood-Anemone (*Anemone nemorosa*)	Mar. 30	Mar. 14	....	....	Mar. 31	Mar. 24	Mar. 11	Apl. 6	Mar. 8	Mar. 18	....	Mar. 20
Blackthorn (*Prunus spinosa*)	Apl. 4	Mar. 25	Mar. 14	Mar. 30	Mar. 24	Mar. 25	Mar. 23	Apl. 3	Mar. 8	Mar. 17	Mar. 29	Apl. 2
Garlic Hedge-Mustard (*Alliaria officinalis*)	Apl. 15	Apl. 11	Apl. 17	....	Apl. 17	Apl. 14	Apl. 25	....	Apl. 6	Apl. 10	....	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 5	May 1	May 4	Apl. 25	May 7	Apl. 21	May 6	Apl. 20	Apl. 26	Apl. 29	....	May 10
Hawthorn (*Cratægus oxyacantha*)	May 6	May 1	May 5	May 1	May 13	Apl. 30	Apl. 25	Apl. 29	Apl. 16	Apl. 22	Apl. 28	May 13
White Ox-Eye (*Leucanthemum vulgare*)	May 21	May 21	May 14	May 21	May 15	May 21	May 25	May 26	May 14	May 13	....	May 20
Dog-Rose (*Rosa canina*)	June 4	June 1	June 1	June 1	May 28	May 30	May 27	May 27	May 28	May 22	June 2	June 5
Black Knapweed (*Centaurea nigra*)	....	....	June 15	....	June 19	June 12	....	....	June 28	....	....	June 21
Harebell (*Campanula rotundifolia*)	July 10	....	July 8	....	July 8	....	....	July 6	July 5	July 12	....	July 5
Greater Bindweed (*Convolvulus sepium*)	July 9	....	....	....	June 18	....	....	....	July 2	June 22	....	July 9
Ivy (*Hedera helix*)	Oct. 1	....	Oct. 2	....	Sept. 28	....	....	....	Sept. 24	....	Sept. 11	Sept. 27

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1896, WITH THE MEAN DATE FOR 1876–1895.

SPECIES.	WATFORD.	ST. ALBANS. The Grange.	ST. ALBANS. Addiscombe Lodge.	ST. ALBANS. Worley Road.	RADLETT.	BERKHAMSTED.	HARPENDEN.	WORMLEY.	HATFIELD.	HITCHIN.	ASHWELL	MEAN, 1876-95.
BIRDS.												
Song-Thrush (*Turdus musicus*)	Jan. 15	Jan. 3	Jan. 19	.....	.....	Jan. 12	Jan. 15	Jan. 2	Jan. 18	.....	.....	Jan. 16
Swallow (*Hirundo rustica*)	Apl. 22	Apl. 20	Apl. 26	Apl. 26	Apl. 26	Apl. 9	Apl. 24	Apl. 22	Apl. 20	Apl. 15	Apl. 23	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 28	Apl. 10	Apl. 17	Apl. 12	Apl. 19	Apl. 18	Apl. 20	Apl. 15	Apl. 18	Apl. 17	Apl. 24	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 29	Apl. 23	.....	Apl. 21	.....	Apl. 18	Apl. 26	Apl. 23	Apl. 22	Apl. 17	Apl. 21	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	June 1	.....	.....	May 31	.....	Apl. 18	.....	.....	.....	.....	May 15	.....
Swallow (last seen) (*Hirundo rustica*)	Oct. 16	.....	.....	Nov. 20	.....	Oct. 22	.....	.....	.....	.....	Oct. 21	.....
INSECTS.												
Honey-Bee (*Apis mellifica*)	.....	Feb. 8	Feb. 13	.....	.....	Feb. 9	.....	Jan. 19	.....	Jan. 17	.....	Jan. 29
Wasp (*Vespa vulgaris*)	.....	Jan. 19	Mar. 19	.....	Apl. 23	Apl. 19	Apl. 26	Mar. 24	.....	Apl. 23	Mar. 22	Apl. 4
Small White Butterfly (*Pieris rapæ*)	.....	Mar. 12	Apl. 7	.....	Apl. 26	Apl. 19	Apl. 20	Apl. 18	.....	.....	.....	Apl. 3
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	.....	May 9	.....	.....	May 15	May 18	May 9	May 7	Apl. 22	.....	May 7
Meadow-Brown Butterfly (*Epinephile janira*)	.....	.....	.....	.....	.....	May 25	.....	.....	.....	.....	.....	May 17

was singularly warm and dry the atmosphere on the whole remained calm and humid, and there was an unusually scanty record of clear sunshine.

