THE

ESSEX NATURALIST:

BEING THE

Journal of the Essex Field Club.

EDITED BY

WILLIAM COLE, ASSOC.L.S.,

Honorary Secretary.

VOLUME XVII.

JANUARY, 1912—*DECEMBER*, 1913.

"*Men that undertake only one district are much more likely to advance Natural Knowledge than those that grasp at more than they can possibly be acquainted with. Every kingdom, every province, should have its own Monographer.*"—GILBERT WHITE, of Selborne.

"*Things seen are mightier than things heard.*"—TENNYSON.

[*The authors alone are responsible for the statements and opinions contained in their respective papers.*]

PUBLISHED BY THE CLUB, AT THE ESSEX MUSEUM OF NATURAL HISTORY, STRATFORD, ESSEX.

1914.

"Which is the shire whose glory
Makes good your every claim?
'Tis famed in song and story,
What need to breathe its name?
Far, far beyond all other,
The beauties that adorn,
The shire you claim as mother,
The shire where you were born!"

TOUCHSTONE.

"The low, bare flats at ebb-tide, the rush of the sea at flood,
Through inlet and creek and river, from dike to upland wood;
The gulls in the red of morning, the fish-hawks rise and fall,
The drift of the fog in moonshine, over the dark coast wall."

J. G. WHITTIER.

Now bursts high up, the clouds among,
The lark's tumultuous joy in song,
Of limpid melody,
The entrancing music throbs and thrills
Through all my being, till it fills
My soul with ecstasy.

WILLIAM KETTLE.

There's a dream of a wild March morning
That often comes to me,
Of a little windy garden
By the tossing Northern Sea,
With its grass patch starr'd with daisies,
And its crocus blossoms gay,
And its daffodils atwinkle
'Mong leaves all blown one way.

AUGUSTA HANCOCK.

"What yearth or Sea, or Skies conteyne, what creatures in them be
My Mynde did seeke to knowe, my Soule the Heavens continually."

Inscription on the Tomb of Sir Thomas Smith, 1577, in the Church of St. Michael's, Theydon Mount, Essex.

When Dr. Edward Jenner came up to London and discussed with the famous John Hunter his hopes and fears respecting the possibilities of vaccination, the characteristic reply of the great anatomist was, "Don't think, Jenner, but *try*."

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PLATES AND ILLUSTRATIONS.

ERRATA.

Page 107, line 21 from bottom, for "*utricularia*," read "*utricularis.*"
Page 111, line 15, for "*Dallyellia*," read "*Dalyellia.*"
Page 211, line 26, for "*Daphia*," read "*Daphnia.*"
Page 216, line 16 from bottom, for "442," read "422."
Page 216, lines 12 and 2 from bottom, for "*Threnall*" read "*Thurnall*"
Page 222, line 15. for "*At*" read "*St.*"

[The Editor is greatly indebted to the continued kindness of Mr. Henry Whitehead for the compilation of the Index.]

Parts I.—III., Vol. XVII.] [JAN—SEPT., 1912.

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"DEWLANDS," RAY'S HOME AT BLACK NOTLEY,

from a photograph by Mr. H. S. Tabor, taken shortly before its destruction by fire, in 1900.

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MORE ABOUT DR. BENJAMIN ALLEN (1666-1738), OF BRAINTREE, NATURALIST.

By MILLER CHRISTY, F.L.S.

[WITH PLATE I.]

[*Read 25th November* 1911.]

IN February last, there appeared in these pages a lengthy account [1] by myself of that interesting old Essex naturalist, Dr. Benjamin Allen, of Braintree, the friend and neighbour of both John Ray and Samuel Dale, my information having been derived mainly from a volume of Allen's "Common-place Book," which was, and still is, in the possession of our member, the Rev. J. W. Kenworthy.

Among much other matter, I gave [2] an extract from Allen's will, in which he made a special bequest to his descendants in the terms following:—

"My Note Books or Manuscripts of Medicine and private Methods of Cure, disclosing much of the Practise of Physick (principally the two vellum folios numbered One and Two, in letters at length, . . .), as a separate matter from Goods, I ordain not to be sold, but preserved in some sufficient hand of one of the Family, in the Practise of Physick or Pharmacy, under the oversight of my Executors and their Executors, for the use and benefit of my Family hereafter, to see they be secure from losing or making away or parting with any way out of their custody; . ."

This shows clearly the very high value Allen set upon the two books in question.

It was evident that the volume I was describing was one or other of the "two vellum folios" which Allen thus bequeathed, although it no longer bore any such inscription as "No. One" or "No. Two." Consequently, I remarked [3] that "it would

1 Essex Nat., xvi., pp. 145–175 (1911).
2 *Op. cit.*, p. 174.
3 *Loc. cit.*

be a matter of great interest if we could discover the fellow-volume"; but I expressed a fear that it had "disappeared beyond hope of recovery."

At the time when I wrote this, I expected few things less than that the missing fellow-volume would shortly come to light. Yet, after all, the unexpected happened; for, within six months, the missing volume appeared in a London sale-room. The occurrence is all the more remarkable, because its appearance in the sale-room at that particular time was, so far as I can ascertain, purely accidental, and had no connection whatever with the publication of my paper. The volume appeared (lot 520) in a sale at the rooms of Messrs. Hodgson & Co., of Chancery Lane, on 7th July 1911. It had been sent there for sale by Mr. Albert Cubitt, the well-known dealer of Ipswich, who has been good enough to inform me that he acquired the book in a mixed lot in a Colchester sale-room some time ago. It appears, therefore, that both volumes had found their way somehow to Colchester. At the sale in London, the book was purchased by our Vice-President, Mr. John Avery, to whom I am indebted for permission to describe it. Both volumes are, therefore, now in the possession of members of our Club.

This newly-discovered volume is of smaller size than that already described, being a pott-folio (12¼ ins. by 8 ins., trimmed). It is bound substantially in contemporary vellum, similarly in all respects to the other volume. On the back, it is inscribed in ink: "Obs. Med., B.A., No. One"—that is to say, "Benjamin Allen's Medical Observations, Volume Number One." This proves that the volume I described previously was "No. Two."

The newly-discovered volume contains [14] + 345 + [22] pages, practically every one being closely written upon. The first 12 pages are insertions. There have been inserted also, in various parts, several letters from Allen's patients, medical correspondents, and others.[4] The last four pages are devoted to a fairly-complete index to the diseases discussed.

The lengthy title on the title-page sets forth the nature of

4 One letter of advice from Sir Hans Sloane is noticed hereafter (see *post*, p. 7). Another, giving advice how to cure "Mr. Pyke's child," is from Sir Richard Blackmore (d. 1729), Physician-in-Ordinary to King William III. and Queen Anne and a voluminous writer of verse.

the contents, and shows that the book was begun in 1710. It reads as follows :—

"Praxis Medica, / Benjamin Allen, Med. Bacc. : / Medicinal Observations towards a / Knowledge and Cure of Diseases, / (consisting of Cures and the Reasons, or what to be minded and understood / for Direction, what to be design'd [and] noted, and what must be / gain'd) ; By Benjamin Allen, Batchillour in Physick, / formerly of Queen's College, in Cambridge ; / For his own use (because, in many cases, thro' general practise, / we are apt to overlook what may be preserv'd with accuracy) / and for the use of his Family. / . . . / Braintry, Essex, 1710."

Below the title are some unimportant general remarks, added, apparently, at a later date. The dates of various entries in the book show that it continued in use up to about 1721—probably, indeed, up 1723, when Allen started the second volume.

It is clear that Allen originally intended to devote both volumes to entries relating to medical matters, records of his cases, notes of prescriptions which he and others had found effective, and the like. The earlier volume now under notice (commenced in 1710, when Allen was about forty-seven years old) was never devoted to any other purpose, there being in it no records of observations in Natural History and few notes of purely personal and biographical interest. Consequently, to us, as naturalists, this first volume is of far less interest than the other (second) volume, which I have already described ; for, although this other volume (commenced in 1723, when Allen was about sixty years old and had probably retired to some extent from active practice) remained to the end mainly a book of notes on medical subjects, Allen came, as time went on, to enter in it(as I showed in my earlier paper) a large number of very interesting notes on all sorts of subjects, making it, indeed, what I called it—a veritable "Common-place Book" rather than a book of medical observations merely.

Coming, next, to a detailed consideration of the contents of this newly-discovered (first) volume : we find that, though in no sense what a physician might call a "Case Book," it contains a vast number of notes on cases which Allen had treated —not jotted down as they occurred, but arranged systematically under diseases, each note giving the name of the patient, the date of his or her illness, the methods of cure tried, and, generally,

the result. The whole leaves us in no doubt that Allen was an exceptionally-careful and observant physician, with a keen interest in his profession. His advice to take certain medicines at certain stages of the moon, his constant talk of electuaries, linctuses, bitter drinks, and the like, and his prescription of millipedes, solutions of peacocks' dung, and other nasty medicines (as noticed in my former paper), may seem to us now as the merest childishness; but the fact remains that his remedies were based on the best medical knowledge of his day. It is clear, too, that he had a very good and extensive practice, extending for many miles around Braintree, and that it included all classes of the community. Thus, we find notes showing that, on the one hand, he attended the Duke of Manchester and his family, at Leez Priory; Mr. Ruggles, of Spains Hall, Finchingfield; Squire Western, of Felix Hall; the Tabors, the Maysents, and other leading gentry of the neighbourhood. On the other hand, he also attended Goodman Hawkins, the saddler, of Bocking, and Mr. So-and-So the butcher his boy, of (say) Coxall. Indeed, the chances are that anyone whose family has long resided in the Braintree district would find in Allen's pages a note in reference to some disease from which some one or other of his ancestors suffered a couple of centuries ago, and exactly how that disease was treated. One or two selected notes on medical matters may be quoted.

In discussing the remedies to be used for the cure of those who have been bitten by a mad dog, Allen says (p. 47):—

"It is certain many have been cur'd by eating the mad dog's liver (as people have told me) fry'd. I know a gentleman of quality [who] cures his dogs when bit . . .by cauterising. Some give hounds that are bitten box-leaves and [box-]wood scrapt and chopt. . . . Some (and they many) cure dogs by charms writ on paper and given to the dogs [to eat] in butter—a plain proof of the operation of evil spirits being here no imagination; and it is matter of fact, as Sir William Barker assur'd me [it] was customary in Ireland, and Mr. Carter sayd it was often done here by many that kept hounds."

A somewhat-similar disquisition is that (p. 271) entitled—

The Bite of an Adder.—The head of an Adder—[the head] of the same that bitt, if it can be had, is best—bruised [and] lay'd to the place, is what the man that catcht them used. Anything that draws, lay'd to the place, doth it, as a red-hot iron held as near to the place as may be, without touching it. Mr. Boyle saw [——— ?] do it. A captain of a ship told me he had four men bit by cutting cabbages at Italy. One dy'd presently,

before he could return him on shore, which his surgeon directed him to. The Viper's bite in hot countrys is quickly mortall. The woman they went to cured them by laying a turky slit at the rump to the places that they ———— [?]. 3 or 5, apply'd one after another, cur'd one man, and so the rest. Any drawer is good, as turpentine, or turpentine and garlick, [or] Venice Treacle, or flesh of Adder given inwardly."

Near the beginning of the book (pp. 68–69), we find that Allen has entered a copy of the report, dated 17th February 1657–8, of an autopsy held on the body of young Robert Rich (only son of Robert Earl of Warwick), who had died at Whitehall, the day before, aged 23. The autopsy was conducted, and the report was signed, by seven physicians and two surgeons—the former including Allen's father-in-law, Dr. Joshua Draper, of Braintree, who held (says Allen) the post of physician to both this and the "last Earl of Warwick"—a post Allen himself held at the time he wrote. The young man was, it appears, in extremely bad health.[5]

Elsewhere (p. 297) we have a most harrowing account of how a certain Mr. Goodrich (evidently an eminent surgeon, who was passing through Braintree) performed the operation of lithotomy, at the White Hart Inn, in Braintree, on a youth named True, aged about seven years, a son of the landlord of the inn, on 12 February 1718–9. The operation was performed entirely without anæsthetics, a fact at which Allen (who witnessed it, the boy being, no doubt, a patient of his) expresses some surprise. Such an operation was, of course, rarely attempted at the period, on account of its danger. Curiously, Allen does not state the result in this case.

Further, we meet (p. 242) with the following note :—

"Sir William Daws, now A[rch]-bishop of York, had a stubborn ague, ever returning. It tir'd him and fainted him, and he then drank our steel'd water at Wethersfield, but at last was cured by taking the [Peruvian] bark every morning for six weeks or two months, as he told me himself, being advised by several at London and [by] one, a physitian, who had success in [curing] many that way."

It is likely that Allen had known Dawes more or less intimately and had attended him professionally ; for Dawes, beside having been born at Braintree, had been, for some ten years (1698–1708), rector and dean of Bocking, where he had been

5 He had married at Whitehall, in the previous November, Frances Cromwell, youngest daughter of the Lord Protector. Had he lived a few months longer, he would have outlived both his father and grandfather, and have succeeded to the earldom. He was buried at Felstead on 5th March (see Miss C. Fell Smith's *Mary Rich, Countess of Warwick*, p. 139, 1901).

extremely popular.[6] It was, no doubt, during the period when he held the deanery, that he suffered from the illness mentioned, and drank the water from the chalybeat spring at Wethersfield. This old mineral spring, now lost, has been noticed by Miss Thresh and myself in our article on the Medicinal Springs of Essex.[7]

One other passage dealing with medical matters shows Allen in a somewhat curious dilemma professionally. He is writing (p. 190) of some year in which small pox was prevalent in Braintree—probably either 1711 or 1721[8]—and of certain patients who suffered from "rhume" as well as small pox. He seems to have considered (so far as one can gather) that he could cure them by administering a certain remedy which would first cure the "rhume," though there was some risk that it might kill the patient by stopping the development of the small pox. He hesitated, therefore, to administer his remedy;

> wch., at that time might have cost me my life; for the malice of the Empirics (chiefly, John Barnard, the apothecary, and Mr. Firmin) had so leaven'd the evil natur of the town that, had I given him anything and he had dyd, they would have sayd I killed him and would have assaulted me, so I was forced to let him dy; so, by abusing my reputation, several others in other cases have dyd, which I could without question have been a means to preserve; but I could not carry it, so on them let it [*i.e.* the blame] ly."

It was a nice point in medical etiquette. How would a modern physician have dealt with it?

Ours is not, however, a medical society, and this fact debars me from dwelling further on the medical aspect of Allen's notes. I may, however, repeat the belief I have already expressed[9]—that these volumes of Allen's are "worth the serious attention of some student of the history of medicine in this country." It is true that they are not of very early date; but, taking the period to which they belong, it would be impossible, I apprehend, to find a fuller personal record of the practice of medicine as carried on at the time by an exceptionally-careful and observant country practitioner, or to discover another equally-precise

6 Sir William Dawes (1671–1724), the youngest son of Sir John Dawes, Baronet, was born at his father's seat, Lyons, in Braintree, and was educated at Merchant Taylors School and at St. John's College, Oxford. Succeeding his father unexpectedly, he removed to St. Catherine's Hall, Cambridge, of which he was chosen master in 1696, becoming chaplain to the King in the same year. He was appointed Bishop of Chester in 1708, and Archbishop of York in 1713.

7 See E.N., xv., p. 229 (1909).

8 See *ante*, pp. 160 and 161.

9 See *ante*, p. 158.

and detailed record of such observations, extending (as this does) to several hundred closely-written pages approximating foolscap size.

The references to Samuel Dale are, in this volume, as in the other,[10] singularly few. I have noticed four only. From the tone of one or two of these, one seems to gather that there was a certain amount of professional jealousy in the way Allen regarded Dale.

In one place (p. 46), Allen refers to the case of a man bitten by a mad dog, who was brought to him for treatment in 1695, "but [he says], I being at London, he went to Mr. Dale."

Elsewhere, Allen pastes in (p. 329) a letter, dated 10th Nov. 1720, from Sir Hans Sloane, the Royal Physician, to Dale, who had written to Sloane, on Allen's behalf, asking his opinion as to the best method of treating some difficult case of fever—indeed, it looks almost as though it had been on behalf of Allen personally that Dale had consulted Sloane. In any case, the great physician seems generally to have approved what was being done in treating the patient—whether Allen or someone else.

Another case in which Dale was concerned was that of Mrs. Luckin, of Bocking, who suffered from "a periodical agueish jaundice," of which Allen says (p. 93):—

"I try'd the bark and common elect[uary] for a jaundys mentioned before, but toucht neither the ague nor the jaundys. I would have had her taken the Epsom Salt and then gone to the waters [at Tunbridge Wells]; but Mr. Dale, her acquaintance, oppos'd me and carry'd her away from sound advice; so, in his essays, she dy'd."

Again, referring (p. 283) to some children belonging to the Tabor family, who were suffering from the small pox and were being treated by Dale, who had bled them, Allen seems to have considered Dale's treatment ill-advised. However, the children recovered, so no harm was done.

References to Ray are, on the other hand, quite numerous. Most of them tend to show that (in the earlier period of their acquaintance, at any rate) the relations of the two men were intimate, and that Allen had for Ray a feeling of respect amounting almost to veneration. Over and over again, Allen has noted down some fact which Ray had told him or some opinion Ray had

10 See *ante*, p. 153

expressed, generally introducing his name with some such phrase as "the learned Mr. Ray, author of So-and-So, my friend and neighbour."

Right at the beginning (p. 15), we meet with this note:—

"Mr. Ray, the famous naturalist, told me he knew a gentleman that had no child could live with him, but all dy'd epileptic at, perhaps, a year or two years old at farthest, till he was directed to purge the child in the mouth with Oyle of Sweet Almonds and Syrup of Violets and give [a pill] the bigness of a pea of Mithridat every night or every other night for some time, to keep out the red gum; but they began to give it in 4 or 5 nights after the birth, before the red gum, which comes not out under a fortnight."

Elsewhere (pp. 111–112), Allen tells of some relative who was cured of "An Obstruction of the Breast [?stomach]" by taking a "Conserve of Common Wormwood," that plant being, he adds, "the right Roman Wormwood, as Mr. Ray inform'd me, who found it growing plentifully about Rome, and none of that w^ch passeth for it. The Common Wormwood is a plant of virtue, [but] the Roman [Wormwood] of the shops hath none."[11]

In discussing "Ey Water," Allen says (p. 303):—"Mr. Ray sayd [that], for pin and web or rhumes, the best is made with a little Roman Vitriol, which he had seen cure them; but it is too sharp, I think."

Of greater interest than trifles such as these are notes regarding illnesses for which Ray and various members of his family were treated by Allen at different times.

Towards the end of the volume (p. 288), we find a note concerning "Mr. Ray's Case of Peripneumonia, March 6, 1689–90," the symptoms of which were "pain, heat at lungs, and difficulty of breathing, and cough, and feaverish heat." For these, Allen prescribed a number of medicines, which he enumerates. The treatment continued until the 10th, Allen apparently seeing

11 Mr. J. C. Shenstone, F.L.S., who has been good enough to investigate this matter, writes me:—There was much confusion in plant-names at the period when Allen wrote The Roman Wormwood of Ray (*Hist. Plantarum*, i., p. 367, n. 5) and of Dale (*Pharmacologia*, 1690) was *Artemisia pontica*, Linn. The "Common Wormwood," referred to by Allen as "a plant of virtue," is, probably, *Artemisia absinthium*, Linn., which was grown in herb-gardens all over Europe and still occurs frequently as an escape in waste places near villages and old buildings, both in England and throughout Europe. It is believed to be indigenous in some of its maritime stations in England and Scotland. It was largely used in medicine until quite recent times, and would still be supplied by druggists or herbalists if "wormwood" were ordered. Miss E. Willmott, F.L.S., states that she has seen Roman Wormwood (*A. pontica*) growing near old buildings in Switzerland—no doubt an escape from herb-gardens. It would be impossible to identify with certainty the Roman Wormwood "of the shops," which Allen tells us had "no virtue." The mugwort (*Artemisia vulgaris*. Linn.), formerly known as wormwood, is common by English waysides. *Ambrosia artemisia* has also been known as Roman Wormwood. Either of these plants might have been sold as Roman Wormwood in the apothecaries' shops in Allen's day.

the patient daily and prescribing different medicaments. Elsewhere (p. 53), we find another note, but of a less technical nature, regarding the same illness :—

"*A Peripnewmonia or Inflammation of the Lungs.*—The learned Mr. Ray, author of the History of Plants and other Natural Historys, my friend and neighbour, in the 62 year of his age [*i.e.* 1689] just entred, was taken with a cold or dry cough, an intense feaver of heat and thirst, troublesome cough, colour in his cheeks, and weight or heavyness at his breast, began to raise bloody [———] and what was with it was some matter and froth. He was concernd at the diseas, being, in that year, of his Grand Climacteric[12]. However, sending for me, I curd him, under God, with this method :—I bled him in arm once, gave him a pectoral drink and linctus of Oyle of Almonds and Syrup of Violets and Pectoral Syrup and Syr. Dealthela to take often : order[ed] Glyster's Emmolient and, afterwards,when he had raised his load and his feaver abated, [I] ordered him a little Syrup of Red Poppies, which is a specific in that [disease] and pleurisies and, indeed, [in] all inflammation. I do not find I gave him any Elect. of Odiband, which I usually do at last ; so he did well. (Note :—Riverius says purging is mostly dangerous before the 7 day.)"

Near at hand, we find (p. 89) a fuller statement as to the means by which Ray was cured of the attack of jaundice, already noticed[13] :—

"The learned author of those several Parts of Natural History, as well as a great Master of Botany, Mr. John Ray, my neighbour and honoured friend, was cured of a jaundys by 2 or 3 daughts of beer in wch. stonehors dung had been steept ; and he sayd [that this medicine] cur'd all the family he was in and is a sufficient remedy."

Next, one may notice references to illnesses from which two of Ray's daughters had suffered. Discussing epilepsy, Allen gives details of some sixteen cases which he had treated, the second (pp. 10–11) being the following :—

Mr. Ray, of Notly, his youngest daughter, Mrs. Jenny, had an Epilepsy Feb 23, 1689–90. Being sent for, I gave her . . . [an old and approved prescription, the details of which he sets out]. She found no benefit till she took, and continued to take, for about a month or six weeks, a julep with Antidatus Montagnance, which I call my Mixtura antepileptica. This she would call for and take if a fit were coming, tho' very unpleasant, as other children I have found do, from feeling some benefit. Thus she was cured."

He then gives further particulars of his special mixture (which, he says," generally cured "), of his method of administering it, and of the cases he had cured with it.

12 A climacteric was supposed to be a specially-critical period in a man's life, indicated by multiples of 7 or 9. The "Grand Climacteric" (7 multiplied by 9) was reached in the sixty-third year.

13 See *ante*, xvi., p. 159.

Elsewhere, in discussing cases of "Chlorosis or Green Sickness in Womenkind" which he had treated, Allen gives (p. 231) particulars of his treatment of the illness of Ray's daughter Mary —the treatment which did not satisfy Ray and led to a partial break in the friendship between the two men, as noticed elsewhere.[14] He says :—

"But the most od and remarkable case was Mr. Ray's daughter Mary, about 13 years old, [who] had a green sickness, but [she] was dark skinn'd so [it was] not discernible in the face. I sent them steel'd wine, but they neglected to give it. Three months after, it turn'd to a yellow Jaundys, and they would not bleed her, and it was difficult to know the remedy, if Steele or Icteric, wch. would do. We had not time enough to try either long enough, much less both, so she dyd ; tho' the Yellow Electuary with Chalybeats were wt. I would have given (that is, the Yellow Electuary on mornings and the Chalybeat Electuary in the afternoon and at night), but, tho' she dyd in 48 hours, with a heavyness of head like a coma, it was evident by the case of her sister that the Jaundys here was only a symptom and that the cure of the Green Sickness was the thing ; for her sister, Mrs. Margaret, fell soon after ill exactly of the same and had a Jaundys and at my instance to Mr. Dale, who was then employed and at my direction, she was cured by steel'd wine."

In another part of the book (p. 145), we find a fuller and clearer account of the circumstances, already alluded to,[15] in which Charles (Rich) fourth Earl of Warwick (died 1673) had sought the assistance of Boyle, Ray, and the younger Van Helmont in the cure of his gout. After writing of the latter's father's method of treating gouty patients, Allen continues :—

"But yet he [*i.e.* the elder Van Helmont] trusted himself to other vulgar medicines or simples ; for, of this, I had a proof :—The learned naturalist and philosopher and my friend and neighbour, Mr. Ray, known to the world by his *Historia Plantarũ*[16] and other writings, informed me that the Earle of Warwick (Charles, being the last), having a severe fit of the gout, sent to his brother by marryage, the great Mr. Boyl, to desire him to consult young Helmont, the son, about it (because his father speaks so much of the Coralline Secret), [he] being then in England. Mr. Boyl did so, and young Helmont's answer was this :—that he would advise him to [use] what his father us'd to give eas to himself in the gout, wch. he was troubled with ; but, as to a cure, he assur'd Mr. Boyl he was certain his father had no such [thing], for he had it much himself ; but, for ease, he had recours to the common true Black Hellebor[17], [for] wch. the Earl sent to Mr. Ray to assist him in the getting, that he might not be impos'd upon. This Mr. Ray had from the Earle's and Mr. Boyl's own mouth[s].'

14 See *ante*, xvi., pp. 151-152.
15 See *ante*, xvi., p. 153.
16 *Historia Plantarum*, 3 vols., 1686-1704.
17 *Helleborus niger*, the "Christmas Rose."

Elsewhere, we meet (pp. 349–350) with a long report of "My Conversation with Mr. John Ray, the author of the 'Generalis Historia Plantarum.'" The diction is so confused in parts as to be almost unintelligible, but it may be of interest to insert a statement of the theological views of so great a man as Ray, even though we have it at second-hand only. Allen says :—

'This gentleman had travell'd and been with all the great men in Europe, to inquire [after] truth and knowledge in Divinity and Learning. He was in both Orders, and had never took the Solemn League. [He was] of most recluse and pious life, and told me he præfer'd that, with just a sufficiency, than to expend time wastefully and enter into temptations wch. he could not see to avoid in making address for preferment or public business. This was his deliberate choice.

"He often would repeat that most extraordinary thought in so early a time, as a most just one of God—'The Heaven of Heavens cannot contain Thee'—that God must fill all, be at the head of all, and that there must be infinity of space; as, if a man go as far as he can in the vast Systems, what hinders him from going farther or putting out his elbow, if anything then matter is beyond; so that God and Eternity, or Infinity of Space, we must allow we can have no apprehension of, and yet it is necessary.

"The Discovery of Letters, he took for Divine Revelation.

"He sayd the Jews were a standing miracle in memory of our Saviour, not to be blended and mixt; no natural caus could solve; yet never to be admitted to settle—a token of God's anger.

"[He said also] that a spoyle or smile of grass[18] shew'd a Deity as much as anything; nothing in it to raise, keep, or support it, but a Divine power by which it stands and grows; indeed sense and design, when it is not in the creature, shows him most, as the Climers do."[19]

"For the Church of England, he sayd no man could well answer for Dissention from the precept of our Saviour, Love and Peace; but how the Clergy dare to impose, he wondered. He sayd they had never prov'd the Church had any power to alter what was appointed in Baptism, to appoint god-fathers to help out God Almighty, to put it in form of Law, to sprinkle for dipping (This he sayd when he stood Deputy God Father for Tommy[20].) The assuming to the Church a separat secular power was not from our Saviour. The taking upon the Church the liberty of making the power of altering, [of] admitting into Cannon, [of] annulling God's special spirit (which no Tongue yet equalled. . .), [of] denying the Ld's. Prayer (other than as from the Church of the Jews) before the Saviour, [of] mixing the Apocrypha, . . . [and so on—all these were, he said, totally unauthorized].

"He told me the auther of the 'Whole Duty of Man' was Mr. John Chappel, who had a living in Lincolnshire and had been a Fellow of [blank]

18 Clearly these words were intended to indicate a small blade or sprout of grass, but I cannot find that either was ever current. [Since this was put into type, I have heard the latter word used, in the sense indicated, by a very intelligent Essex labourer, seventy-two years of age, now in my employ.]

19 The climbing plants, he means, no doubt.

20 On 12th August 1697, "Tommy" being Allen's eldest son (see *ante*, xvi., p. 150).

Coll., in Cambridge.[21] Bp. Wilkin,[22] with whom Mr. Ray lived 7 years, together with Dr. Tillotson[23] examined it and found them to be his Sunday readings to his pupils exactly, by notes which he saw in some special pupil's hand. Mr. Ray told me [also] that the other works, sayd to be by the same hand, were wrote by the Bishop of York (Sterry)[24] who sent the 'Whole Duty of Man' to the press, and were known by his servant and his hand, but this was done by him to make the first seem his own—"

Here the statement breaks off abruptly, owing to a leaf having been torn from the book—perhaps by some person who disapproved of some religious view which Ray had gone on to express.

The closing paragraph is of interest in connection with the much-debated question as to the authorship of *The Whole Duty of Man*, which was first published in 1658 and ran through innumerable editions. In Evelyn's *Diary*, there is a passage so closely similar that one cannot doubt that one was derived from the other or both from some common original. Under date 16 July 1692, Evelyn says[25]:—

"I went to visit the Bishop of Lincoln [Thomas Tenison (1636–1715), afterwards Archbishop of Canterbury], when, amongst other things, he told me that one Dr. Chaplin, of University College, in Oxford, was the person who wrote the 'Whole Duty of Man'; that he used to read it to his pupils and communicated it to Dr. Stern, afterwards Archbishop of York, but would never suffer any of his pupils to have a copy of it."

Nevertheless, the general opinion now is that the work was written by Richard Allestree (1619–1681), a Royalist divine, though edited by Dr. John Fell (1625–1686), Bishop of Oxford.

Elsewhere (p. 47), Allen returns to the discussion as to the identity of the plant, called "Star of the Earth," which was supposed to cure rabies in dogs[26]:—

"Mr. Ray told me [he says, that] King James the 2nd sent a plant to the Royal Socyety with which his dogs had been cured. It was sent [by the Society] to Mr. Ray [for him to identify the species], who found it to be the Otis or Sesamoides salamanticum magnum. It came by [*i.e.*, under] the name of the "Starr of the Earth," and (as he heard) the receipt

21 Possibly the Rev. William Chappel (1582-1649), a scholar and long a Fellow of Christ's College, in Cambridge, also for a time (1638-1641) Bishop of Cork, may have been the man Ray referred to. At all events, others have ascribed to him the authorship of the book.

22 John Wilkins (1614-1672), Bishop of Chester (1668-1672) and one of the Founders of the Royal Society, was a friend of Evelyn, Boyle, and Ray, but it is difficult to see in what period of seven years the latter can have "lived with" him.

23 John Tillotson (1630–1694). a great preacher and theological writer, Dean of St. Paul's (1689–1691) and Archbishop of Canterbury (1691–1694), was a friend and disciple of Wilkins.

24 Without doubt, Allen caught the name wrongly and Ray really spoke of Richard Sterne (1596–1683), who was successively Bishop of Carlisle and Archbishop (1664–1683) of York. He has been regarded by some as the author of the book.

25 *Diary*, Bray's ed., ii., p. 321 (1850).

26 See *ante*, xvi., p. 152.

came from Suffolk ; but Mr. Ray took it for a mistake, thro' the sending not the same original numerical plant, [Mr. Ray] having never heard such virtue in the Otis or Sesamoides ; but such virtue is known to belong to the Plantains ; so, considering this plant was sent by the name of 'Starr of the Earth' [and] that the Coronopus is call'd in Suffolk by the name of 'Starr of the Earth,' he sayd undoubtedly that the right plant should have been the Coronopus, [surmising that] the plant might not be sent with the name, but taken up at second hand."

That there were others who believed in the power of the Coronopus is clear from a note in another part (p. 303) of Allen's book :—

"*Bite of Mad Dog* :—Mr. Smith, of Helen's Bumstead, told me he had known several men and beasts cur'd only by giving them the Star of the Earth, wch. seeds like Plantain and is the Coronopus."

Before I pass from these passages relating to Ray, I am pleased to be able to announce another interesting discovery which has been made since (and, this time, as a result of) the publication of my former paper on Allen.

In that paper, I reproduced the Ray Society's engraving (1848) of "Dewlands," at Black Notley, the house Ray built for his mother and in which he himself afterwards lived many years and ultimately died. This I did, believing it to be the only existing representation of the house, which was destroyed by fire in 1900. Nevertheless, I asked any reader who knew of the existence of a photograph to communicate with me[27] ; and, before my request had been published many days, I heard from our member, Mr. H. S. Tabor, of Fennes, Bocking, that he had a photograph, taken by himself shortly before the house was burned. That photograph he was kind enough to place at my disposal, and I reproduce it herewith (Pl. I.), believing it to be the only photograph of the house ever taken. It shows the house from a different point of view from the engraving—namely, from the north, instead of from the east.

Entries of purely personal interest, such as are frequent in the other volume, are rare in this, as stated already.

One of the few such records (pp. 331 and [361]), "What I learned from Dr. Gale, Maister of St. Paul's School, my maister."[28] The record is too vague to be worth reproducing, but we learn that Dr. Gale had "commend[ed] Mr. Ray and his Vocabulary."[29]

27 See *ante*, xvi., p. 147 *n.*
28 See *ante*, xvi., p. 148.
29 *A Collection of English Words not Commonly Used*, 1674 (second ed., 1691).

Shortly after [pp. 347–348], Allen enters at length his "Reasons for Dissenting from the Church of England," but here, again, his remarks partake so much of the nature of rough memoranda, intelligible only to the writer and almost meaningless to anyone else, that they need not be reproduced. Allen's matter was, at all times, singularly muddled and lacking in lucidity. We gather, however, that Allen had consulted Ray upon the subject; for he says:—

"When I came to inform myself of Mr. Ray['s view], he told me the writers for the ceremonys never shew any power given them to alter what our Saviour had instituted, nor to add [thereto], and that he had consulted foreign churches and they only told him the great commandments of Love and Peace would excuse a complyance, but not an approbation [and so on]."

The fact that Allen has inserted such a statement leaves little doubt that he had left the Church of England, and had become a member of the still-existing Independant Congregation at Bocking, which had been founded by Dale and others in or about 1707; but, the early registers of the Chapel having disappeared, it is impossible now to obtain precise information on the point.

Four or five pages are devoted to a record of dreams, testifying to Allen's firm belief in these phantoms as divine warnings of coming events, as noticed in my previous paper.[30] These dreams have, however, no greater interest for us than those in the previous volume, with the exception of one. This gives us [p. 357] another version of the dream in reference to Ray,[31] which may be be worth quoting, as it shows trifling verbal differences from that already given:—

"I dreamt [sayd Allen], just before Mrs. Mary Ray fell ill, that I was walking in Rain Lane with Mr. Ray and [that] from a tree there [I] gathered an apple hardly ripe and gave him, which he took and presently he was within the field and I in the road as before, so that we walkt and talkt, but a hedge parted us all the way; and so it was his daughter dyd, and it bred a distance [between us] without [our actually] falling out, tho' he had no such caus from me, for the steel'd wine he had of me months and would not give it (which cur'd his other daughter, Mrs. Margaret, soon after in the same case, which was an Icterus upon a green sickness) [would have cured her].."[32]

30 See *ante*, xvi., pp. 162–163.
31 See *ante*, xvi., pp. 151–152.
32 See *ante*, p. 10.

PALÆOLITHIC REMAINS FROM CLACTON-ON-SEA, ESSEX.

By S. HAZZLEDINE WARREN, F.G.S.

[*Read 28th April* 1911].

PALÆOLITHIC Flint-flakes from the Pleistocene fresh-water deposit of Clacton-on-Sea have been known for many years. The most abundant mammalian remains in the deposit are *Elephas antiquus*, *Rhincoceros leptorhinus*, *Bos primigenius*, and *Cervus browni*, although numerous other species also occur. The mammoth is absent. For assistance in the determination of these remains, I am indebted to Mr. E.T. Newton, F.R.S., and Dr. A. Smith Woodward; the earlier list given by Dr. Boyd Dawkins, the collection in the Natural History Museum, and that of Mr. H. Picton, of Clacton, have also been consulted.

Last Easter I found in this deposit a beautifully pointed shaft of wood, which from its size and form is probably the point of a wooden spear.[1] As this object is probably unique, I have made plaster casts for distribution. To accompany these, I have also made casts of some of the characteristic flint implements from the same deposit. Not a single example of the usual ovate or pointed Palæolithic types has yet been found, either by myself, or by other workers, so far as I am aware.

In addition to simple, untrimmed flakes, a certain number of scrapers and pseudo-Mousterien forms of trimmed flakes are found. The only forms of implements, other than these, made from flakes, are rude forms of side-choppers, or "hand-axes." The flint industry does not show the true Mousterien technique and certainly cannot be considered as a series of that date. Strangely enough, the most nearly similar series is found in the ruder surface implements of the Chalk Downs of the South of England, rather than in any Palæolithic group. The flakes are perhaps more distinctly Palæolithic in technique than the implements.

The implements from this deposit not infrequently have calcareous incrustation upon their surfaces. There is a good deal of this on the scraper, a cast of which accompanies the spear; it is represented by suggestive colouring in the cast.

[Mr. Warren has kindly presented a set of the models of the flakes and implement to our Museum.—ED.]

1 *Quart. Journ., Geol. Soc.*, vol. lxvii., 1911. Proceedings, page cxix.

ON THE REMAINS OF VERTEBRATE ANIMALS FOUND IN THE MIDDENS OF RAYLEIGH CASTLE, ESSEX.

By MARTIN C. HINTON.

[*Read 28th October* 1911].

DURING the past two years, the site of the Castle of Rayleigh—the most striking earthwork existing in Essex and one of the few English strongholds mentioned in Domesday—has undergone extensive excavation at the hands of the owner, Mr. E. B. Francis, of Rayleigh, and an extended account of his discoveries, which are of considerable interest, has appeared.[1]

Among other deposits uncovered were extensive middens, containing large numbers of oyster-shells, many bones of Vertebrates, and great quantities of rubbish. Through the kindness of Mr. Francis the Vertebrate remains were placed in my hands for examination and report. The results are of interest, I think, as tending to throw light on the fauna of Essex from the end of the Eleventh Century to the beginning of the Thirteenth—the period during which Rayleigh Castle was in active occupation, it having been destroyed, apparently, by the middle of the last-named century.

The following are the details elicited by me in regard to each species of which any remains were noted.[2]

1. **Erinaceus europæus** (Hedgehog).—Represented only by some spines.

2. **Oryctolagus cuniculus** (Rabbit).—Two right rami of the lower jaw, a humerus, tibia, and some femora of the Rabbit evidently, from their condition, belong to the midden and are not the remains of animals that have burrowed in in later times. This animal inhabited Britain long ago, in the early part of the Pleistocene period, and then, from some cause or other, it apparently became extinct here before late Pleistocene times. The date of its reappearance is uncertain. Rogers inferred,[3] from the high prices paid for Rabbits in the Middle Ages, that they "were introduced into England in or just before the thirteenth century." As Rolleston has pointed out,[4] they

1 *Transactions of the Essex Archæological Society* (n.s., xii., pp. 147—185).

2 A very brief report on the remains, by myself, was appended to the article above mentioned

3 *History of Agriculture and Prices in England*, i., p. 341.

4 *Scientific Papers and Addresses*, i., p. 335 (reprinted in 1884 from his "Appendix on the Prehistoric Fauna of Neolithic Times," in Greenwell's *British Barrows*, 1877).

were certainly familiar objects in Chaucer's time, as witness the lines in the *Romaunt of the Rose*[5] and the *Assembly of Foules*[6] which he quoted. It is, therefore, satisfactory to have the literary evidence supported by the remains from the Rayleigh midden. [Skeat has recently pointed out, however, that the *Romaunt of the Rose* is merely a translation of a much earlier French poem, and, therefore, is really not evidence. For a valuable discussion of this question the reader may be referred to Part X. of Barrett Hamilton's *British Mammals* (pub. Feb. 1912, pp. 184-191). The Rayleigh Castle record appears to be the earliest positive evidence of the re-introduction of the Rabbit into Britain which we possess.—May, 1912.]

3. **Lepus europæus** (Common Hare).—A humerus, tibia, and young femur are referable to the Common Hare. The humerus and tibia indicate an animal of very large size; the extreme length of the former bone is 111 mm., and of the latter 147mm., dimensions which equal those of the corresponding bones in some of the larger forms of the group of Varying Hares.[7] Nevertheless the tibia agrees exactly in form with that of the Common Hare, which does not appear to have arrived in England until after the Pleistocene period; its remains are known from Romano-British deposits.

4. **Mus rattus** (Black Rat).—A left femur, the extreme length of which is 36·2 mm., agrees in form and size with the femur of this species. The specimen is whitish in colour, and may be somewhat more recent than most of the remains from the midden.

5. **Felis** (Domestic Cat).—A right mandibular ramus has the following dimensions:—Length, 51 mm.; molar series (alveolar), 17 mm. It agrees in size with that of the domestic cat.

6. **Canis familiaris** (Domestic Dog).—The dog is represented by part of the skull and mandible, together with a humerus of an aged individual. Alveolar length of mandibular molars and premolars, 72 mm.; length of lower carnassial, 22·3; of upper carnassial, 19·4; length of humerus, 147.

7. **Canis vulpes** (Common Fox).—A nearly-complete

5 Ed. by Thomas Tyrwhitt, 1860, p. 221, vv. 1405-9.
6 *Ed. cit.*, p. 350, v. 193.
7 *Scient. Proc. Royal Dublin Soc.*, xii. (n.s.), pp. 247, 254 (1909).

mandible is referred to the Fox. Alveolar length of molars and premolars, 55 mm. ; length of carnassial, 15.

8. **Sus scrofa** (Pig).—The mediæval pig of Rayleigh, represented by a large number of jaws, teeth, and limb bones, appears to have been a rather small form, and, judging from the large number of cases in which the last molars are well worn, it seems probable that the military inhabitants of the castle let their stock run in a half-wild condition, hunting them for food as occasion required.