From an agricultural point of view, the winter of 1895–96 must be regarded as having been in almost every respect a remarkably favourable one. Owing to the dry and open weather, the cultivation of the land was scarcely interrupted for a single day. During February the ground was in such splendid condition for working that the arrears of wheat-sowing, due to the wet autumn, were soon made up, and the grain was sown under the most favourable conditions possible. The autumn-sown corn was also benefited by the mild season, and yet never became sufficiently forward to be considered "winter proud." This was no doubt in a great measure due to the paucity of sunshine. Moreover, the grass in the pastures remained fresh and green throughout the whole season. Unlike the previous winter, there was always a plentiful supply of green vegetables in the gardens.

Our Watford representative, Mrs. G. E. Bishop, mentions the scarcity of ivy and holly-berries in December, and the unusually green appearance for the time of year of the grass, both in the fields and on the lawns, at the end of February. Miss E. F. Smith, as illustrating the open character of the season, states that as early as the 20th of January she had noticed buttercups, both creeping and bulbous, in flower by the roadside close to St. Albans. At Berkhamsted the winter aconite was in blossom in my garden on January 9th, or a fortnight earlier than its average date for the previous seven years, and three days earlier than in any of those years.

The first plant on the list, the hazel, taking the mean date for all the stations, came into blossom four days in advance of its average date for the preceding nineteen years, while the coltsfoot was one day early.

The song-thrush was first heard after the beginning of the year on January 12th, which is four days earlier than its usual time.

The honey-bee first visited flowers three days later than the mean date.

The Spring.

The weather of March may be concisely described as having been warm, wet, and windy; whereas April and May, although also warm for the time of year, were remarkably dry, and had an unusually calm atmosphere. The first two months of the season proved sunless, while May, on the other hand, continued singularly bright even for this sunny month.

Throughout the greater part of the quarter the weather-conditions were again favourable for the farmer. Indeed, until about the middle of May, seldom has the prospect, all things considered, been so promising. About this time, however, the continued dry weather was beginning to make itself seriously felt, and especially by the pastures, the grass in which made scarcely any growth.

Owing to the same cause seeds germinated slowly, and in many cases failed to come up at all.

The most noteworthy feature of this spring was undoubtedly the abundant blossom on all kinds of flowering shrubs and trees, including fruit-trees, the hawthorn bushes especially presenting in many cases one continuous sheet of bloom.

Mrs. Bishop reports that at the end of May the lawns at Watford were much burnt up, while the grass intended for hay was very thin and short. Miss Lilian Warner, writing from Wormley early in April, remarks that "the unusually mild winter had made less difference in the flowering of early spring plants than might have been expected—the coltsfoot, wood-anemone, and blackthorn not being out so early as they often have been after a moderately hard winter." The chill given to the ground by the cold spell at the end of February, and the absence of sunshine afterwards, no doubt caused these early plants to flower later than they otherwise would have done.

The wood-anemone, taking the mean date for all the records sent in, was two days later than the nineteen years' average, the blackthorn nine days early, the garlic hedge-mustard six days early, the horse-chestnut eleven days early, the hawthorn thirteen days early, the white ox-eye one day early, and the dog-rose six days early.

The three spring migrants on the list, for which we have average dates, arrived somewhat behind their usual time, the swallow being nine days late, the cuckoo five days late, and the nightingale seven days late.

The wasp was first seen nine days in advance of its average date, but the three butterflies made their appearance later than usual, the small white being nine days late, the orange-tip one day late, and the meadow-brown eight days late.

The Summer.

June and July were both hot months, but during August the temperature remained uniformly low for the season. A good deal of rain fell during the first ten days in June, and again in the latter half of August, but throughout the intervening ten weeks the rainfall was extremely light. The record of sunshine was much in excess of the average in June and July, whereas August proved very gloomy for a summer month. Taking the season as a whole the winds were light and unusually dry.

The rain which fell in the early part of June proved very beneficial to all farm and garden crops, but of course came too late to save the hay, the yield of which was extremely light. It served also to start into growth many of the recently-sown seeds. The ground had, however, previously become so dry that the good effect of those heavy rains soon passed away, and a second drought, accompanied by great heat and drying winds, set in.

In order to give some idea of the nature and duration of these two droughts, a few extracts from the records of one of my percolation gauges may be of interest. The gauge referred to is a yard square, and contains $2\frac{1}{2}$ feet of the heaviest soil to be found in the neighbourhood of Berkhamsted, a mixture of clay and flints. It has no grass growing upon it, but is kept constantly hoed on the surface to prevent the formation of cracks. Taking this gauge as a guide, the first drought may be said to have lasted from the 22nd of April to the 10th of June, or for exactly seven weeks, while the second began on the 17th of June and came to an end nine weeks later, on the 19th of August. During the dry periods mentioned, no measurable quantity of rain-water came through the soil in this gauge, and for nineteen consecutive days in the first drought, and for thirty-seven consecutive days in the second, no water at all. On July 26th rather more than a quarter of an inch of rain fell, which is equivalent to a gallon and a half on every square yard of surface, and yet after this tolerably heavy rainfall my lawns remained nearly as brown as before, showing how extremely dry the soil had previously become.

Mr. Willis states that at Harpenden the first wheat-ear was out of its sheath as early as June 3rd.

The black knapweed came first into flower two days in advance of its average date, the harebell three days late, and the greater bindweed eleven days early.

The Autumn.

This was a very cold quarter, and also an extremely wet one. A great improvement in the weather, however, took place in November, which although also cold, had a small rainfall, and for the time of year a very dry atmosphere and a splendid record of sunshine. During September and October the wind was on several occasions very high, while November, on the other hand, proved on the whole unusually calm.

The heavy rainfall in September soon made itself evident in the pastures, which, for the first time for several months, were clothed with green herbage. The root-crops were also benefited, so that from this time there was never any lack of keep for the sheep and cattle. At first these rains were also welcomed by the farmer as facilitating the working of the land, and the planting of autumn corn, but later on the ground became in such a wet and sodden state that it was not until the very end of October that further cultivation was possible. Fortunately, November proved fine and dry, and farming operations were then resumed under very favourable conditions.

All the wild autumn fruits, such as acorns, the hips of the dog-rose, holly and hawthorn berries, etc., were surprisingly plentiful and fine. Mushrooms and other fungi were also unusually numerous early in the season.

Judging by the reports which appeared in the 'Agricultural Gazette' on July 27th, the only really abundant farm-crop in Hertfordshire was that of wheat, whereas all the others were more or less under average, the yield of turnips, mangolds, and hay being specially poor.

There were good crops of all the small fruits, but apples, pears, and plums were in most places below average. In my own garden the yield of apples was very good, but much damage was done to them by high winds. I estimated at the time that nearly one-fourth of the total number were blown from the trees by high winds during September.

From Radlett Miss E. M. Lubbock reports that strawberries were coming again into blossom on October 18th. The same observer mentions the great quantity of acorns on the oaks. Also that begonias, heliotropes, etc., which were then in full bloom, were cut off and blackened by frost during the night of October 18th. On the same night the dahlias in my own garden at Berkhamsted were greatly crippled by frost, but not entirely killed until the night preceding the 28th, which is three days earlier than the average date of their destruction in the previous eleven years. At Watford, dahlias and scarlet-runner beans also succumbed to the latter frost. Miss E. M. Smith states that at St. Albans Gloire de Dijon roses were still flowering in her garden on November 30th.

The last plant on the list, the ivy, flowered on September 25th, or two days in advance of its average date.

XXVII.

NOTES ON LEPIDOPTERA OBSERVED IN THE NEIGHBOURHOOD OF WATFORD IN THE YEAR 1896.

By S. H. Spencer, Jun.

Read at Watford, 30th April, 1897.

A large number of moths visited the sallow-bloom, among which were some good specimens of *Tæniocampa populeti* and *miniosa*. Sugaring during the year yielded but poor results. At ivy-bloom a few moths were taken, but owing to the very wet autumn the bloom was soon destroyed.