Six upper jaws from Rayleigh were examined. In all, m.3 was in wear, and in two cases the wear was advanced. Of a total of 46 lower jaws examined, five were young, with the posterior milk molar still in place ; 17 were fully adult, with the last molar in wear ; and, of the latter, ten had the last molar well worn. The two lower jaws of which the measurements are recorded below are respectively of an old Boar and an old Sow ; in the latter, the anterior premolar (p. 4) had been shed and its alveolus obliterated. The following are dimensions of upper and lower jaws, with some corresponding measurements from Rütimeyer,[8] etc., for comparison :—

Upper Jaws (Adult)	Rayleigh max.	Rayleigh min.	Berkshire.	*S. sc. palustris.*		*S. sc. ferus.*	
Length of molars and 3 posterior premolars ..	99	—	—	—	—	—	
Length of molars m1-3 ..	65	54·5	64	65	77	73	83
,, m3	31	27·3	31	30	40	35	40
Breadth of m3 in front..	18·8	17	—	—	—	—	—

Lower Jaws (Adult)	Rayleigh.	London Wall. Rom.-Brit.	Berkshire.	*S. sc. palustris,*		*S. sc. ferus.*	
Length of lower molars including p. 4	113·5	—	—	132	123	128	140	152
Ditto without p. 4 ..	98	96.5	102	105	102	112	112	120
Length m1-3	63	62·3	65·5	71	65	74	72	82
,, m3	31·3	31	31·2	38	33	37	37	40
Diameter of alveolus for canine	18·4	10·2	—	20	10	17	25	29

9. **Cervus elaphus** (Red-Deer).—Among the bones is the hinder part of a skull of a Red-deer, from which the antlers have been hacked off, apparently with a very bad saw. The base of the left antler (sawn partly through, a little below the burr, and then broken off) has been found ; the right antler is missing.

8 "Die Fauna der Pfahlbauten" : *Neue Denkschr.d.Allgemein. Schweiz Ges.f.d. Gesammt Wissensch.*, p. 185 (1861).

The antler has the bez as well as the brow tyne, so that this is at least the fifth antler that the stag had borne. The dimensions of the skull are :—Median occipital height 77 ; condylar breadth 72·3 ; post orbital breadth 116·2 ; condyle to front edge of basi-sphenoid 100·6.

A part of a left maxilla with four teeth (viz., pm. 2, 1, m1, 2), half worn, and a left mandibular ramus with all the molars in a corresponding state of wear, probably belonged to the same individual. Alveolar length of the four maxillary teeth, 72·5 ; of mandibular molars and premolars, 113 ; of mandibular molars m.1-3, 72.

Some other fragments, including part of a scapula and tibia, give additional evidence of the presence of this species.

10. **Cervus dama** (Fallow Deer).—Part of a right antler, naturally shed and wanting all above the middle tyne, and the base of another, still attached to the pedicle, are referred to the Fallow Deer, agreeing as they do in form and texture with the antlers of this species. The shed antler is either the fourthor fifth. In both specimens, the brow tyne has been hacked off, after two or three abortive attempts to saw it through had been made.

The species is also represented by limb-bones, and the dimensions of the more important are included in the table given under the next heading. Near allies of the Fallow Deer are known from the earlier Pleistocene deposits of Britain, but the group became extinct here in the later part of that period. The date of the re-introduction of the species is uncertain, although it certainly was here in Roman, if not in Neolithic, times.

11. **Capreolus capreolus** (Roe-Buck).—This species is represented by limb-bones only. The limb-bones are distinguished from those of the Fallow Deer, as will be seen from the following table of maximum and minimum dimensions, by their smaller size and more slender proportions.

	Capreolus capreolus.				*Cervus dama.*			
	Radius.	metacarpals.		metatarsals.		Radius.	metacarpals.	metatarsals.	
		max.	min.	max.	min.			max.	min.
Length ..	187 ..	182	178 ..	185	171 ..	207 ..	189[9] ..	224	200
Width proxmal ..	36 ..	26	26·4 ..	18·3	17·6..	42·6 ..	30 ..	27·6	22·5
Width mid shaft ..	20·5 ..	16	15·1 ..	12·1	11·6..	24 ..	17·6 ..	16·8	14·6
Width distal	— ..	27·3	26·8 ..	23	20·6..	— ..	— ..	32	27·6

9 A young shaft without distal epiphysis. The radii of both Fallow-Deer and Roebuck have been cut away behind distally.

12. **Ovis vel Capra** (Sheep or Goat).—A number of limb-bones are referable to either sheep or goat. In the absence of adult jaws, skulls, or horn-cores, I am unable to determine these remains more precisely.

13 **Bos taurus** (Domestic Ox).—The remains of small cattle are numerous in the collection, but with the exception of a fragment of maxilla and part of a lower jaw, no trace of the skull has been found. So far as one can judge from the limb-bones, these cattle very nearly approach *Bos longifrons*, a species or race abundant in Neolithic and later deposits. Besides these small bones, a few specimens indicating the presence of a larger breed have been found. The following tables give the dimensions of the more important bones, together with those of specimens in my possession from other and older deposits, for the sake of comparison.

Radii.[10]	Rayleigh. Larger form. max.	Rayleigh. Larger form. min.	Rayleigh. Smaller Form. max.	Rayleigh. Smaller Form. min.	*B. longifrons.* Swanscombe Denehole
Length inner side ..	267	253	239	219	245
Width proximal articulation	73	66	67	57	68·5
,, mid shaft	39·2	37·3	34·5	27·7	37·2
,, distal artic.	68·5	59·6	61	49·8	66·5

Metacarpals (1) and *Metatarsals* (2)	Rayleigh. (1) max.	Rayleigh. (1) min.	Rayleigh. (2) max.	Rayleigh. (2) min.	*B. longifrons.* Swanscombe (1)	*B. longifrons.* Swanscombe (2)	London Wall. Rom.-Brit. (1) max.	London Wall. Rom.-Brit. (1) min.	London Wall. Rom.-Brit. (2) max.	Walthamstow Alluvium. (1) max.	Walthamstow Alluvium. (1) min.	Walthamstow Alluvium. (2)
Length inner side	179	157	205	174 ..	157	173 ..	207	196	209 ..	200	185	202
Width prox. artic.	48	58	44·2	37·7 ..	52·8	40·6 ..	65·7	58·5	48·2 ..	64	61	48·2
,, mid shaft	27·8	30·6	26·2	22·3 ..	30·9	24·3 ..	38·2	35·2	29 ..	38·1	36·6	2[illegible]
,, dist. artic.	54	59	56·5	47·7 ..	56·2	51·8 ..	69·7	65·3	67·1 ..	68	63·3	62·8

The following are the dimensions of two complete tibiæ from Rayleigh:—Extreme length, 302 (289); length inner side, 270 (262); width proximal articulation, 69·4 (68); least width of shaft, 33 (31·2); width of distal end, 55·3 (51·6).

Astragali.	Rayleigh. max.	Rayleigh. min.	*B. longifrons.* Cleeve Hill Rom.-Brit.	London Wall Rom.-Brit.	Battersea Alluvium.
Length inner side	59·2	48·8 ..	58·8 ..	54·8 ..	78·3
Width tibial articulation	40	36·4 ..	42·1 ..	42 ..	55·6
Ditto articulation for scaphocuboid ..	41·1	35·7 ..	38·6 ..	40·6 ..	58·5

Calcanea.	Rayleigh. max.	Rayleigh. min.	*Bos longifrons.* Cleeve Hill. Rom.-Brit.	London Wall.	Walthamstow Alluvium.	
Length ..	138	109·3 ..	122·8 ..	— ..	118·2 ..	126·2
Height at fibular articulation	55·4	44 ..	49·7 ..	55·6 ..	47·3 ..	48·7
Width ..	40·5	35·6 ..	35·1 ..	46·8 ..	34·3 ..	40·2

10 Thirteen specimens from Rayleigh examined in all—10 of them belonging to the smaller form.

The length of the three true molars in a fragmentary right mandibular ramus is 86·5, that of m.3 being 35.

From the fact that the radii and tibiæ found in the midden are almost always unbroken, one may perhaps conclude that the Rayleigh kine were of a lean description.

14. **Equus caballus** (Horse).—Very few equine remains were found. A detached lower molar, part of a left scapula, and the distal end of a left humerus represent a Horse of medium size. The scapula measures 98 mm. from the posterior margin of the glenoid fossa to the front of the coronoid process; the width of the distal articulation of the humerus is 77·3

A metacarpal, having an extreme length of 205 mm., represents a smaller form, it agreeing in size with the metacarpal of a pony or ass.

Among the specimens found in the midden are two fragments of a long bone of a large mammal (perhaps *Bos primigenius* or Mammoth), which have evidently come originally from some Pleistocene deposit.

Many Bird bones were found, principally belonging to Duck, Fowl, and Goose; and a number of vertebrae and other remains of a large fish.

PAST AND PRESENT HISTORY OF COLCHESTER CORPORATION WATER WORKS WITH RELATION TO UNDERGROUND WATER.

By J. MACKWORTH WOOD, M.Inst.C.E., M.Inst.M.E.

[WITH PLAN, PLATE II.]

[*Read April 29th*, 1911.]

THE town of Colchester is situated chiefly on a plateau which forms a spur or promontory on the south-west side of the Colne Valley, which consists of a bed of glacial gravel of considerable area and thickness, and extends to the east, west and south of the present town, and is bounded on the south and west by the Roman River, which gravel in turn rests on the London-clay formation. When the valleys were formed, the plateau of gravel was cut through down to the floor of the London-clay, and springs probably appeared on the flanks of the

valley level with the top of the London-clay. The existence of springs in early times combined with other favourable geographical and geological conditions no doubt influenced the early inhabitants, and later on the Roman Colony, to establish an important station here. The springs which we know to-day probably formed the water supply of the early communities, and there is ample evidence, from the existence of a number of wells which have been found, that the Romans utilized the gravel beds within the walls of their station to supply their wants.

Probably the springs just outside the walls of the Roman city at the foot of Balkern Hill, and in the railway cutting by St. Botolph's Station (which are thrown out by the London-clay), were also used by the early inhabitants of the city. These springs are still in possession of the Corporation, but are used only for non-domestic purposes. For many years they formed the sources of the early water works. It is somewhat remarkable that history repeats itself even in water supplies, as it remained for the present community to further utilize the gravel beds to which I have referred, but under entirely different conditions, to supplement their deep well supply, by bringing into use those wonderful Lexden Springs which yield so much water from the same plateau of gravel, but some mile and three quarters west of the town and water works, and which it is the province of these notes to describe in some detail.

The site of the present water works is at the foot of Balkern Hill, just outside the Roman wall, in close proximity to the springs already referred to. It also formed the site of the early water works constructed in 1808 to supply the town with water from land springs overlying the London-clay. The engineer, who ever he then was, was not slow to recognise the advantage of the site due to the existence of the springs, which he freely used to supply to the town. The late Mr. Peter Bruff stated in 1850 that, in consequence of the springs having to a great extent run low, it was necessary to seek for a more efficient supply. These springs, however, remained in use for many years, notwithstanding this remark, yielding as late as 1888 some 86,000 gallons per day in summer and probably more in winter. In early days the yield was no doubt considerably more, as many of the springs were diverted in other directions and have since disappeared from view for ever when the main

BOROUGH OF COLCHESTER WATER WORKS.

WATER SUPPLY FROM LEXDEN 1909.

LEXDEN HOUSE

LEXDEN

1ST PROTECTIVE AREA OF 29½ ACRES.

2ND PROTECTIVE AREA ENCLOSED WITHIN UNCLIMABLE WOOD FENCING

2ND PROTECTIVE AREA ENCLOSED WITHIN UNCLIMABLE FENCING

UNCLIMABLE FENCING

FENCING

C O O K S L A N E

L A N E

L A N E

COLLECTING PIT 11'0" DEEP

9'0" DEEP COLLECTING PIT

6" PERFORATED 6 E. PIPES

COLLECTING PIT 10'6 DEEP

Springs

6" PERFORATED 6 E. PIPES

TIDAL FLAP

COLLECTING PIT 5'3" DEEP

6 CAST IRON PIPES

10" CAST IRON PIPES OVERFLOW

10" CAST IRON MAIN PIPES

To Colchester Water Works.

9" CAST IRON MAIN PIPES

COLLECTING PIT 6'9" DEEP

MALTING FARM

3' DEEP COLLECTING PIT

6 PG E. PIPES

MANHOLE TO EXISTING CULVERT

COLLECTING PIT 9'0" DEEP

8" CAST IRON MAIN PIPES

TIDAL FLAP

6" C.I. PIPES OVERFLOW

STREAM

COLLECTING PIT 7'3" DEEP

6" PERFORATED 6 E. PIPES

Springs

5" CAST IRON PIPES

COLLECTING PIT 6'4" DEEP

COLLECTING PIT 7'3" DEEP

5" CAST IRON PIPES

COLLECTING PIT 5'5" DEEP

6" C.I. PIPES OVERFLOW

COLLECTING PIT 8'2" DEEP

6" PERFORATED 6 E. PIPES

Springs

COLLECTING PIT 8'0" DEEP

COLLECTING PIT 13.3 DEEP

6" PERFORATED 6 E. PIPES

COLLECTING PIT 9'10" DEEP

5" CAST IRON PIPES

J. MacPherson Hood M. Inst. C.E.

SCALE 1/500.

10 0 10 20 30 40 50 100 200 300 400 500 FEET.

THE WATFORD ENGRAVING Co

sewers were laid. Owing to the advance of medical and sanitary science, and the increased knowledge of zymotic and other water-borne diseases, these springs, which rise or flow under the present inhabited town, were finally abandoned for domestic use in 1890, but are still retained for non-domestic purposes, for supplying the locomotives, &c., at Colchester station. They include the springs in the neighbourhood of the water works yard, viz., Clark's Meadow Spring and the Sheepen Spring, to be hereafter referred to. The spring in the railway cutting already mentioned is not at present utilized.

In or about the year 1860, the late Mr. Peter Bruff discovered the existence of a very strong gravel spring just south of Sheepen Farm on the south side of the valley, from the same plateau of gravel which is also thrown out by the London-clay. This was brought home by him to the Balkern Hill Works, to supplement the then existing spring supply, but in or about 1880, by the advice of the Corporation's Consulting Engineer, the late Mr. Edward Easton, the spring was abandoned, and immediately taken possession of to supply Colchester Station by the G.E. Railway. As it did not yield sufficient water for their purpose, it was given up a few years later. Through the foresight of Mr. Bland, it is again in possession of the Corporation. In 1905, I had the pleasure of bringing it home to Balkern Hill for the second time, to supplement the non-domestic supply. It is reported to have yielded some 100,000 gallons per day in Dec. 1879, but in the summer of 1904 the yield was about 70,000 gallons, but in this case, as in the case of all these gravel springs, the yield varies as the rainfall.

In 1850, to supplement the then existing spring supply, the late Mr. Bruff, who was engineer and part owner of the water works, conceived the idea of sinking a well into the clay, and boring through the Woolwich and Reading beds, and Thanet Sands, into the chalk formation; so important did he consider the work at the time, that he communicated a paper thereon to the Institute of Civil Engineers, in 1859 (vol. xix., pp. 38 and 39), and which was one of the early papers on water works read before that Society. Particulars of this well and bore hole have since been extracted therefrom, and reported in the *Geological Memoir Colchester* (1880) by Mr. W. H. Dalton and Mr. Whitaker, wherein it is stated that the rest level of the water was five feet

above high water mark, and continued at that level for nine years up to 1859. On enquiring of Mr. Bruff in 1889 as to what high water mark he referred to, he replied "that the circumstances were too remote for his recollection, that it might mean H.W.M. at the Hythe (tidal river) or the Mill Head at North Bridge."

On the 2nd October 1888, I levelled the rest level and found it to be 7·66 above O.D. On the 12th March 1902, it was 2·78 below O.D., or a difference of 10·44 feet, but it must not be lost sight of that the years 1900, 1 and 2 were very dry years. On the 23rd March last, the rest level was 1·72 feet above O.D., or 5·94 feet lower than in 1888, but 4·5 feet higher than in 1902.

As I have before stated, there are many instances and examples of the Roman engineers having sunk wells to obtain water from the gravel beds underlying their camps and stations, but I am not aware there are any examples in existence, or that they understood the art of sinking a well or bore hole, to obtain a supply of water from a permeable formation underlying an impermeable one where the gathering ground or outcrop was at a higher elevation, and situate at a considerable distance from the site of the proposed well.

Mr. Bruff's well and bore holes are still in existence, and assisted in supplying the town up till 1890, when they were put entirely out of use on account of the new well adjoining being sunk to a much greater depth, the water level being depressed when pumping below the bottom of the old well.

As soon as the Corporation came into possession of the water works in 1880, they immediately put down another well 30 feet (centre to centre) away from Mr. Bruff's old well, but only four feet deeper; they, however, carried an 18″ bore hole down to a total depth of 384 feet. Although they obtained very little more water by this operation on account of not being able to depress the pumping level with the then existing machinery, nevertheless this 18″ bore hole turned out to be a very valuable asset, as it formed the nucleus of my new scheme in 1888. The bore evidently penetrated a large and open fissure in the chalk, low down in the bore hole, as on making careful and systematic pumping experiments the bore hole was found to yield water very freely.

In 1887 I advised the Corporation as to how they could

increase the supply from existing wells. After a number of pumping experiments, it was decided that the present new well should be increased to 13 feet in diameter, and carried well down into the chalk; but, unfortunately, it was only carried down through the London-clay into the mottled clay of the Woolwich and Reading Bed series to a total depth of 79 feet from the engine house floor. The present works (except the well which was brought into use in 1891) were then constructed and completed in 1893, and continues to be the chief source of supply to the town; indeed up to 1906 it was the only supply.

After fourteen years more or less continuous pumping, and towards the end of the dry summer season of 1901, when nearly 1,000,000 gallons per day were taken out of the well for weeks at a stretch, the rest level began to show signs of lowering. It was feared that at this rate of extraction, combined with more or less continuous pumping, the rest level might become permanently lowered, and the yield from the bore hole decreased in proportion; hence it was decided to obtain a supplemental supply, which was brought into use in 1905. Since that date the rest level has partially recovered, principally owing to using Lexden Springs, which yield about 40% of the average supply to the town. Before deciding upon sinking and enlarging the new well in 1889, an elaborate series of pumping tests were made, extending over a considerable time, to find out by calculation what would be the probable yield at different depths. After the well had been sunk, the bore pipe was cut off, and the permanent plant fixed, pumping tests were again made, when the bore hole was found to yield practically the amounts calculated at particular levels, or in other words the yield was in proportion to the square root of the head, thereby roughly obeying the law of the discharge of water from pipes, and showing that somewhere in the bore hole there was a large fissure having a very free discharge. This bore hole may be looked upon as a remarkable one, so far as the quantity of water it yields. The only regret is that the well was not carried down into the chalk formation so that headings could have been driven therefrom into the chalk at any time. So far as the well and boring are concerned (geologically), there is nothing abnormal, except that at a level of 48 feet from the surface there is a bed of septaria in the London-clay, which yielded a considerable quantity of water, but is plugged off

This is unusual, but where the water comes from, and how it gets into the clay, will probably interest our geological friends.

The section of the old well is mentioned in the *Geological Memoir, Colchester* (1880), but it does not quite agree with my section of the new well, which is now published for the first time.

Ground surface (Top of Brickwork of New Well) 35·7ft. above O.D.

		Thickness.	
Soil		6	
Gravel (Glacial or River)		4	
London Clay	Blue Clay 38ft. thick Septaria with water 1ft. thick Dark Blue Loamy Clay 14ft thick Dark Loamy sand with water 1ft. thick	54	Base of London Clay—28·3 below O.D.
Woolwich and Reading Beds & Thanet Sand	Mottled clay perfectly dry for 18ft.	79	Base of Thanet Sand or Top of Chalk —107.3 below O.D.

To Top of Chalk (authority, late P. Bruff) 143ft.

NOTE.—The late Mr. Peter Bruff in his paper already referred to states that the level of the top of the chalk was 121 ft. below H.W.M.

When one is investigating a new underground source of supply, the first anxiety is to ascertain the quality of the water; secondly, the maximum daily quantity obtainable from the source without entrenching on the next day or month's supply; thirdly, if a well supply, to see that the natural or rest level of the water is not permanently affected by pumping. Seeing the importance of this latter, an electrical automatic recording apparatus was arranged in the well, so that the level of the water is recorded every minute of the day, whether the pumps are at work or at rest. This record has been continued by Mr. Bland, so that he now has an unbroken record for the last 22 years of the behaviour of the underground chalk water under Colchester. I am not aware of any other similar record existing in this part of East Anglia, and if it is of interest to the Club, the Corporation might be persuaded to supply a copy.

Colchester appears favourably situated as regards obtaining a supply of water from the chalk, and so far as I have been able to ascertain only one bore hole in the Borough has actually turned out a failure, and that was the boring put down by the Government at the Cavalry Barracks, but if I am correctly informed, there is another boring lately put down on the opposite side of the valley, even at a greater elevation, which does not yield the quantity anticipated. Why this former boring

contained no water I have never been able to ascertain, except that it was unfavourably placed as regards elevation, the chalk below being compressed due to the pressure of superincumbent mass above. The result of my experience is that wells placed in the floors of valleys, yield water more freely than when placed high up the flanks, or on the top of the plateau; the reason appears to be that the beds are much more broken up and fissured in the valley, and besides the underlying chalk is not so compressed.

Nearly all the wells and bore holes which have been sunk in the Borough and neighbourhood from the floor of the valley yield water freely, and several of them are practically artesian.

There is undoubtedly a large quantity of water travelling from the outcrop of the chalk on the north-east, beneath the floors of both the valleys of the rivers Colne and Stour, on its way to the sea, that being probably the line of least resistance due to greater fissuring and because the beds are less compressed. It must not be lost sight of that the water does not travel through the whole mass of the chalk, but along planes of bedding, beds of flints, and through a network of vertical and horizontal fissures. It also flows more easily down the dip than across it on the way from the water-shed down to the lowest point, which is the sea. It would be interesting to know whether the water yielded by the wells in Colchester is derived directly from the chalk outcrop to the north-west in Cambridgeshire and Suffolk, or is connected in any way with the River Stour between, say, Borely and Henny about twelve miles distant, through which district the river intersects the open chalk.

Although the Chalk is of great thickness in East Anglia and Essex, say about 850 feet, and is practically water-logged throughout its thickness, it is only the Upper Chalk or porous zone, say from 300 to 400 feet thick, which yields water in this district. This Upper Chalk contains in its mass, locked up in its capillary pores, so to speak, some two to three gallons of water per cubic foot, which cannot readily be got out by pumping, but only by pressure, and has been described as Capillary Water. The water we obtain by wells and bore holes in the Chalk in this neighbourhood is not this capillary water, but water flowing in undefined channels and fissures.

Analyses of Chalk-water are given in the Appendix to this paper.

From personal observations, my impression is that the Chalk discharges freely into the river Stour in the neighbourhood of Sudbury. There might, however, be times when the river is discharging into the chalk at periods of low rain-fall, and these are matters which local geologists might set themselves to determine. No. 1 is an analysis of the chalk water by Dr. Foster, M.A., F.C.S., from the new well, before it was reconstructed in 1889. No. 2 is an analysis of water from the same source in 1894, by Mr. W. Chattaway, Analyst to the Borough, after the reconstruction of the well, and No. 2A from the same source by Dr. Thresh, M.D., D.Sc., in 1898.

It should, however, be noted, when there is water to spare from the Lexden springs, or when the engine which pumps that water is not at work, it is run into the well in order to assist the underground source; this may have some slight effect on the chemical constituents of the pure chalk water when analyses are taken in the future. No 3 is an analysis of the chalk water from the Sudbury Corporation Water Works well, and No. 4 is an analysis of chalk water from Halstead Urban District Council well

Comparing the analyses of the chalk water at Sudbury and Halstead with Colchester, about twelve miles apart, it will be observed that the water at Sudbury and Halstead is tpyical hard chalk water with 21·5 and 18 degrees of hardness respectively and only 3·18 and 4·2 grains of chlorine per gallon, whereas at Colchester the chalk water is comparatively soft, and contains about 10 degrees of hardness, but has from 21 to 22 grains of chlorine per gallon; otherwise the chemical characteristics of the Colchester water compares with the deep well water common to this part of Essex, and which have been so exhaustively treated and recorded in the Club's transactions by Dr. Thresh. The chief characteristic of the Colchester well water is the chlorine in the chalk, but, that has been practically constant to my knowledge for the last 23 years. As to the origin of the chlorine, I believe no definite decision has been arrived at, but as we approach the coast in certain directions it goes up by leaps and bounds. To my mind the only rational conclusion one can come to to account for it is the process of diffusion through ages of time.

It is held by some authorities that the water in the chalk formation is more or less stagnant under central Essex; to that theory I do not altogether assent. It is certainly not the case under Colchester and neighbourhood. If such were the case, then the water level when once pumped down would not recover itself so rapidly as it does on cessation of pumping, nor would the rest level tend to re-establish itself, when one takes into consideration the quantity of water pumped from the chalk at Colchester; neither would the bore holes east of Colchester continue to be artesian. The water is undoubtedly moving seaward, but the exact direction is impossible to state until a systematic hydrogeological survey of each district is complete. I appreciate the extraordinary fact that the underground water in the chalk in the eastern part of Essex is alkaline in character, whereas in the north and west it is more or less calcareous. This condition of affairs an eminent authority (Dr. Thresh) suggests is due to the existence of a fault. Having set up a number of sections in the chalk from wells in all direction, in northern and eastern Essex, I am unable to find any direct physical evidence of such a fault across Essex to support this contention, although I am aware of considerable disturbance of the Tertiary beds in the neighbourhood of Wickham and Tiptree. It seems, therefore, we must search further to find the real cause of the difference of the chalk water, if it is not due to any process of diffusion.

I have much information on wells and bore holes which have been sunk to the chalk in Essex and Suffolk, and which ultimately have had to be abandoned, due to chlorine, upon which much money, both public and private, has been expended; these I will tabulate and communicate to the Club, if of sufficient interest, when time permits, so that future generations may not be spending their own money, and other people's, in searching for that which they cannot possibly obtain. It is hardly credible, but such is the case, that within recent times borings have been put down to the chalk in close proximity to abandoned wells and with-a mile or so of the coast. Before such works were commenced, had the promoters possessed the most elementary knowledge of the subject, or had consulted reliable experts, they would not have been doomed to disappointment and failure.

In or about 1905, the population of Colchester was still increasing and had already increased to such an extent that it

was deemed prudent to look for a supplemental supply, as the demand was gradually overtaking the yield of the well, as the rest level was gradually falling, due to continuous pumping and a series of dry years. It is difficult to at once trace the connection of a dry year in a well situated as this is, so far away from the outcrop of the chalk, and at such a small elevation above sea level. The rest level records have, however, since clearly shown that as soon as the pumping ceased to be continuous, due to the supplemental supply and a series of wet years, the rest level speedily recovered.

As the present wells could not be touched or deepened under any circumstances, an entirely independent source had to be found, but there was not much necessity to search far, as the Lexden Gravel Springs were close at hand with the water in sight. When I was first consulted in 1888, a suggestion was then made that the Lexden Springs might be used to supplement the then existing supply to the town. The springs were carefully gauged, and the whole nest, including the two eastern springs, which rise close to the village, were found to yield some 513,000 gallons per day, but 1887 was a dry year. They were then carefully examined by the late Dr. Tidy, a then eminent chemist and authority, also by the late Dr. Foster, but as the analysis revealed a rather large proportion of nitrates, they suggested that a well supply from the chalk would be preferable, hence it was that the new well was constructed. At that time a certain prejudice existed by a particular school of chemists against so-called surface springs containing nitrates, for the reason that the method of protecting them against unoxidised manurial matter was not so fully developed or understood, nor was so much importance then attached to the purifying action of the soil. From 1888 until 1902, the matter was allowed to sleep, until Dr. Thresh was consulted, when he was so impressed with their importance and the possibility of protecting them, that he reported most favourably on their adoption.

The springs are situated on the western boundary of the Borough, in the valley of the River Colne, in the Parish of Lexden ; they consist of a group of very strong gravel springs, which are thrown out to the surface by a junction of extensive sand and gravel beds with the London-clay, and are shown on Ordnance Map (25 inch scale), sheet xxvii. 7. They unite to

form a small stream or tributary of the Colne, and had from time immemorial been the only motive power for driving Lexden Corn Mill; after passing through the mill the stream discharged into the main river. (See Plan of the Lexden Springs. Plate II.)

The source or gathering ground is a large plateau of gravel and sand to the south west, extending to Stanway in the west, to the limits of the Roman river in the south, which river runs in an easterly direction around the plateau to a junction with the river Colne nearly opposite Wivenhoe. The area of this enormous bed of sand and gravel is about 13 square miles, and the bed falls both towards the main valley of the Colne and the Roman river. The plateau rises to a maximum altitude of about 130 feet above O.D. The springs rise or show themselves at an elevation varying from 40 to 50 feet above O.D. to the south-west of the Malting Farm. From the left of the springs the gravel rises rapidly, the 100 feet contour being only a short distance away. The water escapes from four or five well defined springs, and yields considerable quantity, even after abnormal dry periods; in fact the discharge has been looked upon in the neighbourhood for ages past as practically constant, but such is not quite the case, as it varies with wet and dry periods. The beds are of a porous nature, and of considerable thickness, and due to their porosity a considerable portion of the rainfall percolates into the soil, and ultimately finds its way in the shape of springs into the valleys before mentioned, especially at Lexden. The beds undoubtedly form a most efficient natural filter, as at the points of collection the formation is practically all clean sand, and even after heavy rain the water always comes away perfectly bright and clear; there is very little doubt that the beds form an underground reservoir of no mean capacity. The water is collected by cutting a trench in the water-bearing bed at right angles to the direction of the flow of the water, well at the back of each spring and below the level of the natural discharge or lip, and laying therein special perforated stoneware pipes, around which is packed shingle. The trench is then refilled with the material in the order it was taken out. The collecting pipes are then led to a pit common to each spring, and each pit is connected by an iron pipe controlled by a valve to the main gravity aqueduct. By this means each spring

can be isolated, and regulated, to discharge its natural yield; and in event of necessity arising the underground reservoir can be drawn upon (by virtue of the collecting pipes being below the natural lips) for a time thereby providing a quantity in excess of the natural yield.

The natural yield of the springs varies slightly, as before stated, with wet and dry periods. So far as I am able to ascertain, there are no records of their yield previous to 1888, when I had them gauged during the months of September and October; they were then found to yield about 416,000 gallons per day, excluding the two eastern springs, which have not been utilized. These, however, were approximately gauged and found to yield about 97,000 gallons. No further gaugings were taken until November 1902, which was after a series of three dry years, when they were found to yield about 300,000 gallons per day, excluding the two eastern springs. On the 31st October 1903, they yielded about 319,000 gallons. After the works were completed in 1905, they were found to yield nearly 350,000 gallons, but as much as 500,000 gallons per day was drawn from them for a short period in 1906.

The average annual rainfall from records taken at the Home Farm, Lexden, at an elevation of 125 feet above Ordnance Datum, by Mr. Bird from 1893 to 1909, a period of 17 years, amounts to 20·15 inches, and for the same period at Colchester, at an elevation of 82 feet above Ordnance Datum, from records taken by Mr. H. Goodyear, Borough Engineer, amounts to 19·66 inches (see *British Rainfall*). For the purpse of my argument, I have taken the average annual rainfall throughout this Lexden gravel area or gathering ground as 20·15 inches, and assuming 37 % of this rainfall, equal to 7·45 inches, percolates into the formation, then each square mile will absorb, say, 107,864,229 gallons of water, equal to a daily yield therefrom, if conditions are favourable, of some 295,518 gallons throughout the year.[1] If the gravel bed, as before stated, is 12 square miles in extent, then the quantity contained therein will be twelve times the above-mentioned figure, or 1,294,370,748 gallons, equal to a daily supply therefrom of 3,546,216 gallons throughout the year. The quantity of water actually extracted by the Corporation from all their springs, viz., Lexden, Sheepen and at the water-

1 An inch of rainfall over a square mile equals 14·48 million gallons (14,478,420).

works, probably does not exceed, say, 550,000 gallons, or about one-seventh of that percolating into the formation; consequently there is a considerable quantity of water escaping along the fringe of this plateau of gravel in the shape of visible and invisible springs other than those mentioned, and feeding the rivers and streams bounding the gathering ground and ultimately finding its way into the river Colne.

In order to thoroughly and efficiently protect the springs from pollution, an area of no less than 29½ acres of land has been acquired at the back of the springs in a south-westerly direction, which is also the direction the underground water is flowing.

Upon this land no manure or grazing of cattle is allowed. As an additional protection, there is a second zone around each spring, enclosed with an unclimbable fence.

In addition to the precautions mentioned, the springs are zealously guarded by Mr. Bland, and the water therefrom is examined periodically, both chemically and bacteriologically, by the Medical Officer of the Corporation, and I am not aware that the health of the town has suffered in any way from the adoption of these springs as an auxiliary source of supply.

My excuse, if any is needed, for writing at length upon these interesting springs, is to impress upon communities, both large and small, that they may be situated in proximity to a supply of water within sight of their doors, and all that is needed to bring it into use is a little common sense combined with geological, medical, chemical, and engineering skill. Prejudice has existed in the past against so-called surface springs, but all water which we consume, whether it has been collected from the moors or the hillside, and impounded in reservoirs, or taken from rivers and stored in storage reservoirs and filtered, or pumped from wells in permeable or under impermeable formations, has at one time or another been in contact with the surface. Even a well sunk into the open chalk is as liable to be polluted by man as a gravel supply, if not protected, and especially if the cone of depression caused by pumping extends to a distance, as illustrated by those interesting experiments with fluorescine lately conducted by the Local Government Board at Fulbourne in Cambridgeshire. There are some towns so situated along the coast, and particularly in East Anglia, whose means are not sufficient to go

miles back from the coast in order to sink a well into the chalk without the risk of getting an excess of chlorine, and who must of necessity rely upon gravel beds in their neighbourhood from which to obtain a supply. Within the last few years I have carried out several such schemes. Only a few years ago, in conjunction with the late Sir Frederick Bramwell, F.R.S., Mr. Whitaker, F.R.S., and Dr. Thresh, M.D., D.Sc., I surveyed a large part of the county not far from this town, in order to find a water-supply for Clacton free from chlorine, and among the sites selected was an admirable gravel bed at Great Bentley. Other counsels then prevailed, the gravel bed was abandoned, and a well sunk on the site, to the Chalk. This turned out a failure, as one might have expected, and the gravel bed has since been utilised as the only means of supply.

APPENDIX-ANALYSES OF CHALK-WATER.

NO. 1. COLCHESTER CORPORATION WATER WORKS.

ARTESIAN WELL WATER (CHALK SUPPLY).

	Grains per gallon
Total Solids	72·10
Chlorine (as Chlorides)	21·31
Ammonia from Salts of Ammonia	·057
Ammonia, animal and vegetable matter	·006
Nitrites	none
Phosphates	mere trace
Hardness before boiling 9·8°	
Hardness after boiling ·55°	
Total Hardness 10·35°	
Lead Salts	none

(Signed) W. Foster, M.A. (Cantab.), F.C.S., 1st April 1889.

NO. 2. ARTESIAN WELL WATER (CHALK SUPPLY).

	Grains per gallon
Total Solids	69·1
Volatile Solids	5·4
Fixed Solids	63·7
Chlorine	21·0
Hardness (each degree equals one grain of chalk per gallon)	12°
Nitrogen expressed as parts per million	
As Free Ammonia	0·593
As Free Albuminoid Ammonia	0·05
As Nitrates	trace
As Nitrites	none

(Signed) Wm. Chattaway, 27th December 1894.

NO. 2A. ARTESIAN WELL WATER (CHALK SUPPLY).

Sample taken a few feet below surface of water in well, 24th February 1898.

The organic matter contained in the water yielded :—

When distilled with alkaline permanganate ·06 parts per million of Ammonia

When boiled with acid permanganate for 15 minutes, it absorbed 1·40 parts per million of oxygen

When digested with acid permanganate for 4 hours at 80° Fah., ·52 parts per million of oxgyen.

Hardness.

The total hardness in degrees per gall. was 9·0.

Each grain of hardness represents the soap-destroying power of one grain of carbonate of calcium (chalk) or its equivalent of other salts.

The Saline constituents are given below in grains per gallon

Carbonate of Calcium	4·6
Carbonate of Magnesium	4·2
Carbonate of Sodium	11·8
Chloride of Sodium	36·3
Sulphate of Sodium	7·5
Traces of Ammonia Nitrates Iron and Silica	·5
Phosphates	none
Total solids dried at 180°C.	65·1

The free Ammonia amounted to ·80 parts per million.

The Nitric Nitrogen to ·1 per million.

(Signed) JOHN THRESH, M.D., D.Sc. and F.I.C., 24th February 1898.

NO. 3. SUDBURY CORPORATION WATER WORKS. CHALK WATER.

	Parts per million
Free Ammonia	·0
Ammonia Albuminoid	·03
	Grains per gallon
Total solid residue	34·27
Chlorine	3·18
Chloride of Sodium (calculated)	5·25
Nitrogen as Nitrates and Nitrites	0·17
Nitrate of Soda (calculated)	1·02
Temporary Hardness	16·6
Permanent Hardness	4·9
Total Hardness	21·5

NO. 4 HALSTEAD WATER WORKS. CHALK WATER.

Sample taken 200 feet from surface

One gallon contains the following number of grains and decimal parts of a grain of the respective substances :—

Total suspended solid matter dried at 250° Fah.	none
„ dissolved „ „ „ „ „	32
Ammoniacal matter yielding 10% of Nitrogen (equal to ammonia per million 0·07)	0·04

Albuminoid organic matter yielding 10% of Nitrogen (equal to ammonia per million 0·04 nearly)		0·02
Nitrites		none
Nitrates containing 17% of Nitrogen (equal to grains of Nitrogen per gallon 0·0)		none
Chlorides containing 60% of Chlorine (equal to grains of Chlorine per gallon 4·2)		7
Hardness reckoned as Chalk grains or "degrees"		18
Removed by ebullition	14	18
Unaffected „ „ ..	4	
Lead or Copper		none
Physical examination satisfactory		
Oxygen absorbed in 3 hours		0·03

(Signed) Professor ATTFIELD, F.R.S., 11th January 1889.

NOTES ON THE FAUNA AND FLORA OF THE SO-CALLED "ARCTIC-BED" OF THE VALLEY OF THE LEA, AT PONDERS END.

AT the meeting of the Club on November 11th 1911, Mr. S. Hazzledine Warren, F.G.S., referred to the discovery of fossil Arctic mosses in the Valley of the River Lea. The speaker said that in the large ballast pit belonging to the Great Eastern Railway Company at Ponders End, and also in another large excavation near Angel Road station, he had discovered the presence of a plant-bearing deposit. This is embedded in the Low Level River Drift Gravel, which passes under the Holocene Alluvium of the Lea valley. Associated with this plant-bearing bed are found remains of *Elephas primigenius, Rhinoceros antiquitatis* (=*R. tichorhinus*) and other mammalia. The stratigraphical evidence shows that the deposit belongs to the close of the Pleistocene period, and is later than the epoch of River-Drift man.

The flowering plants, which have been determined by Mr. Francis J. Lewis, include amongst many others *Betula nana, Salix herbacea,* and *Potentilla sibbaldi.* These three species are exclusively Arctic in habitat, while all the remainder that are associated with them have a high Northern range, and are found living under the same conditions as the foregoing. Land and freshwater mollusca are also abundant. These have been determined by Messrs. A. S. Kennard and B. B. Woodward, who

find that they are of the stunted or dwarfed forms occurring only under Alpine-Arctic conditions.

The determination of the mosses has been undertaken by Mr. H. N. Dixon, and he has succeeded in naming 40 or more species. The nearest assemblage to these would be found to-day in Northern Lapland. Several of these, namely *Tortula aciphylla*, *Timmia norvegica*, *Hypnum fastigiatum*, *H. molle* and *H. turgescens*, are now either extinct in Britain, or are confined to the summits of one or two of the highest mountains of Scotland. Full reports on the fauna and flora are being prepared, and will be presented to the Geological Society of London.[1]

The twigs and leaves of the dwarf Arctic willow occur in the greatest profusion in the deposit, but no trace of the wood of any larger tree has yet been found. The climatic conditions represented must have greatly resembled the bleak tundra of Northern Europe.

No such complete or definite evidence of this late Pleistocene Arctic stage has previously been discovered in the South of England.

LIST OF FOSSILS.

An asterisk is placed against the most abundant species. The Mammalia were chiefly determined by Mr. E. T. Newton, F.R.S.; the Mollusca by Messrs. A. S. Kennard, F.G.S., and B. B. Woodward, F.G.S.; the Coleoptera by Mr. C. O. Waterhouse, I.S.O.; the Entomostraca, etc., by Mr. D. J. Scourfield, F.R.M.S., and Dr. T. Scott; the Flowering Plants by Dr. F. J. Lewis, M.Sc., F.Z.S., and the Mosses by Mr. H. N. Dixon, M.A., F.L.S. To all these gentlemen my best thanks are due for their kind work.

Mammalia.

**Elephas primigenius.*
**Rhinoceros antiquitatis.*
**Equus caballus.*
Bos (or *Bison*).
Rangifer tarandus. (?)
Sorex kennardi.[2]
Dicrostonyx henseli

Mollusca.

Arion sp.
Limax arborum Bouch-Chant.
Agriolimax lævis Müll.
**Sphyradium columella* G. V. Mts.
Vertigo parcedentata A. Brann.
**Jaminia musscorum* Linn.

1 See also "Arctic Plants from the Valley Gravels of the River Lea," *Nature*, vol. 85, p. 206 (December 15th 1910), and "Excursion to Ponders End and Chingford," *Proc. Geol. Assoc.*, vol. xxii., 1911, p. 166.

2 Martin A. C. Hinton, *Geological Magazine*, dec. v., vol. viii., 1911, p. 533.

Limnœa pereger Müll.
,, *palustris* Müll.
* ,, *truncatula* Müll.
,, *stagnalis* Linn.
Valvata piscinalis Müll.
Sphœrium corneum Linn.
Planorbis crista Linn.
,, *arcticus* Beck.
,, *spirorbis* Linn.
,, *leucostoma* Millet.
**Succinea oblonga* Drap.
,, *schumacheri* And.
,, *grœnlandica* Beck.
,, *elegans* Risso.
Pisidium obtusale Pfr.
,, *nitidum* Jenyns.
,, *pusillum* Jenyns.
,, *henslowianum* Shepp.
,, *subtruncatum* Malm.
,, *casertanum* Poli.

Coleoptera.

Carabidæ.
Anchomenus. Several species.
Cyrtonotus sp.
Pterostichus sp.
Carabus sp.
Elaphrus cupreus.
Dytiscidæ.
Agabus ?
Hydrophilidæ
Hydrobius fuscipes L.
Aphodiidæ
Aphodius.
Ægialia ?
Curculionidæ
Otiorhynchus
Phylophaga
Donacea (*sericea ?*)

Entomostraca, etc.

Entomostraca-Cladocera
Chydorus sphœricus
Acroperus harpae ?
Ostracoda
Cypris affinis
,, sp.
Candona candida
C. acuminata ?
C. neglecta
C. lactea
C. rostrata
Limnicythere inopinata
Ilyocypris bradyi
Herpetocypris strigata ?
H. reptans.
Cyclocypris serena
Vermes
(*Egg-cocoons of aquatic forms*)
Rhizopoda
Arcella vulgaris

Flowering Plants.

Silene maritima With.
,, sp.
Alchemilla vulgaris L.
Potentilla comarum Nestl.
,, *tormentilla* Scop.
,, *sibbaldia* Hall.
**Hippuris vulgaris* L.
**Littorella lacustris* L.
Betula nana L.
Menyanthes trifoliata ?
Atriplex sp.
**Salix herbacea* L.
**Carex* sp.
Isoëtes lacustris L. *?*
Scirpus (*lacustris*) *?*
Potamogeton zosterifolius
,, *crispus.* L.
,, *heterophyllus*
,, sp.
Ranunculus hederaceus L.
,, (*acris ?*) L.

Mosses.

**Ditrichum flexicaule*, var. *densum*
Distichium capillaceum
Ceratodon purpureus
Barbula rubella
**Tortula aciphylla*, var. *mucronata*
**Encalypta rhabdocarpa*
Orthotrichum diaphanum
Philonotis fontana
Timmia norvegica
**Bryum pallens*
B. capillare
B. intermedium ?
B. pseudo-triquetrum.
B. cirratum ?
Mnium rostratum
M. punctatum (or *subglobosum*)
Thuidium sp.
Camptothecium nitens
Brachythecium mildeanum
Amblystegium fluviatile
**A. filicinum*
,, ,, var. *vallis clausæ.*
A. serpens, B. and S.

Hypnum polygamum Brid.
H. stellatum
**H. aduncum* Hedw.
,, ,, *pseudofluitans*
**H. sendtneri*
**H. wilsoni*
**H. capillifolium*
H. fluitans
,, ,, (*falcatum*)
* ,, ,, *exannulatum*
,, ,, *rotæ*
,, ,, *vir.* var. *orthophyllus* Milde
**H. revolvens*
H. fastigiatum
**H. vaucheri*
H. molle
H. scorpioides
**H. giganteum*
**H. cuspidatum*
H. sarmentosum ?
H. stramineum
H. turgescens
H. callichroum Brid.

THE GARDENS OF WARLEY PLACE, BRENTWOOD, ESSEX.

By J. C. SHENSTONE, F.L.S.

[*With Plates III., IV. and V., and four other illustrations.*]

ESSEX has figured in books upon plants and gardens from the time when English gardening emerged from the obscurity of the medieval period. Our county was a favourite collecting ground of John Gerard (1545–1612), who wrote the first "Herbal" in the English language, and we learn from this book that Gerard explored Essex very thoroughly in search of plants. About one hundred years later John Ray (1627–

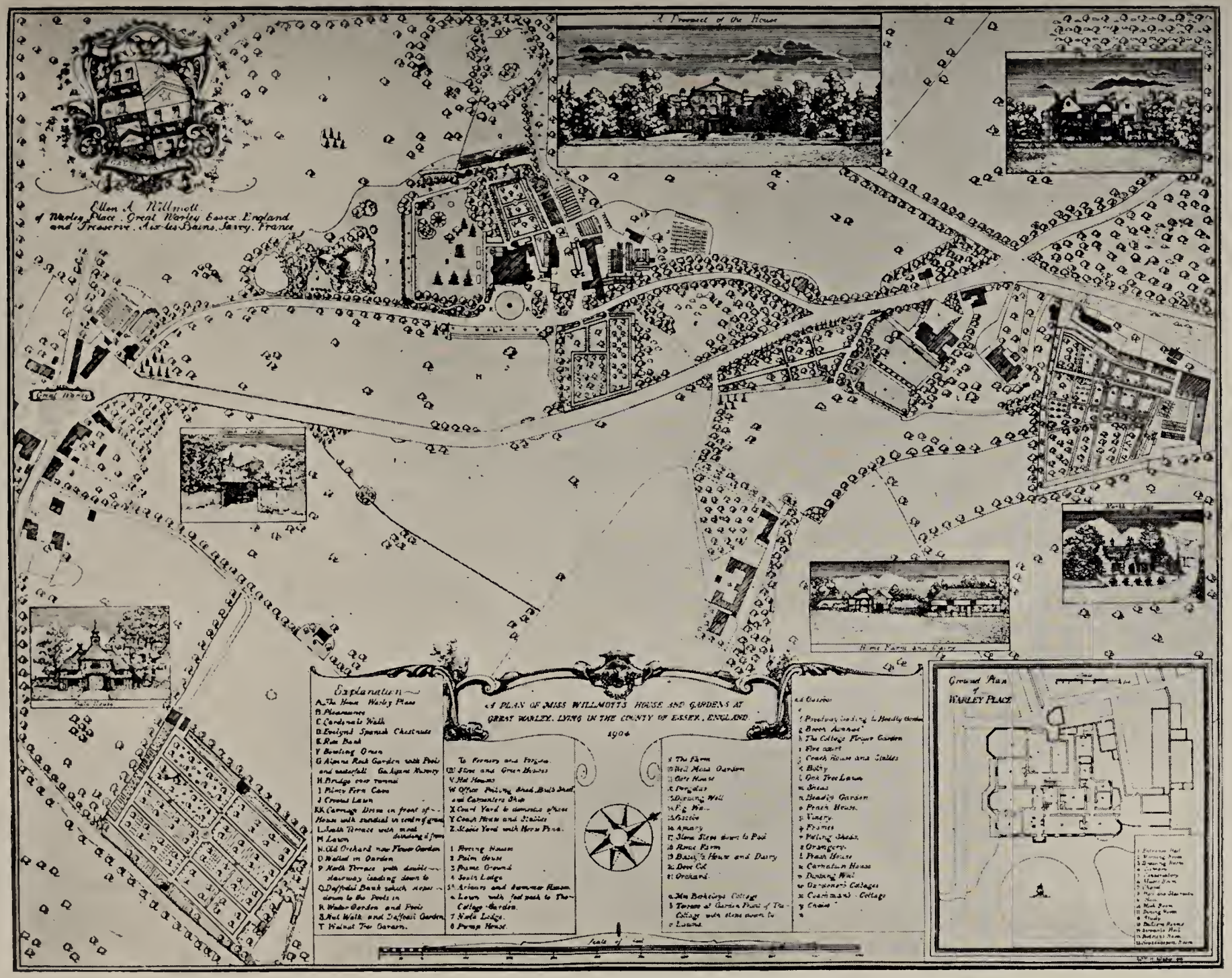
WARLEY PLACE.

1705) was born at Black Notley, where he lived during the later period of his life, and where most of his scientific work was accomplished. John Ray was one of the great botanists of the world, and one of the first to classify plants successfully; indeed, much of his work is accepted at the present day. During the same period Samuel Dale (1659–1739), an apothecary and physician at Braintree, and a friend of Ray's, wrote his *Pharmacologia*, one of the most useful of the later "Herbals."[1] Passing by another hundred years, we find Samuel Curtis, a celebrated gardener, and for some time proprietor of *Curtis' Botanical*

1 See *History of Botany in Essex*, by Professor G. S. Boulger, F.L.S., in ESSEX NATURALIST vol. xi., pp. 61-68 and pp. 169-173.

NARCISSUS CAMPANELLE IN THE WARLEY GARDENS.

From *The Garden.*



A Plan of Miss Willmott's House and Gardens at Great Warley.

TO FURTHER ILLUSTRATE THE ACCOUNT OF THE WARLEY GARDENS.

Magazine, residing at Glazenwood, near Coggeshall, where he had extensive nurseries. Curtis' *Botanical Magazine* was founded in or about the year 1790, and continues to be issued at the present day. It gives figures and descriptions of the most interesting and noteworthy of newly introduced plants, and of others which have not previously received adequate notice. During the Victorian period Benjamin Cant, of Colchester, did much to develop Rose Culture in England, being the first professional gardener to specialize in one genus of plants. Cant's descendants carry on the large rose nurseries which he established.

Essex may be congratulated upon the fact that, four centuries after the first English work upon plants was published, it still attracts botanists, gardeners, and artists within its borders, for the "Gardens of Warley Place" are regarded as a Mecca by all plant lovers.

The Essex Field Club visited Warley Place in the summer of 1911, and the visit has been repeated in 1912, by the kind invitation of Miss Willmott. It is therefore appropriate to place a record of these beautiful gardens upon the pages of the ESSEX NATURALIST.

Warley Place passed into the possession of Miss Willmott's parents when she was still quite young. From her early days Miss Willmott took much interest in the gardens, assisting her mother in their management. In due course they passed into her complete control. The gardens as they now exist were evolved—the beautiful Alpine Garden, the Well Mead Garden, with the adjoining wild garden added as time passed, and the old fish ponds made to serve as water gardens. The old orchard was remodelled, and other changes made, but, in carrying out these changes, care has been taken to leave unchanged the old gardens, which tradition tells us remain to-day as they were when laid out by Evelyn.

Miss Willmott's collection of living plants, including varieties as well as species, probably exceeds one hundred thousand, and these are carefully preserved in a living condition, and the likes and dislikes of each plant have been studied before selecting its place in the garden. Each plant insists upon a proper amount of light and air, some demand chalky soils, others object to chalk. Some insist upon damp, boggy situations, others demand dry

sandy spots. Each plant goes through its cycle of development in its own season, and much attention is necessary in mapping out a garden, otherwise we should have large bare and uninteresting spaces during a great part of the year.

Miss Willmott has succeeded in satisfying the demands of her thousands of plants, which are successfully tended in the Warley Gardens, and she has succeeded beyond most of her contemporaries in arranging her plants so that they give pleasure to the most critical artists throughout the year. So cleverly has she organized the landscape portions of her gardens that any suspicion of artifice is absent from the delightful views meeting one at every turn. There are few botanical gardens in which such a wealth of plant-life can be seen throughout the year, and few, if any, which afford so much material for study.

These gardens extend over several acres, but the plants spread over the park and meadow land adjoining, which in spring are gay with early spring bulbs, crocuses, snowdrops, daffodils, and snowflakes. It has been stated by no mean authority that it would be impossible to find anywhere a similar space so closely planted with the choicest and most beautiful plants, yet at Warley there is no sacrifice of broad effects to small details.

Miss Willmott's constant aim seems to be natural gardening, for one comes upon some rare plant growing apparently as freely, luxuriantly, and sporadically as a wild primrose, yet its place has been selected after careful consideration, and perhaps the same plant will have been tried in several successive positions before one has been found to suit its requirements.

To fully describe a garden of this character within the limits of an article would be impossible. The writer can therefore only attempt to descant upon some leading features ; the reader must endeavour to complete the picture.

Miss Willmott's interest in plant life is so many-sided that almost any plant would find some hospitable corner in her gardens ready to receive it. Her name is, however, especially associated with the Daffodils, with the Rose genus, and with her remarkable success with the hardy plants.

When visiting Warley during February this year I found the lawns and park already bright with early spring bulbs, snowdrops, early daffodils, snowflakes, and crocus. Amongst them were seen the beautiful Pyrenean Narcissi, *pallidus*,

LILIUM TESTACEUM AT WARLEY PLACE. TO ILLUSTRATE THE OVERFLOW OF PLANTS INTO THE PARK.

From *The Garden.*

praecox and *varieformis*, which are rarely seen so happy away from their native vallies. Here they looked as much at home as our own daffodil, which was just coming into flower. *Narcissus cyclamineus* and *N. minimus*, with some early *N. bulbocodium* and *monophyllum*, were seen in full bloom in the rock gardens and borders. *Erica carnea* was in luxuriant blossom, and *Erica mediterranea* was just beginning to flower, as well as many hybrids between the last two Heaths. *Erica lusitanica*, *E. arborea* var. *australis*, form bushes six to eight feet high. I noticed self-sown seedlings coming up around *E. codonodes*. The berries upon some large sized *Pernettya mucronata* looked gay in the early spring sunshine.

I found scattered in all directions species of *Chionodoxa, Scilla, Anemone, Cyclamen, Eranthis, Pulmonaria, Helleborus, Saxifraga*, and many rare Alpine and lowland plants. The lovely early *Narcissi* suggested to one the feast of colour which would shortly follow the coming awakening from winter sleep. Possibly the early English *Crocus* (*Crocus vernus*) purpling the lawns until they suddenly dip down into the sheltered Alpine garden, would appeal most to our native lovers of wild plants. It will interest Essex botanists to learn that this plant has grown in the park at Warley Place from time immemorial ; although it appears to have been overlooked by Gibson and his co-workers. Essex should surely be added to Nottinghamshire and Suffolk as one of the habitats of this rare plant. Miss Willmott has simply left them to grow in a situation in which they have flourished from the olden time. The assemblies of species of *Crocus* grown by Miss Willmott in specially made beds would rejoice the botanist illustrating as they do, by living specimens, so many of the forms described in Maw's great Monograph upon the genus.[2]

Many of the species, such as *Crocus ancyrensis, C. chrysanthus, C. dalmaticus, C. fleischeri, C. imperati, C. longiflorus, C. sieberi, C. speciosus, C. susianus, C. tomasinianus, C. vernus albiflorus*, and *C. zonatus*, were to be seen naturalized in the grassy slopes round the Alpine gardens and amongst the smaller shrubs.

Warley Place, like many an Essex seat, commands an extensive view of hill and dale extending over five counties. It is a settlement of some antiquity (A.D. 1400), and portions of the

2 *The Genus Crocus*, G. Maw, 1886.

old buildings still remain. The house contains a wealth of beautiful things, bearing witness to the fact that the owner by no means confines her attention to her flowers alone. The botanical and horticultural library would appeal forcibly to the members of the Essex Field Club. Few ancient or modern works upon plants or horticulture are absent from this collection.

Warley Place was at one time the property of the Evelyn family, having been purchased by John Evelyn the diarist, in 1649. He sold it in 1655, on account of the imposition of high taxes on Essex property during the Commonwealth. John Evelyn first laid out the gardens and planted the Chestnuts and Walnuts which still cast a welcome shade upon the lawns.[3]

The immemorable existence of the English Lent Lily at Warley gave promise of a good daffodil soil, and in early spring the gentle lines of the park scenery are rendered more beautiful by the golden colour of Daffodils relieving the monotony of the grasslands. The selection of the variety which groups most effectively in the situations has produced a remarkable effect.

We find in one situation large and irregular masses of *Narcissus varieformis*, *pallidus*, and *praecox*, which in unbroken sunlight afford unequalled quality of glistening prettiness. The starry *Narcissus* (*incomparabilis*) against a dark background affords ample illustration of the scenic value of these flowers. There are few known species which may not be seen in due season either in this dell, consecrated to the daffodil family, or in nooks of the Alpine Garden and other spots which happen to suit special kinds. Many are of great rarity and beauty, which are hardly found in other gardens.

At the present time Miss Willmott's name is especially associated with the genus *Rosa*. For many years she has made a special study of the rose, and has collected wild roses and ancient types of roses from all quarters of the globe. Her book upon

3 John Evelyn purchased Warley Place and part of the manor of Great Warley of his wife's cousins, the Flemmings, who inherited the property from Ann Flemming, daughter and co-heir of Benj. Gonson, to whose ancestors Great Warley Manor was granted, when Barking Abbey was suppressed. (See Evelyn's *Diary*, Morant's *Hist. of Essex*, vol. i., p. 111, Wright's *Essex*, vol. i., p. 530, Foljambe's *Evelyn Pedigrees and Memoranda*., and other writers.) The Flemmings continued to reside at Warley Place after it was purchased by Evelyn, the latter residing at Sayes Court a few miles distant, which he also acquired from the family of his wife. He interested himself in gardening at this period, and doubtless frequently visited his wife's relations at Warley Place. In 1655 he sold Warley Place to John Hart. In 1664 Sir Eustace Hart married Jane Evelyn, a relative of the diarist. It would appear likely, therefore, that Evelyn's interest in this property continued after he had sold it. Miss Willmott tells the writer that a contemporary author refers to a visit to Warley Place when John Evelyn was laying out the gardens, and that a letter from John Evelyn exists which is dated from Warley Place. John Evelyn's wife was a direct descendant of the Gonsons, who owned Warley Place for so long.

the genus will undoubtedly remain the standard work upon roses for many years.[4] There appear to be from 160 to 200 recognized species of rose. The rose is intimately connected with English history, and our love for this flower is probably as old as the Roman invasion. The Damask-Rose, the Musk Rose, the Moss-Rose, the Cabbage-Rose, and the Yellow Cabbage-Rose, the York and Lancaster, and the Scotch Roses, the latter probably descendants from the Burnet roses, and some hundreds more were known during the last century, whilst the number obtained from these original species and older races by hybridization now amounts to some fifty thousand. In England, Benjamin Cant, of Colchester, did much to nurture this love of the rose during Victorian times by distributing all the best varieties from his extensive Colchester nurseries. His attention was first called to the flower by Mr. W. H. Penrose, of Dedham, in Essex, who had brought some Hardy Perpetual and Tea-roses from the celebrated gardens of J. B. Laffey, of Belle Vue, near Paris. He persuaded Cant to give them a place in his nursery. From this beginning, after one or two removals, the present nurseries, covering upwards of one hundred acres, were evolved. Essex has also produced several celebrated amateur rose-growers. Having regard to the important part taken by Essex in the cultivation of the flower, it is a matter for congratulation that the scholarly work upon roses alluded to above should have been written by an Essex lady.

The Well-Mead garden at Warley contains the collection of wild and ancient types of roses collected for study ; it is one of the best collections of the kind that exists. Here are also Tea-roses, Hybrid Perpetuals, Moss-roses, and others raised before 1870. Many of these latter are so beautiful in themselves and so deliciously scented that it is a matter for regret that they should have been largely discarded by modern gardeners. Whilst many of the newer roses are truly splendid, there are a far larger number which cannot be compared in any way with some of the old favourites. It is interesting to see these old roses at Warley and to know that although so many of them are already forgotten, some at least are here saved from oblivion. This garden, which is entered through a typical Essex red brick

4 *The Genus Rosa*, by Ellen Willmott, F.L.S., 1910. Drawings by Alfred Parsons, A.R.A. John Murray, Albemarle Street, W.

and timber gate-house, serves as orchard and as a vegetable and herb garden, and also as nursery for shrubs, whilst against the long south wall is a collection of Fig-trees, illustrating the comparative value of the different varieties which thrive and bear fruit in Essex. Different varieties of dessert-grapes are also grown here, such as Chassellas de Fontainebleau, Madeline Royal Norillon hatif, Malingris precoce, Charles Vibert and others. Although the crop is not so plentiful, and the grapes have not the fine flavour of those grown under a Continental sun, they are, nevertheless, good, whilst some varieties, such as Grenache, are very beautiful in the autumn, when the foliage becomes brilliantly scarlet.

As a rule the " Herb Garden " now exists in England upon sufferance, for our modern cooks prefer the flavouring essences prepared from chemicals. On the Continent the culinary herb still holds an important place in the " jardin potager " and are cultivated with care. A large number of herbs were cultivated at Warley, and many still remain, such as Sorrel, Wormwood (or Dian's blood of " Midsummer Night's Dream "), Rue, which Pliny tells us grows best if filched from a neighbour's garden, and which was formerly planted near to Sage, to counteract the poisonous effects of toads, whose favourite resting place was in a bed of Sage. Tarragon, Pimpernel, Purslane, Clary, Camomile, and many other culinary and medicinal herbs are to be found in the garden. Nor are the sweet-scented herbs, used in olden times for strawing floors, and also for keeping insects away from linen, overlooked. Amongst these we find Bergamot, Hyssop, Balm, " Old Man," Basil, Tansy, Woodroffe, and many others. A notable feature is a double hedge of Lavender, with a foot-path between, two hundred and ten feet in length ; a similar one of Rosemary may be seen in another part of the garden. The land slopes to the south-east, thus rejoicing in the early morning sunshine, and below are a few acres of wild land divided from the Well-Mead Garden by a valley (a natural depression) and a pool of water. On this land a large part of our British flora has been naturalized, to which has been added many interesting plants collected from the Continent by Miss Willmott. These have been planted in a natural way, so that, in wending along the little tracks, one could imagine oneself upon a botanical expedition, findng surprises at every turn, and coming suddenly upon a

rare British plant or an interesting alien. Some species have "crossed" with other plants, affording most erratic results, extremely puzzling to the British botanist. This wild garden is beautiful at all times of the year, and the surroundings lend themselves charmingly to the natural effect. Bounded on the east by a wood, the view to the south is typically Essex, affording a landscape such as Wimperis loved to paint, widening over a broad stretch of country away over the marshes and across the Thames to the Kentish Hills. There is that mysterious blue-steel haze so often seen in Essex, and which is, perhaps, peculiar to the Eastern Counties, giving a character and charm to the landscape which cannot be surpassed. It is quite impossible to enumerate the plants naturalized in this wild-garden, but some thousand species are represented, and many have come from great distances to their new home. And often a plant believed to have been smothered out is again found springing up in some unexpected spot.

There is the Teazle, the cultivated variety of which is used in dressing cloth, though now almost superseded by machinery. *Bupleurum falcatum*, our Essex rarity, from Norton Mandeville, which, though scarce in England, is common on the continent. *Lathyrus tuberosus* from Fyfield, probably first introduced into Essex by Dutch labourers employed in embanking the marshes of the Thames,[5] and the third rare Essex plant, honoured with coloured illustrations by Gibson in his *Flora of Essex*, while *Lathyrus hirsutus* is here from Rayleigh with *L. nissolia*. The "Bardfield Oxlip" of Essex has crossed with some Ural Mountain *Primulas*, and so created a beautiful and striking race of brilliantly coloured flowers. *Osmunda regalis* and *Lastræa thelypteris* from Warley Woods, with *Convallaria majalis* and *Chrysosplenium oppositifolium* from the same locality. "White-Heather" from Coombe Green, with *Scabiosa succisa* and white forms of *Ononis arvensis* and *O. spinosa* from Upminster Common. *Ulex nanus* and *Hypericum pulchrum* from Warley Common; *Sedum telephium* from the Magpie Wood, with *Prunus padus* and *Pyrus torminalis* and *P. aria*; the latter from near Felix Hall. *Lamium galeobdolon* still grows where Gibson found it in 1862, and *Sonchus palustris* has been introduced from marshes of the Medway.

5 "*Lathyrus Tuberosus* in Britain," by Miller Christy, *Journ. of Botany*, vol. xlviii., pp. 170-177.

WHERE ROCK AND PASTURE MEET. TO SHEW HOW THE ALPINE GARDEN HAS BEEN EXCAVATED IN PARKLANDS.

From *The Garden.*

Most modern floriculturists would probably seek the Alpine Garden as the *chef-d'œuvre* of these delightful grounds, and truly Miss Willmott has concentrated her great knowledge of plants in this spot, and with her genius for artistic arrangement, avoiding all suspicion of artificiality, she has developed a singularly beautiful arrangement. Miss Willmott has followed her own instinctive knowledge most wisely and successfully, in departing from the usual method of building up an Alpine garden. She has dug a deep ravine for the reception of the plants, and by following out the natural contour of the land, being favoured by the presence of an inexhaustible stream of water, which keeps up a constant ripple through the bottom of the ravine, she has not only solved many artistic difficulties, but has warded off the winds of cold seasons, the stream keeping the ravine moist in hot summers. No wonder that the Alpine plants have taken full possession of their home, and by strikingly luxuriant growth shown how they appreciate the provisions made for them.

In this valley one finds an almost complete exemplification of the Alpine Flora of the world. Plants from the Alps rub shoulders with those from New Zealand. Those from the Andes with those from Greenland, Cashmir, and California, the heights of the Kilmandgaro, and with those of Parmi. In short, the mountain ranges of the whole world have contributed their treasures to this charming spot.

The stream which runs through this little valley, from north-west to south-east, through a series of picturesque gorges, is the home of many aquatic and moisture loving plants, such as the beautiful red *Nymphaea froebelli* and the dark red American variety, "William Falconer." On the edges of the water Japanese Primulas look very happy growing with *Trollius*, double and single King-cups, and a grand *Caltha* from the Vatican gardens. On the boggy ground almost level with the water, *Primula rosea* thrives with *Ledum palustre* and *latifolium*, *Cardamine latifolium* (single and double forms), *Gunnera manicata*, *G. scabra*, and the diminutive *G. majallanica*. The American Ladies-Slipper, *Cypripedium spectabile*, *Orchis foliosa* from Madeira, and many of the Orchids of Central Europe, such as *Orchis coriophora* from St. Girod and *O. laxiflora* from the Lac de Bourget. Here also may be found *Orchis maculata*, *O. mascula*, *O.*

sambucina, *O. morio*, and the "Bee," the "Spider," the "Fly," the "Lizard," and the "Hanging-Man" Orchises.

A grotto to the south is devoted to "Filmy-ferns," and in passing from the open into the cool diffused light the contrast is delightful. In this grotto one finds *Trichomanes cruentium* and *T. reniforme* from New Zealand, *T. radicans* from Killarney, *Hymenophylum tunbridgense* from Westmoreland, and *H. demissum* from New Zealand.

The gorge ends at the old Watergate-pond, from which in old times the villagers of Great Warley drew their water. It stretches southwards, and is fed by a little stream of pure water. No longer serving its former utilitarian purposes, it is now devoted to the welfare of aquatic and moisture loving plants. The pink *Nymphæa sphaerocarpa* from Sweden, mentioned and figured in the *Flora Danica*, is grown here, and also many of the hybrids raised by Latour Marliac and Lagrange from the plant. Here, in the shade of some White Poplars, grow fine clumps of *Cypripedium*. *C. spectabile* sends up its fine pink slipper-like flowers, 18 inches high, showing that they are as thoroughly content with their present conditions in the old world as they were in their North American home. Here also *Cypripedium calceolus* from Savoy, and its variety from Pralognon, *C. macranthum*, *C. fasciculatum* and *C. punctatum* are thoroughly well established, and show increase from year to year.

Between the Bowling-green and the Alpine-garden is one of the finest bushes of red Venus Sumach in the country; *Erica mediterranea* and *E. multiflora* grow some six feet high. *Indigophora gerardana* and large bushes of *Fuchsia globosa*, which have not been cut down by any winter for the last eighteen years, *Desfontainia spinosa*, five feet high, flourishing in an exposed position, bears myriads of little red and yellow flowers every summer.

Plants which always attract much attention are a fine bush of *Juniperus sabina* var. *tripartita*, spreading twelve feet in diameter from a central stem, and a very beautiful and unique *Ceanothus*.

Alpine *Rhododendrons* and *Daphnes*, and many varieties of *Asters* grow naturally on the water-fringes of the Alpine-garden, and in spring rare flowering bulbous plants from many distant regions give a charm to the whole which would be difficult to

GENERAL VIEW OF THE ALPINE GARDEN AT WARLEY PLACE.
From *The Garden*.

describe. *Libocedrus microlepis*, usually so tender, passed safely through the hard winter of 1906; *Juniperus oxycedrus* also. *Cytisus pilosus* from the shores of the Mediterranean is growing near *C. spinosus*, and not far off is *Colletia spinosa*, with its formidable prickles, *Eugenia ugni*, which flowers and fruits, and the rare *E. apiculata*.

Ceanothus rigidus, which is rarely seen in the Eastern Counties, and a large bush of *Andromeda japonica*, scarcely twelve inches above the water-line, flowers more freely than in many a milder climate. *Azara microphylla* grows twenty feet high, and in spring perfumes the air with its vanilla-like scent.

Amongst the Alpine life on the sunny slopes, between large boulders of rocks, are to be found clumps of *Saxifrages*, such also the encrusted species of this genus. Masses of *Campanulas*, such as *C. portenschlagiana*, *C. garganica*, and *C. hirsuta*, with the more delicate *C. raineri*, *zoysii*, *cenisia*, and *C. warley*. A large collection of *Achilleas*, noteworthy amongst them being *A. serbica*, *kellereri*, *griesbacki*, *huteri*, and *holocericia*. *Lithospermums*, such as *L. prostratum*, *petræum*, *intermedium*, *rosmarinifolium*, with the shy Pyrenean *L. gastoni*. That charming little dwarf, *Spiraea decumbens*, not often to be met with, here makes a clump some two feet across.

Acantholimon, *Daphnes*, and the small varieties of *Cytisus* grow over boulders, whilst *Armeria cæspitosa* is one of the plants which thrive unusually well here. A plant of *Genista horrida*, three feet in diameter, looks as comfortable as in its native home at Couzon (Rhône).

Here, too, in fitting season grow *Drabas*, Alpine *Phlox*, and *Aubretias* in well-established masses, and the beautiful *Oxalis enneaphylla* from the Falkland Islands, which blossoms freely and increases, and is apparently thoroughly at home in every way, excepting in its failure to keep to its regular number of leaflets, which are as often as not too few or too many.

Oxalis lobata is rarely seen in gardens, being a Chilian plant which would scarcely be considered sufficiently hardy, but at Warley it has accommodated itself perfectly to the climate, and bears bright yellow flowers, large in proportion to the length of its stems. Here are *Origanum pulchrum*, *O. tournefortii* from Greece, and *O. dictamnus* from Crete. There are about thirty different species of *Erodium*, some of them, such as *E*

chrysanthum, usually considered difficult of culture. In reality they are dicœcious, and the seed is not fertile unless both forms are grown as here.

Growing in chinks between the rocks are many of the *Sempervivums* collected by Alexis Jordan as material for his projected monograph upon this genus.

A striking effect in early autumn is produced by *Zauschneria californica* grown on a ledge which receives direct sunlight. *Androsaces*, such as *A. chumbyi*, *A. sarmentosa*, *A. primuloides*, *A. lanuginosa*, *A. oculata*, and others are growing as though their culture was of the simplest nature. *Æthionemas* grow into regular bushes, a very interesting Warley hybrid between *Armenum* and *jucunda* retains the best characters of both parents, and forms in a very beautiful and distinct plant. In a sunny spot *Daphne alpina* thrives, and the tender *Daphne odora*, the delicious perfume from which justifies its name. *Daphne striata* from Lautaret and *D. rupestris* from the Tyrol, *D. arbuscula* from Hungary, and possibly the most beautiful of all, that joy of old cottage gardens, the *Mezerium*, with its earliest of early blossoms, succeeded by the brilliant scarlet berries. Interesting, though not so beautiful, is a form with deep purple flowers and dark leaves, and one producing white flowers.

Many of the rocks are clothed with different kinds of *Dianthus*; some of them are well marked species, but a very careful study of William's monograph of the genus would be necessary to name all the forms of this important group. Some, such as the *D. subacaulis*, which lengthens its stems in cultivation, are apt to forego their principal characteristics when placed in gardens. There is the Cheddar-pink, *D. gallicus*, and that little gem *D. microlepis* from Transsylvania, while *D. plumosus* from the Pyrennees, *D. olympicus* from Bythynia, *D. glacialis* from the Alps are amongst the one hundred and twenty-four species and sub-species of the genus grown at Warley.

The *Cisti* and the *Helianthemums* are as gay and pleasing as anything in these gardens. Every shade and colour of the latter may be seen enlivening the rocks and sunny ledges, *Helianthemum salicifolium* from Aignues Mortis, *H. obscurum* from Fontainbleau, *fumanum* and *pulverulentum* from the Pyrenees, *tuberaria* from Frigus, and *guttatum* from Holyhead.

Some truly grand bushes of the *Cistus* continue to

flower for so long a period that one is surprised that these plants do not suffer from overflowering, but nature makes its provisions to meet the needs of these very floriferous plants, and they do not appear to suffer.

The true *C. purpureus* is, perhaps, the most beautiful of all *Cisti*. This, like many of those figured and described by Sweet, is rarely seen. *C. ladaniferus* is offered in every catalogue, but it can seldom be supplied. *C. monspeliensis* from the Ile St. Honorat. *C. laurifolius* and *C. cupanianus* and *florentinus* are those most commonly grown in gardens.

The *Onosmas* are especially good at Warley, the rare *O. alboroseum* and *echioides* grow as freely as *O. tauricum*.

In shady cool places facing north and west most of the plants which need such situations are to be found. *Ramondias, Haberleas,* the mossy *Saxifrages,* Ferns, *Trilliums,* the Japanese *Tanakea radicans,* the Canadian Bloodroot (*Sanguinaria canadensis*), and the beautiful *Ourisia coccinea,* with its bright red flowers, and *O. macrophylla,* with white flower spikes. There is a colony of lovely little *Gentiana bavarica* in a moist but well drained corner. *Gentiana acaulis* and its variety from Chambery, *gagnipanii,* the giant flower *G. excisa* from the Tyrol, while near by are colonies of the fine *Gentiana lutea,* sending up many tall yellow flower spikes. This is such a fine plant that it should be more often grown in gardens. The new Chinese *Primulas* have already made themselves at home, *P. sinensis, littoniana, bulleyana, beesiana, veitchii, gagnipaini,* and a very beautiful hybrid between *cockburniana* and *pulverulenta*.

Peeping out of ferns and low bushes of *Empetrum nigrum* and *scoticum,* and the fragrant *Myrica asplenifolia,* are many varieties of Dog-Tooth Violets, the beautiful pink *Erythronium johnsonii,* the yellow *E. nuttalianum,* the creamy white *E. americanum,* the mauve *E. hendersoni,* besides many others. *Osmunda regalis* is the "Royal Fern" indeed in this garden. It sends up fronds fully six feet in height. But we must leave the Alpine garden, though we feel that we have passed by interesting plants; to do justice to this ideal spot we should need an entire part of the NATURALIST.

Turning eastward on to the grass under Evelyn's fine Evergreen Oak and his giant Sweet Chestnuts, and descending a steep slope, we come to the old fish-ponds, which are still inhabited

by carp of great age. These ponds date from the time when Warley Place was the sanatorium of Barking Abbey. Here we find two picturesque pools fed by natural springs which rise in the hill-side. They show very little diminution in the water level, even in the dryest summers. There are many rare trees and shrubs round these pools, but there is no sense of artificial arrangement ; they look as though placed there by nature, and a king-fisher darting across the water completes the illusion. A most interesting feature is an Alpine hut, fitted with its mountain furniture and herdsman's gear, which is sheltered amongst the bays. It was brought from Bourg St. Pierre, where it had witnessed the passing of the First Consul Buonaparte and his army in that memorable May of 1800 when he crossed the Alps by the Great St. Bernard pass, and descended into the Val d'Aosta on his way to occupy Milan.

Many British plants are naturalised on the borders of the ponds. The " Saracen's Consound " (*Senecio saracenicus*) from the banks of the Dee, *Campanula macrantha* from Thirsk, *Mimulus aureus* from Fountains Abbey, and some plants of *Mimulus luteus* collected near Ware on the occasion of an Essex Field Club expedition up the river Lea. *Doronicum pardalianches* from Devon, and *Cladium mariscus* are amongst the many interesting British plants. In the water and at its edges are many of our British aquatic plants brought to Warley from their native habitats.

Ascending the sharp incline by the nut-walk, we skirt an old red-brick garden wall, thick and high enough to withstand a siege, but which now serves the peaceful purpose of sheltering some fine *Camellia* bushes, which grow well and produce myriads of blossoms, appearing to be equally indifferent to hot summers and biting winds and late frosts. A *Camellia reticulata* planted some ten years since, when about twelve inches high, has now reached nine feet high, and bears thirty or forty splendid blossoms. It is probably the only plant known to have flourished so luxuriantly away from the West Country. On the same wall is a fifteen-year-old *Lapageria*, which produces some forty or more flowers, and has ripened seeds. Here also are *Ampelopsis striata*, *Carpentaria californica*, *Azara gillesii*, and *Stuartia pseudo-camellia*, while flourishing in the border is a thick mass of *Lomaria magellanica*, and in addition to all the *Hepaticas* some fine *Dodecatheons*.

Growing among the Nut-bushes is *Lathraea squamosa*, our only indigenous representative of the genus, whilst upon the roots of Poplars and Willows are large masses of that more showy and more beautiful parasite, *Lathraea clandestina*, from the Basque country. Bamboos, Willows, and Himalayan Rhododendrons, Sea-Buckthorns, and Spindle-trees grow as though friendly neighbours from the same locality.

The lawn recalls the beautiful stretches of green sward around the Oxford and Cambridge Colleges, and is no doubt of great age. There is a fine specimen of *Araucaria imbricata*, upwards of forty feet high, with its lower branches sweeping to the ground. It was brought to England with the first shipload of these plants which arrived. An unusually fine specimen of *Quercus ilex* bounds the lawn on one side, and some sweet Chestnuts serve as a break to the westerly gales, which, if unchecked, would speedily devastate this part of the garden. Amongst trees in this part of the garden are some very fine Elms, and a group of Oaks of great age, but still full of strength and vigour.

Turning to John Evelyn's old walled-in garden, one could imagine oneself back into the seventeenth century, were it not for the plants of recent introduction, for the garden mainly keeps to its old world aspect. Evelyn's apricots have now made way for flowers, and the south wall now gives support to the tender *Berberis fremontii*, whilst high above the wall *Cytisus virgatus*, *Elceagnus argenteus*, and the pink July-flowering *Acacia neo-mexicana* breaks the straight outline against the sky.

A grand sight in summer is *Solanum crispum*, with a thick trunk and spreading branches, covered with large purple flowers of such unusually large dimensions that the plant is rarely recognized by botanists at first sight. Equally beautiful, and still more unusual in this part of England, is the red flowered Pomegranate, *Punica granatum*, growing more than four feet over the nine foot wall. This flowers so profusely that a Cornishman who saw it could not recollect having seen a finer specimen in his favoured county. *Berberidopsis*, *Lardizabala*, *Stauntona*, *Crinodendron*, and *Apios tuberosa* have also places upon the walls.

In a dry, sunny corner of this garden is a mount which sufficiently fulfils the conditions required by the *Cacti*, and induces several varieties of *Opuntias* to flower and bear fruit. *Agaves*, *Echeverias*, *Mesembryanthems*, and other succulents withstand

the winter here, if given slight protection from rain. *Aphyllanthes monspeliensis* from the Croir Haute, and *Erysimum montosicolum*, and *Fritillaria delphinensis* from Gap, *Stachys glutinosa* and *hermanii* from Corsica, *Camphorosma monspeliacum* and *Anthyllis marsiliensis* from Marseilles. *Acanthosonchus cervicornus* and many other plants rarely seen in cultivation in England in the open air are found in this spot.

Many tender plants grow against the adjoining wall, such as *Aristolochia sempervirens, Correa alba, Nertinei, Coronilla glauca, Azara integrifolia variegata, Pentstemon cordifolius, Nierembergia frutescens, Corokia buddleioides, Lardizabala biternata, Escallonia montevidensis*, and others. Near by, a good old specimen of *Quercus acuta* with persistent foliage resembling that of Portugal Laurel, and a very good large flowered form of *Plagianthus lyalli. Illicium religiosum*, with its lovely orange-blossom-like flowers, is looking as happy as if growing in the West of England.

Noticeable amongst plants growing in these gardens, which are unique in Eastern England, are a sweet bay tree (*Laurus nobilis*) forty feet high, a *Ceanothus cærulea*, thirty feet high, and a *Strawberry-Tree* (*Arbutus unedo*), about twenty feet high, dimensions which would attract attention in the warmest corner of the south-west of Great Britain, or even in the south of Europe.

Many rare peat loving plants flourish in this garden, and the diminutive *Rhododendron kamschaticum, R. lapponicanum, R. racemosum, R. intricatum, R. linarifolium, Broughtoni aureum, B. multiflorum*, and others succeed each other in flowering from January until midsummer There are also growing species of *Rhododendrons* recently collected by E. N. Wilson during his expedition in China in search of new plants.

Besides *Rhododendrons* there are representations of many other genera, such as *Gaylussacca resinosa, Cassandra calyculata, Epigaea repens, Linnea borealis, Dinanthe bifida* and *cærulia, Ilex cornuta, Plagianthus lyalli.*

In spring the Crown-Imperials attract much attention, for it is rare to find a clump which is not flowering. The fine cream coloured *F. askhabadensis* blossoms early and defies the frosts and storms alike.

Although the old orchard-garden still contains some veteran

apple trees, and among them the rarely seen Essex Spice-Apple, the garden is now given almost wholly to flowering trees and shrubs, which do well, for the sun can shine upon them, and they are amply protected from cold wimds. Bushes of various Himalayan *Rhododendrons*, growing without peat, in the natural soil, have attained the height of fourteen or fifteen feet, and flourish freely. Amongst these are *R. arboreum, cinnamomum, gloxiniflorum, shilsoni, fulgens, barbatum, aucklandi, thompsoni,* and others. *Rhododendron falconeri* bears a few trusses of flowers in favourable seasons. These *Rhododendrons* have accommodated themselves wonderfully to conditions which here obtain, and flourish as they rarely do in a bleak country.

Other shrubs in this garden are *Citrus trifoliata,* which flourishes well and bears fruit. *Colletia spinosa* nine feet high, *Pitosporum tenuiflorum* fourteen feet high, *Raphiolepis ovata* ten feet in diameter, *Erica codonodes* ten feet high, around which seedlings come up spontaneously and freely, and a bright coloured *E. mediterranea,* nearly as tall. Various *Magnolias* flourish well and a tree of *Eucalyptus coccifera* is forty feet high, and flowers and fruits every year. It has passed unscathed through all the inclement weather of the last twenty years.

Against the wall are fine flourishing plants of *Rhyncospermum jasminoides variegatum,* which bears myriads of sweet scented blossoms every year. *Billardiera longiflora, Edwardsia microphylla, Clematis cirrhosa,* with its varieties *balearica* and *calycina, Bignonia Mme. Galen,* a very free flowering variety of *B. grandiflora.*

Herbaceous plants are cultured here in a natural way, which suits their requirements admirably. All the old favourites are to be found as well as the novelties which are coming in almost daily. It was in this garden that the*Phloxes* showed such grand vistas of floral colouring when it was visited by the Essex Field Club in 1911.