At light many moths made their appearance, but not in such large numbers as in the previous year. While collecting at dusk in the garden of "Elmcote," Watford, Mr Arthur Cottam had the good fortune to capture a specimen of that recently-found moth, *Plusia moneta*, and we have together prepared the following note on the appearance of the above species in England:—

"*Plusia moneta* was first taken in Great Britain on 25th June, 1890, by a schoolboy at Dover, as it was hovering over a *Delphinium* blossom. In recording this capture Mr. Barrett remarks ('Entomologists' Monthly Magazine,' vol. xxvi, p. 255) that it is a rather curious fact, but one well established, that those seasons which are remarkable for unfavourable weather, and consequent scarcity of insects, are also noticeable for the unexpected occurrence of novelties or rarities. On the night of the 2nd July in the same year another was taken, by Mr. W. Holland, flying about a gas-lamp at a railway station near Reading. And in August one was taken at Cambridge, by Mr. J. C. Rickard, at rest just outside Downing College grounds.

"In 1891 a specimen was taken at Dover on the 20th September, evidently one of the second brood. In 1893, on about the 10th July, a specimen was taken at the flowers of *Nicotiana affinis* at Tonbridge. In 1894 a specimen was taken at Sprowston, near Norwich, on 26th June, by Mr. B. Tillett, hovering over a large rose-bush, at about 9.30 p.m., and another at Eastbourne, on the 13th July, by Mr. Saunders, flying at privet-bloom in College Road. In 1895 Mr. Tillett took another specimen at Sprowston on the 26th June, at sugar, where one had been taken by his brother the previous year. In the same year two were taken at Harrow Weald, Middlesex, by Mr. Peers, the son of the Vicar, but he did not record the captures, and I am not able to give the dates.

"The first specimen taken in Hertfordshire was captured by Mr. Arthur Cottam in Watford, on the 19th June, 1896. He was catching the moths that came to a large clump of honeysuckle (then in full flower) in the garden of 'Elmcote,' with the late Mr. Clarence E. Fry, who then resided there. It was nearly ten o'clock when the insect was taken, and although Mr. Cottam, from its shape when he held his net against the sky, thought it was a *Plusia* of some sort, and said so to Mr. Fry, it was too dark to see what it was, and it was only when Mr. Cottam reached home that he discovered the value of his capture. In the last week of June and the first week of July, 1896, eight specimens were taken at Tring, and in fact the insect is now becoming fairly common all over the south of England. Last year, besides those already mentioned, four were taken at Leatherhead, Surrey; nine at Weybridge, also in Surrey; three at Bromley, Kent; a long series at Ascot, Berks; and single specimens at Waltham Cross, Sutton, Winchester, Wallington, Ashford, Wye, Folkestone, Hastings, Bournemouth, etc.; and Mr. Sidney Webb stated that it appeared at Dover as a second brood at large.

"The tendency of insects to move in the direction from east to west has been noticed for some years by continental entomologists, and is clearly shown by this insect. It was known to be a common insect in the south and south-east of Germany, but until 1875 was not recorded from the north-west of Germany, nor from the Netherlands. But in 1875 began the invasion of those districts, and it rapidly spread over them. Herr Hoffmann, of Hanover, writing in 1890, stated that having crossed the Channel he expected *moneta* would probably spread as rapidly over England. In this surmise he appears to have been correct. Duponchel, however, stated that as early as 1829 it was found in France as far north as, and only at that time in, Normandy, where it was double-brooded, and fed on a variety of plants, including sunflower and Jerusalem artichoke, burdock and cucumber. According to this statement, its first appearance in the north of France is by no means recent. This information was given to the French Entomological Society on the 10th December, 1890, by the veteran Lepidopterist Mons. J. Fallon.

"For the above particulars as to the geographical distribution of the insect we are indebted to various articles in the 'Entomologists' Monthly Magazine' for the years 1890–91, by Mr. C. J. Barrett, Herr Hoffmann of Hanover, and others.

"*P. moneta* is a very lovely insect, the prevailing colour being a metallic golden grey tinged with pink. The orbicular stigma is circular, and bright gold, and a smaller circular spot, also gold, joins it. They look like two minute coins side by side, hence the name. The palpi are remarkable, being long and recurved. The larva feeds on aconite (monkshood), and the young larva in May spins the young shoots of the plant together. Later the large yellow cocoon can be found hanging on the under-side of a leaf."

In the following account of the more interesting captures, when the name adopted differs from that in South's List, the latter has been inserted as a synonym.

Sphinges.

Chærocampa porcellus.—On June 16th I captured a fine specimen of this moth flying around honeysuckle in the garden of "Elmcote," Watford.

Smerinthus ocellatus.—The caretaker of the Endowed Schools sent me a pair of the moths in cop., which he found in the playground. I obtained a large number of ova, and bred some fine specimens.

S. tiliæ.—Three specimens taken during June at electric light.

Bombyces.

Nola cucullatella.—Saw several specimens at electric light.

Zeuzera pyrina.—Mr. Edwin Jackson brought me a specimen which he found near The Hall, Bushey, on June 26th.

Trichiura cratægi.—On Sept. 10th I took a specimen at electric light.

Pœcilocampa populi.—Mr. Cottam found this moth fairly plentiful at electric light, Nov. 24th, Dec. 10th.

Clisiocampa (= *Bombyx*) *neustria.*—Mr. Cottam found some webs of larvæ on sloe at Bricket Wood.

Odonestis potatoria.—Several specimens at electric light.

Drepana falcataria.—One damaged specimen at electric light, June 4th.

D. hamula (= *binaria*).—One specimen at electric light, June 4th.

Dicranura furcula.—One specimen at electric light.

D. bifida.—One specimen at rest on a fence in Clarendon Road at 8 o'clock in the evening of May 23rd.

D. vinula.—Mr. Cottam found a specimen on an aspen at Bricket Wood.

Pterostoma palpina.—Two specimens at electric light, June 4th and 15th One specimen near Watford tunnel, June 22nd.

Notodonta dromedarius —Several specimens at electric light.

Pygæra (= *Phalera*) *bucephala.*—Larvæ plentiful on lime-trees along the roads.

Phragmatobia fuliginosa.—Two specimens at electric light in June.

Thyatira derasa.—One specimen at light, near Watford tunnel, June 22nd.

Cymatophora flavicornis (= *or*).—I found the larvæ of this moth at Bricket on the young birch-trees on May 16th. The perfect insect emerged during the following March. Mr. Cottam took this moth at rest on the young birch-trees on Stanmore Common.

Noctuæ.

Acronycta psi.—A specimen at honeysuckle in Mr. Fry's garden.

Diloba cæruleocephala.—Taken at electric light, Nov. 4th.

Leucania comma, *impura*, and *pallens.*—Plentiful at electric light in June.

Nonagria typhæ (= *arundinis*).—On Sept 1st, a dark warm night, I took a specimen of this beautiful moth at electric light.

Neuria saponaria (= *reticulata*).—Mr. Cottam took two specimens at light in his house.

Neuronia popularis.—Abundant at light.

Luperina cespitis.—Several specimens at electric light.

Apamea ophiogramma.—Mr. Cottam took a specimen at electric light.

Mamestra persicariæ. — Good specimens at electric light, on June 29th.

Caradrina cubicularis (= *quadripunctata*).—Three specimens at electric light, June 4th and 15th.

Agrotis puta.—Two specimens at electric light.

A. exclamationis.—Swarmed at electric light in June.

Noctua augur, plecta, C-nigrum, bella (= *rubi*), and *xanthographa*, at electric light, *C-nigrum* and *xanthographa* being very plentiful and *bella* fairly plentiful.

Amphipyra pyramidea.—A few at light and sugar.

Pachnobia rubricosa. — Fourteen specimens at electric light on a dark night in April.

Tæniocampa gothica.—Not so common as usual at sallow.

T. instabilis (= *incerta*).—At sallow and light.

T. populeti.—A few specimens at sallow and light.

T. stabilis.—At sallow and light.

T. gracilis.—A few specimens at sallow.

T. miniosa.—More plentiful than usual when the sallow-bloom was nearly over.

T. munda.—Very few specimens.

T. cruda (=*pulverulenta*).—In abundance at sallow and light.

Orthosia lota and *macilenta.*—A few at ivy-bloom, Oct. 17th and 21st.

Anchocelis lunosa.—Abundant at electric light.