The little village of Great Warley is near by, and was in years past probably of more importance than now. It is a quiet country village, with its old time green and inn. Roses and Jasmins climb around the village casements, and wallflowers edge the paths ; there are flowers in the old cottage windows and glimpses of gay little gardens. The village appears to have been inspired with a love of flowers by its neighbour, Warley Place.

Space will not permit of reference to the extensive range of glass-houses, frames, and hot-beds, nor of an adequate description of the orchards, peach-houses, vineries, and many other features in these remarkable gardens. The plants are all carefully named in accordance with the *Index Kewensis*. It is also with some regret that we must conclude this paper without reference to Miss Willmott's gardens in Savoy, and upon the Mediterranean coast. Miss Willmott was this year awarded the Grande Medaille Geoffroy St. Hilaire by the Société d'Acclimatation de France, and it will be remembered that she was among the first women to be admitted to the Linnean Society of London.

We cannot make a better conclusion to this article than by quoting the dedication of the *Botanical Magazine* of 1907. "To Miss Willmott, F.L.S., V.M.H., of Warley Place, Essex, whose skill in gardencraft is only surpassed by the generosity with which she dispenses the treasures of her gardens and accords to others the benefit of her experience."

The illustrations to this paper are from blocks kindly lent by *The Garden* and by Miss Willmott.

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The Essex Museum of Natural History.

We venture again to call attention to the needs of our County Museum, in the hope that lovers of natural history will each and all do **something** to aid forward the work. We have in the Museum ample means of preservation, so that all collections and specimens entrusted to our care will always be available for study, and will be carefully and lovingly curated. Amongst our desiderata may be mentioned the following :—

MAMMALS.—Skulls or complete skeletons of Essex species —Pelts, particularly of Voles, Shrews, Mice and Bats.

BIRDS.—Similar specimens, and in particular we are in want of a **good** collection of **BIRDS' EGGS.**

MOLLUSCS.—Specimens (Land and Freshwater and Marine) from as many Essex localities as possible.

INSECTS.—We are greatly in want of **COLEOPTERA, HYMENOPTERA, HEMIPTERA, DIPTERA,** and obscure groups.

PLANTS.—Authentic specimens of plants, coming from as many Essex stations as possible, to aid in the preparation of a Botanical Survey of the County.

Any information and advice in our power will be gladly given.

WM. COLE, Curator,
H. WHITEHEAD, Assistant-Curator,
THE ESSEX MUSEUM,
ROMFORD ROAD,
STRATFORD, ESSEX.

Parts IV.—IX., Vol. XVII.]
[OCT., 1912—MAR., 1913.

The Essex Naturalist:

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OF THE

ESSEX FIELD CLUB,

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WILLIAM COLE, Assoc.L.S., F.E.S.,
Honorary Secretary and Curator.

Contents.

The Authors alone are responsible for the statements and opinions contained in their respective papers.

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The Pictorial Record of Essex at the Museum.

As Curator of the "material" of the Record I would like to suggest a few by-paths of work which might lead our amateur photographers to produce results of lasting value.

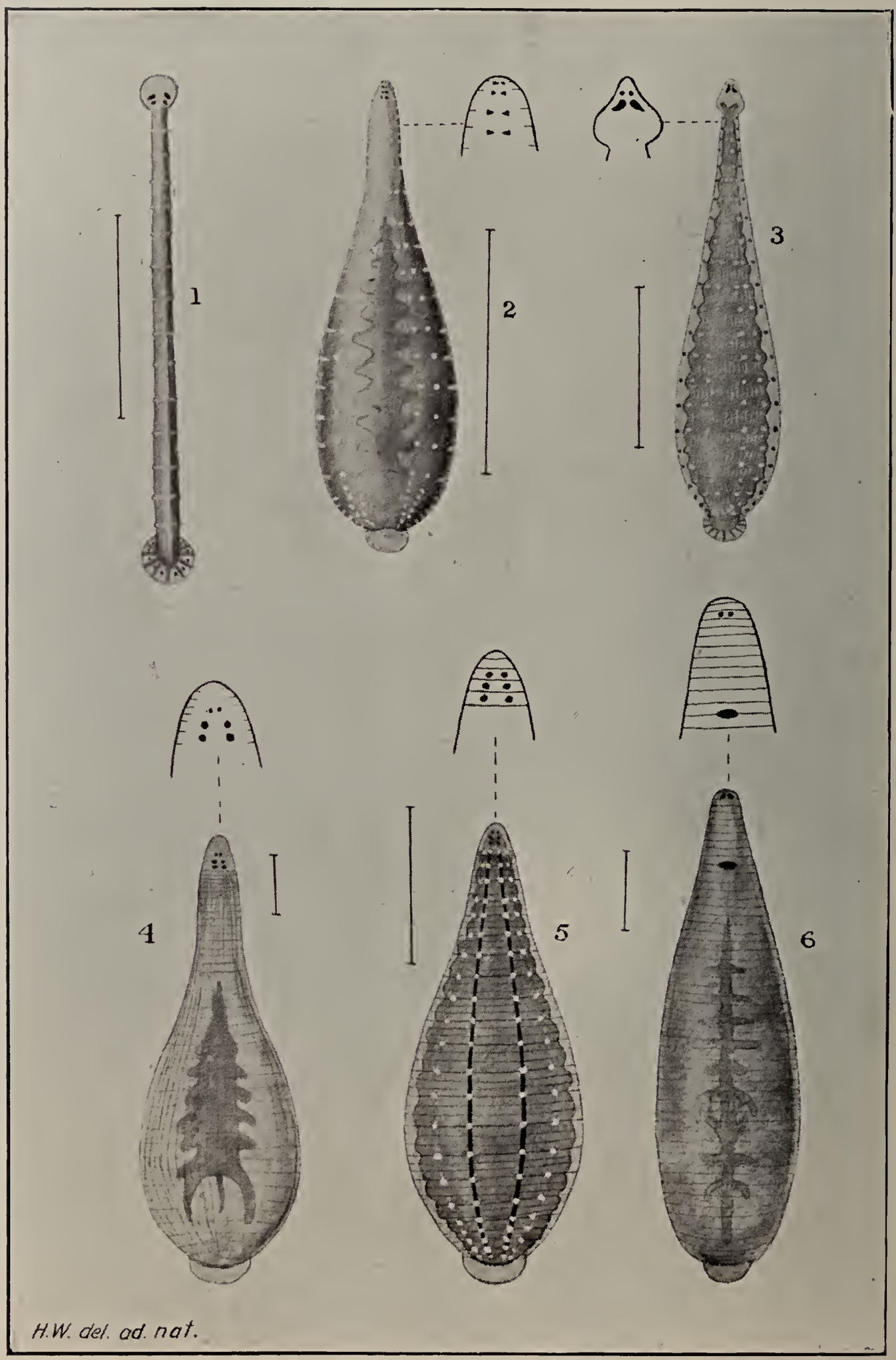
We shall doubtless receive for the collection pictures of Churches and Church-porches galore, but these are very persistent things, and will be in evidence, it is to be hoped, for many centuries yet to come. It is the changeful and fleeting, rather than the permanent, that first claims our care.

Personally I should welcome photographs of work-a-day and holiday costumes, methods of making things in village industries, modes of fishing, agricultural scenes, street scenes, and pictures of markets and fairs. In remote parts of the county smock frocks are still worn, sturdy teams of oxen draw the plough ; by keen searching we may find some of the old-time waggons and tumbrils ; the flail is still being swung even in transforming Essex and the gleaners still claim largess from the wayfarer ; the piquant sun-bonnet shades the pretty faces of the children as they trudge through the lanes to school, and the graceful shawl drawn over the head has not been everywhere flung aside to make room for shabby copies of French millinery. I hope even to secure a photograph of a chimney-pot hat *in situ*, before that strange and wonderful thing vanishes into the limbo of the past !

And beside such records of fleeting fashions, let us not forget interiors of humble homes and "Liberty"-furnished "drawing rooms," rose-covered thatched cottages and stuccoed "villas," vistas of village life and photographs of mean streets, Constable bridges and modern railway arches ; Burket Foster-like groups of rosy-cheeked urchins in the lanes, swarms of pale-faced slum-children dabbling in the gutters—beauty and health, ugliness and misery. In short, truthful sun-pictures of our social life and its strange contrasts, that men to come in happier times may wonder and pity.

WILLIAM COLE.

N.B.—Many of the above-named "subjects" may be secured by means of the interesting and really valuable modern "cult" of the PICTURE POST-CARD. These very truthful records will form an important part of our collection, and cards from the county and its border-lands will be most welcome.



ESSEX LEECHES.

(For explanation, see Text.)

SOME NOTES ON THE NATURAL HISTORY OF BRITISH FRESH-WATER LEECHES: WITH RECORDS OF THEIR OCCURRENCE IN ESSEX.

With Plates VI. and VII.

By HENRY WHITEHEAD, B.Sc.

[*Read 28th October* 1911.]

IN 1911 a very important paper, entitled "A Revision of the British Leeches," by Mr. W. A. Harding, was published in *Parasitology*. Previous to the appearance of this paper, the most recent work dealing with British leeches was Johnston's *Catalogue of the British Non-parasitical Worms in the Collection of the British Museum*, published in 1865.[1]

Mr. Harding's paper gives full descriptions of all the known British species with lists of synonyms. It contains an extensive bibliography and is well illustrated by coloured plates and figures. With such an admirable work in existence, some explanation seems necessary for the appearance of this paper. Few members of the Club have an opportunity of consulting the work mentioned,[2] and therefore the writer proposes to give a brief description of each species, emphasizing only those features by which specimens may be recognized. A number of observations on the life-histories and habits of these animals are scattered through the scientific periodicals of this and other countries, but these observations do not appear to have been brought together. An attempt is being made in this paper to do so and to add to this material a few notes made by the writer whilst collecting and studying Leeches during the past two years.

Folk-lore and early references to Leeches.—Leeches are referred to in very early writings, but unfortunately the species were hopelessly confused, and therefore the observations are of little scientific value.

Probably the earliest reference to Leeches is in *Proverbs* xxx., 15. "The horseleach hath two daughters, crying, Give! Give!" The word translated as horseleech in this passage has been the subject of much discussion. The original Hebrew word was *Aluka* (*Halucah* or *Gnaluka*) and this was translated by

1 An account of the Irish fresh-water leeches by Dr. R. F. Scharff is given in the *Irish Naturalist*, vol. vii.. (1898) pp. 188-194.

2 A copy has been kindly presented to the Library of the Club by Mr. Harding—*Ed*

Luther and Gesner as "leech." Their reasons were that in Arabic writings, leeches were denoted by the words *Aleca*, *Aletha*, *Alag*, which approach the Hebrew word. The word "*Alak*" is used by the inhabitants of Cairo for the Leeches of the Nile. Other translators maintain that the Hebrew word means fate or destiny (37).[3]

The ancient Hebrews and Orientals were apparently unaware of the use of the Medicinal Leech (27). The Greeks and Romans used it in medicine, and early writings abound in references. Themison, an eminent physician of Laodicea in Syria, who lived about 100 B.C., is credited with being the first to use Leeches for medicinal purposes.

Brandt and Ratzeburg (8) give many references to early classical writings, and from these we learn that the ancients applied Leeches to wounds caused by rabid dogs, and in cases of bites and stings. Leeches were also used in cases of angina accompanied by dyspnœa, in hepatitis, and lumbago (*Aretæus*, Lib. ii., c. 6). Liver troubles, headaches, vertigo, epilepsy and piles were treated by the application of Leeches. One physician (*H. Mercurialis*) stated that the Leech made such a small hole that only the thinner portion of the blood passed out, while the thicker parts remained behind. This observation is interesting, as recent researches have shown that the Medicinal Leech secretes a fluid which prevents the coagulation of blood (*see* p. 67). In the Saxon Glosses of the 10th century the word "Sanguisuge" is translated as *læce, liche leche*, &c. In Chaucer's time the word Leech also meant a physician. Dr. Murray says that probably the words were at one time distinct, but were assimilated to *læce* through popular etymology.

In Queen Elizabeth's time Dryden uses the word to mean physician :—

"Wise Leeches will not vain receipts obtrude,
While growing pains pronounce the humours crude."

Bartholomeus Anglicus, a Minorite friar who lived in the early part of the 13th century, compiled an encyclopædia entitled *De Proprietatibus Rerum*. In an English translation of a later date we are told that

"The water leech sitteth upon venomous things, and therefore, when he shall be set to a member bycause of medicine, first he shall be wrapped

3 Numbers within brackets refer to the Bibliography at the end of the paper.

in nettles and in salt, and is thereby compelled to cast out of his body if he hath tasted any venomous thing in warm water."

Moufet, who lived about the middle of the 17th century, has a good deal to say about Leeches in his *Theater of Insects*, though most of his remarks are quotations from classical authors. He calls them all "Horsleaches,"[4] but it is evident that the Medicinal Leech is meant in many cases. Like all the naturalists of his time he was a firm believer in the doctrine of spontaneous generation and states that Leeches are bred from the mud of stagnant pools. He quaintly continues thus:

"Once bred they most greedily thirst after bloud, and therefore lie in wait at the very entrance of the pools, so that they may light upon Horses, Oxen, Elephants, etc., so soon as they come to drink for thirst of cold water. Pliny writes, that they are so troublesome to the Elephant, that the beast is by their tickling and sucking in his snout, almost mad; which doth manifestly show the wonderful power of Insects. For what is there greater than an elephant, and what is there more contemptible than a Horsleech? Yet the greatness and the wit of the Elephant must give way and yield to this worm."

After citing numerous cases of the cure of various diseases by bleeding with Leeches, Moufet goes on to state, on the authority of Gilbertus Anglicus, that certain diseases may be cured with the "ashes of Horsleeches boyled with storax":—

"For they are not only useful for men whilst they are alive, but when they are dead and burnt to ashes. Pliny reports that Horsleeches will black one's hair, if they be corrupted in black wine for sixty days; others bid us take one sextarius of Leeches and let them lie to corrupt in two sextarii of vinegar, in a leaden vessel for so many days and then to anoynt them in the sun."

It would seem that the use of this particular hair-dye has not always produced happy results, for Moufet adds:—

'Sornatius relates that this medicament is of so great force that unless they hold Oyl in their mouths that die the hair, it will also black their teeth."

The beauty doctors of those days found yet another use for this ingredient, and we are told that

"Meges writes that live Frogs putrified in vinegar will take off the hair, but the ashes of Leeches anoynted with vinegar will doe the same."

This belief seems to have survived for some time, for Fernie, in his *Animal Simples*, quotes from a book entitled a *Thousand Notable Things*:—

"It is ordered to take Horse leeches and burn them to powder, and

4 In the New Forest Medicinal Leeches are called "Horseleeches" and they feed on horses

mix them with eyesel; then use to rub the place therewith where you would have hair grow no more, and there will no hair grow in that place."

A curious statement occurs in Bullein's *The Booke of Simples* (Bullein was a native of the Isle of Ely and lived early in the reign of Henry VIII.).

"Horseleches are wholesome to draw forthe foule blood, if they are put into a hollow rede, and one of their endes cutte of, whereby the blood maie run forthe."

The old writers gravely warn people against the danger of swallowing Leeches. Pliny states that they were frequently administered to an enemy. It seems rather difficult to understand in what circumstances such a dose could be given without the victim knowing it. Several cures are prescribed, such as salt-water, vinegar and holding a moist sponge in the mouth. One of the methods recommended seems original. The patient is to get into a hot bath and hold cold water in his mouth, the Leech being supposed to be attracted by the latter.

Leeches were at one time considered to show changes of the weather, and were used as barometers. Dr. J. Forster says that Leeches confined in a glass of water by their movements foretell rain and wind, before which they seem much agitated, particularly before thunder. Dr. G. Johnston (32) says that he made many experiments to test this assertion, and came to the conclusion that such forecasts were not reliable.

Systematic position and general outlines of structure.—The class Hirudinea (Leeches) is a well-defined one, and is nearly allied to the Oligochaeta, to which the Earth-worms belong. Their worm-like form and segmentation are characters which suggest an affinity with the Oligochaetes, but Leeches are distinguished, as a rule, by the possession of two suckers, one at each end of the body, a more oval outline when viewed from above, and a dorso-ventral flattening of the body. It is interesting to note that the members of a family of Oligochaetes —the Discodrilidæ—are parasitic in habit, one species being found on the gills of crayfish.

The number of transverse rings which cross the body exceed the number of somites or body segments, and the number and arrangement of rings and somites are of great importance in classification. The extent of each somite can usually be defined by noting peculiar external markings on the dorsal surface,

which are repeated at intervals—each repetition corresponding to a somite. The number of rings to a somite is greatest in the middle region and decreases towards the extremities, where a somite may possess only one ring.

Distinct patterns are often to be recognised on the dorsal surface, and where these are of use in the identification of species attention will be called to them.

A well marked sucker, disc-like in form, is to be seen at the posterior extremity. The mouth functions as an anterior sucker, but it is not, as a general rule, disc-shaped.

The eyes appear as black spots and are placed on the posterior surface over the mouth region. They vary in number from one pair to five pairs, and their number and position are of great value in the determination of species.

The alimentary canal consists of a straight tube extending from the mouth to the anus, the latter being situated on the dorsal surface, a little in front of the posterior sucker. The alimentary canal is often provided with lobes which serve to store the food until digestion is completed.

In certain species the mouth is provided with three jaws which are armed with a large number of teeth. Others again do not possess jaws, but have an extensile proboscis. A third series have neither jaws nor proboscis. These characters serve to divide the class in the following manner.

Sub-order I. RHYNCHOBDELLÆ (Without jaws, but with an exsertible proboscis.)

Family I. ICHTHYOBDELLIDÆ. (Body cylindrical in fresh-water species. Anterior sucker discoidal. Eggs enclosed in capsules attached to foreign bodies and left by the parent to hatch.)

Family 2. GLOSSOSIPHONIDÆ. (Body ovate, flattened, never cylindrical. Anterior sucker not conspicuous. Eggs deposited in thin capsules either fixed to a foreign body or to the body of the parent, but, until hatched, always brooded by the parent, to whose body the young then attach themselves.)

Sub-order II. ARHYNCHOBDELLÆ. (Without a proboscis.)

Family I. GNATHOBDELLIDÆ. (With jaws.)

Family II. HERPOBDELLIDÆ. (Without jaws.)

Space will not permit me to enter into a description of the vascular, excretory and nervous systems. These are fully

treated of in standard zoological text-books. It may be remarked, in passing, that these systems are of the same general type met with in Annelids.

Leeches are hermaphrodite, and the canals carrying the genital products open on the ventral surface of the body. The male genital pore is anterior in position to the female genital pore, and the number of rings separating the two is a very important character. It has been pointed out by Goddard (18) that all the members of any genus, from whatever part of the world they are taken, fall into two groups, one of which has the genital pores separated by one ring, while in the other group two rings intervene.

Habits and Life-History.—Harding gives the number of species of British Leeches as fourteen. Of these three are marine and the remainder live in fresh-water or in fairly damp places. The true land-leeches belonging to the genus *Hæmadipsa* are not represented in Britain.

The fresh-water leeches are found in ponds and streams, under the leaves of water plants, and under stones and logs. They all travel by a looping movement with the alternate application of the suckers to solid bodies. The members of the group Arhynchobdellæ are able to swim about by undulating their bodies in an eel-like fashion, but this power is not possessed by the Rhynchobdellæ.

The eyes of leeches, although simple in structure, are capable of recognising the varying intensity of light. Prof. Whitman (45) observed that when a shadow was cast over a dish containing a number of hungry Clepsines, they immediately raised the anterior end of the body as if in search of prey. When a turtle was placed in the dish they immediately fixed themselves upon it and began to feast. The attention of the Medicinal Leech may be attracted by striking on the surface of the water with a stick, or splashing the water. This is similar to what occurs when cattle and horses go to drink. Ebrard (14), p. 92, states that when the leech gatherers agitate the water with their feet, the leeches rise to the surface, remain there a moment, and then swim towards the men. He says that they are not guided by sight, but by the direction of the impulses given to the water. He confirmed this by pushing the water in a tank

containing leeches, in such a manner as to reverse the direction of the impulses. The leeches swam away from him.

Each species seems to have its favourite diet, and in some cases the variety of food is very limited. *Piscicola geometra* and *Hemiclepsis marginata* are parasitic, as a rule, upon fresh-water fish. It has recently been demonstrated by Miss M. Robertson (38) that certain trypanosomes found in the blood of perch, bream and goldfish complete their life-cycle in the latter species of leech. *Protoclepsis tessellata*, the Chequered-leech, feeds upon the blood of various species of ducks. The favourite food of the two British species of *Glossosiphonia* is fresh-water Gastropods. The members of the group, Arhynchobdellæ, with the exception of the Medicinal Leech, prey upon worms, aquatic larvæ, frogs and sickly fish, indulging in a comparatively varied diet. The Medicinal Leech is the only British species which is able to pierce the skin of mammals. This specialisation in diet is correlated with peculiar modifications in the physiological processes of digestion and in the structure of the alimentary canal. Haycraft (24) has shown that a fluid is secreted in the mouth which prevents the coagulation of the blood. It was found that the action was the same in the case of the blood of the rabbit and dog as in that of man. The secretion is, however, unable to prevent the coagulation of crustacean blood. The alimentary canal of the Medicinal Leech is provided with lateral pouches which serve for the storage of food. Spiess (41) has shown that specialisation extends further than this. Special muscles are developed in the pharynx which enable suction to be performed. The ordinary digestive ferments are not secreted and the intestinal epithelium is the same in character throughout almost its entire length. Comparing this with the digestive tract of its near ally, the Horse-leech (*Hæmopis sanguisuga*), whose diet consists partly of solid food in the form of earthworms and similar creatures, and partly of the blood of frogs and large worms, we find a different state of affairs. No anti-clotting secretion is present, the alimentary canal is not provided with lateral pouches, and special muscles for the purpose of suction are not present. Moreover, the intestinal epithelium secretes digestive ferments and the epithelium is differentiated in the various regions.

Leeches show some very remarkable features in their modes

of reproduction. As stated above, they are hermaphrodite, but self-fertilization does not take place. The spermatozoa are enclosed in a case or spermatophore, the shape of which depends upon the species. Generally speaking, they are lance-shaped and are driven through the skin of another individual. The precise spot at which they are introduced is immaterial, but it is generally on the dorsal surface and in the region of the clitellum. A portion of the spermatophore remains projecting from the body for some time after impregnation. The spermatozoa enter the body cavity and gradually make their way to the ovaries. Phagocytes are produced by special phagocytic organs, and it has been suggested that the former consume empty follicles and excess of spermatozoids which may remain after the period of egg-producing is over. In some cases the injection of the spermatozoa is brought about by the elasticity of the walls of the spermatophore, in others the ejaculatory canals furnish the necessary force. Impregnation and deposition of the cocoon has been studied in detail by E. Brumpt (10). The descriptions given below are taken chiefly from his paper.

From some observations made by the writer on specimens of *Herpobdella*, about six days elapsed between impregnation and the deposition of the first cocoon. Brumpt states that the average period is two days in the case of *H. atomaria*. The period is much longer in some other species. A specimen of *Protoclepsis tessellata*, taken by the writer on May 6th, did not lay eggs until the middle of June. The period in this case must have exceeded five weeks.

In order to describe the process of cocoon laying, I cannot do better than give a free translation of Brumpt's description of what he observed in the case of *Piscicola geometra*. A suitable spot having been chosen, the *Piscicola* fixes itself by the two suckers and applies its body to the wall of the vessel. The white cuticle formed by the clitellum is gradually detached from the skin and looks like a large annular blister. The animal then fixes the band to the glass and, relaxing its anterior point of support, rolls itself around on its axis, evidently endeavouring to remove the band from the body. At intervals it takes a rest, allowing the fore part of the body to hang limp, a position which gives the animal an air of exhaustion. When the animal

is satisfied that the cocoon is firmly fixed, it withdraws the body in the following manner. A wave of dilation passes forward along the body, enlarging the posterior orifice of the cocoon, which is thereby detached at its hinder part. The fore part of the body is then drawn backwards, but instead of simply passing out of the sheath, it brings the two extremities of the cocoon into contact, by a process of invagination. The body is withdrawn and in less than a minute the cocoon assumes its natural egg-like shape without the help of the leech. In the case of *Herpobdella* the animal presses down the margins with the aid of the anterior sucker and fixes the edges by means of a secretion. This produces the oval, dome-shaped cocoon characteristic of this species, in which the apertures through which the body has passed may be seen in the form of two dots—one near each end of the cocoon. Brumpt goes on to say: At the moment when the cocoon is deposited the anterior part of the body, contaminated with bacteria, infusoria and a number of other impurities, is not brought into contact with the contents of the cocoon. It would seem that a paradoxial problem had been solved, viz., to pass through an albuminous mass without touching it. The cocoon is deposited with due regard to aseptic precautions.

All the members of the Sub-order Arhynchobdellæ deposit cocoons which receive no further attention from the animal. The same statement, of course, applies to *Piscicola geometra*, described above. A group of leeches forming the Family Glossosiphonidæ carry the eggs on the under side of the body in some cases, and in others the eggs, though deposited on foreign bodies, are brooded over by their parents. The young when hatched attach themselves to the body of the parent and are carried about for some time. A primitive maternal instinct seems to have been developed in some instances. A specimen of *Protoclepsis tessellata*, taken by the writer, laid 36 eggs on the side of a glass tank and brooded over them. When prodded with a pen holder, the mother struck out viciously. Unfortunately the eggs never hatched, but some months afterwards three small specimens of the same species were placed in the tank with the adult. Two of them immediately attached themselves to the underside of "her" body. The third, which was a little larger, refused to seek protection of a foster-parent.

Since observing this, I find that a Russian naturalist, Moltschanov (36), noted that when the young of *Hemiclepsis marginata* were taken from their parents, they crept about until they met with some other leech (not necessarily of the same species) to which they attached themselves. I have failed to observe any evidence of the maternal and filial instincts in species which deposit their eggs in cocoons, which are left to their fate, receiving no further attention from the parent.

Economic uses, &c.—The only British leech which is of any economic importance is the Medicinal Leech (*Hirudo medicinalis*). It is seldom used now, but was a favourite agent for blood letting during the first half of the nineteenth century. Leuckart (35) states that in 1863 seven million leeches were used in London alone, and France consumed between twenty and thirty millions in 1846.

Leech-gathering was at one time a fairly common pursuit in this country. It was carried on by the poor, especially old people, women and children. Dalyell (12) remarks that "a lady in the county of Fife is the reputed owner of a pond containing Medicinal Leeches, which she reserves exclusively for the poor." Johnston (32) (p. 310) says that an old woman (Mrs. Darling) used to collect Medicinal Leeches in a small lakelet at Whitehall, near Chirnside—this was from 1808-1825.

Wordsworth, in his poem *Resolution and Independence,* written about 1807, describes the leech gatherer as a very old man.

"He told that to these waters he had come
To gather leeches, being old and poor:
Employment hazardous and wearisome!
And he had many hardships to endure;
From pond to pond he roamed, from moor to moor."

Medicinal Leeches were evidently becoming scarce at this period, for the poem continues :—

"He with a smile did then his words repeat;
And said, that, gathering leeches far and wide
He travelled; stirring thus about his feet
The waters of the pool where they abide.
'Once I could meet with them on every side;
But they have dwindled long by slow decay;
Yet still I persevere, and find them where I may.'"

The extensive use of Medicinal Leeches at the beginning of the 19th century resulted in the formation of a thriving industry all over Europe.

The methods adopted for the capture of leeches were various, and some are of interest.

The most primitive mode of capture was for the gatherers to wade into the pools bare-legged and splash the water. This causes the leeches to rise to the surface, and some were caught by hand; others of course fixed themselves to the gatherers' legs and were subsequently detached. The fact that medicinal leeches rise to the surface when the water is splashed is hinted at in Wordsworth's poem already quoted, for the old leech-gatherer

> ....." the pond
> Stirred with his staff, and fixedly did look
> Upon the muddy water, which he conned
> As if he had been reading in a book".

In Russia, and on the frontiers of Prussia, the men stripped to the waist, but near Smyrna the gatherers stripped entirely, in order to offer a greater surface of attraction. It was found that the chest and limbs were the favourite places for the leeches to attack.

More scientific methods of capture were practised on the Continent, and especially in France. In some cases the leeches were made to rise by splashing with rods and were caught in nets of horse hair attached to the end of a light pole. The gatherers very often wore flannel trousers or top-boots. Baits in the form of bodies of animals and pieces of meat were also used. Lines covered with blood served as an excellent bait.

On the approach of storms and during persistent rain, leeches do not rise readily, and on these occasions the mud from the pond is scooped up in large wooden spoons, the contents of which are carefully examined.

The horns and hoofs of cattle were used in certain parts of Germany; the leeches crawling into the hollows.

The best time of the year for leech gathering was in spring and late autumn. The leeches leave the water towards the end of July and beginning of August, in order to deposit their cocoons in moist earth.

The large consumption of leeches in Europe almost led to their extinction. The following quotation from a writer (40) in the *Pharmaceutical Journal* in 1870 shows the state of affairs at that time :—

" France is now obliged to seek leeches from the adjacent countries, Switzerland, Belgium, the Sardinian States and Greece. Spain and Portu-

gal, which used to export, are now obliged to draw supplies from abroad. It is the same in Italy. Tuscany exports some leeches, but they are considered of an inferior quality. Bohemia, which used to furnish supplies, now possesses only exhausted marshes. Hungary, so rich in leech morasses, commences to be impoverished of the kinds which the dealers used to send as far as the frontiers of Russia and Turkey, Poland and other countries in the north of Europe. Great Britain, which used to be rich in leeches, is now forced to draw supplies from France, Germany and Portugal."

Legislation in France and Germany followed, relating to exportation and closed seasons. The French encouraged the establishment of breeding grounds, and the Société d'Encouragement pour l'Industrie Nationale gave several medals and prizes. The first to breed leeches successfully in France was, according to Ebrard (14), an illiterate butcher, of Dompierre, named Micholet. He was an excellent observer, and by carefully imitating the conditions under which the leeches lived naturally he raised large quantities of these animals. His efforts were rewarded by the Society named above, which gave him a medal and a prize.

Briefly, leech-culture consisted in placing mature and overfed leeches (termed *vaches*) in suitable ponds and artificial sheets of water. Cocoons were deposited in the banks and in due time the young (*germements*) hatched out. As soon as they grew large enough to be retained in the meshes of the net used in fishing for them, they were called *filets*. The young are able to draw blood from frogs, newts and man also immediately after escaping from the cocoon. The leeches were then fed on blood for about three or four years, when they were ready for market.

Several books on leech-culture were published in France, the more notable being those of Moquin-Tandon (37), Ebrard (14), Vayson (43), Fermond (16) and Laurens (33). From these authors we gather that the most suitable sheets of water are those having a sloping bottom of sandy clay. This would allow aquatic plants to flourish in the shallower parts, and the deeper parts would serve as retreats during periods of heat or cold. Medicinal Leeches seem to flourish best in ponds in which the following plants grow readily, viz. :—*Glyceria fluitans, Potamogeton natans,* Carices of various species and *Chara hispida.* The pond should be supplied with water from a stream or another pond or with rain water, as water taken

direct from springs is too cold. Little islands should be provided with plenty of peat so that the cocoons may be deposited without the animals being disturbed. Various methods of feeding were adopted. A favourite method was to drive into the water poor worn-out horses, asses and mules. Later, more healthy animals were used, and frequently changed. Less repulsive methods were to place the leeches in small flannel bags and take them to slaughter houses, where the bags and their contents were placed in blood which had been defibrinated by beating. The bags serve as points of support, without which leeches are unable to suck. Another plan was to spread blood on boards which were floated on the pond, and the attention of the leeches was attracted by striking the surface of the water. Some of the "farmers" fed their stock by throwing frogs and newts into the water. We learn that the *vaches* require feeding about once a year, medium sized leeches (*moyennes*) about twice and the *filets* about three or four times. Food is given to the leeches as soon as they emerge from their winter quarters. Towards the breeding season (about June), feeding is discontinued and is not resumed until September when the cocoon laying is over.

The young leeches have many enemies, among which are moles, shrews, voles, hedgehogs, ducks, storks and herons Certain fish[5] and aquatic larvæ like *Hydrophilus* do a great deal of damage. Their own kind also attack them, Horse-leeches and Dutrochet's leech either cut them in two or swallow them whole. Even the harmless snail leeches suck them when young and tender.

Leech-farming does not seem to have been practised in England, but in Ireland, in Co. Wexford, Lord Desart let a piece of marsh land of about 40 acres to a company of Frenchmen for the purpose of leech-culture (Simmonds, 40). The ponds were prepared and the crops sown, but I have not been able to trace the later development of this venture. Dr. Scharff (39), p. 193, says : "I have never seen an Irish Medicinal Leech, and my efforts to get a specimen have hitherto proved fruitless," but O'Flaherty in his "West or H.-Jar Connaught" refers to them (they are called *dallog* in Irish) as being common on the south side of Lough Mask in 1684, and the late Sir W. Wilde stated

5 Mr. Blair tells me that he placed some young medicinal leeches with carp, expecting the leeches to feed on the carp, but perversely the carp fed on the leeches.

that in 1849 they were still found in pools and wells in the vicinity of the same lake. He also mentions that in summer the leech-gatherers sat with their legs in the water and the leeches fastened on them.

The supply of leeches in France at one time ran so low that Algerian leeches (*Hirudo troctina*) were imported. Their use was at first forbidden, but careful and extensive experiments showed that no harm followed their application. These Algerian leeches have a number of red spots, and a faint similarity to the uniform of the French dragoon suggested the name of "le dragon d'Alger." They were also used in England, where they were called "Trout-leeches."

Mr. E. M. Holmes, F.L.S., tells me that only one firm in London now imports leeches regularly. They are used in infirmaries and hospitals and in physiological laboratories, where the secretion "hirudin" is extracted and used to prevent the clotting of blood in various experiments. A medical friend informs me that they are still used in the East of London by the alien population in cases of neuralgia, gumboils, etc. The non-alien population sometimes use them for curing "black eyes."

Methods of capture and preservation of specimens.—Leeches should be sought amongst aquatic plants growing in ponds and streams and under submerged twigs and stones. It is best to bring them home alive, and they may be easily carried in corked tubes or bottles with a little water. Mr. Harding writes me that a good plan for obtaining the small species is to place quantities of weed in large aquaria. After two or three days the leeches crawl to the sides and may be picked off. Identification should be attempted before killing the specimens. The small species may be narcotised with soda water from a siphon, and if they are not kept too long in the carbonated water they will revive on being transferred to fresh water. For the larger species, the writer found that by carefully adding methylated spirit to the water they are in, the animals become narcotised. Mr. Harding advises immersion in water at about 120° F. For the preservation of colour and markings a 5% solution of formalin is best. Specimens required for histological work need different treatment. Castle (11) recommends the following method :—"Stupefy in soda-

water and kill in Perenyi's fluid at about 70° C. For whole preparations use Mayer's hydrochloric acid carmine (70% alcoholic). Decolorize in 1% hydrochloric acid in 70% alcohol until specimens have a light rose colour. Then wash in neutral alcohol, clear in cedar oil and mount in balsam."

LIST OF BRITISH SPECIES OF FRESH-WATER LEECHES.[6]

Sub-order I. RHYNCHOBDELLÆ

Family I. ICHTHYOBDELLIDÆ.

Piscicola geometra, Linn.

Family II. GLOSSOSIPHONIDÆ.

**Protoclepsis tessellata*, O.F.M.

**Hemiclepsis marginata*, O.F.M.

**Glossosiphonia heteroclita*, Linn.

**G. complanata*, Linn.

**Helobdella stagnalis*, Linn.

Sub-order II. ARHYNCHOBDELLÆ.

Family I. GNATHOBDELLIDÆ.

**Hæmopis sanguisuga*, Linn.

Hirudo medicinalis, Linn.

Family II. HERPOBDELLIDÆ.

**Herpobdella octoculata*, Linn.

**H. atomaria*, Carena.

**Trocheta subviridis*, Dutrochet.

**Indicates species recorded from Essex.*

Piscicola geometra, Linn. "Fish-leech." PLATE VI., FIG. 1.

Description.—Body slender, cylindrical and semi-transparent. From 20–30 mm. long. Has well marked anterior and posterior suckers, the former with two pairs of eyes. Posterior sucker has 14 dark rays with a black spot in each of the intermediate areas, and is about twice the diameter of the hinder portion of the body. Colour greenish, yellowish or brownish, with a pair of lateral, pulsating vesicles on each somite of the posterior region. Body dotted with small dark spots. Complete somite with 14 rings.

Habits, etc.—Very active. Attaches itself to weeds and stones by the posterior sucker and waves its body about until prey comes within reach. It can swim well. It attacks most

6 The classification and nomenclature adopted is that of Harding. See p. 65 for family characteristics.

species of fresh-water fishes, and may remain on its host for some days. It is fairly common in trout fisheries.

The cocoons are deposited on water plants, and each cocoon contains one egg. According to Brightwell (9) the cocoons are laid within 24 hours of copulation and the young are hatched 30 days after deposition of cocoon.

Distribution.—So far this species has not been found in Essex, but it probably occurs.

Britain :—R. Thames, Bourne End (Blair) ; R. Wensum (Brightwell, 9) ; Eckington Canal (Evans, 15).

Ireland :—N. Ireland; R. Dodder, Co. Dublin (Scharff, 39).

Foreign :—Widely distributed in Europe.

Protoclepsis tessellata, O.F.M. (*Clepsine tesselata*). The Chequered Leech. PLATE VI., FIG. 2.

Description.—Body flattened, translucent. Large specimens have a brownish tinge, smaller ones are greyish and sprinkled with fine black dots. When extended the body tapers slightly towards the anterior end, but when contracted it is ovoid in outline. Length of adult about 25mm. The body has on its dorsal surface six well marked longitudinal rows of greenish grey dots, while smaller dots are distributed irregularly. The head has four pairs of eyes which are placed in two parallel rows. Complete somite consists of three rings. The genital openings are separated by *four* rings.

Habits.—Small specimens taken by the writer were very active, but a very large one measuring 30 mm. long and 13 mm. across when contracted and 55 mm. long when stretched was very sluggish in its habits. It is found on weeds and under stones. It drags the body along without raising it from the ground, and is unable to swim. Accounts of the egg-laying habits of this species differ considerably. The large specimen mentioned above deposited in June 36 eggs in 3 cocoons on the bottom of the tank and then brooded over them. The young when hatched attach themselves to the parents' body (*ante* p. 69). Houghton and O. F. Müller state the number of young as 200 and 300 respectively, but it does not necessarily follow that all the young attached to the body of an adult are offspring of that individual.[7] This species is parasitic upon ducks and other water-birds. Examples have been taken from wigeon, teal, long-tailed duck and domestic duck, the favourite

7 Mr. Blair furnishes me with the following note. " A specimen of this species laid 250 eggs in three cocoons and hatched them all, but had to reject 100 as there was not room for them to attach themselves to the parent. They hatched about 20 days after deposition."

places of attachment being the breast plumage, nasal cavities and œsophagus. De Guerne (20) has shown that migrating ducks may aid in the distribution of the species.

Distribution.—Britain :—R. Stort, near Little Parndon ; E. London Waterworks, Tottenham ; Botanic Gardens, Regent's Park ; Staines (H. W.) ; Histon, near Cambridge (Harding, 21) ; R. Thames, Bourne End ; New Forest (Blair) ; Aldenham Reservoir (Miss Robertson, 38) ; Shropshire Union Canal (Houghton, 28) ; Costessey, Norfolk (Brightwell, 9) ; Holy Island Lough (Johnston, 32) ; Coldingham Loch, Berwickshire, Cos. of Edinburgh and Linlithgow and the Isle of Bute (Dalyell, 12).

Ireland :—Lough Neagh (Thompson, 42) ; Clonbrock : Santry, Co. Dublin ; Glenomeragh, Co. Clare (Scharff, 39).

Foreign :—Germany (Johannson, 30), France, Denmark, Sweden, Finland, Prussia, Austria and Hungary ; Chili (Blanchard, 33).

Note.—An allied species, *P. meyeri*, has been recorded from Western Europe. It differs from *P. tessellata* in the fact that the genital apertures are separated by *two* rings.

Hemiclepsis marginata, O. F. Müller (*Clepsine marginata*). Plate VI., Fig. 3.

Description.—Body flattened, claviform, more or less transparent. The anterior portion bears two pairs of eyes and is spade-like in form. Colour olive green or yellowish. Seven longitudinal rows of yellow spots run along the back, the ventral surface is without spots. The posterior sucker has reddish brown rays with yellow spots between. Length from 20 to 30 mm., and breadth from 2.5 to 5 mm.

Habits.—A fairly active leech which creeps about quickly, but is unable to swim. Is found amongst water plants and on the under surfaces of stones. It is parasitic upon fish and when once attached may remain upon its host for some days. It is an agent in the transmission of certain trypanosomes which infest fish (*ante* p. 67). A specimen taken in May 1911 had 12 eggs attached to the under surface of the body. Another specimen taken at Bletchingley in April 1912, had 60 eggs. On hatching they attached themselves to the mother, but left her about three weeks later. They were then about 10 mm. long, and attached themselves to foreign objects by the dorsal sucker and waved their bodies about as if in search of prey.

Distribution.—Britain :—Lake, Regent's Park ; Wake Valley,

Epping Forest (per Mr. C. H. Bestow); nr. Clacton (per Mr. Picton); Bletchingley, Surrey; Higham's Park Lake[8] (H. W.); Elstree (Robertson, 38); Histon, Cambridge (Harding, 21); New Forest; R. Thames, Bourne End; R. Roding (Blair); Bala Lake, Solihull, Warwickshire (Houghton, 25); Shropshire Union Canal (Houghton, 28). This species has not been recorded from Ireland.

Foreign:—France, Denmark, Prussia, Hungary, Poland, Russia, Italy (Blanchard, 7); S. Norway (Jensen, 29).

Glossosiphonia heteroclita L. (*Clepsine hyalina*,Moq.-Tan.) PLATE VI., FIG. 4.

Description.—Body yellowish, almost transparent. Length 6—12 mm., breadth 2–4 mm. Three pairs of eyes, the anterior pair being very near to each other, and separated from the next pair by one or sometimes two rings. The dorsal surface has often longitudinal rows of faint, brownish interrupted stripes.