A. litura.—A few specimens at electric light.

Cerastis vaccinii and *spadicea.*—At ivy-bloom and light. A few hibernated specimens at sallow in March and April.

Scopelosoma satellitia. — At ivy-bloom, and a few hibernated specimens at sallow.

Xanthia flavago.—Two specimens at electric light.

X. aurago.—One specimen at light in the Hall Road.

X. gilvago.—Several specimens at electric light.

Cirrhœdia xerampelina. — On August 31st, a dark night, Mr. Cottam and I each took a specimen at electric light.

Dianthœcia carpophaga —The larvæ I found last year (1895) pupated, and the perfect imago first appeared on 16th May, 1896, and on through the first fortnight of June.

Hecatera serena.—One specimen at light, June 22nd.

Polia flavocincta.—Mr. Cottam found several specimens on the fences here. He gave me a larva which was feeding on the ivy outside his house, and it turned out to be of this species.

Phlogophora meticulosa.—Very abundant, principally at electric light.

Hadena pisi.—Some fine specimens at electric light, June 4th.

Cucullia umbratica.—Several specimens of this moth were netted whilst flying around honeysuckle, by Mr. Cottam and myself, in Mr. Fry's garden, on June 16th, 23rd, and 24th. Two specimens at electric light.

Plusia chrysitis.—Taken at electric light, fairly plentiful. A specimen over sweet-william blooms.

P. festucæ.—On August 31st Mr. Cottam took a good specimen of this beautiful moth at electric light.

P. iota.—Two specimens at electric light, June 15th.

P. moneta.—This great prize for the year was taken by Mr. Cottam in Mr. Fry's garden whilst flying around honeysuckle. A short account of the history of this interesting moth has already been given.

P. gamma.—Not so plentiful as last year.

Brephos parthenias.—Saw several specimens at Bricket Wood.

Geometræ.

Amphidasis prodromaria (=*strataria*).—A specimen reared from pupæ found beneath an oak-tree in Rowse Barn Lane.

Geometra papilionaria.—Two larvæ found on young shoots of the birch at Bricket Wood.

Melanthia rubiginata (= *bicolorata*).—One specimen of this beautiful little moth taken in the garden of "Elmcote," Watford.

XXVIII.

CLIMATOLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE IN THE YEAR 1896.

By John Hopkinson, F.L.S., F.G.S., F. R. Met. Soc., Assoc. Inst. C. E.

Read at Watford, 30th April, 1897.

The year 1896 is the tenth at which observations have been made at our five Climatological Stations, and this report, which comprises the usual series of tables, thus completes a decade.

The mean temperature of Hertfordshire in 1896, deduced from these observations, was 1°·0 above that of the previous nine years, and 0°·1 above the mean of 1882–86. The year was therefore above the average temperature. It had an average mean daily range of temperature, and although the maximum was rather high the extreme range was not great. The air was of average humidity, and the sky was nearly of the usual brightness. The rainfall was about the average for the county for the last half-century. Royston was as usual about a degree warmer than any of the other places, and New Barnet had much the greatest range of temperature.

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	40·0	35·1	44·9	9·8	24·0	52·1	86	7·7	·81	15
Feb.	39·5	33·0	46·1	13·1	18·0	56·3	84	7·4	·49	8
March	45·4	38·1	52·7	14·6	30·6	67·2	83	7·0	3·27	23
April	48·6	39·3	57·9	18·6	29·5	66·7	80	6·4	·85	12
May	53·7	42·5	64·8	22·3	32·6	77·9	74	5·7	·30	4
June	63·6	52·0	75·2	23·2	43·4	86·2	75	6·6	2·02	10
July	64·5	52·3	76·8	24·5	44·2	89·0	70	5·9	·65	7
August	59·5	50·1	68·9	18·8	42·6	76·0	78	6·7	2·38	13
Sept.	57·3	50·2	64·3	14·1	39·0	71·4	83	7·1	5·25	22
Oct.	45·7	38·7	52·7	14·0	30·7	65·8	87	6·8	2·96	20
Nov.	39·1	33·4	44·8	11·4	24·0	50·9	89	6·2	1·05	11
Dec.	38·1	33·6	42·7	9·1	24·2	52·0	89	8·0	3·06	24
Year	49·6	41·5	57·6	16·1	18·0	89·0	81	6·8	23·09	169

BERKHAMSTED.

(Rosebank.)

Latitude: 51° 45′ 40″ N. Longitude: 0° 33′ 30″ W. Altitude: 400 feet.

Observer: *Edward Mawley, Pres.R.Met.Soc.*

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	39·6	35·0	44·1	9·1	26·2	52·2	93	8·5	·97	11
Feb.	39·1	32·7	45·6	12·9	18·6	56·1	90	7·6	·38	8
March	44·8	37·7	51·9	14·2	27·0	65·3	84	8·0	3·52	23
April	48·1	39·1	57·1	18·0	29·4	66·6	77	7·6	·71	10
May	53·0	41·8	64·2	22·4	30·1	77·4	68	5·5	·26	2
June	61·3	50·8	71·8	21·0	36·3	81·9	70	7·3	2·19	11
July	62·6	51·1	74·1	23·0	41·4	84·9	65	6·1	·81	10
August	58·4	49·2	67·6	18·4	41·4	75·2	77	7·4	2·78	16
Sept.	56·3	50·2	62·4	12·2	36·5	70·6	85	7·9	6·54	23
Oct.	45·4	38·1	52·7	14·6	26·8	61·8	88	6·6	3·50	20
Nov.	39·8	33·9	45·7	11·8	23·3	52·4	89	6·2	1·33	9
Dec.	38·3	33·7	42·9	9·2	20·8	52·4	95	8·0	4·31	22
Year	48·9	41·1	56·7	15·6	18·6	84·9	82	7·2	27·30	165

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	39·6	34·9	44·2	9·3	26·7	51·2	91	8·0	·79	11
Feb.	38·7	32·3	45·2	12·9	20·9	56·7	91	7·5	·46	9
March	44·5	38·1	51·0	12·9	29·5	63·3	85	7·5	3·62	26
April	47·6	40·1	55·1	15·0	32·0	64·8	75	6·4	·87	12
May	52·9	43·1	62·6	19·5	34·0	75·1	73	5·1	·34	5
June	61·4	52·2	70·6	18·4	37·7	81·1	70	6·5	1·60	10
July	63·0	52·4	73·5	21·1	45·3	84·3	69	5·5	·90	9
August	58·2	50·7	65·8	15·1	43·8	72·7	78	6·6	2·42	16
Sept.	55·8	50·0	61·6	11·6	38·3	68·9	87	6·9	6·69	24
Oct.	45·1	39·0	51·3	12·3	27·9	61·5	89	6·4	3·46	21
Nov.	39·0	33·8	44·3	10·5	25·3	49·8	89	5·9	1·49	11
Dec.	37·9	33·2	42·7	9·5	24·5	50·7	93	7·1	4·16	24
Year	48·6	41·7	55·7	14·0	20·9	84·3	82	6·6	26·80	178

BENNINGTON.

(Bennington House.)

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	39·1	34·7	43·5	8·8	26·7	51·3	92	8·0	·66	10
Feb.	38·8	32·8	44·7	11·9	20·8	55·5	90	7·7	·47	10
March	44·2	37·5	51·0	13·5	29·7	63·4	84	8·2	3·34	25
April	47·7	39·3	56·0	16·7	31·3	65·8	75	8·0	·64	11
May	52·6	42·3	62·9	20·6	33·5	77·0	69	5·9	·25	4
June	61·4	51·4	71·5	20·1	39·0	81·1	68	7·9	2·34	9
July	63·1	52·0	74·2	22·2	44·0	85·2	62	6·4	1·20	7
August	58·6	49·9	67·3	17·4	43·0	75·1	73	7·1	2·98	13
Sept.	56·1	50·2	62·0	11·8	37·9	68·7	86	7·5	6·26	22
Oct.	45·3	38·7	51·9	13·2	27·0	61·9	89	7·4	3·43	21
Nov.	39·4	34·2	44·6	10·4	23·9	51·9	88	5·9	1·29	12
Dec.	38·1	33·8	42·4	8·6	25·6	51·6	93	8·2	3·61	26
Year	48·7	41·4	56·0	14·6	20·8	85·2	81	7·4	26·47	170