Habits.—This is a sluggish species and is found chiefly upon water plants. It attacks the smaller mollusca. Harding states that it breeds in June and July and may lay as many as 60 eggs which are attached to the underside of the parent.

Distribution. — Britain: —Walthamstow Reservoirs; near Staines (H. W.); near Norwich (Brightwell, 9); Scilly Isles (W. Blair). Probably widely distributed, though it has not yet been recorded from Scotland.

Ireland:—Belfast; Clonbrock, Co. Galway; Tempo, Co. Fermanagh (Scharff, 39).

Foreign:—Germany (Johannson, 30); S. Norway (Jensen, 29); Italy, Central Europe (Blanchard, 7); North America (Castle, 11.)

Glossosiphonia complanata L. (=*sexoculata*). PLATE VI., FIG. 5.

Description.—Body flat, ovate elliptical in outline. Greenish or brownish in colour with variable colours and patterns on the dorsal surface. Dorsal surface with six longitudinal rows of yellowish papillæ. The two innermost rows have the spots joined by longitudinal dark brown lines, commencing at the 5th somite. The ventral surface has two uninterrupted longitudinal bands. Length 15–30 mm., breadth 5–10 mm.

Harding states that the three following forms may be distinguished:—

"A. Body greenish, the six dorsal rows of yellow spots well marked (typical form).

8 Found by Mr. A. C. Akehurst on the occasion of a visit of the Quekett Microscopical Club. A variety *striata* may occur in this country. It is distinguished by having blackish transverse stripes on every third ring

"B. Body brown, the brown pigment being disposed in the form of minute longitudinal and transverse striae; the six dorsal rows of dots more or less dispersed into irregular blotches.

"C. Body olive brown or brown, the pigment not striated, the longitudinal dark brown lines less distinct; without spots in regular rows; the anterior pair of eyes sometimes absent."

Habits.—This species is very sluggish and rolls itself up like a wood louse when touched. It is of common occurrence in ponds and streams on water plants and under stones and twigs. It is parasitic upon water snails—*Limnæa* and *Planorbis*. Harding says that it also attacks larvæ of *Chironomus* ("Bloodworms"). The eggs are laid during April and May, about 50 being produced. The eggs are carried by the parent on the under side of the body, and are hatched in about 10 days. The young attach themselves to the body of the mother, but frequently leave her to make little excursions on their own account.

Distribution. — *Britain*:—Common everywhere. R. Stort; Walthamstow Reservoirs; nr. Clacton (per Mr. Picton); Higham's Park; ponds, Epping Forest; R. Roding, near Abridge (specimens from this locality are nearly all var. B.); New Barnet; R. Chess; Totteridge; Bletchingley, Surrey; Staines (R. Colne, var. B.); Seven Arches, Leeds (H. W.); Carlisle (Friend, 17); R. Porter, Yorks (Evans, 15); near Norwich (Brightwell, 9); R. Whiteadder, Berwicks (Johnston, 32); Scilly Isles (W. Blair).

Ireland:—Dingle and Ventry, Co. Kerry; Tempo, Co. Fermanagh; Clonbrock, Co. Galway; Cashel, Co. Tipperary; Lough Neagh and Coleraine; Holywood and Belfast, Downpatrick (Scharff, 39).

Foreign:—Germany (Johannson, 30); S. Norway (Jensen, 29); Italy, Spain, Hungary, France, Sweden, Denmark, Saxony, Bohemia, Russia, Siberia, America (Blanchard, 5).

Helobdella stagnalis L. (=*Clepsine bioculata*). PLATE VI., FIG. 6.

Description.—Body flat, lanceolate, nearly transparent and of a greyish or greenish colour, with fine black spots. Length from 8–12 mm. long and 2–4 mm. across. One pair of eyes. A characteristic feature is a brown, chitinous plate situated in the middle line on the dorsal surface between rings 12 and 13. This plate often has a colony of *Epistylis* upon it, and is the remains of a byssus-gland which serves to attach the young to the body of the parent before the suckers are developed.

Habits.—This species is very active and is common in ponds,

ditches and sluggish streams, chiefly among aquatic plants. Its favourite food is the larva of *Chironomus* ("Bloodworm"). The whole contents of the body are sucked out and the empty skin left. It is said to attack small worms, injured fish, frogs and newts. It is able to creep along by the aid of the surface film. The eggs are laid in May and June and are attached to the body of the parent.

Distribution.—Britain :—Walthamstow Reservoirs ; Higham's Park ; R. Stort ; R. Roding, near Abridge ; Chigwell Row ; Botanic Gardens, Regent's Park ; Totteridge ; R. Chess ; Seven Arches, Leeds ; R. Wharfe, near Grassington (H. W.) ; R. Porter, Yorks (Evans, 15) ; near Carlisle (Friend, 17) ; Holy Island Lough (Johnston, 32) ; Bavelaw, near Edinburgh (H. W.) ; Scilly Isles (W. Blair).

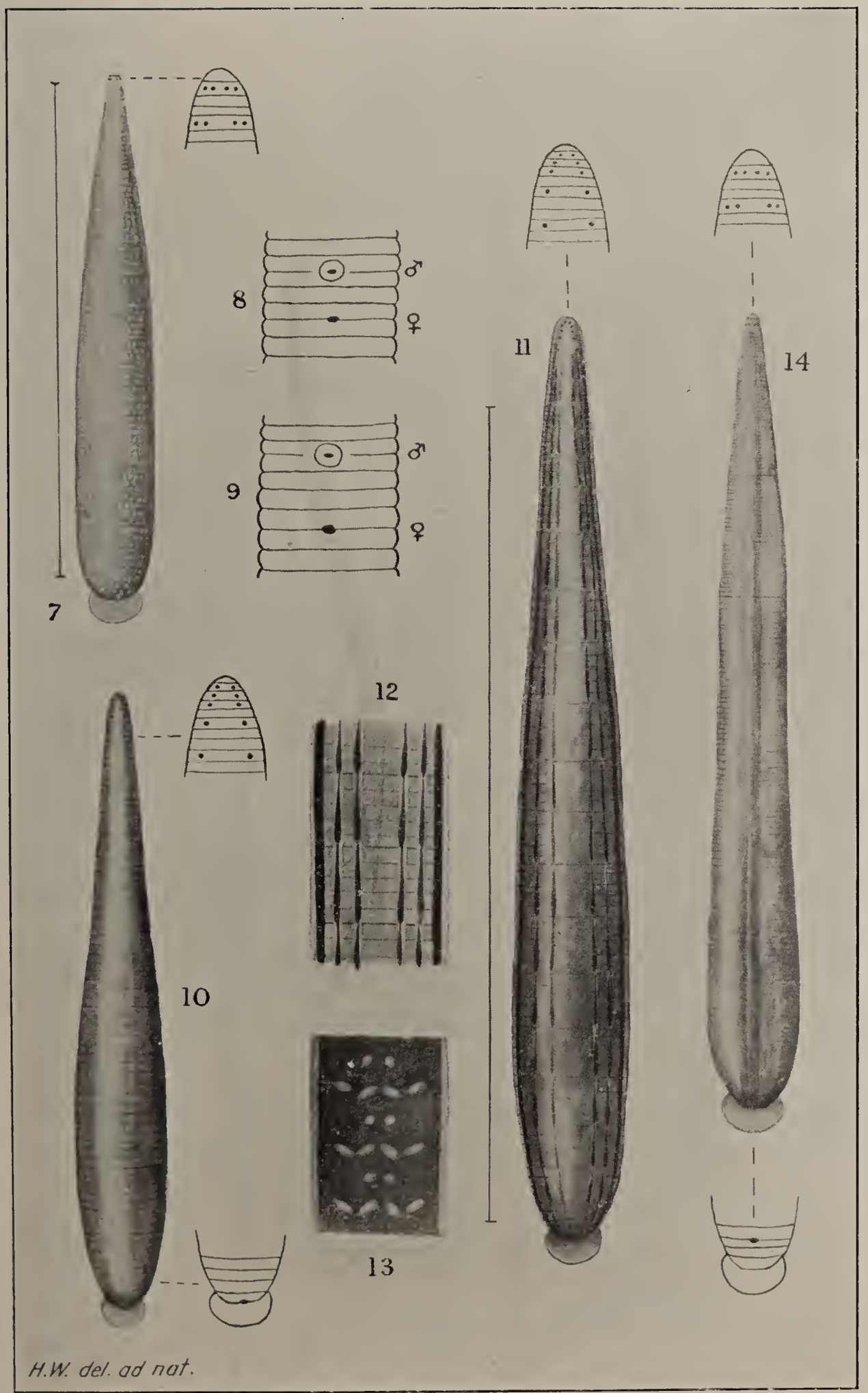
Ireland :—Lough Neagh (Thompson, 42) ; Co. Antrim ; Co. Fermanagh ; Co. Dublin (Scharff, 39).

Foreign :—Germany (Johannson, 30) ; S. Norway (Jensen, 29) ; Italy, Spain, North and Central Europe (Blanchard, 7) ; Western Asia ; United States from Atlantic to Pacific coasts and S. America (for references see Harding, *loc. cit.*, p. 164).

Hæmopis sanguisuga L. (=*Aulastomum gulo*). The Horse Leech. PLATE VII., FIG. 10.

Description.—Body elongate, slightly flattened. Dorsal surface generally of uniform tint, brownish or greenish. There is often a lateral yellowish band and the ventral surface is of a yellowish grey colour, spotted with irregular black, patches. Young individuals are of a grayish tint, finely speckled with black, and have a faint geometrical pattern on the dorsal surface. Length from 100–150 mm., and breadth from 8–12 mm. Five pairs of eyes are present. The anus pierces the last ring (cf. *Hirudo medicinalis* and *Trocheta subviridis*).

Habits.—This species is to be found in the mud of ponds and slow streams. It frequently leaves the water for the purpose of depositing its cocoons, or for obtaining food. It is unable to draw blood from a mammal and lives chiefly upon earthworms, aquatic larvæ and any other small creatures that it can capture and swallow. It will also suck weak frogs and newts. This species has been confused by earlier writers with *Hirudo medicinalis* and *Limnatis nilotica*, both of which are able to pierce the skin of horses, cattle and human beings. The cocoons are about 15 mm. long and 12 mm. broad and are surrounded by spongy tissue.



ESSEX LEECHES.

(For explanations, see Text.)

Distribution.—Britain :—Generally distributed. Near Clacton (per Mr. Picton) ; Epping Forest ; Chigwell Row ; R. Stort (H. W.) ; Finchley, Hampstead, Muswell Hill, Walthamstow, Tottenham, Totteridge (W. Blair) ; near Norwich (Brightwell, 9) ; Eckington Canal (Evans, 15).

Ireland :—Common (Scharff, 39).

Foreign :—Occurs throughout the greater part of Europe, and is found in Transcaucasia and Syria (Blanchard, 6).

Hirudo medicinalis, L. (=*Sanguisuga officinalis*, Sav.). The Medicinal Leech. PLATE VII., FIGS. 11-13.

Description.—Body elongate and slightly flattened. The dorsal surface has a well marked pattern with three pairs of longitudinal yellowish bands. The lateral pair has an uninterrupted inner band of dark brown, while each of the median and intermediate pairs has an interrupted band of dark brown running down the middle. The ground colour of the dorsal surface is usually a dark olive green, but may be slatey grey or reddish brown. The ventral surface is dark brown with irregular grayish green patches. Length 100–150 mm., and width 10–15 mm. Another specimen when extended measured 250 mm. long and 30 mm. wide. (I am indebted to Mr. Wm. N. Blair, jun., for two specimens taken in the New Forest in 1911, from which the above description has been written.

Habits. (See pp. 70-74.)

Distribution.—Britain : — Near Norwich (Brightwell, 9) ; Christchurch, Hants ; Weymouth (Johnston, 32) ; Loch Leven ; L. Fleury near Blairnlone, near Comrie ; L. of Monteith ; Gartincebar (Dalyell, 12) ; New Forest (W. N. Blair, 1911).

Ireland :—Lough Mask (Scharff, 39).

Foreign :—Germany (I. of Borkum and Thuringia, Johannson, 30) ; Italy (Blanchard, 7).

Herpobdella octoculata (=*Nephelis octoculata, L.*). PLATE VII., FIG. 9.

Description.—Body elongate, slightly flattened. Colour brown or reddish brown on dorsal surface, lighter beneath. Colour generally uniform. Length 20–50 mm., and width 2–5 mm. The clitellum is often well marked. Genital openings separated by 4 rings (see Plate VII., Fig. 9). Somite V is triannulate. Eight eyes, 4 in the first ring and two pairs in the 5th, as in *H. atomaria.*

Habits.—Lives in mud in stagnant ponds, on weeds and under stones in running streams. This is a very common species and has often been confounded with *H. atomaria.* It preys upon the smaller aquatic worms and insect larvæ. The cocoons are elliptical in outline (4-6 mm. long and 2-4 mm. wide), are

flat and of a brownish colour. They are deposited on leaves and stems of plants, sticks, stones, etc. The mode of fertilization and the manner in which the cocoon is fixed are described on p.p. 68-69. Breeding takes place from May to October. Rawlins Johnson (31) states that one individual deposited 12 cocoons during a period of 21 days. Each cocoon contains from 6-12 ova, and the period of incubation extends 30 to 70 days according to the state of the weather.

Distribution.—As this species is so often confused with *H. atomaria*, it is impossible to know to which species the records belong. It is very widely distributed, however. The writer has taken specimens from the following localities:—Epping Forest, near Abridge in stagnant pond, Richmond Park, Chalfont St. Peters, Staines.

Herpobdella atomaria Carena (*Nephelis vulgaris*). PLATE VII., FIGS. 7 and 8.

Description.—Very much like *H. octoculata*, but lighter in colour and with yellowish spots on the dorsal surface. The first ring of each somite is much lighter in colour than the others. In this species the genital pores are separated by three rings (Plate VII., Fig. 8). Somite V is usually biannulate.

Habits.—Similar to those of *H. octoculata.*

Distribution.—Common. The writer has taken examples at Chigwell Row; Epping Forest; R. Roding, near Abridge; Richmond Park; Staines; Totteridge; R. Chess; R. Wharf, Grassington, Yorks.

Trocheta subviridis Dutrochet. Dutrochet's Leech. PLATE VII., FIG. 14.

Description.—Body elongated, vermiform with well marked sucker at the posterior end. Dorsal surface dark brownish green, with two dark brown longitudinal bands. Ventral surface of a lighter hue. A distinct clitellum is often present. There are normally eight eyes, 4 in the second ring and two lateral pairs in the fifth ring. The anus opens between the third and fourth ring, reckoning from the posterior disc (cf. *Haemopis sanguisuga*). Length at rest 80–100 mm.; 200–215 mm., when extended. Width 7–15 mm.

Habits.—Lives in streams contaminated with sewage, and on land in gardens, on lawns, paths or under boxes. It feeds upon earthworms, which are swallowed whole. The cocoons are elliptical, dark brown and are attached to foreign bodies. They measure from 9–14 mm. in length and 6–8 mm. in width.

Distribution.—Britain :—Theydon Garnon (Whitehead, 44) ; Beddington, near Croydon (Lee, 34) ; near Maidenhead (Bell, 2) ; Regent's Park (Gray, 19) ; Lyne, between Dorking and Horsham ; Elstree, Herts (Harting, 23) ; Capel, Surrey ; Withington Sewage Works, near Manchester (Harding, 21) ; Penge (Harding, 22).

Foreign :—At present recorded only from France, Italy and Algeria.

Note.—I am indebted to my friend Mr. W. N. Blair, junr., for reading through the MS. and for several valuable suggestions and additions.

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(A full bibliography of the subject is given at the end of Harding's paper.)

EXPLANATION OF PLATES.

PLATE VI.

FIG 1. *Piscicola geometra.*
,, 2. *Protoclepsis tessellata.*
,, 3. *Hemiclepsis marginata.*
,, 4. *Glossosiphonia heteroclita.*
,, 5. *G. complanata.*
,, 6. *Helobdella stagnalis*

PLATE VII.

FIG. 7. *Herpobdella atomaria.*
,, 8. *H. atomaria*, showing positions of genital pores.
,, 9. *H. octoculata*, showing positions of genital pores.
,, 10. *Hæmopis sanguisuga.*
,, 11. *Hirudo medicinalis.*
,, 12. *H. medicinalis*, details of pattern on dorsal surface.
,, 13. *H. medicinalis*, details of pattern on ventral surface.
(Figs. 11-13 are drawings from a specimen taken in the New Forest).
,, 14. *Trocheta subviridis.*
(Drawn from a specimen taken at Theydon.)

NOTE ON ZYGODON FORSTERI MITT.

By PERCY THOMPSON.

THE recent re-discovery by my wife of *Zygodon forsteri* Mitt., one of our rarest and most local British mosses, in or close to its first recorded habitat in Epping Forest,has been considered by the Editor of sufficient interest to warrant the following note on the few occurrences of this moss hitherto recorded. The moss was first noticed by T. F. Forster at some time prior to 1794, on a felled tree-trunk in a timber-yard at Chapel End, Walthamstow, which trunk had most probably come from the neighbouring forest.

For many years no second occurrence of *Zygodon forsteri* was noted, save a dubious record from Sussex, by E. Jenner, which has never been verified.

In 1879 Miss I. Gifford found a specimen in a field at Minehead,

in Somerset, and in the following year was able to conduct Mr. E. M. Holmes to the spot, when the moss was again found growing on the rotten top of a gate-post at the entrance to the field.

In September 1882, at one of the early field meetings of our Club, Mr. E. M. Holmes re-discovered this interesting moss in fruit in Monk Wood, in Epping Forest,[1] " on the root of an old tree,where water collects in little depressions among the roots " ; what sort of tree not being noticed, but believed to be beech; and at a later field-meeting in the same neighbourhood the plant was again (in March 1896) seen by Mr. Holmes.

Zygodon forsteri has also been recorded by Mr. H. N. Dixon on a beech near the " Wake Arms," about one mile distant from Mr. Holmes' station, growing on a vertical wet strip of trunk down which rain travels ; Mr. Dixon's date of collection was July 8th 1884.

In 1902 a variety of this species (var. *sendtneri* Dixon) was found at Burnham Beeches, Bucks., by Mr. W. E. Nicholson, of Lewes.

The above are, so far as I have been able to trace, the only records of this rare moss from the United Kingdom, although it has been found rarely on the Continent, growing on a variety of trees.

Mrs. Thompson's specimens were met with on Nov. 5th 1911, in Little Monk Wood, growing, with an alga, on the wet margins of and below a hole near the base of a beech bole, from which water issues in wet weather ; two small developing capsules were present. Three weeks later, on Nov. 26th, I was myself fortunate enough to find other fruiting specimens growing on another beech trunk about 135 yards distant from the first, and under similar damp conditions to those mentioned by Dixon. A drawing of the leaf-structure of the first met with specimens was sent, with an actual plant, to Mr. E. M. Holmes, and was unhesitatingly identified by him as *Zygodon forsteri* (type).

During January of the present year (1912) my wife and I have found other flourishing specimens of this moss, growing at 8 feet above the ground on two beech-trunks in Great Monk Wood, and in abundant young fruit. These later finds, on being forwarded to Mr. H. N. Dixon, were referred by him to his variety, *sendtneri*, which had hitherto only been recorded from Burnham Beeches.

1 Trans. Essex Fie.d Club, III., pp. lxii. and lxiii.

ten years before; and this varietal form has again turned up (in February 1912) on a beech-trunk near the Verderer's Path, between Highbeach and Woodreddon Hill: so that there are five distinct stations in Epping Forest, in which this rare species, or its variety, have been noted during the winter of 1911-12.[1]

Specimens of both the type species and its variety will be placed in the Club's cryptogamic herbarium at the Essex Museum for future reference.

It is reassuring in these pessimistic times, when veteran entomologists shake their heads dolefully and declare the Forest to be barren as compared with its condition in their younger (and, perhaps, more energetic) days, and when lichenologists lament the non-existence of species they themselves have failed to detect, to find that this little moss, at all events, persists, and has known how to maintain itself during at least 118 years, in its original habitat.

THE GOLDEN-EIGHT MOTH (*PLUSIA MONETA*) IN BRITAIN.

BY CHARLES NICHOLSON.

(Read in substance 4th March, 1911.)

AS the publications of the Club do not contain a circumstantial account of *Plusia moneta* and its arrival in Britain, and as it seems desirable that such an important and interesting occurrence should find a place in our records, I have compiled from various publications and unpublished observations of myself and others, the following history of the appearance and doings of the moth in this country.

Its first appearance in Britain seems to have been in 1857, when two specimens were taken in Kent, but remained unidentified and unrecorded by their captor until 1893.[2] Its historic invasion of our isles took place in 1890, when its arrival was made known by the capture of a specimen at flowers of *Delphinium*, on the 25th June by a schoolboy at Dover[3]. From that time to the present, *i.e.* in 21 years—it has spread over practically the whole of England, south of Lancashire and

1 Since the above was written, a sixth station (in Great Monk Wood) has been noted for this moss, where it was in abundant fruit.
2 *Entomologist's Record*, IV., p. 228.
3 *Entomologist's* XXIII., p. 344.

Yorkshire, but I have seen no records from Scotland, Ireland, Wales or the Isle of Man.

The first recorded capture of the moth in Essex was in 1893, by our member, the late Charles Oldham, of Woodford, who took it flying over honeysuckle in his garden[3a]. The next record was at Mucking by the Rev. C. R. N. Burrows in 1902[4], and in 1904 the Rev. W. Claxton found about 2 dozen cocoons on *Delphinium* at Navestock in June[5]. Then we have Mr. B. G. Cole's note in the Essex Naturalist (vol. xiv. p. 136) in 1905, and finally a record[6] by Mr. J. W. S. Harrison of cocoons found, in June 1907, at Ilford, on the underside of leaves of *Aconitum lycoctonum*, a yellow-flowered continental species of monkshood frequently cultivated in gardens. I myself have found it more or less commonly in the larval state on the plants of monkshood and larkspur in my garden at Hale End every year since 1905, and have taken the moth at the larkspur flowers on many occasions. The *Plusiids* appear to have strong emigratory instincts, and seem on the whole to be a very restless lot. Several species show a tendency to emigrate steadily in a westerly direction and *moneta* has made itself very conspicuous in this respect. In a note in the Essex Naturalist for 1905 (p. 273), our senior secretary says: "It is one of the most remarkable instances of a species spreading across Europe in a southern migration. In about 50 years it has spread from Russia . . . . to England." In the *Entomologists' Monthly Magazine* for 1891 (p. 21), Mr. A. Hoffmann writes that it was known to be common in S. and S.E. Germany, but was not recorded from the N.W. until 1875, when it commenced to invade that district, and in 1882 had reached Holland. According to Duponchel, however, it was known in Normandy previous to 1829, and was taken regularly at Falaise.

An idea of the rapidity with which the insect has become common and generally distributed in this country may be gathered from the sales of British collections of lepidoptera. In 1897—seven years after its invasion—bred specimens fetched 2s. 6d. a piece, whilst in 1905 they could be had for half that price. In a list just to hand they are priced at 6d. !

3a *Essex Naturalist*, VII., p. 127.
4 *Ent. Rec.* XIV., p. 285.
5 *Ent.* XXXVII., p. 214.
6 *Ent. Rec.* XX., p. 214.

The following brief sketch of the moth's life-history will complete this summary.

The cream-coloured eggs are laid in July (or late June) on the flowerspikes of monk'shood (*Aconitum*) and larkspur (*Delphinium*) and in about a week the larvæ hatch and commence to feed on the flowers. They are at first maggot-like with brownish heads and pale bodies dotted with black, but gradually become green with from four to six black dots on each segment, a short stiff bristly hair springing from each dot. They remain of this colour substantially until the last moult which leaves them pale green with a darker line down the back and a white one along each side. In this stage they feed quite exposed on the leaves, and when fully grown retire to the yellow leaves at the bottom of the plant and spin beautiful creamy white or yellow cocoons on the underside with a transverse slit at one end through which the moth emerges. The pupa is black on the back and otherwise green. The moth measures about an inch and a half across the expanded wings, which are rather broad in proportion to their length and are of a golden grey colour, with darker lines and shadings and on the fore wings a central marking of a shining golden or brassy colour, like an ear in shape, or sometimes like two small coins with darker centres, whence the name *moneta*.

Under favourable climatic conditions this species appears to be double-brooded, but in cool seasons a single brood is the rule. In this country—at least, in the south—there appears to be sometimes a partial second brood in September, the first, or normal, brood appearing in May or June. The moths of the first brood fly about 9 p.m. ; those of the second about 6 p.m., and they frequent other flowers besides those of the food-plants.

The larvæ pass the winter close to or under the ground, in the dead hollow stems of the food plants, or amongst the new growths waiting to shoot up, and commence feeding as soon as the plants have grown sufficiently to provide the necessary accommodation, the 26th March being the earliest record I can find[7] for this. They spin the young leaves and developing buds together forming a sort of tent or bower, in which they feed. I have found very young ones in autumn feeding on the seeds in the late capsules.

7 *Ent.* XXXVI., p. 101.

When the moth is at rest it assumes a very remarkable position in which it strongly resembles a dead and dry leaf still attached to the stem. The front legs are stretched out straight in front of the head at a right angle to the axis of the body, the second pair of legs being pressed close to the body, whilst the last pair just hold to the support, almost, or quite, covered by the tips of the fore wings which just touch beyond the body, the moth appearing to be clinging to its support by the front legs and wings only. It falls to the ground when touched.

REPORT ON THE LICHENS OF EPPING FOREST (SECOND PAPER.)

BY ROBERT PAULSON, F.R.M.S. AND PERCY G. THOMPSON.

[*Read February 24th, 1912*].

IN our earlier paper on this subject, ESSEX NATURALIST, vol. xvi., pp 136–45, we adduced evidence to show that the view held by the Rev. J. M. Crombie in 1883, as to the condition of the Lichen-flora of Epping Forest was, happily, not borne out by our experience. Our optimism has been fully justified by two years' further experience. Crombie's list of 85 forms, which he presumed to be the total number of lichens then existing in the Forest, has been by far exceeded, and our record to date comprises 109 fully-determined forms which our researches have proved to be still extant within the limits of the Epping Forest district. Moreover, our present total includes not only a number of forms, in flourishing condition, which Crombie variously described as "evidently extinct," "very rare," or "sterile and sparing," or which he himself had not observed, but also some really rare forms which have not hitherto been recorded by any observer from this locality or from the County.[1]

In the light of these facts, although it would seem probable that our list is now nearing the actual total of the present-day lichen-flora of the Forest district, it would be folly to insist too strongly upon this, as new discoveries are always possible in the case of such inconspicuous plants. As an instance of this, we need only cite the case of *Gongylia viridis* which, known

1 At the same time it should be noted that of our total number of forms several occur only in small quantity and in scattered localities.

to science only from examples gathered in Surrey two years ago, we have since found in three distinct stations in Epping Forest, though never in masses larger than a half-crown.

If a particular form of Lichen should happen to become totally extinct within the Forest, there is but little chance of its recolonizing the district, considering the distance of other large tracts of woodland from the locality; should, however, certain forms be struggling on in the leprous condition, there may, under the conditions now obtaining, be a recovery similar to that which we have noted with regard to the ground forms. Throughout the Forest there are, upon tree-trunks, in places where conditions are unfavourable for vigorous lichen-growth, powdery patches of a grey-green or yellowish colour, which consist of algal cells, among which are scattered numerous fungus hyphal threads. Some of these patches are probably imperfect lichen-plants which have failed to develop normally owing to the adverse conditions; by the older lichenologists they were classified with Lichens under distinct generic names, as *Lepraria* and others. It is possible that lichens may persist in this imperfect leprous form for long periods, and, should more favourable conditions arise, then develop normally and produce a perfect thallus with ripe apothecia; but much careful investigation is still needed in this connection before a definite statement can be put forward. It is indeed by no means certain that a lichen finds this leprous, rudimentary condition a disadvantage to it in its peculiar mode of life. Its nutrition would seem to be as well secured in this state as in its more perfect one, after building up an elaborate thallus; while, as to reproduction, many lichens fail, except at rare intervals, to produce fertile fruits, and trust to simpler, adventitious methods of self-distribution. The most usual way in which this is effected is by what are termed *soredia*, which are simply small pulverulent masses of intermixed algal cells and fungal hyphæ produced, often in enormous abundance, upon the upper surface, or at the extremities of the lobes of the thallus, at spots where the cortex is ruptured, and which have the potentiality of reproducing the lichen-thallus when blown by the wind to suitable stations. Now, these soredia are but localised patches of leprous thallus, and are the normal means of self-reproduction in many lichens; so that it is not

improbable that a lichen-thallus in the leproid condition satisfies its ordinary requirements, both of nutrition and reproduction: whether, at long intervals, the production of definite spores, produced sexually, is necessary to the permanent well-being of the species, may be surmised, but is not yet demonstrated. Certain forms (as *Lecidea lucida*), whose thallus is wholly leprose, do produce, but infrequently, proper apothecia and spores.

Before giving our list to date, it may be interesting, having regard to the comparative little that is known by the general botanist with regard to the natural history and ecology of Lichens, to make a few remarks on this subject, based mainly on our own observations in the field, and having reference chiefly to the conditions which obtain in the district with which we are here concerned.

HABITATS AND PLANT-ASSOCIATIONS.

We have already noticed, in our first paper, that Epping Forest is specially rich in the ground forms of Lichens—those which grow on open heaths. Although our Forest heath-lands are of but moderate extent, and are, alas, tending to become less in area each year by the invasive growth of young Birch, nevertheless Epping Forest presents probably a more extensive assemblage of heath-dwelling lichens than any other district, of equal area, within the same radius of the metropolis.

On bare heaths, we find an association of such lichens as *Bæomyces roseus, B. rufus, Pycnothelia papillaria, Cladonia coccifera, C. macilenta, C. furcata, Cetraria aculeata, Peltigera spuria, Lecidea granulosa,* and (where flints occur, partially imbedded in the gravelly soil) *Rhizocarpon petræum* and *Lecidea crustulata*; together with *Polytrichum piliferum* and dwarf heather (*Calluna*) and *Salix repens. Peltigera spuria* commonly establishes itself on burnt patches of earth, the site of fires, where it keeps company with the moss *Funaria hygrometrica.*

On wet heaths, amongst heather and *Erica tetralix,* we get *Cladina sylvatica* form *tenuis, Cladonia fimbriata* sub-sp. *fibula,* together with *Hypnum schreberi, Polytrichum communis, Dicranum scoparium, etc.*

The tree-dwelling lichens of Epping Forest are not so flourishing as the ground forms, except in the case of a comparatively few dominant forms which crowd out all competitors. We

have already remarked the almost entire absence of fruticulose forms, such as *Evernia*, *Ramalina*, and *Usnea*, which are common enough in other districts of the S.E. of England. In the Forest, perhaps the most abundant tree-dwelling lichen of all is *Lecanora varia*, which (with its doubtfully distinct relative, *L. conizæoides*) is universally met with clothing the trunks and branches of trees ; in open situations, such as about "Black Bushes," N. of Earls' Path, Loughton, and elsewhere, the stems and branches of small hawthorn bushes are frequently entirely covered with this lichen, in full fruit, giving the bushes a characteristic, hoary grey-green appearance, from which only the smaller and younger twigs are exempt. These smaller twigs show, too, that the lichen starts from definite centres, where spores have germinated, whence, spreading as circular patches, these at length coalesce and clothe the entire bush with a dense tomentose fur ; occasionally, another lichen, *Parmelia physodes*, form *labrosa*, grows with *Lecanora* on the older branches of the hawthorn. Bushes of Sallow, small Crab and Oak trees, and the stems of Gorse and heather are so covered, and the same two species of lichens are often seen associated together on old Birch trunks, especially the rough, corky portion near the butt.

On bare trunks of Hornbeam, where free from *Chlorococcus*, many of the less conspicuous crustaceous lichens find their habitat, the more characteristic forms being *Lecanora rugosa*, sub-sp. *chlarona*, *Pertusaria wulfenii*, *Lecidea griffithii* (this species is extremely abundant in a spermogoniferous condition), *Enterographa crassa*, *Opegraphas* and *Graphis* of various species, and *Acrocordia gemmata*.

On decaying tree-trunks, *Lecidea granulosa* sometimes occurs in great profusion, although its more usual habitat is,as already stated, on bare heathy ground.

On the cut ends of stumps and on decorticated timber, *Parmelia fuliginosa* and *Lecidea flexuosa* are often met with.

Old brick walls, on their northern faces especially, yield *Lecanora galactina*, *L. exigua*, *Buellia canescens*, *Lecidea lucida*, and *Urceolaria scruposa*, among other forms ; while *Lecanora saxicola* prefers the upper surface of the wall-top. The cement joints and rendering of the walls are the favourite stations of

Lecanoras vitellina, murorum, and *galactina,* and *Verrucaria nigrescens.*

Tombstones in old churchyards present a quite characteristic assemblage of lichens, including *Physcia pulverulenta* sub-sp. *pityrea, P. stellaris* sub-sp. *tenella, P. parietina,*form *congranulata, Lecanora murorum, L. subfusca,* var. *campestris,* and *Buellia canescens.*

Old leather will afford a rest-place for various lichens if sufficiently soddened; we have noted *Cladonia fimbriata,* var. *tubæformis* and *Lecidea granulosa* growing on an old boot in the Forest: and we have even seen tiny fruiting individuals of *Cladonia macilenta* and *C. fimbriata,* var. *tubæformis* growing on the dry dung of rabbits.

ASPECT.

All lichens love the light, but there is a considerable difference in the intensity of the light which various species prefer. The yellow-coloured forms appear to revel in full sunlight,the flavescent Physcias and Placodia being striking instances. Thus, *Physcia parietina,* form *congranulata,* prefers the south faces of walls, where the surface of the stone or brick becomes unbearably hot to the touch in the full glare of the summer sun; and the form *cinerascens* of the same species occurs chiefly on the south side of beech trunks in the Forest. *Lecanora murorum* is more frequent on sunny walls and tombstones, and *L. vitellina* affects the south faces of walls. In contrast with these, the green-hued Parmelias are very frequently found in the Forest on the north and west sides of tree-trunks.

FRUITING SEASON.

There would seem to be few records as to the season of the year when lichens are accustomed to produce their apothecia in this country. Our own fragmentary notes in this connection must be regarded as merely tentative,pending the accumulation of further observations, but so far as they go, they undoubtedly tend to show that the fruiting period for these plants is the winter months, extending from the beginning of November to the end of April. Thus, taking *Bæomyces rufus* as a type of many others, we have noted it with small apothecia on September 9th and 19th, with well-formed apothecia on November 26th,

at various dates from January to March, on March 15th, and on April 22nd, and again with small (?undeveloped) apothecia on May 14th and onwards through the summer. *Cladonia coccifera* shows much the same time-range in the production of its fruit, and *Peltigera spuria* and *Lecidea granulosa* are in full fruiting vigour from the end of October to March. On the other hand, we have been repeatedly unable to find ripe spores in the apothecia of the Opegraphas and Verrucariæ between the months of October and January, so that it is evident that much more detailed observation is needed before this question can be considered as answered.

RATE OF GROWTH.

It has been more or less assumed by writers that lichens as a class are of extremely slow growth and of immense duration of life. Thus Ruskin (*Modern Painters*, v.) in an oft-quoted passage, says.

"Sharing the stillness of the unimpassioned rock, they share also its "endurance; and while the winds of departing spring scatter the white "hawthorn blossom like drifted snow, and summer dims on the parched "meadow the drooping of its cowslip-gold, far above, among the "mountains, the silver lichen-spots rest, star-like, on the stone; and "the gathering orange stain upon the edge of yonder western peak "reflects the sunsets of a thousand years.

Berkeley watched individuals of *Rhizocarpon geographicum* for 25 years, which, at the end of that time, were in much the same condition as when he commenced his observation. *Physcia parietina* has been known to grow for 45 years before bearing fruit, and the Rev. Hugh Macmillan (*Foot-notes from the Page of Nature*) even suggested that existing individuals of certain crustaceous lichens on Scottish mountains might have commenced their growth soon after the last glaciation of these islands. We cannot help suspecting, however, that the ascertained slow rate of growth and assumed longevity of a few species have been too hastily assumed to be characteristic of all Lichens: whereas habitat, and the consequent degree of exposure to heat and drought, is probably the determining factor. It will be noticed that the forms quoted as examples are all such as live exposed to the full effect of the sun's hottest rays in summer and to intense cold in winter; the effect of the one being to desiccate the plants, that of the other to freeze them solid. Under

these extreme conditions, the lichen, while not actually succumbing to its inclement environment, is compelled to suspend its growth until the return of more favourable seasons; and so its rate of growth is slow. In moist warm climates, where lichens attain their greatest development, external conditions are favourable to much more rapid development; but here, unfortunately, we have as yet no data as to rate of growth. But even in our own temperate latitudes it is evident that the extremely slow development claimed for lichens does not always hold. When we meet with fruiting lichens, overspreading decaying leaves, which can scarcely have lain on the ground more than two or three years, others growing on old boots, or on dung, and fruiting freely, others overspreading growing mosses; and when we notice, as we do sometimes, that on an old wall the best developed lichens are growing, not on the wall itself, but on the cement jointing which was added when the wall was last repaired, perhaps 20 years before; we begin to suspect that, after all, under more equable conditions of temperature, and in a humid atmosphere, the rate of growth of some lichens at least must be far more rapid than has been generally assumed to be the case. We know one mass of concrete at Theydon Bois, surrounding a surface-water drain which was formed in 1903, and which, in 1910, after only seven years, was covered with *Lecanora galactina* in abundant fruit; and a Portland stone garden-ornament, new in 1904, was, in 1910, after only six years, covered with patches of a fruiting *Verrucaria* (probably *nigrescens*). It is perhaps noteworthy that these forms have always a very scanty development of thallus and produce their fruit very freely.

ENEMIES AND PROTECTIVE RESEMBLANCE.

We have now to enquire what are the enemies with which Lichens have to contend in our Forest.

Mites of the family *Oribatidæ* must be reckoned among the chief foes of these plants, upon which they feed, seeming to have a special predilection for the ripe fruits. We have had excellent specimens of *Physcia parietina* spoiled by hidden mites of this family, which have eaten out the contents of the mature apothecia after the lichens have been gathered. One can sometimes see small flocks of the mites browsing upon the thallus of tree-

dwelling lichens,like cattle in a meadow. Michael, in his *British Oribatidæ* 1883, describes numerous species of these mites as haunting, and feeding upon, Lichens and specially mentions four species as being "true lichen-loving creatures, seldom found elsewhere," one species indeed (*Oribata parmeliæ*) owes its specific name to its lichen-habitat. Of the nymph of this form (*O. parmeliæ*), Michael notes that its bright-orange-yellow colour resembles that of the lichen upon which it feeds (*Physcia*, or, as it was formerly called, *Parmelia, parietina*) and suggests that this may be a case of protective resemblance.

We have noticed other scarlet-and-black, oval mites (apparently not of this family), with whose names we are not acquainted, crawling in numbers over the thalli of lichens on tombstones at Loughton and Theydon Bois, but whether actually feeding upon the plants could not be decided. Specimens of *Parmelia* have frequently been seen by us with the thin green cortical layer wholly or partially eaten away, possibly by mites, leaving the white woolly medullary layer exposed.

Some Poduræ, also, frequent lichens growing on walls.

Many moth-caterpillars feed on lichens on trees and walls; nearly all the "Footmen" moths (*Lithosiidæ*) do so,for example; and we have several striking instances, both in the case of the larva and of the perfect moth, of protective coloration and resemblance to the lichens upon which the insects rest. A very striking example is *Moma orion*, a common moth in many parts of Europe, though rare in this country; specimens of the imago of which, at rest upon the lichen-covered bark which they frequent, are exhibited at the Natural History Museum at South Kensington; other quite common British moths, as *Bryophila muralis*, *B. perla* and *Agriopsis aprilina*, are examples of this resemblance, and the ground tone of the coloration of the wings of these moths is stated to vary according to the prevailing hue of the lichens which they select for their resting place.

One of the most remarkable examples of this protective resemblance to lichens is that of the larva of the geometrid moth,*Cleora lichenaria*, which feeds upon foliose lichens growing upon tree-trunks and palings, and being of a green-grey hue and possessed of two little humps on many of their body-segments, they so exactly resemble the lichens in colour and appear-

ance as to be extremely difficult of detection: this moth is found in the New Forest, but I have not heard of its having been met with in Epping Forest.

Another, and even more curious instance of protective resemblance to lichens, has come under our notice in the case of a member of the micro-lepidoptera. Tutt (*Natural History of the British Lepidoptera*, 1900) states that all the families of the Psychides, many of which feed on wall and tree-dwelling lichens, such as *Physcia pulverulenta*, *Physcia parietina*, *Lecanora candelaria*, and *Buellia canescens*, have larvæ which form cases; which cases they carry about with them and cover externally with extraneous substances, among which fragments of lichens are prominently included. Into these cases the larvæ retreat when disturbed, and in them they pupate. The close resemblance in colour of these larval cases to the lichen-patches upon which the creature feeds renders them difficult of detection, and the resemblance is still further increased by the habit that at least one species of these moths (*Bacotia sepium*) has of fixing its thickly lichen-covered larval case in an upright position, that is, perpendicularly to the surface upon which it is resting, so as to exactly simulate, in position, size and colour, the podetium of a lichen of the genus *Cladonia*. It is specially noted of this larva, also, that it lives on the lichen-covered trunks of trees and on fences, and appears (unlike most of its congeners) never to live on the ground, nor to change from one tree to another. This creature has been recorded from Epping Forest. We exhibit some of the larval cases of an allied species of moth (*Luffia ferchaultella*),which were found on old palings in Chigwell Lane, Loughton, and which we owe to the kindness of Mr. A. W. Bacot, F.E.S., in which the resemblance to the podetia of Cladoniæ is sufficiently evident. There is also, so Miss G. Lister informs us, a minute creature, *Hymenobolus parasiticus*, Zukal, at present grouped doubtfully with the Mycetozoa, which feeds regularly upon living lichens, but no true Myxomycete does so.

A number of Micro-fungi attack living lichens, and some obscure lichens are themselves constant parasites upon the thalli of larger species. We have observed living specimens of *Peltigera spuria* attacked by a flesh-coloured fungus, *Illosporium carneum*, which forms numerous small, circular, floccu-

lent eruptions on the upper surface of the thallus of the lichen : when the ripe spores of the parasite are dispersed, each eruption leaves a white spot in the lichen-thallus. This spot represents the medullary layer, exposed by the decay of the algal components of the cortical and gonidial layers, which, it is to be presumed, the parasitic fungus chiefly attacks.