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				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	39·2	33·1	45·2	12·1	20·0	55·5	88	7·7	·79	8
Feb.	39·0	31·3	46·6	15·3	15·0	57·8	90	6·4	·37	6
March	44·7	36·0	53·4	17·4	22·0	66·5	86	7·5	3·47	20
April	48·2	37·4	59·0	21·6	24·0	68·5	79	6·9	·54	8
May	53·0	39·5	66·5	27·0	25·0	79·2	74	5·1	·23	2
June	62·0	48·7	75·4	26·7	30·8	86·8	73	5·5	1·91	9
July	63·1	49·1	77·0	27·9	37·0	89·5	67	4·9	·98	8
August	58·5	47·3	69·8	22·5	38·0	77·8	76	6·8	2·44	11
Sept.	56·7	48·2	65·2	17·0	32·0	75·0	88	6·8	6·79	22
Oct.	45·1	36·3	53·9	17·6	22·0	64·5	88	5·2	3·07	18
Nov.	38·9	31·9	45·9	14·0	15·0	53·0	86	5·3	1·19	9
Dec.	37·9	32·1	43·7	11·6	19·5	52·0	91	7·7	4·02	19
Year	48·9	39·3	58·5	19·2	15·0	89·5	82	6·1	25·80	140

HERTFORDSHIRE.

Means of Climatological Observations (with extremes of temperature) in 1896, at Royston, Berkhamsted, St. Albans, Bennington, and New Barnet.

Months	Temperature of the Air						Humidity	Cloud, 1–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	39·5	34·6	44·4	9·8	20·0	55·5	90	8·0	·80	11
Feb.	39·0	32·4	45·6	13·2	15·0	57·8	89	7·3	·43	8
March	44·7	37·5	52·0	14·5	22·0	67·2	84	7·6	3·45	23
April	48·0	39·0	57·0	18·0	24·0	68·5	77	7·1	·72	11
May	53·0	41·8	64·2	22·4	25·0	79·2	72	5·5	·28	3
June	61·9	51·0	72·9	21·9	30·8	86·8	71	6·8	2·01	10
July	63·3	51·4	75·1	23·7	37·0	89·5	67	5·8	·91	9
August	58·7	49·5	67·9	18·4	38·0	77·8	76	6·9	2·60	14
Sept.	56·4	49·8	63·1	13·3	32·0	75·0	86	7·2	6·31	23
Oct.	45·3	38·1	52·5	14·4	22·0	65·8	88	6·5	3·48	20
Nov.	39·2	33·4	45·0	11·6	15·0	53·0	88	5·9	1·27	10
Dec.	38·1	33·3	42·9	9·6	19·5	52·4	92	7·8	3·83	23
Year	48·9	41·0	56·9	15·9	15·0	89·5	82	6·9	26·09	165

Results of Climatological Observations, 1887–95.

Stations.	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Royston	48·6	40·4	56·8	16·4	3·5	93·0	83	6·2	22·17	160
Berkhamsted	47·6	39·9	55·3	15·4	7·5	91·0	83	7·1	26·05	179
St. Albans	47·9	40·7	55·1	14·4	10·1	91·0	82	6·7	26·73	184
Bennington	47·7	40·4	54·9	14·5	9·7	90·9	81	7·2	24·14	186
New Barnet	47·8	38·5	57·1	18·6	1·0	94·5	83	6·2	23·81	141
County	47·9	40·0	55·9	15·9	1·0	94·5	82	6·7	24·58	170

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APPENDIX.

LIST OF MEMBERS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

July, 1898.

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.*

1882 Cooke, M. C., M.A., LL.D., A.L.S., 146, *Junction Road, London, N.*

1879 Etheridge, Robert, F.R.S., F.R.S.E., F.G.S., 14, *Carlyle Square, Chelsea, London, S.W.*

1893 Flower, Sir William Henry, K.C.B., D.C.L., LL.D., F.R.S., F.R.C.S., F.L.S., F.G.S., Pres. Z.S., 26, *Stanhope Gardens, London, S.W.*

1890 Geikie, Sir Archibald, Sc.D., D.C.L., 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., *The Shola, Heathfield Road, South Croydon.*

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., *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.*

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, 17, *Parson's Green, Fulham, London, S.W.*

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