Coming now to our List of Additional Lichens recorded from the Epping Forest district since the reading of our first paper on 5th March, 1909, we have to call attention to the publication, in the interim, of Miss A. Lorrain Smith's completion of the British Museum Monograph on the Class[2]; this important work considerably affects the nomenclature of these plants. The systematic arrangement adopted by Miss Smith has been uniformly followed in the following list, and, in addition, we append a supplementary list of those forms included in our first paper, the names of which have been altered in the work mentioned.

The number of forms included in the present list is 63, which, added to the 46 given in our former list, makes a total of 109 fully-determined forms. We have again to express our grateful thanks to Miss A. Lorrain Smith and to Mr. E. M. Holmes for help in identifying critical forms.

Family—COLLEMACEI.

Tribe—COLLEMEI.

Collema furvum, Ach.

Several sterile examples, on a flat-topped tombstone in St. Nicholas Churchyard, Loughton.

Family—LICHENACEI.

Tribe—CALICIEI.

Calicium melanophæum, Ach., var. *β. ferrugineum.* Schær.

On oak trunk, Green Ride near Loughton Camp ; fertile.

C. quercinum, Pers. Tent, f. *chlorodes*, Nyl.

On oak trunk between Woodberrie Hill and Green Ride ; fertile.

C. trachelinum, Ach.

On oak trunk near Debden Slade ; fertile.

2 *A Monograph of the British Lichens*, Part II., by Annie Lorrain Smith, F.L.S., 1911.

Trachylia tympanella, Fr.

On stump, Woodreddon Hill ; on oak rails, Great Parndon, and Thornwood Common ; fertile.

Tribe—CLADONIEI.

Pycnothelia papillaria, Duf. Bory.

On bare, heathy ground to the east of Great Monk Wood, in two stations ; spermogoniferous.

Cladonia pyxidata, Fr.

var. *chlorophæa*, f. *myriocarpa*, Cromb.

On heathy ground, Blackweir Hill ; fertile.

var. *chlorophæa*, f. *lepidophora*, Flörke.

At base of stump, border of Little Monk Wood ; fertile.

C. fimbriata, Fr.

var. *tubæformis*, Fr.

On stump, S.E. of Loughton Camp ; spermogoniferous.

var. *carneopallida*, Nyl.

On decayed fallen tree, between Broadstrood and Debden Green ; fertile.

Sub. sp. **fibula**, var. *subcornuta*, f. *nemoxyna*, Nyl.

Wet heath, Woodreddon Hill ; sterile.

var. *radiata*, Nyl.

Heathy ground, border of Little Monk Wood ; sterile.

C. furcata, Hoffm.

Sub. sp. **racemosa**, Nyl.

On bare, heathy ground, Blackweir Hill ; Epping Lower Forest ; Lodge Road ; spermogoniferous.

C. cœspititia, Flörke.

On bank, Blackweir Hill ; fertile.

C. macilenta, Hoffm.

f. *scolecina*, Nyl.

On decayed oak fence rails, Great Parndon Church ; on stump, Loughton Camp ; between Broadstrood and Debden Green ; sparingly fertile.

var. *δ. ostreata*, Nyl.

On ditch-bank, Alderton Hill, Loughton ; at base of oak by the gravel-pit near Monk Wood ; very sparingly fertile.

Tribe—RAMALINEI.

Ramalina calicaris, Nyl.

On ash trunk, Epping Upland ; sterile.

Tribe—USNEEI.

Usnea hirta, Hoffm.

On sallow trunk, Blackweir Hill ; sterile.

Tribe—CETRARIEI.

Cetraria aculeata, Fr.

form *hispida*, Cromb.

Heathy ground, E. border of Great Monk Wood ; Blackweir Hill ; Highbeach ; spermogoniferous.

Platysma glaucum, Nyl.

On projecting beech-roots, Great Monk Wood ; sterile.

Tribe—PARMELIEI.

Parmelia perlata, Ach. Meth.

On oak trunk, S. slope of Loughton Camp ; on beech roots, Great and Little Monk Woods ; Epping Thicks ; sterile, in poor condition.

P. sulcata, Tayl.

On stump, Great Monk Wood ; on oak trunk, Staples Hill ; on projecting hornbeam root, W. of Wake Valley ; sterile.

P. caperata, Ach. Meth.

On tree-root, Epping Upland ; small and in poor condition ; sterile.

P. fuliginosa, Nyl.

var. *laetevirens*, Nyl.

On hornbeam and crab trunks, S. of Loughton Camp ; sterile.

Tribe—PELTIGEREI.

Peltigera spuria, Leight.

On heathy ground about the Wake Arms ; west of Loughton Camp ; fertile.

Tribe—PHYSCIEI.

Physcia lychnea, Nyl.

At base of ash trunk, by the Roding at Buckhurst Hill ; ditto at Blackacre, Theydon Bois ; fertile.

P. pulverulenta, Nyl.

Sub. sp. **pityrea**, Nyl.

On old tombstones, St. Nicholas Churchyard, Loughton ; fertile ; on beech trunk, Little Monk Wood, on tree

trunks, Nether Hall, Roydon, Rectory Lane, Loughton, and elsewhere; sterile.

P. ulothrix, Nyl.

var. *virella*, Cromb.

On beech trunk, Little Monk Wood; sparingly fertile.

P. erosa, Leight.

On tiles, Nether Hall, Roydon; sterile.

Tribe—LECANO-LECIDEEI.

Sub-Tribe—LECANOREI.

Lecanora (Squamaria) saxicola, Ach.

On brick walls, Epping Upland, Loughton Bridge, Waltham Abbey, Nether Hall, Roydon; fertile.

Sub. sp. **albomarginata**, Nyl.

On sandstone boulder, Chamber's Farm, Epping Upland, fertile.

L. (Candelaria) laciniosa, Nyl.

On cement, "Robin Hood," Loughton; fertile.

L. aurantiaca, Nyl.

Sub. sp. **erythrella**, Nyl.

On cement, Epping; fertile.

L. cerina, Ach.

On ash trunk, Blackacre, Theydon Bois; fertile.

L. exigua, Nyl.

On oak trunk, Epping Lower Forest; on projecting beech-roots, Fairmead; on old tombstones, St. Nicholas, Loughton; on cement and sandstone, Epping Upland; fertile.

L. galactina, Ach.

Sub. sp. **dissipata**, Nyl.

On cement, Snaresbrook Railway Station; fertile.

L. subfusca, Nyl.

On trunk of hornbeam, Baldwin's Hill; fertile.

L. subfusca, var. *campestris*, Nyl.

On ash trunk, Epping Lower Forest; on old tombstone, Epping Upland, fertile; on brick coping, Debden Slade.

L. albella, Ach.

On hornbeam trunks, between Broadstrood and Debden Green, S. of Broadstrood, and elsewhere; fertile.

L. parella, Ach.

On mortar of brick wall, Copt Hall Green ; fertile.

Sub-Tribe—PERTUSARIEI.

Pertusaria leioplaca, Schaer.

On hornbeam trunk to west of Staples Hill ; on oak trunk between Woodberrie Hill and Grubbs Pits ; fertile.

Sub-Tribe—THELOTREMEI.

Phlyctis argena, Koerb.

On hornbeam trunk, between Broadstrood and Debden Green ; fertile.

Urceolaria scruposa, Ach. Meth.

On brick walls, Theydon Bois ; Uplands, Loughton ; fertile.

Sub-Tribe—LECIDEEI.

Lecidea ostreata, Schaer.

On oak trunks, usually towards the base, in and about Loughton Camp ; Jacks Hill ; sterile.

L. lucida, Ach. Meth.

On north faces of brick walls, Theydon Bois, Loughton, Highbeach, and elsewhere ; sterile.

L. quernea, Ach. Meth.

On decaying bark, Great Monk Wood ; near Loughton Camp.

C. coarctata, Nyl.

On flint pebble, Blackweir Hill ; on brick coping, Debden Slade ; fertile.

L. flexuosa, Nyl.

On decayed stump between Sandpit Plain and Little Monk Wood ; on hornbeam trunk, Grubb's Pits ; fertile.

L. uliginosa, Ach. Meth.

On damp ground, Oak Hill, Theydon ; about Loughton Camp ; Great Monk Wood ; near Robin Hood ; fertile.

L. fuliginea, Ach.

On rotting stumps, Loughton Camp ; between Sandpit Plain and Little Monk Wood ; fertile.

L. parasema, Ach. Meth.

On hornbeam trunk, near Grubb's Pits ; fertile.

L. crustulata, Koerb.

On flint-pebbles, Little Monk Wood, Blackweir Hill ; fertile.

Rhizocarpon alboatrum, Th. Fr.
var. *epipolia*, A. L. Sm.
On mortar of wall, Copt Hall Green; fertile.

Tribe—GRAPHIDEI.

Opegrapha herpetica, Ach. Meth.
On hornbeam trunk, near Honey Lane Plain; fertile.
O vulgata, Ach. Meth.
On hornbeam trunk, Broadstrood; fertile.
Graphis scripta, Ach.
var. *serpentina*, Nyl.
On hornbeam trunk between Woodberrie Hill and Grubb's Pits; fertile.
Phœographis inusta, Muell-Arg.
On hornbeam trunk, near Grubb's Pits; fertile.
Graphina anguina, Muell.-Arg.
On felled hornbeam, Epping Lower Forest; fertile.
Enterographa crassa, Fée.
On hornbeam trunks, Epping Lower Forest; near Grubb's Pits and elsewhere; common; fertile.

Tribe—PYRENOCARPEI.

Verrucaria viridula, Ach.
On cement, Jacks Hill, Theydon Bois; fertile.
Verrucaria nigrescens, Pers.
On cement, Jacks Hill, Theydon Bois; fertile.
Gongylia viridis, A. L. Sm.
On sandy banks, near Broadstrood, April 1910; Blackweir Hill; Oak Hill, Theydon Bois, November 1910; fertile (The first record of this recently described species was from near Horsley in Surrey, February, 1910).
Pyrenula nitida, Ach.
On hornbeam trunk near Grubb's Pits; on hornbeam trunk between Broadstrood and Debden Green; fertile.

The nomenclature of the undermentioned forms, included in our first list, having since been affected by the publication of Miss A. L. Smith's monograph, we give the new synonymy :—
Lecidea decolorans, Flk. *is now* **Lecidea granulosa**, Schaer.
L. tricolor, With. *is now* **Biatorina griffithii**, Massal.

UNDER SIDE UPPER SIDE

CHONEZIPHIUS MOOREI, BELL.
FROM WALTON-ON-NAZE, ESSEX.

L. petræa, Wulf. *is now* **Rhizocarpon petræum**, Massal.
Opegrapha atra, var. *hapalea*, Ach., *is now* var. **denigrata**, Schaer.
Verrucaria gemmata, Ach., *is now* **Acrocordia gemmata**, Koerb.

ERRATA.

Parmelia lorreri, Turn., given in our former list, should be **Parmelia borreri**, Turn; *Cladonia flærkiana*, Fr. should be **C. floerkeana**, f. *trachypoda*, Nyl.

Parmelia exasperata, Nyl., given in our former list, is now known to have been wrongly identified; it is probable that Crombie's record of this species from Epping Forest is also at fault, as the true *exasperata* is found to be much rarer than is sometimes supposed, and is probably often confused with the commoner "*fuliginosa*" Nyl., as in our case. We have to thank the Rev. H. P. Reader, M.A., of Leicester, for this correction.

Pertusaria amara, Nyl., given as "fertile," should read "sterile."

"CHONEZIPHIUS MOOREI."

A NEW SPECIES OF FOSSIL ZIPHIOID WHALE FROM WALTON-ON-NAZE, ESSEX.

By ALFRED BELL.

With Plate VIII.

[*Read 22nd February* 1913.]

THE fine rostrum here figured is in the collection of Major E. St. F. Moore, of Felixstowe and was obtained by him in Colchester a short time since. This and an equally well preserved crown of a molar of *Mastodon arvernensis* were dredged from off Walton-on-the-Naze. The latter has a number of *Serpula*, and one or two species of the Lepralian Polyzoa attached.

The beak is in a very perfect state of preservation, the surface of the bone almost free from the usual pittings and only rubbed to a slight degree across the prefrontal tract. From its condition it had evidently been buried a little below the surface, as the pores and vomerine cavity were filled with loose sand.

The bone is somewhat akin to *Choneziphius planirostris*, Cuv. but differs in many particulars from the figures of that species given by Prof. Owen (*Cetacea of the Crag*) or E. T. Newton, Esq., F.R.S., in the *Geological Survey Memoir on the Pliocene Vertebrata*, from a specimen also dredged from off Walton-on-the-Naze. It does not agree with any of the snouts in the British Museum collection. It is shorter in proportion to breadth, the prefrontal tract is narrower and more compressed at the sides with a slight crest rising towards the skull. The mesethmoid or vomerine canal opens a short distance from the extremity, and is open to a depth of $3\frac{1}{4}$ inches, the opening being 1in. by $\frac{3}{4}$in. in diameter. Immediately behind the orifice is a rather pronounced superficial depression, shallowing out as it recedes from the front. The pterygoid is prolonged as a sharply defined tract of little depth. Length 14 inches, greatest breadth $5\frac{1}{2}$ inches, depth $4\frac{1}{2}$ inches, from end of beak 3 inches, and the same from the upper surface to base or edge of pterygoid ridge bone.

I have named this beautiful and, at present, unique example after the owner of the relic whose cabinet it adorns.

THE ESSEX FIELD CLUB.—REPORTS OF MEETINGS.

THE 400th MEETING.*

SATURDAY, 27TH JANUARY 1912.

**See note at end of this report.*

The 400th meeting of the Club was held at the Technical Institute, Stratford, at 6 p.m., the President, Mr. W. Whitaker, F.R.S., in the chair.

New Members.—The following were elected Members:—

Mr. Frank Cavers, D.Sc., F.L.S. (*Lecturer on Botany, School of Pharmacy, &c.*), *Tynedale, Hamilton Road, Golders Green, N.W.*

Mr. N. Fortescue, C.C., *Hainault, Chingford.*

Mr. T. W. Huck, F.L.A. (Diplomate), *Librarian, Literary and Scientific Institution, Saffron Walden.*

Miss Ellen Read, *Fernside, Theydon Bois.*

Mr. Alfred R. Tattersall, *Greylands, Rectory Road, Walthamstow.*

Mr. E. N. Buxton's Golden Wedding.—The President said:—"In view of the fact that our Vice-President, Mr. Edward North Buxton, has recently celebrated his Golden Wedding, the Council, at the meeting held this afternoon, on the motion of Prof. Meldola, seconded by Mr. David Howard, resolved unanimously that a congratulatory letter should

be sent to Mr. Buxton as a mark of esteem, and in recognition of his long and valued services to the cause of Natural History in Essex in his capacity of Verderer of Epping Forest. I now propose that this resolution should be accepted as coming from the general body of members also."

This resolution was put to the meeting, and carried by acclamation.

Gift of Mycetozoa from Epping Forest.—The Curator (Mr. Cole) exhibited a collection of Mycetozoa from Epping Forest, comprising all the species hitherto recorded from the district. This collection had been made and presented to the Club by Miss Gulielma Lister, F.L.S. The whole series had been mounted in glass-topped boxes in the Museum, and constituted a very welcome contribution to our collections.

A vote of thanks was most cordially given to Miss Lister for this interesting collection.

Rough Pottery from Lincolnshire Coast.—Mr. Hazzledine Warren exhibited and presented some rough pottery from the Lincolnshire coast, which closely resembled the briquetage found in our Essex Red-hills, but which has no red-earth associated with it, nor does it form hillocks; much charcoal was found with the pottery.

"Arctic Bed" at Ponders End.—Mr. Warren also exhibited a sample of the Moss-bed at Ponders End, containing *Hypnum exannulatum* var. *orthophyllum* and a small quantity of *H. giganteum*. The nearest present-day forms of these mosses grow on the summit of Ben Nevis in Scotland. In the Ponders End bed the Mosses are associated with bones of *Elephas primigenius*. [See *ante*, pp. 36-39.]

The President, Messrs. Miller Christy and W. Cole joined in the discussion which these exhibits provoked, and the thanks of the meeting were accorded to Mr. Warren.

Mr. C. Nicholson exhibited living examples of a Myxomycete, *Badhamia utricularia*, in various stages of plasmodium and sporangia, and gave some account of the creatures.

In the ensuing discussion in which Mr. Paulson, F.R.M.S., and Mr. T. C. Shenstone, F.L.S., joined, Miss Hibbert-Ware spoke of the great abundance of Myxogasters in the neighbourhood of Leytonstone during the last month, saying that she had found 28 species during January.

Mr. William Marriott, F.R.Met.S., gave a *Lecture* on "Weather Observation in connection with the work of the Essex Field Club." The lecturer treated of the following matters, among others, and his observations were fully illustrated by lantern slides:—*Luke Howard's Observations at Plaistow—Instruments used at Meteorological Stations—Forms of Clouds—Rainfall—Snow—Hail—Thunderstorms—Climatological Observations—Work done by Natural History Societies—Work which might be undertaken by the Essex Field Club.*

An interesting discussion followed, in which the President, Mr. David Howard, F.C.S. (who exhibited a portrait at the age of 90 of his grandfather, Luke Howard, F.R.S., the celebrated "Father of British Meteorology"), Mr. T. S. Dymond, F.C.S., Mr. Paulson, Mr. Shenstone, Mr. Thompson, Mr. Nicholson, Mr. Wilson and Dr. Graham took part.

A cordial vote of thanks was passed to Mr. Marriott, at the instance of the President.

*N.B.—It has been considered desirable to re-enumerate the Meetings of the Club, commencing at the Foundation Meeting on 10th January 1880. Up to the present time only Ordinary Meetings, at which minutes are read, have been reckoned. There is no valid reason why ALL Meetings (other than Council and Committee Meetings) should not be enumerated. A careful counting has been made, with the result that the present stands as the 400th Meeting of the Club. This method will be adopted in future on the circulars and in the reports in the "ESSEX NATURALIST."

THE 401st MEETING OF THE CLUB.

SATURDAY, 24TH FEBRUARY 1912.

This meeting took place at the Technical Institute, West Ham, as usual, Mr. W. Whitaker, F.R.S., F.G.S., President, in the chair.

The Secretary read a letter from Mr. E. N. Buxton acknowledging the Club's message of congratulation on the occasion of his Golden Wedding.

In accordance with the Rules, nominations were made of members of Council and Officers in view of the Annual Meeting.

Donations.—The Curator, Mr. W. Cole, exhibited various recent donations to the Museum, including the collection of Epping Forest Lichens, illustrating Messrs. Paulson's and Thompson's paper down for reading that evening—a collection of Zonal Fossils from the Red Crag, presented by Mr. Alfred Bell—specimens of the Red-throated Diver (*Colymbus septentrionalis*) and one of the Little Auk (*Mergulus alle*) from the Stour River, presented by Mr. W. B. Nichols, J.P., M.B.O.U., Manningtree, and examples of a supposed new species of *Crepidula* from Oyster Beds near Harwich, presented by Mr. Bell: and made some remarks upon each of these exhibits.

Lord Lister.—The President referred to the recent death of Lord Lister, F.R.S., and proposed, in the name of the Council, that a letter of condolence should be sent to the family through our member, Miss G. Lister. This was unanimously agreed to.

Lichens of Epping Forest.—Mr. Robert Paulson, F.R.M.S., on behalf of himself and Mr. Percy Thompson, presented their Second Report on the Lichens of Epping Forest, supplemental to the paper already published in the ESSEX NATURALIST (Vol. xvi. pp. 136-145). The paper was illustrated by the collection referred to above, and by a series of very excellent lantern-slides, prepared from photographs of individual forms.

A discussion followed, in which the President, Messrs. Cole, Nicholson, Dr. Graham, and the authors took part.

Very cordial votes of thanks were passed to the authors, and to the donors of the specimens for the Museum.

DEMONSTRATION OF THE COLLECTIONS OF THE LATE MR. J. E. GREENHILL, F.G.S.

THE 402nd MEETING.

SATURDAY, 2ND MARCH 1912.

In November 1909, a portion of the collections of the late Mr. J. E. Greenhill, F.G.S. (who was one of the Honorary Members of the Club),

was presented to the Hackney Borough Library. A visit was paid to the Library in order to inspect the collection, under the guidance of Mr. Arthur Wrigley, who had arranged it in the cases, and our President, Mr. W. Whitaker, F.R.S., and Mr. Hazzledine Warren.

Unfortunately but few specimens bear any indication of their locality, and this detracts somewhat from their scientific value.

Perhaps the chief interest was found in a series of about 150 palæolithic implements, believed to have been found in North-East London. They are all of the types that have been usually met with in this locality. In the absence of any record of the precise situation where they were found, it has been deemed best to arrange them according to the method of classification employed by French archæologists. The greater number of these palæoliths are of Chellean type, the series starting with a characteristic group of greatly rolled and deeply patinated specimens. Attention was drawn to a "chopping-tool" of unusual type, with a semicircular cutting-edge, and unworked back; and also to a fine "ficron" or pick measuring 11½ inches in length, with an unworked back. Another group is of S. Acheul type, the flaking being finer and the cutting edge rendered straight by secondary chipping. Mr. Hazzledine Warren pointed out that a flat, triangular specimen, with a whitish patina, was of a type commonly found in the bed of the Thames.

Mr. Wrigley has recently obtained a few specimens from a gravel-pit at Temple Mills (near Leyton), and has placed them in the collection. The gravel is at a low level (15 feet O.D.), and is covered by alluvium. It has yielded a few derived palæoliths, and teeth of *Equus* and *Bos*. Opinions were divided as to whether a series of concave scrapers from the same place, which have an Eolithic appearance, were of human workmanship or not. It is hoped that a visit may be paid to this pit, which affords an extensive section of alluvium with an old marsh level and roots of plants, and low level gravel resting on (?) Woolwich beds.

The Neolithic series includes a fine flint knife (?Danish), numerous flakes and scrapers, a few celts (both rough and polished), and an unusual dagger or spear-head. This is of circular section and appears to have been intended for hafting: its patina is of a brown colour, unusual in Neolithic specimens. The bronze celts afford a good illustration of the evolution by types. One of them exhibits rudimentary wings, produced by hammering. Three socketed celts are from Clavering.

The organic remains from the drift include mammalian teeth, and mollusca. Among the latter were noticed *Corbicula fluminalis* from Crayford gravel, mollusca from the Alluvium of the Lea, found during the excavations for reservoirs at Lea Bridge in 1834, and a very large *Unio* from the brick earth.

The collection of English fossils contains many interesting specimens whose "provenance" is unfortunately unknown. Among these may be mentioned a perfectly complete *Rostellaria macroptera* (Barton Beds), and two large groups of palatal teeth of *Ptychodus*.

Mr. W. Whitaker pointed out that the teeth of fishes from the Norwich Crag and Cambridge Greensand are difficult to obtain now, as the deposits are almost worked out.

The upper shelves of the cases contain some pottery, mostly of mediæval date.

Several members found considerable interest in inspecting the Tyssen collection of prints and drawings relating to Hackney. These were collected many years ago and form a most valuable record of that older Hackney which has been for the most part demolished.

Before separating Mr. Whitaker expressed the thanks of those present to Mr. Wrigley for the trouble he had taken in arranging the meeting, and for his interesting expositions.

THE 403rd MEETING OF THE CLUB.

SATURDAY, 30TH MARCH 1912.

A meeting at the Technical Institute as usual, the President in the chair.

Exhibits.—Mr. D. J. Scourfield, F.R.M.S., exhibited on behalf of Mr. C. Soar, a beautifully executed water-colour drawing of a Fresh-water Mite (*Arrenurus*) which was presented to the Museum.

Mr. W. Cole showed a Museum preparation of the nest of the Great (or "Horse") Wood Ant (*Formica rufa*) exhibiting the structure in vertical section, and with the various "commensals" living in the nest.

Mr. Whitaker spoke of the pugnacious habits of this ant as often observed by him in the Kentish Woods.

Mr. David Howard, F.C.S., exhibited drawings of sections of two Artesian wells in his works at Stratford, 100 yards apart, and gave some particulars of the character of the water in the wells.

Paper read.—Dr. Thresh, M.D., D.Sc. (*Medical Officer of Health to the Essex County Council*), read a paper on "The Alkaline Waters of the London Basin." The main subjects touched upon were as follows :—

"The saline constituents of the deep well waters in various parts of the London Basin, but more especially in Essex—The Thanet sand, analysis of—Comparison with granite—Peculiar effect of granite upon hard and soft waters—Comparison with effect of Thanet sand—Action of brine upon granite and Thanet sand—Origin of the sodium and potassium salts in the deep well waters—Presence of bromine and iodine and their significance."

A long and interesting discussion followed the reading of the paper.

The President first called upon two visitors, Mr. Burgess and Mr. Matthews, who spoke on the subject from a chemical and engineering point of view, and Mr. Dymond, Mr. Wood, Mr. David Howard, Mr. Dalton, and the President, amongst others, continued the discussion.

Dr. Thresh replied to the various questions asked, and incidentally gave his opinion that waters containing up to 80 grains of sodium chloride per gallon were perfectly harmless to health.

The paper was illustrated by many tables of comparative analyses of the composition of various deep-well waters in Essex (shown by means of the lantern) and by some experiments.

On the motion of the President, the warm thanks of the meeting were accorded to Dr. Thresh for his valuable paper.

VISIT TO BLACK NOTLEY AND BRAINTREE.

404th MEETING.

SATURDAY, 27TH APRIL 1912.

This meeting was of unusual character and interest, its primary object

being to inspect the tombs of John Ray and Dr. Benjamin Allen, in the Churchyard of Black Notley, which had been recently restored under the auspices of the Club, and to attend the unveiling in Braintree Church, of a Bronze Memorial Tablet of Samuel Dale, erected also on the initiative of the Club.

A full account of the memorials and of the meeting is given in another place, to which the reader is referred. (See pp. 129-38).

Ordinary Meeting.—During the afternoon, a short meeting of the Club was held in Braintree High School, Mr. W. Whitaker, F.R.S., in the chair.

New Members.—The following were elected Members :—

Mrs. D. J. Scourfield, 63, *Queen's Road, Leytonstone.*

Mrs. C. N. Tween, *Lee House, Enfield Lock, Middlesex.*

The Secretary on behalf of Mr. H. Whitehead, B.Sc., exhibited some specimens of the Turbellarian worm, *Dallyellia viridis*, from a pond at Chigwell Row, Essex, and also a coloured drawing of the same. An account appears in the " Notes " columns.

Professor Boulger and Mr. W. Cole made some remarks on this interesting exhibit, and the formal meeting closed.

VISIT TO WARLEY PLACE, BRENTWOOD.

SATURDAY, 18TH MAY 1912.

THE 405th MEETING.

The object of this Excursion was to visit, again, by kind invitation of our Member, Miss E. Willmott, F.L.S., at Warley Place, and so afford members an opportunity of inspecting her famous gardens under a different floral aspect from that seen on our previous visit, in August.

On assembling at Brentwood, brakes were in readiness to take the party for a circular drive of four miles through some of the beauty spots of this very picturesque neighbourhood, visiting Harts Wood, Little Warley, Warley Gap and Great Warley Church, and so reaching Warley Place. Some very fine views over the Thames Valley and the Laindon Hills were enjoyed during the drive.

At Warley Place the Club was welcomed by Miss Willmott, and the afternoon was spent, under her guidance, in the magnificent gardens, containing, it is said, nearly 100,000 species and varieties of plants. The reader is referred to the full account of the gardens by Mr. Shenstone in the present volume of the ESSEX NATURALIST (*ante* pp. 40–60). Owing to seasonal changes, the gardens were quite altered in appearance since last year. Special interest was taken in the wild flower garden, the water garden and the rock-plants. Our hostess was full of interesting information in all sections, and the tour of the domain was a botanical and gardening treat such as is rarely experienced.

At the end of the rambles, all assembled in the house, where tea was served. The President, Mr. W. Whitaker, expressed the members' high appreciation of a delightful and instructive afternoon, and their warm thanks to Miss Willmott for her hospitable attentions and informing " talks " about the innumerable objects of interest in the gardens.

A meeting (the 405th of the Club) was held in an informal manner,

when the following were elected members :—Dr. G. A. Troup, 2, *Romford Road, Stratford, E.*, and Mr. Alfred Wright, *Rayleigh, Essex.*

Afterwards a special visit was made to the wonderful and charming "Alpine Garden," and then the members walked back to Brentwood station, home-going.

THE 406th MEETING,
INCLUDING THE ANNUAL MEETING, SPECIAL MEETING, AND ORDINARY MEETING.

SATURDAY, 1ST JUNE 1912.

These meetings were held as usual at Stratford, at 6 o'clock, the President, Mr. W. Whitaker, F.R.S., in the chair.

Annual Meeting.—The Minutes of the last Annual Meeting, held on 1st April, 1911, were read and confirmed.

The Hon. Secretary read the Annual Report of the Council for 1911, which was accepted. [This has been issued to the members as a Supplement to the *Year-Book* for 1911–12.]

The Treasurer's account of Receipts and Expenditure was also received.

The Secretary also read the accounts of the "Tea Fund," showing a deficiency of £1 7s. 8d.

Election of Members of Council and Officers.—The President announced that at the meeting on 24th February, the following members retired from the Council in rotation: Messrs. Hugh McLachlan, D. J. Scourfield, and J. C. Shenstone. They offered themselves for re-election, and were duly nominated. Mr. John Spiller having resigned his seat on the Council, Mr. Joseph Wilson, F.R.M.S., was nominated to fill the vacancy.

As officers, the following were nominated :—*President*, Mr. William Whitaker, B.A., F.R.S., F.G.S.; *Treasurer*, Mr. David Howard, J.P., F.C.S., F.I.C.; *Hon. Secretaries*, Messrs. W. Cole, B. G. Cole, and Percy Thompson; *Librarian*, Mr. Thomas W. Reader, F.G.S.; *Auditors*, Mr. Walter Crouch, F.Z.S., and Mr. F. Reichert.

The President also stated that, no other members having been proposed, he declared the above-named gentlemen elected as members of the Council and Officers for 1912–13.

Vice-Presidents.—Some conversation took place as to the nomination by Presidents of the Club of four members of the Council to act as Vice-Presidents during their years of office. [See Rule III.] The opinion was expressed that it would be well to make more frequent change of members of the Council chosen for these positions. The Secretary pointed out that this was a matter wholly at the discretion of the President for the time being.

This concluded the business of the Annual Meeting.

Special Meeting.—By order of the Council, a *Special Meeting* was then held for the consideration of the recommendations of the Council respecting the *Library*.

The President read the heads of the proposed Agreement between the Corporation of West Ham and the Essex Field Club with respect to the

BRASS OF ARCHBISHOP HARSNETT
IN CHIGWELL CHURCH.

From the "Chigwell Register,"

BY PERMISSION.

Library of the Essex Museum, a copy of which had been sent by post to every member of the Club.

These heads of Agreement are embodied in the Agreement itself, which is printed in the *Supplement to the Year-Book for* 1913-14.

Mr. Avery proposed that the explanatory paragraphs which had been inserted in the circular of the meeting by the Secretary, should be voted on first. The paragraphs were as follows :—

" The condition of the Library has been for many years past a matter of great concern with all well-wishers of the Club, and the growth of the collection renders the problem of its proper conservation one of increasing difficulty. In the opinion of the Council the best solution is that embodied in the accompanying Memorandum, and for the reasons given in the Preamble (which will be fully explained at the Meeting) the scheme is strongly recommended for support by our members :—

" Preamble.—In view of the fact that there is at present a very large and constantly increasing number of volumes of Transactions of Natural History Societies, etc., which would be exceedingly valuable if available for reference, and inasmuch as these cannot, owing to their unbound condition be placed in the Library, and inasmuch as the finances of the Essex Field Club cannot provide the necessary funds for binding, the Council suggest that in the interests of the Members of the Club, it is desirable to approach the Council of the County Borough of West Ham with a view to making the Library of the Field Club participate in the benefits of the financial assistance available for Museum purposes."

Mr. Avery proposed as an *amendment* that the Preamble should read as follows :—

" Preamble.—In view of the fact that there is at present a very large and constantly increasing number of volumes of Transactions of Natural History Societies, etc., which would be exceedingly valuable if available for reference, and inasmuch as these cannot, owing to their unbound condition, be placed in the Library, in the interests of the members of the Club it is desirable to allocate out of the general funds of the Club the sum of at least £10 per annum for the purpose of binding the books, with a view of making the Library available for members."

After considerable discussion, the amendment was put from the chair, and *lost*.

The President then proposed on behalf of the Council the heads of the proposed agreement.

After full discussion, the President put the same *en bloc*, and they were agreed to with one dissentient.

This ended the business of the Special Meeting.

A short Ordinary Meeting was held, at which Mr. Thompson, on behalf of the author, read a paper on " The Coast Flora of the Clacton District," by Mr. F. Saxer.

Some remarks were made by the President and by Mr. J. C. Shenstone, F.L.S., and the meeting ended.

MEETING AT CHIGWELL.—THE 407th MEETING.

Saturday, 8th June 1912.

An enjoyable meeting was held in this interesting district, at the kind invitation of our members, Mr. and Mrs. Howard Wall. It was an " all-

day " ramble, the morning party assembling at Chigwell Lane station at about 11 o'clock, and the afternoon party at Loughton Station about half-past two. The previously unsettled weather prevented members from attending in large numbers, but fortunately for the party Chigwell was spared even a shower throughout the day. The " conductors " were Mr. Wall, Mr. Robert Paulson, F.R.M.S. (*Botany*), Mr. W. Cole (*Entomology*) and Mr. H. Warren, F.G.S. (*Geology*). For much information concerning Chigwell, and the interest taken in the village by Charles Dickens, the reader is referred to the report of a visit by the Club on 25th July 1881, at which meeting Mr. Fisher Unwin read a paper on the village and its memories (*Journal of Proceedings of the Essex Field Club*, vol. II., pp. xxxiv.—xl.).

The early party on leaving Chigwell Lane walked across the Roding Valley to Rolls Park (three-quarters-of-a-mile), the house and park having been kindly thrown open to the Club on this occasion by Mr. and Lady Sybil Smith, who at present are in occupation of the estate. The house is in the main a seventeenth century mansion with eighteenth century additions ; the oak-panelled hall and grand staircase with massive carved balustrade are especially worthy of note. The " Harvey Room " contains a series of oil paintings, of dates ranging from the mid-seventeenth to the mid-eighteenth centuries, framed in decorative plaster panels on the walls. Some time was spent in the house and park, and the Club afterwards proceeded through the village to the well-known Grammar School, which was open by the courtesy of the Rev. Canon Swallow, Head Master. In the unavoidable absence of Mr. Swallow, Mr. Simkins received the visitors, and gave a short account of the history of the School, which was founded in 1629 by Samuel Harsnett, Archbishop of York, who had been vicar of Chigwell, and whose fine monumental brass, dated 1631, will be seen in the Church close by. William Penn, founder and governor of the State of Pennsylvania, was one of the early pupils of the School.

At the Church (St. Mary), the party was received by the Vicar, the Rev. F. A. Murray. Mr. Howard Wall gave an interesting account of the building and its history. It has been changed very considerably since the Club visited it in 1881 ; it is now quite a model village church with every aid to reverent worship. From Mr. Wall's remarks the following details may be quoted.

The old nave, now the south aisle, has a good Norman door-way, with a cloistered avenue of yews leading to it. The steeple with a copper-covered spire has a fine oak bell-cage, supported by heavy timbers, detached from the brick-work, and dates from 1500.

The four-bay arcade, built in 1480 to allow entrance to the north aisle, now opens into a noble nave, built in 1887, 70 feet long by 25 feet 6 inches wide and chancel 30 feet long and 22 feet 6 inches wide, designed by Mr. Blomfield ; the opening from the old chancel to the new is pleasingly and cleverly designed. This new part of the church is beautifully decorated from designs of Mr. Bodley, who also designed the pulpit ; there are three good windows by Powell, Kemp and Burlingson respectively.

The very large brass to Archbishop Harsnett (1631) is in perfect preservation, and ranks with only one other post-Reformation brass in the country as of special interest, the effigy being vested in full canonicals.

CHIGWELL GRAMMAR SCHOOL.

From the "Chigwell Register,"

BY PERMISSION.

By the kindness of our member, Mr. John Phelp, Plates from photographs of this celebrated "Brass" and of the School-House are inserted in the present number (see p. 125). The altar plate, which was exhibited and explained by the Vicar, is sixteenth century, of beautiful design and workmanship, and is believed to be one of the best sets in Essex.

Luncheon was taken in the Chester Room of the "King's Head" Inn, opposite the Church. This picturesque old hostelry is, as all Essex folk know, the "Maypole" of Dickens' *Barnaby Rudge*, and the building and gardens are well worthy of inspection. A stroll down Hall Lane to the "White Bridge" over the river Roding enabled those coming by field paths from Loughton to join the company. Some time was spent in collecting plants and insects, and in inspecting the Chigwell Moat, a small square enclosure without any trace of buildings, surrounded by a moat, as to which not even a local legend exists.

On returning to the village, the Club was most kindly entertained at tea by Mrs. Wall, at "Brook House," and afterwards a short meeting (the 407th) was held, Mr. J. C. Shenstone, F.L.S. *Vice-President*, in the chair. The following were elected members:—

Mr. J. R. Airey, M.A., B.Sc., Principal of the West Ham Technical Institute, 73, *Claremont Road, Forest Gate, E.*

Mrs. J. R. Airey, 73, *Claremont Road, Forest Gate, E.*

A hearty vote of thanks was passed to our kind hosts, and an inspection of the house enabled the visitors to see some very good 17th century oak-panelling, which had been recently exposed from its coating of plaster. Then the party walked by a field path to the cutting of the loop railway line between Chigwell and Grange Hill Stations, to inspect, by permission of the G.E.R., the section (now somewhat defaced by slips), at about 200 ft. O.D., of the high-level gravel of the Valley Drift.

MEETING IN THE ARKESDEN AND ELMDON DISTRICT (THE CHALK DOWNS OF ESSEX).—THE 408th MEETING.

Saturday, 22nd June 1912.

This meeting was organised by Mr. Guy Maynard, Curator of the Saffron Walden Museum, and Mr. G. Morris, B.Sc., of the Friends' School. Other conductors were Mr. L. F. Newman, of the School of Agriculture, Cambridge, Mr. Whitaker, F.R.S., and Mr. J. T. Wilkes, J.P.

The geology and botany of the district are of considerable interest, and, aided by fine weather, a most enjoyable day was spent.

The London party arrived at Audley End station by slip carriage attached to the 8.40 express from Liverpool Street, and being met by the county members, proceeded by brakes to Newport, where Mr. Whitaker made a few remarks on the interesting well boring at Newport Grammar School. Here, although the Chalk was expected at a moderate depth from the surface, yet no less than 340 feet of drift sands and clays were pierced without its being reached, the bottom of the bore being 138 feet below the present sea level when it was abandoned. The evidence of other local wells also pointed to the existence of an ancient gorge or river channel running through the district, which was filled up with drift sands and clays probably during the Glacial Period. Proceeding to Wicken Bonhunt, the little wayside chapel of St. Helen, now used as a stable,

was inspected. The building has been regarded as Saxon in origin, but the recent discovery of fragments of ornamented stone work of a transitional character between the Norman and Early English styles confirmed a suspicion previously aroused by the construction of the building. The large gravel pits between Wicken and Arkesden next received attention. Mr. Whitaker pointed out that the 40 feet of gravel and sands shown in these pits were at a higher level than the deposits pierced in the Newport wells and probably overlay them. The gravels were classed by Searles Wood as Mid-Glacial, and he confirmed their glacial age. They appeared to run in under the great deposit of boulder clay which covered the highest ground in the district, and were found underlying that deposit in many local well borings.

The drive was continued to Wood Hall, Arkesden, where they were received by Mr. Charles Beadle, and light refreshments were partaken of. Great interest was taken in the curiously carved chimney beam, part of the original house and probably of the time of Henry VIII.; while the appointments and gardens of the fine old residence were greatly admired. A hearty vote of thanks to Mr. Beadle closed a short but most enjoyable visit. In Arkesden village the enormous elm tree, one of the largest in the county, was noticed, and the group of large stones collected in the fordway below the old bridge. These were pronounced to be remnants from the great sheet of sandstone and conglomerate, or pudding-stone, which once covered wide areas in the Eastern and Southern counties overlying the chalk. This formation had been gradually worn through and broken up in past ages, and only the larger and heavier fragments remained on the present surface. They were best termed "Sarsens," an ancient word for stones, and were not "boulders" in the geological sense of transported rocks, foreign to the district in which they were found. After an inspection of Arkesden church, the drive led through lanes to Duddenhoe End, where they were entertained to lunch by Mr. J. F. Wilkes in one of the fine old timbered barns on his estate.

The President called upon Mr. Morris, B.Sc., to offer some remarks upon the chief object of the day's expedition, the areas of Boulder-clay land which have been lying out of cultivation for many years. Mr. Morris, who has made a special study of the vegetation of these waste grounds, described the relation between the geology and botany of the district leading up to the development of the characteristic vegetation which has covered the waste grounds since their abandonment 20 to 30 years ago during the great depression of corn prices. He outlined the succession of peculiar phases or plant associations, which finally converted those areas into thick thorn scrubs. A general discussion took place in which Mr. Wilkes confirmed the statements that it was the lands mostly expensive to work which went soonest out of cultivation in times of depression, and that the reason for the position of the oak woods on the high ground was that they undoubtedly represented patches of original forest, left untouched in the gradual extension of arable ground because they occupied the areas where the clay was heaviest and most unprofitable to work.

After lunch the party walked across a belt of cultivated land on the Boulder-Clay. The fine crops of wheat and beans were noted. A

belt of the characteristic Oak-Ash woodland was then examined. The principal features of this were the absence of the Oxlip (*Primula elatior*), which is so marked a feature of the woodland on the east of the Cam, and the characteristic associations of *Carex pendula* and *Aira*. Attention was also called to the great abundance of the bramble *Rubus cæsius*, and the absence of *Rubus fruticosus* was commented upon.

Leaving the wood, the party passed across the clay waste where the different plant associations were examined.

(1) The open flora of the most barren parts with *Taraxacum dens leonis*, *Fragaria vesca* and *Hypericum hirsutum*, dominants.

(2) The *Lotus corniculatus* association on slightly richer soil.

(3) The invasion belts of *Brachypodium*, *Rubus*, etc., from the woodlands.

(4) The damp hollow associations of *Centaurea nigra* and *Arrhenatherum elatus* which culminate in a ditch zone of *Spiræa ulmaria*.

During a short rest, Mr. L. F. Newman, of the School of Agriculture, Cambridge University, gave an address on the chemistry and physical character of the local soils from the agriculturist's standpoint, dwelling on the great importance of the size of the soil particles upon plant life. He pointed out that the extreme fineness of the clay particles was the chief reason for the difficult nature of the boulder clay. In dry weather the particles were baked together into a hard crust, which effectually kept out light and air and prevented plant development.

Crossing the waste, specimens of *Blackstonia perfoliata*, *Hieracium pilosella* and *Centaurium umbellatum* and other chalk-flowers were gathered. On the top of hill specimens of the Bee and Spotted Orchids and Twayblade were found, while in a belt of woodland to the north specimens of the Bird's-nest and Butterfly orchids were seen. In this wood the characteristic *Melampyrum cristatum* occurs and also a few plants of Bracken, which is rare in this district.

Leaving the wood, the party then passed through a waste area of considerable age which had reverted to White-thorn scrub. Here many Bee Orchids were seen.

Lower down the hill the presence of *Helianthemum* was noted, showing the presence of the chalk outcrop.

Later in the day *Lamium galeobdolon* was obtained in a wood behind Chrishall Church.

At one point the highest land of the county was crossed, the elevation being just under 500 feet above sea-level, and eventually the excursionists made their way to the brakes at Bilden End.

Chrishall Church was visited and the fine canopied brass to Sir John de la Pole and lady, 1370 A.D., and other monuments were inspected, and the party then drove through Chrishall and Elmdon, glorious views over Cambridgeshire and the Fen Country being obtained from the high ground. At Elmdon Bury, tea had been provided on the lawn by Mr. J. F. Wilkes, after which a short visit was paid to the ancient entrenchment from which the property takes its name, and to the church. Hearty votes of thanks were passed to Mr. and Miss Wilkes for their hospitality, and the great interest they had taken in the day's proceedings, and the company then

drove back to Audley End station, passing through the grounds of Lofts Hall *en route*, and left for London by reserved carriage on the 9.27 express, which was stopped by special arrangement to pick them up.

VISIT TO STAPLEFORD TAWNEY AND THEYDON MOUNT.—THE 409th MEETING.

SATURDAY, 20TH JULY 1912.

The main object of the Meeting was to visit, by kind invitation, our member, the Rev. Lewis N. Prance, M.A., F.S.A., at Stapleford Tawney, and incidentally to inspect several places of interest in the district.

Situated many miles from any railway station, both Stapleford Tawney and Stapleford Mount are the most charming of rural parishes and amply repay the trouble which is necessary to reach them. They stand on very high land overlooking extensive stretches of valley and woodlands, and also contain many features of internal interest. The visitors were conveyed in brakes from Theydon Bois and Brentwood stations to the church of St. Mary, Stapleford Tawney. The Rev. L. N. Prance, who is the rector of both parishes, met the visitors at the church, the interesting features of which were explained by him, and by Mr. Sworder, of Epping, and Mr. Percy Thompson, one of the hon. Secretaries of the Club.

Outside the south porch there stands a coped stone coffin of unusual design, which is one of the finest examples of its kind in Essex. It was discovered during the restoration of the Church in 1861 buried beneath the floor of the nave. It is in a perfect state of preservation. It has been described and figured by Mr. Miller Christy in the *Trans. Essex Archæological Society*, vol. VII., pp. 371 and 392. A second mutilated stone-coffin, without a lid, was discovered at the same time, and now stands outside the north wall of the church. The perfect coffin probably owes its good preservation to the fact that it has only recently been brought out into the open air, and the suggestion was made that some form of protection from the weather should be given to this ancient relic.

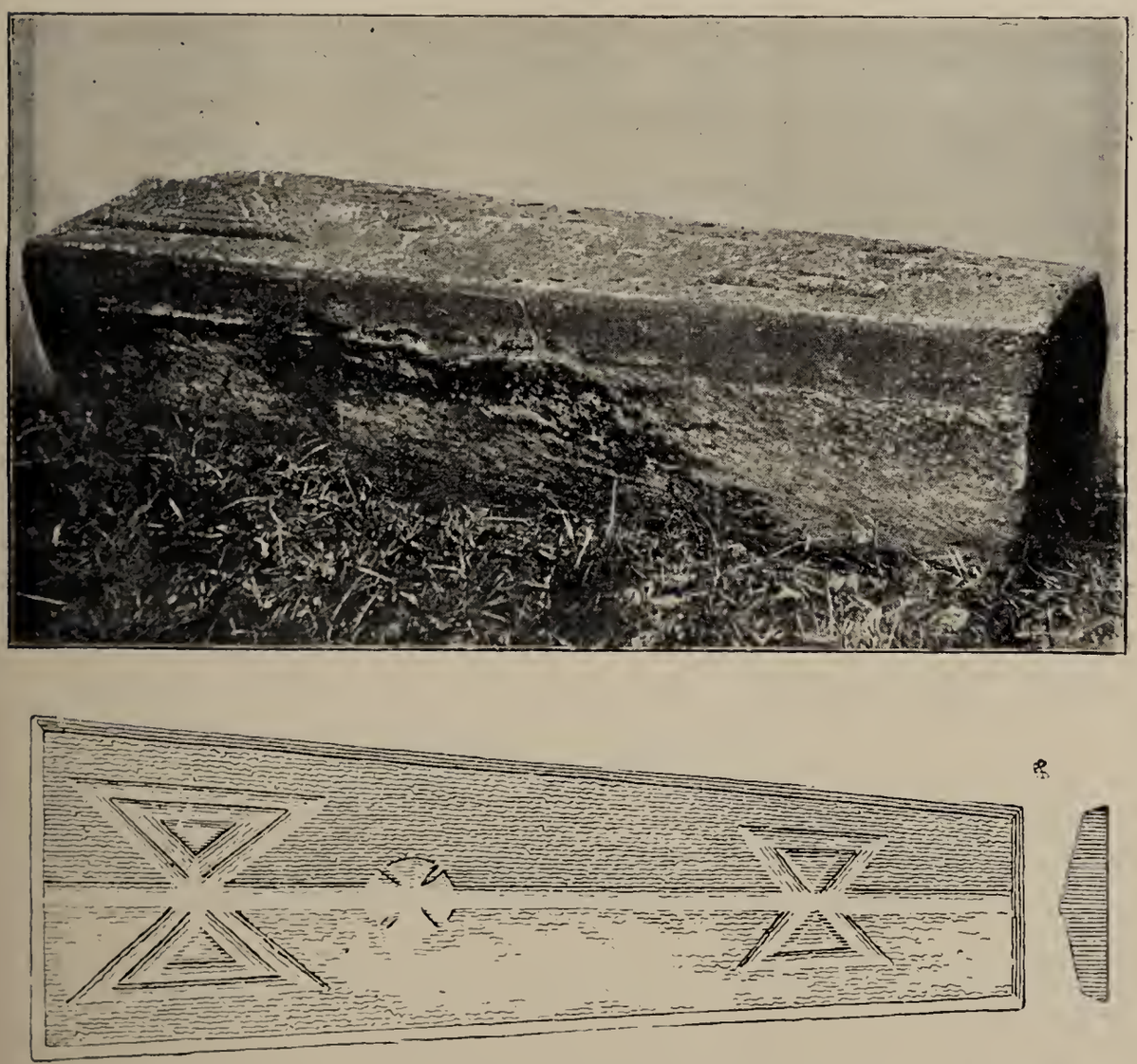
The visitors were entertained to lunch at Tawney Rectory, by the kindness of Mr. Prance, and spent a considerable time in investigating his well-stocked garden, Mr. Prance being an ardent horticulturist. Then a walk across the fields was taken to Theydon Mount and the charming little Church of St. Michael was visited, under the rector's guidance. It is dated from 1611, and is built in picturesque Jacobæan brickwork; the quaint south porch is of moulded red-brick. The unusual shaped openings which admit light to the Tower stair should be noticed. Internally some large and elaborate Monuments to the Smijth family are noteworthy, and the Font, an old Italian *lavabo* of coloured marbles and white alabaster, is unique. Some curious garlands of flowers or paper, with several pairs of gloves or mittens, suspended from the roof of the nave, have attracted much attention in the past, and were described in the report of a Club Meeting at the Church on 28th May 1892 (ESSEX NATURALIST, vol. VI., p. 105), and further notes were printed in the same volume on pp. 99 and 117. They were probably funeral garlands used at the burials of maids, and they are alluded to by many old writers and in ballads.

An inscription on the alabaster tomb of Thomas Smith, 1577, which runs :—

" What Ye arth, or Sea, or Skies conteyne, what Creatures in them be
My Mynde did seeke to knowe, my Soule the Heavens continually."

appealed favourably to the naturalists present.

Mr. Prance was cordially thanked for his kind hospitality and his very pleasant and interesting leadership. Leaving the church, the brakes conveyed the party to the Brick-Pit at Theydon Mount, where, by the



STONE COFFIN AND COFFIN SLAB AT STAPLEFORD TAWNEY

(Block kindly lent by the Essex Archæological Society).

kind attention of the Manager, Mr. Bonner, the section shows passage-beds from London Clay to Bagshot Sands, comprising sandy loam, passing down into more clayey beds with septaria, and containing intercalated seams of brickearth. Sharks' teeth have been met with here, but no other fossils.

Small oval surface pockets containing burnt wood, clay, and fragments of coarse dark prehistoric pottery, but no bones, have been noticed from time to time in this pit, and may be small Kilns, of unknown age.

The members subsequently walked through the adjacent Beachet

Wood, under the guidance of the head keeper, Mr. Tyler, in order to inspect some fine specimens of Wild service Tree (*Pyrus torminalis*), which occur in the wood ; the largest of these was measured by Mr. Thompson some years since, and found to be 75 inches in girth at three feet above the ground, and in height over 50 feet—a giant of its kind.[1] The extremely vigorous and handsome growth of the Rose-Bay (*Epilobium angustifolium*) and the fine plants of species of St. John's-Wort (*Hypericum*) were outstanding features of a very pleasant woodland walk.

A drive through the Park led the party to the fine old Elizabethan Mansion, Hill Hall, which had been very courteously thrown open for inspection by the occupier, Mr. Charles E. Hunter. Tea was taken in a tent specially erected in the park, and then a short formal meeting of the Club was held, Mr. J. C. Shenstone, F.L.S. *Vice-President,* in the chair.

New Members.—The following were elected :—

Mr. F. A. Lindsay Smith, C.C., 18, *Sussex Place, Regent's Park, N.W.*

Mr. Charles B. Sworder, *Lachmore, Epping.*

At the suggestion of the chairman, hearty votes of thanks were passed to the Rev. Mr. Prance, and to Mr. Hunter for throwing open the Hall for inspection.

The chairman also alluded in feeling terms to the recent loss that the Club and the county had sustained in the death of Alderman E. A. Fitch, J.P., one of the early Presidents, and so highly esteemed for his knowledge of some obscure groups of insects and the history of Essex.

Mr. W. Cole added some personal recollections, and he was asked as Hon. Secretary to convey the sincere condolences of the Club to Mrs. Fitch.

AFTERNOON RIVER-SIDE RAMBLE BY THE RODING. THE 410th MEETING.

SATURDAY, 21ST SEPTEMBER 1912.

An informal meeting was held this afternoon, under the leadership of Mr. C. Nicholson, Mr. R. Paulson, F.R.M.S., and Mr. Thompson. Mr. W. Cole was away in the country, and unable to be present.

The object of the ramble was to study the botany and entomology of the banks of the Roding between Chigwell Lane and Abridge, where a typical river-side assemblage of flowering-plants occur. The way, about $2\frac{1}{2}$ miles, was partly by field-paths and partly through the open meadows. Frequent demonstrations were given *en route.*

Tea at the "Blue Boar" at Abridge, of which little old town Sir Walter Besant wrote in *All in a Garden Fair* :—"A town of which nobody ever heard ; whither nobody goes ; a town of red-bricked gabled houses, with red-tiled roofs, standing all huddled together in a circle, as if there was once walls round it ; a strangely quiet town, which looks as it it had never even heard of the outer world, and took no interest in anything but itself."

Thence the road to Theydon Bois on the way home was taken, pausing

1 Mr. Edwin E. Turner writes that there is in the Park at Holfield Grange, Coggeshall, a tree of this species of far greater dimensions, being in girth 10ft. 8in., and he believes there are even bigger trees in the neighbourhood.

on the way at the old deserted Church-yard of St. Mary's, for an admirable description of which we may again quote Besant :—

"Again, there is another way beyond the Forest which leads along narrow leafy lanes, the like of which you cannot find outside of Devonshire. You pass by the way . . . . to look over crumbling old wooden palings into a strange, deserted graveyard. There is no Church or Chapel in it or sign of any building ; it is a small square covered with graves, and containing one or two headstones ; trees stand round it, and it is covered with long grass ; a wild and ghostly place."

The following quaint epitaph occurs upon one of the few tombstones :

"Farewell vain world I bid adieu to y^e^,
I value not what thou canst say to me,
For friends I care not or my Foes I fear
All's one to me my Head lyes quiett hear^e^,
Whatt Faults you see in me take Care to shun
And looke at Home theres Something to be done."

The retort contained in the last line, after the professed indifference to hostile criticism of the first few lines, is charming !

Another tombstone in this churchyard is to the memory of one John Finch, died 1826. "He was 30 years Ostler at the King's Head, Loughton." The King's Head was an old coaching house, and this inscription indicates the relative importance of ostlers in the olden days.

VISIT TO TEMPLE MILLS, LEYTON.—411th MEETING.

SATURDAY, 5TH OCTOBER 1912.

On this afternoon a visit was made to the Gravel-Pit, Temple Mills, Leyton, under the guidance of Mr. Hazzledine Warren, F.G.S., Mr. Arthur Wrigley, Mr. W. Whitaker, F.R.S., and Mr. W. H. Dalton, F.G.S.

The pit was reached by a ten-minute walk from the station, by way of some roads built upon the edge of the Middle Terrace Gravel, to the low marshland by the side of the Lea River, in the neighbourhood of Temple Mills.

After a brief explanation of the relation of the low level gravel to the adjacent deposits, the party went into the pit. The natural surface here is at 15 feet O.D. The extensive section exposed shewed (1) 3 ft. of Alluvial Clay, subsoil, (2) 13 ft. to 16 ft. of River-gravel, very evenly bedded, with occasional seams of loam and sand. This gravel rests on the eroded and uneven surface of a bed of greenish blue loam.

By kind permission of the owner of the pit, two small trenches had been sunk in this bed. They disclosed a downward extension of at least 5ft. On the top of this bed of green loam, between it and the gravel, is a thin stratum of tertiary-pebbles in buff loam. The geologists present agreed that these beds are of Lower Tertiary age, though from their unusual appearance and the absence of fossils it is difficult to speak very precisely of them. Mr. Wrigley mentioned that during the previous week he had seen the basement bed of the London clay at 4ft. in Hackney Wick, about a mile to the west, and thought that this supported the idea that the beds in question were of Lower Tertiary age. In the lower part of the gravel, lenticular patches of greyish clay with plant remains occur. An

examination of these has led to the collection of a series of mosses, seeds, and leaves which suggest a relation with the "Arctic Bed" at Ponders End. (See his paper "Notes on the Fauna and Flora of the so-called 'Arctic Bed' of the Valley of the Lea at Ponders End," *ante* pp. 36–39). Mr. Hazzledine Warren was able to announce that in one of these lenticular patches he had found dwarf mollusca, of the same species as those found in the Ponders End deposit. A few derivative Palæolithic implements have been found in the gravel, and remains of *Elephas* sp. *Rhinoceros*, *Bos* and *Equus*.

The party returned to Leyton and took tea. Afterwards several members availed themselves of the kind invitation of our Member, Mr. Z. Moon, the Chief Librarian to the Leyton Council, and inspected an extensive series of Essex books, maps and prints in the adjacent public library. On the suggestion of the President, a cordial vote of thanks was passed to Mr. Moon for his kindness.

[The Editor is indebted to Mr. Wrigley for this report.]

"FUNGUS FORAY" AND 412th MEETING

SATURDAY, 19TH OCTOBER 1912.

At least one hunt for Funguses has been held every autumn since the foundation of the Club, and a great deal of information thus gathered concerning the Cryptogamic Flora of the Forest will be found in our publications. The present meeting was held to explore the ground from Loughton to Theydon Bois. The Referees were:—*Basidiomycetes* and *Ascomycetes*, Miss A. Lorrain Smith, F.L.S., and Mr. George Massee, F.L.S. (*Royal Herbarium, Kew Gardens*); *Myxomycetes*, Miss G. Lister, F.L.S., whilst many other expert members gave their assistance either in collecting or identifying the specimens.

The morning party, having assembled at Loughton, rambled over Staples Hill, through "Cowper's Camp," Little and Great Monk Woods and Broadstrood, to Oak Hill Farm, Theydon Bois, the headquarters for the day. The afternoon party assembled at Theydon Bois station and joined their comrades in the woods.

Every effort was made to secure good "bags," but notwithstanding the abundance of rain throughout the year, the larger Fungi were everywhere comparatively scarce, both as regards variety and numbers. As usual on such occasions, certain species not met with on ordinary occasions were found. Amongst white-spored species the genus *Tricholoma* was most in evidence. The following species were collected:—*T. saponaceum*, *T. melaleucum*, *T. sulphureum*, *T. stans*, *T. saevum* and *T. tenuiceps*, the last named being new to Essex. *Mycena galericulata*, var. *calopus*, was met with in some quantity growing in decayed hollows of oaks, to which it appeared to be confined. A very beautiful tuft of *Mycena polygramma* was found growing on a log. Dark-spored species were very meagrely represented, as were also the genera *Boletus* and *Polyporus*.

The beautiful and somewhat rare *Stereum sanguinolentum*, which liberates a blood-red juice when cut or bruised, almost covered the surface of a fallen trunk of hornbeam.

After tea at the head-quarters, a meeting (the 412th) was held, Mr. W. Whitaker, President, in the chair.

New Members.—The following were elected :—Mr. William Howard, *The Willows, Prince's Road, Buckhurst Hill ;* Mr. W. Richter Roberts, *Monkwood Cottage, Baldwyn's Hill, Loughton ;* Miss Elvina M. Heath, 84, *Claremont Road, Forest Gate.*

The Conductors, Miss Lorrain Smith, Miss G. Lister and Mr. Massee, gave short addresses on the observations of the day. Miss Lister's researches are printed in her report in connection with the two Fungus meetings printed elsewhere (see pp. 126-8).

Representatives of the Selborne Society and the School Nature-Study Union expressed the pleasure of their members at the cordial invitations extended to them by the Club.

The Meeting then resolved itself into a conversazione for the examination of the specimens obtained during the day.

THE 413th MEETING.

SATURDAY, 26TH OCTOBER 1912.

This meeting was held as usual at Stratford at 6 o'clock, Mr. W. Whitaker, F.R.S., in the chair.

New Member.—The Rev. C. Grinling, 10, *Rectory Place, Woolwich, Kent,* was elected.

Paper Read.—A paper entitled "Some Recent Observations on the Physiography of the Stort Valley, with special reference to the Rubble-Drift Deposits" was read by the Rev. A. Irving, D.Sc., and Percy A. Irving, B.A.

The paper dealt with a few of the more conspicuous examples of the Rubble-Drift movements that have taken place by the simple operation of gravitation acting upon materials placed in an unstable condition on the slopes and bluffs of the valley flank. They supplement the inland series of such deposits recorded in Prestwich's map, attached to the most important of his two papers (ii). The opening up of the Stort Valley in public works and otherwise in recent years has afforded opportunities for observing the structure of such deposits. Special notes are added (1) on the Harlow Boulder-Clay and its differentiation from the Upper Stort Valley Drifts ; (2) on the north end of the section of plateau-gravel (prequaternary) at Braintree (Prestwich, *Q.J.G.S.*, vol. xlvi. page 133, fig. 9), a case of special interest to Essex Geologists and Archæologists ; (3) on the Bronze "Hoard" found at Matching (Essex) in 1893, now in the Colchester Museum ; (4) Comparative study of Horse-molars (prehistoric) from Essex and Herts ; (5) Note on the Henham Horse-bones (*Nature,* May 2nd, 1912).

The two papers of Prestwich's alluded to above are (i) "On the Age, Formation, and Drift Stages of the Darent Valley" (*Q.J.G.S.* xlvii) ; (ii) "On the Raised Beaches and 'Head,' or Rubble-Drift of the South of England ; their Relation to the Valley Drifts and to the Glacial Period" (*Ibid.* xlviii.).

The paper was illustrated by specimens of animal remains, and by samples of the various boulders occurring in the strata, etc.

Remarks were made by Mr. H. Warren, F.G.S., and by the President. A vote of thanks was passed to the authors, to which Mr. Irving responded.

Conference of Delegates of Scientific Societies of the British Association at Dundee, and the extirpation of Wild Flowers.—Mr. Joseph Wilson, F.R.M.S., as Co-Delegate of the Club, with Mr. Whitaker at the Conference briefly reported on the subjects brought forward. See report p. 138.

Exhibits.—In addition to the exhibits made by Dr. Irving, in illustration of his paper, the following special exhibits were made :—Mr. H. Rand : (*a*) Neolithic Implements, &c., from Hull Bridge, near Rayleigh (cup-marked mortar, grinding stones, hammer stone, axes, scrapers, saws, borers, flakes, &c., including a series of about 100 pygmies) ; (*b*) Primitive Fishhooks (thorns and bent pins) used on the river Crouch. Mr. Arthur Wrigley : Implements, Bones, and Plant-remains from the Pleistocene deposit at Temple Mills, recently visited by the Club.

Remarks on the exhibits were made by Mr. Rand, Mr. Warren and Mr. Wrigley, and votes of thanks were cordially accorded to these gentlemen.

THE 414th MEETING.—THE ANNUAL CRYPTOGAMIC FORAY.

SATURDAY, 2ND NOVEMBER 1912.

This Meeting was arranged for the observation in the field of groups of the Cryptogamia other than the larger Hymenomycetal Fungi.

The Directors and Referees were :—*Mosses,* Mr. E. M. Holmes, F.L.S., Mr. A. Bruce Jackson ; *Hepatics,* Mr. Frank Cavers, D.Sc., F.L.S. ; *Lichens,* Mr. R. Paulson, F.R.M.S., Mr. Percy Thompson ; *Myxomycetes,* Miss Gulielma Lister, F.L.S.

The Head-Quarters for the day were at the Royal Forest Hotel, at Chingford.

The morning party started from Chingford Station about 11.30, and the route was through Chingford Village to the Hawk's Mouth, there entering the woodlands and proceeding through Hawk Wood to Yardley Hill, and thence through Bury Wood and across Chingford Plain to the Club's Forest Museum at Queen Elizabeth's Lodge, where a junction was effected with the afternoon party.

After an inspection of the Museum, Mr. Cole gave a few particulars of the building and of the Club's efforts to establish an interesting local and Nature-Study Museum there, efforts which he feared would, after nearly 17 years' hard work, be frustrated by the non-sympathetic attitude of the Corporation of London. Then the combined parties rambled over Fairmead and the adjacent woods, finally returning to the Forest Hotel for tea and the evening meeting.

A short formal meeting (the 414th) was held, Mr. W. Whitaker, F.R.S., President, in the chair.

The following were elected Members :—Mrs. W. H. Dalton, 85, *Hayter Road, Brixton Hill*; Miss Elsie Peake, 58, *Kensington Gardens, Ilford*; Mr. Arthur Wrigley, 72 *Cassland Road, South Hackney*.

An account of the species of Mycetozoa observed during the day was given by Miss Lister. Her remarks are embodied in a short paper printed in the present part of the E.N., pp. 126-8.

Dr. Cavers reported concerning the species of Hepaticæ, and Mr. Paulson on the Lichens.

Mr. E. M. Holmes, F.L.S., exhibited some living specimens of a rare Liverwort, *Ricciocarpus natans*, recently found by Mr. J. G. Everett in a pond at Chigwell, and some account of this form was also given by Dr. Cavers.

Professor G. S. Boulger, F.L.S., made a short speech, in which he expressed the pleasure of the members of the Selborne Society who had taken part in the meeting.

The remainder of the evening was spent in examining the various specimens gathered during the day.

THE 415th MEETING.

SATURDAY, 30TH NOVEMBER 1912.

This meeting was held at the Technical Institute, West Ham, at 6 o'clock, the President in the chair.

New Member.—Miss Emelia F. Noel, of 37, *Moscow Court, London, W.*, was elected a member.

Paper Read.—Mr. Thomas Barrett-Lennard, M.A., J.P., read "Some Letters of the Rev. Wm. Derham, F.R.S., Rector of Upminster, to Dacre-Barrett, of Belhus, Essex (1704-10), together with some remarks on the same."

Some observations were made by the President and by Mr. W. Cole, and Mr. Barrett-Lennard was thanked for his communication.

A *Lecture* was then given by Miss G. Lister, F.L.S., on the *Mycetozoa*. The lecture was illustrated by diagrams, and coloured lantern-slides from Miss Lister's own drawings and by actual living specimens of the plants (or animals ?).

A very cordial vote of thanks was accorded to the Lecturer on the proposal of the President, seconded by Mr. Paulson.

Observations were also made by Mr. Charles Nicholson and others, and Miss Lister replied to the several questions raised.

[*Plates for the Chigwell Report* (ante p. 115). These two photographs, ready printed off as Plates, are the gift of our Member, Mr. J. Phelp, but in error are numbered VI and VII. These insertions may face pages 113 and 114.—ED.]

MYCETOZOA OBSERVED IN EPPING FOREST IN THE AUTUMN OF 1912.

By Miss Gulielma Lister, F.L.S.

[At the "Fungus Forays" in October and November, Miss Lister kindly acted as Referee for the Mycetozoa, and furnished the following lists of the species gathered.—Ed.]

I.—Ramble between Loughton and Theydon on 19th October 1912 :—

Badhamia utricularis Berkeley: found in the plasmodium stage, creeping on *Irpex* on a fallen branch, and in mature sporangia.

Physarum nutans Persoon: Several forms of this variable species were found, viz., the typical form with nodding lenticular sporangia on slender dark stalks; the subspecies *leucophaeum*, with sporangia either sessile or on short dark stalks; and the remarkable var. *robustum* of this subspecies, a form that occurs regularly in the autumn and winter both in Epping Forest and Wanstead Park. It is characterized by the large sporangia having an unusual amount of calcareous matter in the capillitium, in the stalks, and in the hypothallus. Sometimes the stalks are as white as in *Physarum leucopus*, but are frequently associated with others of the usual grey or drab colour. The capillitium is more robust than usual; there are many flat membranous expansions at the angles of the branches, and the time-knots are often more or less concentrated to form a central mass or "pseudo-columella." A fine specimen of this variety was obtained by Mr. Ross near Chingford.

Craterium minutum Fries. (syn. *C. pedunculatum* Trentip) : on holly leaves.

C. leucocephalum Ditmar: on holly leaves.

Leocarpus fragilis Rost. (syn. *L. vernicosus* Link): on holly leaves twigs, grass, etc.

Didymium squamulosum Fries. (syn. *D. effusum* Link): on holly leaves.

D. nigripes Fries: on holly leaves.

D. melanospermum Macbr. (syn. *D. farinaceum* Schrader): on dead twigs.

Stemonitis fusca Roth: on a poplar log.

Comatricha nigra Schroeter (syn. *C. obtusata* Preuss): on fallen boughs.

Trichia varia Pers.: on dead stumps of oak and hornbeam.

T. persimitis Karstin: on dead wood and leaves.

Arcyria ferruginea Sauter: on dead wood. Sporangia were found both in the pale pink young stage, and in the deep red mature condition; the latter when dry became bright orange-red.

A. incarnata Persoon: on dead oak twigs.

A. denudata Sheldon (syn. *A. punicea* Persoon): on hornbeam stumps.

A. cinerea Pers. (syn. *A. albida* Pers.): on twigs.

II. Chingford, 2nd November 1912.

The rains of the previous week, succeeding the long spell of dry weather, had been favourable for those species of Mycetozoa whose "plasmodium," or creeping and feeding stage, is passed within the substance of dead wood; the prostrate logs, stumps, and fallen branches had probably never become quite dry, and the recent rains had encouraged the plasmodia to feed, and emerge into the open air to form their sporangia. But the thick

beds of dead leaves of oak, hornbeam and holly that looked so promising a hunting ground, and which in suitable weather are so prolific in the species that feed among dead leaves, were not sufficiently soaked with moisture and proved singularly barren. Of the twenty species we obtained, only four were found among dead leaves.

The following is the list of our gatherings :—

Badhamia utricularis Berk. : on woody fungi or prostrate logs.

Physarum nutans Pers. : abundant on stumps.

P. viride Pers. : on an oak log.

P. sinuosum Weinm. (syn. *P. bivalve* Pers) : on dead brambles.

Craterium minutum Fries (syn. *C. pedunculatum* Trentip) : on holly leaves.

Stemonitis fusca Roth. : on dead wood.

Comatricha nigra Schroeter (syn. *C. obtusata* Preuss) : abundant on dead sticks and boughs.

C. pulchella Rost. (syn. *C. persoonii* Rost.) : on dead leaves and grass stalks.

Lamproderma scintillans Lister (syn. *L. irideum* Mass.) : on dead holly leaves ; only a few sporangia found.

Enesthenema papillatum Rost. (syn. *E. elegans* Bowman) : on a hornbeam log ; this species is one that we usually find during the late autumn and winter months.

Trichia affinis De Bary : on dead wood.

T. persimitis Karstin : on dead wood.

T. decipiens Macbr. (syn. *T. fallax* Pers.) : on logs ; both the white and rosy forms of the young sporangia were seen, as well as the brown mature condition.

T. botrytis Pers. : abundant on fallen boughs.

T. varia Pers. : on dead wood.

Arcyria ferruginea Sauter : on a prostrate log.

A. incarnata Pers. : on decayed oak boughs.

A. denudata Sheldon (syn. *A. punicea* Pers.) : on moss and dead wood.

A. nutans Grev. (syn. *A. flava* Pers.) : on a prostrate log.

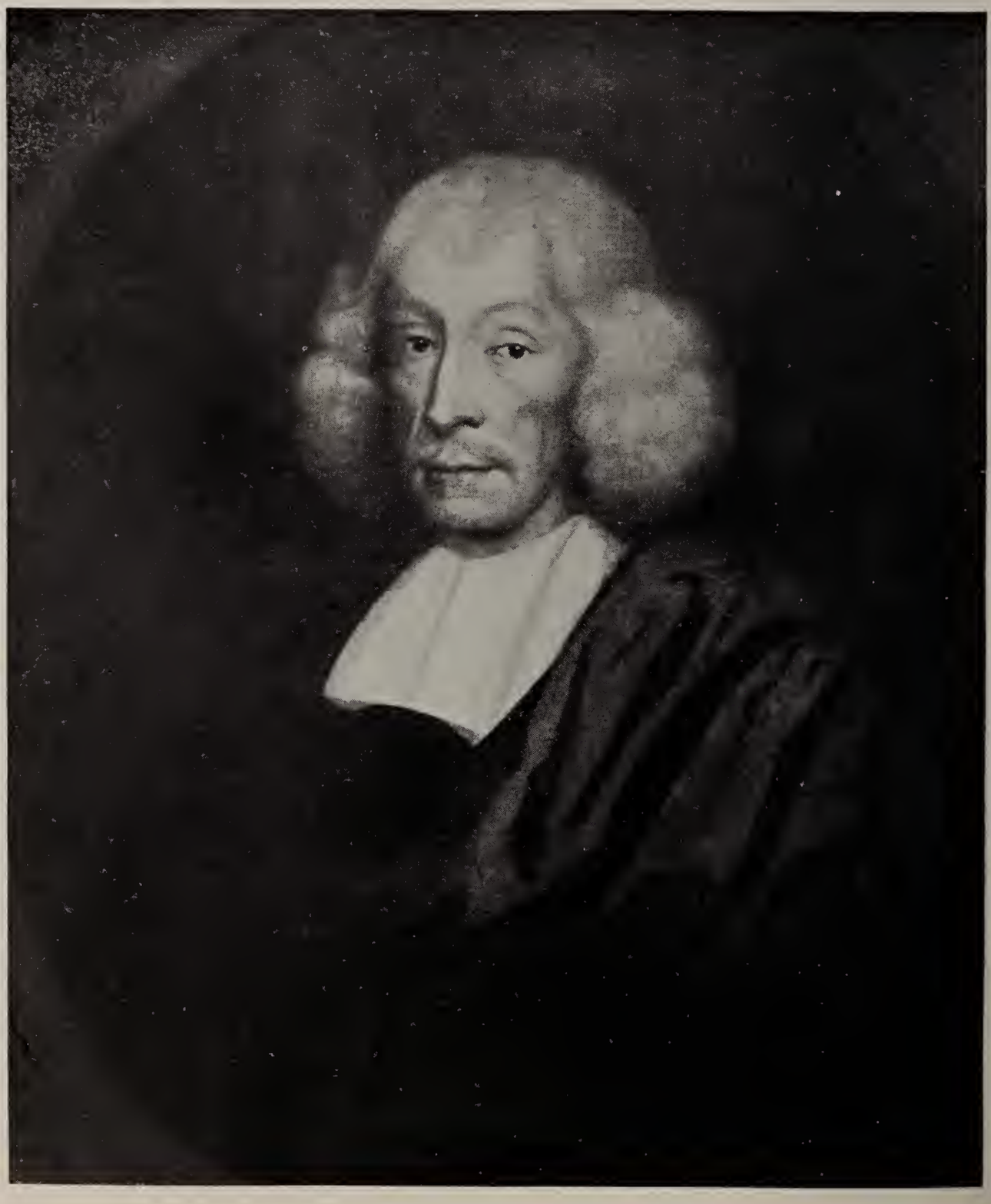
Colloderma oculatum G. Lister : among moss and liverworts on the trunk of a living oak, several feet from the ground. It is only within the last year that this species has been recorded for the British Isles ; it may therefore be of some value to give a brief description of its appearance, and an account of its distribution as far as we know it up to the present time. The mature sporangia are usually rather glossy and of a dark olive-brown colour ; they are globose or sausage-shaped, and vary from 0.3 to 3mm. in length. As regards minute structure we see that outside the membranous wall that encloses the spores and capillitium, is a more or less completely investing mucilaginous coat, which again is clothed with a layer of olivaceous granules and refuse matter thrown out from the plasmodium. In wet weather this remarkable mucilaginous coat swells up and one sees through its translucent substance the dark compact mass of spores, looking rather like a little eye, to which character the species owes its specific name *oculatum*. When the mucilaginous coat covers the lower part only of the membranous wall, the upper part of the latter is exposed and shines with iridescent colours.

The species was first noticed in the winter of 1892, by Christian Lippert, of Vienna, on a piece of wood which he had brought back two months before from the Austrian Alps and kept moist. He published an account of it in 1894, under the name *Didymium oculatum*.[1] I first became acquainted with this curious species in October 1911, when my friend, the Rev. W. Cran, sent for my determination some minute sporangia he had found among moss and lichens on a tree at Skene, near Aberdeen. His attention was first caught by seeing the pale yellow cushions of plasmodium as they emerged from the wood. I recognized the species as being very similar to the description and illustration of *Didymium oculatum*, and when by the courtesy of Prof. von Hohnel preparations of Lippert's type were lent me, I saw that the Austrian and Scotch specimens were clearly the same thing. Lippert died about eleven years ago. He had placed his new species in the genus *Didymium* on account of the purple-brown colour of the spores, of the purplish network of capillitium threads, and because of what he took to be scanty deposits of carbonate of lime in the sporangium-walls. None of the later gatherings show a trace of lime in the walls, and it now seems probable that he was mistaken in this matter; the species appears to be nearly allied to *Lamproderma*; the presence of the gelatinous coat to the sporangia was, however, so striking a feature that in publishing an account of Mr. Cran's gathering[2] I transferred it to a new genus *Colloderma*. Since then we find that *Colloderma oculatum* occurs in many parts of the world.

In the first place I recognised that a single puzzling little iridescent sporangium, sent me in the spring of 1908, from Portugal by the Rev. Camille Torrend, belonged to this species. Then Prof. Farlow sent me a specimen he had gathered on bare wood in the autumn of 1911 in New Hampshire. Last summer Mr. Kumagusu Minakata sent me two fine developments he had obtained on the mountain of Ando, Kii, Japan, in December 1910. At the Foray of the British Mycological Society in the neighbourhood of Forres last September, we found several specimens on fallen pine boughs. Again last October while Miss Schinz and I were searching for Mycetozoa in Epping Forest near Debden Green, she found several of the pale-yellow immature sporangia about five feet up the mossy trunk of a pollard oak, and later we found a number in the mature state. Only last week I received specimens of both iridescent and olive-coloured sporangia gathered on mossy bark in October on the Jura mountains at an altitude of over 4,000 feet by that ardent and gifted student of the Mycetozoa, M. Charles Meylan.

From these records we may infer that this interesting species is not rare, but that its inconspicuous appearance and habit of frequenting the trunks of living trees has caused it to be overlooked.

1 Im Verhandl. der k. k. zool. bot. Gesell., xliv., p. 72, taf. iv.
2 *Journal of Botany*, Dec. 1911.



JOHN RAY (1627-1705)
(from the Original Portrait in Oils in the National Portrait Gallery)

THE RAY, DALE, AND ALLEN COMMEMORATION FUND, 1912:

FIRST AND FINAL REPORT.

By MILLER CHRISTY, F.L.S.

(With Plates XI., XII., XIII., XIV., and XV.)

SOME considerable time since, I observed that the tombs of John Ray and his friend Dr. Benjamin Allen (which stand adjacent to one another in the churchyard at Black Notley, near Braintree : see Plate xi.) had been allowed to fall into disrepair. Further, it occurred to me that to Samuel Dale (another, and still more intimate, friend of Ray) there was no memorial of any kind in Braintree, where he spent his life, or elsewhere.

Much information in regard to the three men named was given in my recent papers on Benjamin Allen[1]. It may be convenient, however, to repeat here that, beside being friends and contemporaries, all were naturalists of distinction, living at Braintree or in its immediate vicinity, in the closing years of the Seventeenth Century and the opening years of the Eighteenth. They formed a highly-remarkable trio, whose residence in or near the little town brought it prominently to the front at the time as a centre for the study of Natural Science.

John Ray (1627-1705), by far the most eminent of the three, was born at Notley, where, on the death of his mother in 1679, he took up his residence at "Dewlands," a house he had built for her some years earlier (see Plate xii).[2] There he spent the remaining 26 years of his life, and there he wrote many of those works which have made his name famous. He was not only by far the most eminent British Naturalist of his day, but has been rightly described as "the Father of Modern Natural Science." The Ray Society (founded 1844) is, of course, named after him. He was buried at Black Notley, where the present monument was erected over his grave by Dr. Henry Compton, Bishop of London, and other distinguished contemporaries. The monument was moved into the church in 1737, but restored to its original position in 1792. Since then, it has been the shrine to

1 ESSEX NATURALIST, xvi. (1911), pp. 145-175, and xvii. (1912), pp. 1-14.

2 "Dewlands" stood, just as Ray built it, to our own day, and was visited by the Club on 23 June 1898 (see ESSEX NATURALIST, x., pp. 402-404). Unfortunately, it was completely destroyed by fire on 19 September 1900 (see ESSEX NATURALIST, xi., pp. 331-333). The view of it here given is from a photograph (the only one known to exist) taken by Mr. Henry S. Tabor, three months only before the fire. It shows the house from the north ; whereas the well-known view engraved for the Ray Society (*Corresp. of John Ray*, 1848) shows it from the east.

which many eminent men and various scientific societies (including the Linnean Society in 1844 and the Essex Field Club in 1885, 1898, and 1912) have made pilgrimages. The accompanying portrait (Plate xiii.) is from that formerly in the British Museum, but now in the National Portrait Gallery.[3]

Samuel Dale (1659-1739), though a younger man and of less eminence, was widely known in his day as a naturalist, more especially as a botanist. He settled as a young man at Braintree, where, for the rest of his life, he carried on his profession as an apothecary. He was a close friend and follower of Ray, who appointed him his executor; a prominent member of "The Company of Twenty-four" (the governing body of the town for several centuries); one of the founders (in 1707) and first deacons of the Independent Chapel at Bocking; author of *Pharmacologia* (three editions, 1693, 1710, and 1737), of the *History and Antiquities of Harwich and Dovercourt* (1730), and of many articles published in the *Philosophical Transactions*. A portrait of him is given hereafter.

Dr. Benjamin Allen (1663-1738), the youngest and least renowned of the trio, was an excellent naturalist and a skilled physician. He settled early in life at Braintree, where he practised till his death nearly fifty years later, living in what is known as "The Great House." He was author of *The Natural History of the Chalybeate and Purging Waters of England* (1699), the earliest systematic treatise on the subject, of *The Natural History of the Mineral Waters of Great Britain* (1711), and of several papers in the *Philosophical Transactions*. His manuscript "Common-Place Book," in which he entered a vast number of observations on natural history, medicine, and other subjects, has been described by me in the articles above mentioned. He was buried at Black Notley, with which parish he seems to have had some family connection. No portrait of him is known.

It seemed to me that, in view of the eminence of these three men in Natural Science, the dilapidated condition of the tombs

3 The portrait (No. 563) measures 29¼ by 24¼ inches, and is ascribed conjecturally to Mrs. Mary Beale. It has been engraved several times—among others, by W. Hole, in 1799, and by J. Roffe, in 1820. There exists also, at Trinity College, Cambridge, another portrait of Ray, by W. Faithorne (as well as a fine bust by Roubilliac). and this also has been engraved several times—by W. Elder, in 1694, by A. de Blois, about the same date, by G. Vertue, in 1713. by W. Hibbert, in 1760, and by an unnamed hand, as a vignette on the dinner ticket of the Ray Commemoration held on the 20th November 1828. I have not seen this latter portrait; but, judging from the engravings of it, it is far less pleasing than the foregoing Neither portrait has ever before been reproduced photographically so far as I have been able to ascertain.

"Dewlands," Ray's Home at Black Notley.

From a photograph by Mr. H. S. Tabor, taken shortly before its destruction by fire in 1900.

of two of them and the absence of any memorial at all to the third was discreditable to present-day naturalists, and that the taking of some action in the matter was a duty which fell inevitably upon the Essex Field Club, as the county scientific society.

Accordingly, in April 1911, I brought the matter before the Council of the Club. I suggested that, to ensure some action being taken, our member the Rev. J. W. Kenworthy, formerly vicar of Braintree, and myself should be appointed a committee to appeal for subscriptions from members of the Club and others, with a view to restoring the tombs of Ray and Allen and erecting a suitable memorial to Dale. The Council accepted my suggestion ; appointed the two of us as a Committee, with power to add one to our number (a power we never exercised) ; and authorised us to proceed with the carrying out of such work as we deemed necessary, as soon as the requisite funds should be forthcoming.

Our first step was to obtain from the Rev. W. Warren, rector of Black Notley, permission for the restoration of the two tombs under his care, and from the Rev. T. Eddleston, vicar of Braintree, permission for the putting up in his church of a suitable memorial to Samuel Dale.[4] Both very willingly gave consent.

In the next place, we obtained from Messrs. L. J. Watts, Ltd., of Colchester and Braintree, the well-known monumental masons, their expert opinion as to what was necessary to be done to put the two existing tombs into a thorough state of repair and as to the cost of doing this.

Ray's tomb, though structurally sound (having been carefully restored in 1792 and again about 1844), presented a very time-worn appearance. It was found that it required to be cleaned, the iron paling round it to be re-painted, and the four Latin inscriptions to be blacked-in to make them legible. Ultimately, also, it was decided to add a further brief inscription recording the present restoration.

4 We had thought at first of offering to place the Dale Memorial in the Independent Chapel at Bocking, on the ground that Dale, having been one of the founders thereof, was probably buried in its burial-ground. We found, however, that, owing to the disappearance of the early registers of the Chapel, it was impossible to establish this with certainty. Further, we came eventually to the conclusion that, inasmuch as Dale was for long a prominent public man in Braintree, quite apart from his connection with the Chapel, a memorial to him would be more in place in the Church of the parish in which he resided so long than in the Chapel, which is in an adjoining parish. Moreover, we found that most of the subscribers to the fund whose views we were able to ascertain preferred that the destination of the memorial should be the Parish Church. Hence our final decision.

Allen's tomb (which is of the kind usually spoken of as an "altar tomb") was in much worse condition. Not only had its foundations settled considerably, but the joints of its stones had been forced apart by the roots of plants, while the inscription upon the top was much defaced by age. It was found that it would be necessary, therefore, to take the tomb down completely, to cleanse all the stones, to replace a few, and to re-erect the whole, while the lettering of the inscription required to be partially re-cut.

As to the intended memorial to Dale: we decided, in conference with the vicar of Braintree, that it could take no more appropriate form than that of an inscribed bronze wall-tablet, having inset into it a portrait-medallion, reproduced from the original portrait in oils preserved at Apothecaries' Hall. From this same painting has been reproduced the accompanying portrait (Plate xiv.)[5] The work of cutting the tablet, we entrusted ultimately to Messrs. Gawthorp & Sons, of Long Acre, and we were fortunate enough to induce Mr. W. B. Fagan, R.S.B.S., of Chelsea, to undertake the portrait-medallion.

Meanwhile, we had issued, to members of the Club and others likely to be interested, appeals for subscriptions; and, as soon as it became fairly certain that the sum necessary would be forthcoming, we put in hand the work above described. It was carried out ultimately by those named above, and to our entire satisfaction. Mr. Fagan's portrait-medallion was particularly good.

The total cost exceeded by a good deal what we had expected at the outset. Including certain incidental expenses, it amounted in all to £72 17*s*., a sum which was, in the end, covered exactly by subscriptions from scientific societies and individuals, together numbering eighty-six. A list is appended hereto. Among the contributions given by scientific societies (apart from that of the Club itself) were liberal sums sent by the President and Council of the Royal Society, the Members of Council of the

5 The portrait, which is by an unknown painter, measures 30 inches by 24 inches. It was painted in 1731, when Dale was aged seventy-two, and was presented to the Society of Apothecaries in 1816 by a descendant of Dale, as shown by the following inscription on the back:—"Samuel Dale, M.L., 1731. Died 1738[-9], aged 72. Presented to the Society by the Widow and Family of Thomas Dale, M.D., who was his great nephew, 1816," It has, I believe, never before been reproduced photographically, though it has been engraved at least twice—first, by Vertue, in 1737, as a frontispiece to the edition of Dale's *Pharmacologia* published in that year, and, secondly, by Rivers, in 1812, apparently to form one of some series of portraits. Neither engraving is a quite satisfactory reproduction of the original. Both omit the hat; while the later (which appears to have been copied from the earlier and not from the original) lacks also the books and the oval, besides being in other ways unpleasing.

THE TOMBS OF JOHN RAY AND BENJAMIN ALLEN IN THE CHURCHYARD AT BLACK NOTLEY.

Ray Society, and the Council of the Selborne Society. Among the individual subscribers (a majority of whom were members of the Club) were many whose names are well known in the County of Essex and in the scientific world. To one and all, the Committee tenders, on behalf of the Essex Field Club, warmest thanks.

The work having been completed in the course of April 1912, a meeting of the Club was held at Braintree and Notley on the 27th of that month to inspect the result, all subscribers who were not members of the Club being invited.

Fine, though rather chilly, weather prevailed. The party, which met first at Chelmsford, was rather small, but was augmented, later in the day, by members and friends from other parts of the county. A pleasant drive of eleven miles brought the company to Black Notley, where they were welcomed at the Rectory by the Rev. W. Warren. A stroll through the Rectory grounds was enjoyed. These contain many varieties of conifers,

AGAIN RESTORED (TOGETHER WITH THE ADJACENT TOMB OF RAY'S FRIEND, BENJAMIN ALLEN), IN 1912, BY PUBLIC SUBSCRIPTION, ON THE INITIATIVE OF THE ESSEX FIELD CLUB.

THE DATES OF RAY'S BIRTH AND DEATH, AS STATED ON THE OTHER SIDE, ARE WRONG. HE WAS BAPTISED 6TH DECEMBER 1627, HAVING BEEN BORN PROBABLY 29TH NOVEMBER IN THAT SAME YEAR. HE DIED 17TH JANUARY 1704-5.[6]

which were planted under the direction of the late Professor C. C. Babington, of Cambridge, the well-known botanist. The visitors then proceeded to the churchyard, where the renovated tombs of Ray and Allen were inspected and the work which had been done on them was approved. On that of the former had been added a new inscription, reading as above.

6 There has been much confusion as to the dates of Ray's birth and death. Dr. Derham, Ray's earliest biographer, says (*Select Remains of John Ray*, p. 1, 1760) that "he was born November the 29th, 1628," and this is the date inscribed on the tomb. Later, the Rev. W. L. P. Garnons, of Sidney College, Cambridge, after "searching the parish registers," wrote (see Lankester's *Memorials of John Ray*, p. 7n.: Ray Soc., 1846) that Ray "was baptised on the 29th of June 1628." From these two statements (both of which are wrong), most subsequent writers have been led to conclude that Ray must have been born on 29 November 1627 and baptised 29th June 1628. The first to ascertain the real date was Mr. W. H. Mullens, who, on consulting the parish registers, found that, on the same page thereof, are recorded the baptisms of *two* John Rays (doubtless related) which had been confused together. Both of these entries Mr. Mullens has produced photographically (see *British Birds*, ii., p. 296, 1909). They read respectively:—

"1627.—John [son] of Roger and Elizabeth Ray [was baptised] December 6", and

"1628.—John son of Thomas and Dorothie Wray, bap. June 29."

The first entry alone relates, of course, to the great John Ray. It shows that Ray was born probably, as Derham states, on Thursday, 29 November, but in 1627, not in 1628, and was baptised, seven days later, on Thursday, 6th December. Similarly there has been confusion as to the date of Ray's death. Derham gives it correctly (*op. cit.*, p. 80) as 17th January 1704-5. Yet the inscription on the north side of the tomb gives the year as 1705-6, and this has been widely followed. It was in consequence of these muddles that it was decided to add an inscription giving the correct dates.

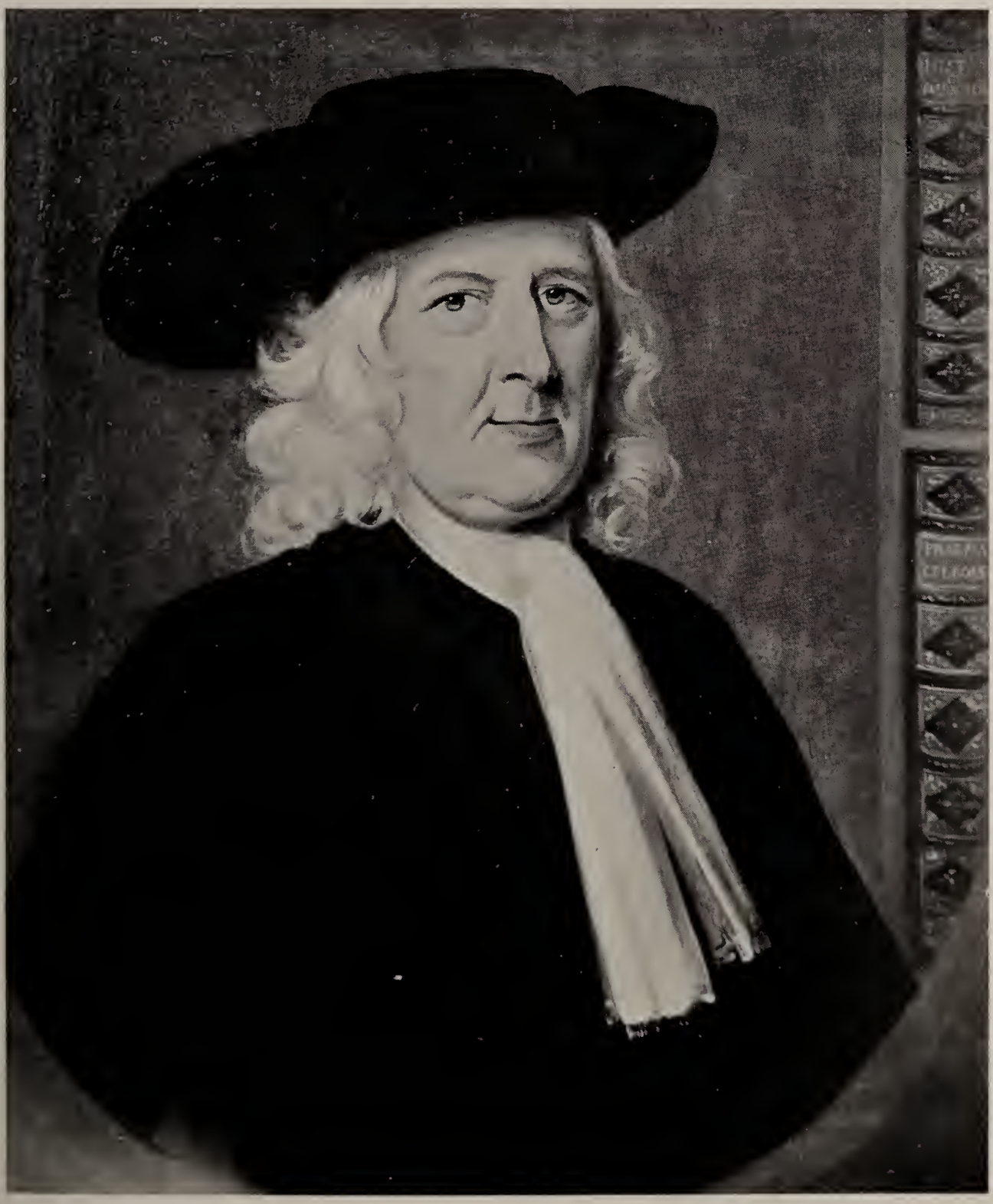
From Black Notley, the party drove to Braintree, two miles distant. After having taken luncheon at the Horn Hotel, all adjourned to the Parish Church (St. Michael), at 2.30 p.m., to take part in a service for the unveiling of the Samuel Dale Memorial Tablet, for which an excellent position on the south wall of the Jesus Chapel had been chosen. At the service, the members of the party formed but a small portion of a large congregation, composed mainly of Braintree residents. The service was short and simple, but impressive. The vicar, the Rev. T. Eddleston, officiated; but, at the selected moment, he called upon my colleague, the Rev. J. W. Kenworthy, formerly vicar, to perform the actual unveiling ceremony and to deliver a brief address.

At the outset, Mr. Kenworthy said how happy he was at being able to meet again so many friends in that venerable fabric, and especially on such an occasion as this. The hearts of his friends and the Essex Field Club must be full of gratitude to those who had responded to the appeal to put up this monument to, and record of, a great and worthy man, who spent the greater portion of his life usefully and religiously in that district. He prayed that their work there that day would redound to the honour of Science and to the honour and glory of God. He went on to say that that particular portion of the church—the South Chapel, or Jesus Chapel, as it was called formerly—might be regarded as the "Mecca of Braintree." It was of great historical interest, and contained many features and memorials which he could not touch upon on that occasion, except to say that for many generations the chapel was partitioned off and used as a school, evidences of which were still seen on the walls and pillars. There, too, John Ray received his early education before going to the University. Among the mural tablets was one to Daniel Copsey, who was also educated there and became a famous Egyptologist and Coptic scholar. It was a fitting place in which to do honour to the memory of Samuel Dale.

Mr. Kenworthy then unveiled the Memorial Tablet, afterwards reciting a prayer composed by Ray himself[7]:—

> Assist us, O Lord, in all good undertakings, in the services we are this day to perform. Help us to mind and intend the business we are about, to wait upon Thee without distraction, and not to suffer our

7 See *Select Remains*, pp, 94-95 (1760).



SAMUEL DALE (1659-1739)
(from the Original Portrait in Oils in the possession of the Apothecaries' Company)

thoughts to wander about other objects, but that we may serve Thee with purpose of heart, with intention of mind, and with true zeal and devotion ; that so we may offer unto Thee spiritual sacrifice, pleasing and aceptable, by Jesus Christ our blessed Saviour and Redeemer. Amen.

The service ended, the Memorial (see Plate xv.) was inspected and was generally approved. The wording on it reads :—

IN MEMORY OF SAMUEL DALE.

BORN (?AT WHITECHAPEL) ABOUT 1659 ; FOR MANY YEARS A PHYSICIAN AND APOTHECARY IN BRAINTREE ; A PROMINENT MEMBER OF "THE COMPANY OF FOUR-AND-TWENTY" ; ONE OF THE LEADING ENGLISH BOTANISTS OF HIS DAY ; AUTHOR OF *Pharmacographia* (THREE EDITIONS : 1693, 1710, AND 1737), OF A *History of Harwich and Dovercourt* (TWO EDITIONS : 1730 AND 1731), AND OF MANY LEARNED SCIENTIFIC PAPERS ; A NEIGHBOUR, CLOSE FRIEND, AND FINALLY THE EXECUTOR OF THE ILLUSTRIOUS JOHN RAY, OF BLACK NOTLEY, "THE FATHER OF MODERN NATURAL SCIENCE."

HE DIED 18TH MARCH 1738-9, AGED ABOUT 80, AND IS BELIEVED TO HAVE BEEN BURIED, WITH HIS TWO WIVES, JUDAH AND SARAH, IN THE ADJOINING PARISH OF BOCKING.

THIS TABLET WAS ERECTED ON THE INITIATIVE OF THE ESSEX FIELD CLUB IN 1912.

Later, the company adjourned to the Braintree High School, in the Great Hall of which was held, by the permission of the Head Master, Mr. F. J. Weever, M.A., a largely-attended joint-meeting of the Club and of the Braintree Educational Society, to hear a Eulogy on Ray, Dale, and Allen and their life's work, by Prof. G. S. Boulger, F.L.S., a past-President of the Club. Mr. William Whitaker, F.R.S., presided over a gathering of members and friends, which completely filled the hall.

After the Address,[8] various books, manuscripts, etc., of interest in connection with the three Braintree naturalists, were exhibited. The Rev. J. W. Kenworthy and Mr. John Avery showed the two

8 Printed hereafter.

volumes of Allen's Commonplace Book, which belong to them respectively.[9] The Rev. W. Warren showed the Parish Registers of Black Notley, containing the records of Ray's baptism and burial. Mr. J. Luard Pattisson sent a copy of Dr. Derham's *Select Remains of Ray* (1760), on the flyleaf of which a number of Fellows of the Linnean Society and others who paid a visit to Ray's tomb and to "Dewlands" in July 1844 had signed their names.[10] The Trustees of the Independent Chapel at Bocking also showed various documents bearing upon Dale's connection with the building of that Chapel in or about 1704.

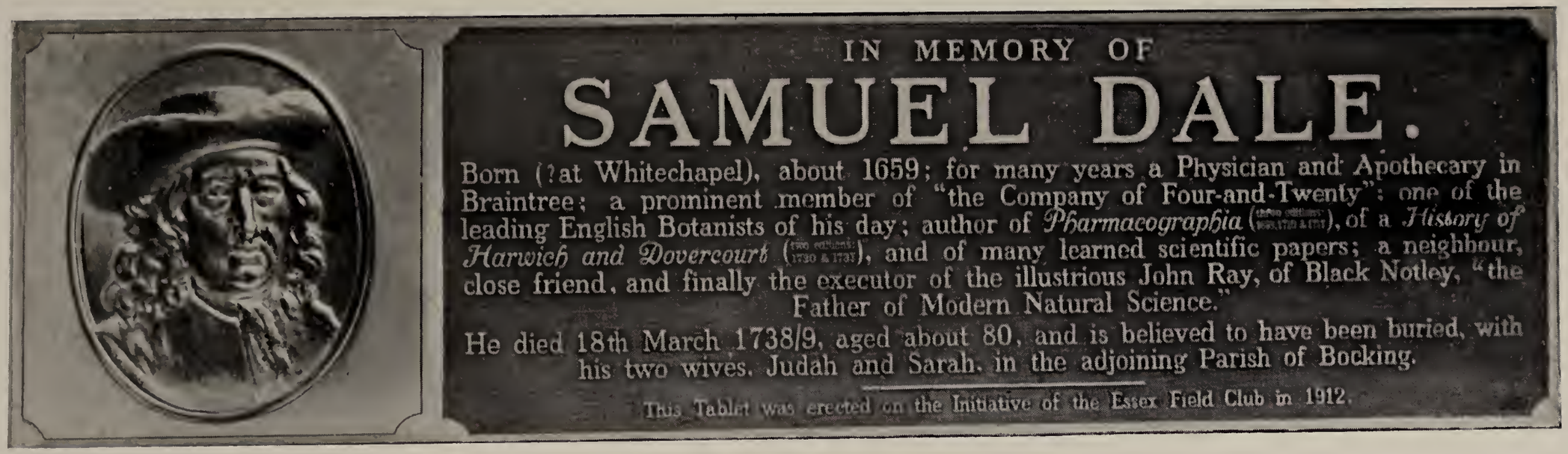
These inspected, the party took tea in the Art Room, afterwards strolling through the town to inspect its various objects and places of interest (including Allen's house and garden in the Great Square), finally driving back to Chelmsford, to catch evening trains home.

LIST OF SUBSCRIBERS.

	£	s.	d.
G. E. Adamson, Highgate		7	6
Robert Adkin, F.E.S., Lewisham	1	1	0
John Avery, F.S.S., Forest Gate		5	0
Thos. Barrett-Lennard, M.A., Horsford Manor		10	6
G. Thorpe Bartram, J.P., C.C., Braintree	1	1	0
Prof. G. S. Boulger, F.L.S., Richmond		5	0
Fred. J. Brand, Ilford		5	0
A. E. Briscoe, B.Sc., Little Baddow		10	6
G. L. Bruce, M.A., Loughton		10	0
Rev. R. Ashington Bullen, F.L.S., Woking	1	1	0
Rev. H. Montagu Butler, M.A., Trinity College, Cambridge	1	1	0
Miller Christy, F.L.S., Chelmsford	1	2	0
William & B. G. Cole, St. Osyth		10	6
Bryan Corcoran, C.C., Croydon	1	1	0
George Courtauld, J.P., Halstead	5	0	0
Herbert J. Cunningham, Braintree	1	1	0
W. H. Dalton, F.G.S., Brixton Hill		10	6
G. Claridge Druce, F.L.S., Oxford		5	0
T. S. Dymond, F.C.S., &c., London		10	6
Rev. T. Eddleston, Braintree	5	0	0
Essex Field Club	3	3	0
E. & M. Evitt (The Misses), Theydon Bois		5	0
W. B. Fagan, R.S.B.S., Chelsea		10	6
R. C. Fowler, Public Record Office		5	0

9 See ante, p. 130.

10 The names include those of the Bishop of Norwich (President, Linn. Soc.), Professor Thos. Bell, Professor Edward Forbes, Professor D. T. Ansted, Robert Brown, Edward Forster, J. J. Bennett (Sec. Linn. Soc.), S. R. Kippist, Dr. Edward Lankester, Jas. E. Winterbottom, Richard Taylor, R. H. Solly, W. Yarrell, A. White, Joshua Milne, and John Van Vorst. At this date, Dewlands belonged to a member of Mr. Pattisson's family. Later, the volume in question passed out of the family and was purchased by Mr. G. Thorpe Bartram, of Braintree (see *Chelmsford Chronicle*, 4 December 1882), by whom it was presented to Mr. J. L. Pattisson.



TABLET IN MEMORY OF SAMUEL DALE.

(erected in Braintree Church, on the initiative of the Essex Field Club in 1912)

	£	s.	d.
Major E. Carrick Freeman, M.D., Colchester		10	6
John French, Waltham Cross		5	0
Sir F. Carruthers Gould, Tavistock Square, W.	1	1	0
Alexander Graham, M.B., &c., Forest Gate ..		5	0
Professor J. Reynolds Green, F.R.S., &c., Cambridge	1	1	0
F. J. Hanbury, F.L.S., East Grinstead ..		5	0
Dr. Harrison, Braintree		5	0
J. Edmund Harting, F.L.S., Weybridge ..	1	1	0
Alfred Hills, Bocking '..	1	1	0
C. H. Howard, Braintree		5	0
David Howard, D.L., &c. Buckhurst Hill ..	1	1	0
Rev. W. C. Howell, M.A., London	1	1	0
M. E. Hughes-Hughes, Leez Priory	1	1	0
Reuben Hunt, J.P., Earls Colne	1	1	0
Samuel F. Hurnard, J.P., Colchester		10	0
Dr. B. Daydon Jackson, F.L.S., Clapham Common		10	6
Mrs. Johnson, Loughton		10	6
Robert J. Johnson, Braintree		5	0
Robert Jones, M.D., F.S.A., Woodford Bridge	1	1	0
Rev. J. W. Kenworthy, Colchester		10	6
Philip Laver, M.D., F.S.A., Colchester ..		10	6
Miss Gulielma Lister, F.L.S., Leytonstone ..		10	0
Robert Lodge, Eastbourne..		5	0
A.C.M.		3	0
Geo. Mathieson, Chingford	1	0	0
Prof. Primrose McConnell, B.Sc., F.G.S., Southminster		5	0
Professor R. Meldola, D.Sc., LL.D., F.R.S., Brunswick Square, W.	1	1	0
E. McArthur Moir, Colchester		10	6
W. H. Mullens, F.L.S., Westfield Place, Battle	2	2	0
E. T. Newton, F.R.S., Canonbury, N. ..		10	0
Charles Nicholson, Highams Park		2	6
Charles Oldham, F.L.S., Berkhampstead . ..		10	6
Norman Orfeur, Braintree		5	0
C. H. Packer, Braintree		10	6
Mrs. Jane Parris, Braintree	1	1	0
Jacob Luard Pattisson, C.B., Eastbourne ..	1	1	0
Robert Paulson, F.R.M.S., Pinner ..		10	6
John W. Phelp, Buckhurst Hill		5	0
W. F. Pilcher, Braintree		5	0
W. Ping, F.C.S., Wanstead		10	6
Prof. E. B. Poulton, D.Sc., F.R.S., Oxford	1	0	0
Ray Society (the Council of), London ..	2	10	0
F. W. Reader, Finsbury Park		5	0
F. A. Reichert, Forest Gate		5	0
Hon. N. Charles Rothschild, Tring	2	2	0
Royal Society (President and Council of the), London	5	0	0
F. W. Rudler, I.S.O., F.G.S., Westerham ..		10	0
Dukinfield H. Scott, F.R.S., Pres. Linn. Soc., Basingstoke ..	1	0	0
D. J. Scourfield, F.Z.S., Leytonstone		5	0
Selborne Society (the Council of), London	1	1	0
Henry S. Tabor, Braintree		10	6

	£	s.	d.
Percy Thompson, Loughton		10	6
John C. Thresh, M.D., D.Sc., &c., Chelmsford	1	0	0
Prof. Sydney H. Vines, D.Sc., F.R.S., Oxford	1	0	0
Howard Wall, Chigwell		10	0
Percy Warner, M.R.C.S., Woodford Green ..		5	0
Mrs. C. E. Warren, Black Notley		5	0
Rev. W. Warren, Black Notley		5	0
Alderman L. J. Watts, Colchester	1	1	0
W. Whitaker, F.R.S., Pres. Essex Field Club, Croydon	1	0	0
Jos. Wilson, F.R.M.S., Walthamstow ..		10	6
Horace B. Woodward, F.R.S., Croydon ..		10	0
X			6
Total	£72	17	0

J. W. KENWORTHY,
MILLER CHRISTY, } Committee.

THE CORRESPONDING SOCIETIES COMMITTEE OF THE BRITISH ASSOCIATION, DUNDEE, 1912.

REPORT OF THE CLUB'S DELEGATES.

For the meeting at Dundee the Club appointed as delegates Mr. W. Whitaker, F.R.S., and Mr. Joseph Wilson, F.R.M.S. The following is Mr. Wilson's report:—

The delegates from the various Corresponding Societies held their annual conference in the Technical Institute, under the presidency of Professor F. O. Bower, F.R.S., on September 5th and September 10th respectively.

Following the Chairman's address on the Life and Work of Sir J. D. Hooker, Miss A. Lorrain Smith submitted a brief report on a circular issued by the British Mycological Society, respecting certain diseases occasioned by fungi, asking that observations be made thereon, such as the disease among plum trees, known as *Silver-leaf*, and the injury occasioned by the *Polyporaceæ*.

The response to this circular was not very encouraging, as only four societies replied to it.

Dr. Wager, of Sheffield, suggested the desirability of the local societies helping the British Mycological Society in collecting information respecting fungi, and he thought something definite would be accomplished if the *Silver-leaf*, the *Gooseberry-mildew* or one or two other fungoid diseases were thoroughly investigated and the results published.

Mr. A. R. Horwood, of Leicester, submitted a preliminary report on the protection and preservation of our native wild plants, and suggested that the local societies could do much to further this object.

At the second meeting of the conference Professor Bower was again Chairman.

This meeting was opened by Dr. Wager referring to the death of the Rev. Ashington Bullen, their honorary secretary, and moved that a vote of condolence be sent to Mrs. Bullen in her bereavement.

Mr. Claridge Druce referred to the national trust and to the work it has accomplished in purchasing land for the preservation in a natural state as a sanctuary for our native *fauna* and *flora*. Several delegates spoke in favour of it, and suggested that the scope of the trust be extended in the interests of geology as well as in preserving our native wild animals and plants.

[At the meeting of the Club on October 26th, at which this report was read, Mr. W. Cole remarked that it was unfair to charge the evil of destroying wild plants upon children. He referred to some recent letters in *Nature* in which the probable approaching destruction of two rare British plants—the Cheddar Pink (*Dianthus cæsius*) and *Arabis stricta*—was discussed by several eminent botanists. Only collectors of botanical specimens for Herbaria would be likely to gather these. Mr. Cole referred to the experiments of his sister Miss Jane E. Cole, in growing the *Dianthus* from seed. Simply hundreds of plants had been obtained in two years. Why then seek to destroy the few wild ones still lingering in Britain ? He strongly advocated the growing of wild plants from seed, an occupation which amateur botanists would find most delightful and instructive.]

Some dissatisfaction was expressed as to the work done at the conference, it being thought by some delegates that much important time was wasted and that the benefits derivable by having delegates from all parts were not sufficiently utilised.

Mr. W. Mark Webb, the *Honorary Secretary* of the Selbourne Society, delivered an interesting lecture on "The Brent Valley Bird Sanctuary," and illustrated his remarks by a series of lantern slides and specimens of the nesting boxes used there, which he said were fully taken advantage of by the feathered inhabitants.

NOTES—ORIGINAL AND SELECTED.

BIRDS.

Owl Hunting in Day-time.—Mr. E. E. Turner, of Coggeshall, writes :—"On the afternoon of 4 February 1912, in broad daylight, at 3.30 p.m., when the ground was covered with snow, and the temperature very low, a Barn Owl came from just over the hedge in the parish of Feering, and as it passed a few yards over my head, a mouse could be seen in its claws ; it then crossed the corner of a field to a large elm tree, where it, no doubt, devoured its quarry. As there had been a blizzard during the previous night, one could not but think that the bird had gone

supperless to bed, and then awaking hungry and cold had been compelled to seek a meal before its usual time in the twilight."

Lesser Redpole nesting in Essex —I see from *The Birds of Essex* that the Lesser Redpole (*Linota rufescens*) is not usually found in Essex in the breeding season. This year (1912) I have had a pair nesting on a low bough of a Scotch Fir by the side of a road-way. I have the nest and four eggs, as the birds forsook it. There was another pair in the same locality, though I did not succeed in finding the nest.—CHARLES E. W. HAWKINS, *Old House, Great Horkesley, 12th May* 1912.

Peregrine Falcon at Birch.—Mr. Walter B. Nichols writes under date 30th October 1912 :—" I am sending you by parcel-post a Peregrine Falcon, just shot by me at Birch, near Colchester. I hope that it may be acceptable for the County Museum collection."

Miscellaneous Bird-notes from the Stour Valley.—Our member, Mr. Walter B. Nichols, J.P., of *Stour Lodge, Bradfield, near Manningtree,* from time to time very kindly sends interesting notes of Bird-life in his district. In December 1911, he sent for the Museum a Red-throated Diver (*Colymbus septentrionalis*) and a Little Auk (*Mergulus alle*). He wrote that " the Diver was killed on the Stour about 3rd December ; the Little Auk by Charles Porter on the Hamford Water nearly opposite Walton Channel. He told me ' that fared a doddy little thing, and looked like a tossel of wool on the water, and kep springing up and settling again.' I have records of three others obtained in this neighbourhood, one shot in the early '70's by my father's coachman, near Cattawade Bridge, when I was a child ; one by Mr. H. N. Dunnett on 1st January 1895, on the Stour at Lawford, and one brought by Lucas to Mr. R. Brooks, Mistley, December 1900. The cold spell of a fortnight ago (beginning of February, 1912) brought a good many Duck up the estuary of the Stour. My house here is on the edge of the slope down to the river, and about 90 feet above it. It commands a very fine stretch of water, both up and down. I have a three-inch telescope, and have had a great deal of pleasure ' duck-hunting ' with it. My ' bags ' have not been very heavy, but they were varied :—*e.g.* on 3rd February 1912, 7 Goosanders ; 4th February 9 Whooper Swans, five adult and four juniors, and

many various ducks ; on 5th February, Mallard, Wigeon, Pochards, Scaup, Goosanders, Mergansers ; 6th February, Mergansers, Wigeon ; 7th February, Wigeon, Goldeneye, Pochards and Mergansers ; and so on every day up to to-day (February 16th), when my 'bag' was five Mallard, nine Mergansers, eight Goldeneye, besides some 3,000 Coots, hundreds of Dunlin, Redshanks, Curlew and Gulls innumerable." On 22nd of October 1912, Mr. Nichols wrote :—"Five Glossy Ibises (*Plegadis falcinellus*) were shot at Walton-on-the-Naze on 14th October, by Mr. W. Woodruffe Eagle and his brothers. One of his men reported that six 'black curlews' were on a pond in the marshes. Mr. Eagle and his brothers went out and found the birds at the pond, and killed five, two adults and three young. The sixth bird was afterwards found dead by somebody else."

INSECTS.

Duke of Burgundy Fritillary (*Melitæa athalia*).—For many years this butterfly has not been known in Essex, and entomologists will now be pleased to hear of its existence in some large woods in this county. In May 1911, Mr. Charles Cork and I made this interesting discovery, and, from the few specimens obtained, judged it to be very scarce, but on revisiting the spot this year we were agreeably suprised and delighted to find it in greatly increased numbers. Having communicated this fact to Mr. Frohawk, he expressed the opinion that the species, being very local in its distribution, and, so far as known in this country, never migrating from one place to another, it must always have been present in the locality referred to, but, owing to its former scarceness, had been overlooked. Having collected in this particular part for nearly twelve years, it is certainly strange that, at some time or other during that period, especially the hot summers of 1905-6, it did not come under our notice, and I can only assume that some other natural influence, resultant, perhaps, from the exceptional climatic conditions of the last two years, caused it to become plentiful.—J. Forsyth Johnstone, (Hutton, Essex) in *Field*, 8th June 1912.)

FLATWORMS (TURBELLARIA).

Dalyellia viridis (G. Shaw) (Vortex helluo, Mull.).—This interesting Turbellarian Worm was found in considerable numbers amongst vegetation in a pond at Chigwell Row on Saturday, 20th April 1912. The writer took specimens from a pond in Richmond Park the week previously and has been told that it has been seen recently in similar places in the neighbourhood of Chingford. *Dalyellia viridis* is about $\frac{3}{8}$inch long and is, as its name suggests, green in colour. The colour is due to an associated, unicellular alga. The worm is provided with two small eyes. The alimentary system consists of a mouth at the anterior end, a muscular pharynx and a blind alimentary sac which serves as a stomach. The animal is hermaphrodite.

The chief point of interest is the animal's association with a living unicellular alga, great numbers of which are present in the body immediately beneath the colourless cuticle.

Professor Sekera, of Tabor, Bohemia, kept specimens under observation for some time, and the following notes are taken from the account of his observations. Young specimens were taken in ponds in March when ice was still floating on the water. The animals were colourless, but as soon as they approached maturity and the sexual pore developed, it was noticed that a few algal cells or "zoochlorellae" had entered the body cavity by this means. Streaks of green granules then began to spread from this region and extend beneath the cuticle over the whole body until finally the animal became quite green. Solid food in the form of diatoms, rotifers, etc., was ingested during this period. While rapid division of the algal cells was taking place, they formed spherical or ellipsoid clusters, each group being surrounded by a colourless membrane. The membrane finally disintegrated and the green algal cells dispersed in streaky formation. The mature algal cells showed no signs of an enveloping membrane. The animals, at this period, showed a distinct tendency to crawl towards the light, but sank to the bottom of the vessel at night. During the third week, eggs were formed in the body cavity. Sekera says that he never found more than 20 in one individual, but a healthy looking specimen from Chigwell Row contained 49! The worms at this stage began to avoid the light and spent the whole day at the bottom of the vessel or under vegetation. During the first

week in May, the animals died off rapidly, and with the decomposition of the body the eggs were liberated. The writer has noticed that isolated individuals containing large numbers of eggs never deposit them while alive. The algal cells set free on the death of the worm continued to live, and developed an investing membrane and passed into a resting stage, probably awaiting an opportunity of invading the next generation of *Dalyellia*.

Prof. Sekera thinks that the alga is of little or no value to the worm by way of providing food, his reasons being that closely allied species living under similar conditions do not contain algae, and that solid food is ingested after the algal cells are fully developed.

Sir J. G. Dalyell wrote an account of this interesting species in 1814, and states that it sometimes occurs in large numbers, and then disappears suddenly. He found his specimens chiefly in the spring, but some were found in autumn.

Von Graff in his Monograph on the Turbellaria gives a list of 24 species living in fresh water which are frequently associated with algal cells.

An interesting description of the association of algal cells with a marine Turbellarian worm (*Convoluta roscoffiensis*) is given by Keeble in his little book on *Plant Animals*. In this case, however, true symbiosis is undoubted, as the animal abstains from solid food when in an adult state, and digests the products assimilated by the alga.—H. Whitehead, B.Sc., *Essex Museum of Natural History, Stratford.*

BOTANY.

Lathyrus tuberosus L. at Buckhurst Hill.—The Fyfield Pea has appeared during the last two summers as a "casual" upon the railway embankment of the loop line between Woodford and Chigwell, in the parish of Buckhurst Hill, between there and the river Roding. Several plants, covering a square yard of surface, and possibly all originated from a single tuber, were found by Mr. Howard growing amongst the clinker ballast thrown down upon the embankment, and an unmistakable specimen was (September 1912) brought to me for specific confirmation.

The railway embankment in question has proved a rich ground for "casuals" for years past, but the present record, by which

the Fyfield Pea becomes entitled to be admitted into the list of Epping Forest plants of occasional occurrence, is one of the most interesting, and deserves to be noted.

For a complete review of the known localities for this interesting pea in Britain, a paper by our Member, Mr. Miller Christy, F.L.S. (in *Journal of Botany*, xlviii., 1910), should be consulted.—PERCY THOMPSON, *Loughton, September* 1912.

The Former Cultivation of Woad in Essex.—When writing, seven years ago, on the history of our Essex Industries[1], I knew of no definite record to the effect that woad (*Isatis tinctoria*) had ever been cultivated in the County, though there is every probability that it has been at some time or other, as it is still (or was recently) at Parson Drove, in the adjacent county of Cambridge[2].

Recently, however, I have come upon a definite record of the fact in a sixteenth-century will preserved at Somerset House. John Maynard, a wealthy Colchester "clothyar" (or manufacturer of woollen cloths) and an Alderman of the Borough, died on 6th May 1569 and was buried in St. James's Church, where there still remains a brass to his memory, representing him wearing his alderman's gown and tippet. Clearly, he was a "weyder" or "wadman" (as woad-growers were variously called), beside being a clothier; for, by his will[3], he appointed his wife as his executor, directing her "to kepe and maineteyne my woade howse, with the leades, cesternes, and appurtenances, in good reparacon duringe her said naturall lyfe."

Yet it seems likely that the woad-growing industry was never very wide-spread in the county; for reference to Mr. W. C. Waller's valuable lists of Essex Field-names reveals[4] but one single field-name (Little Woadley, in Alphamstone) which seems to commemorate the former cultivation of woad. On the other hand, there are many names which commemorate the former cultivation of saffron, hops, flax, and other crops now no longer grown in the county. It seems possible, however, that some of the many Woodleys, Wood Crofts, Wood Fields, and the like may be so called through corruption of "woad" into "wood."—MILLER CHRISTY, *Chignal St. James, Chelmsford.*

1 *V. C. H. Essex*, ii., pp. 353-500: 907.
2 See E. Corder, in *Trans. Norf. & Norw. Nat. Soc.*, v., pp. 144-156: 1894.
3 Made 1st Nov 1565 and proved 22nd June 1569: P. C. C., 15 Sheffeld.
4 *Trans. Essex Archaeol. Soc.*, n.s. vols. v.-ix.

MISCELLANEOUS.

Salt (anent Red-hills).—" For it is gendered of sea water by working of the sunne : for some of the sea abideth at cliffes and is dried with the sunne, and is sometimes drawn out of salt-pits and sodde till water turne into hardnesse of salt, that was fleeting before, and so made hard and thicke with heat."—*Batman uppon Bartholome, His Booke, De Proprietatibus Rerum* (1582) *Bk.* 16, *c.* 95.

JOHN RAY, SAMUEL DALE, AND BENJAMIN ALLEN: A EULOGY.

Delivered at the Meeting of the Club at Braintree, 27th April 1912.

By Prof. G. S. BOULGER, F.L.S., F.G.S., &c., *Vice-President of the Essex Field Club.*

THE main purpose of our coming together to-day is to do honour to the memory of three Essex worthies. Unlike Mark Antony, we come not to bury them, but to praise them.

I should be sorry to think, with regard to one at least of the three, John Ray, that it may be suggested it is necessary, in so doing, that we should resuscitate a forgotten reputation. It cannot, I think, be doubted that it is more difficult to acquire a lasting reputation in science than it is in art—by work, that is, of pure reason, as distinguished from works of the imagination. The imaginative genius, whether poet or painter, scarcely seems to be the product of a slow process of orderly evolution. He seems to burst upon his age like Athene fully armed from the head of Zeus ; or shall we say, with Wordsworth,

> " Trailing clouds of glory . . .
> " And by the vision splendid
> " Is on his way attended . . . [from] "
> " That Imperial palace whence he came " ?

The man of science, on the other hand, is but the heir of preceding ages : he builds on the foundations laid, more or less securely, by his forerunners ; or, perhaps, we should rather say, he does but pick up a few pretty shells from the shores of the great ocean of truth and add them to the frail grotto begun by those before him.

The achievement of the artist, moreover, remains—the marble speaking to far distant ages, the fresco painting to be copied and sent to the uttermost ends of the earth when it shall have faded from the monastery wall, or the poem, "monumentum ære perennius."

But what of the work of the man of science? It was but a foundation hidden by the superstructure, a roughly-polished gem to be subsequently re-cut, mere old bricks worn beyond recognition by later criticism and built into a structure bearing no resemblance to that of which they originally formed a part. Who remembers the careful observer, the sound reasoner, or the industrious recorder of the early days of science? In literature or art we reverently worship the glories of the past: in science we constantly strive to add something new to the store of knowledge: the text-book of ten years ago is dangerously misleading: we want the latest work of yesterday or, rather, we are looking forward to that of to-morrow.

To the man in the street, to whom the names at least of Shakespere and Milton, of Dryden and of Pope, of Reynolds and Gainsborough, Hogarth and Constable will be known, I fear that the name of John Ray, not to presume to mention those of Samuel Dale and Benjamin Allen, may convey little or nothing —even in Braintree itself. To-day, however, I would appeal from the man in the street to those who take some interest in the history of science and in the lives and work of those men in the past to whom we are so much indebted for the present position of our knowledge.

The seventeenth century saw a renaissance of pure science based upon observation and experiment. However much truth there may be in the flippant comment that the Lord Chancellor Francis Bacon wrote about science like—a Lord Chancellor, we have the express testimony of the founders of the Royal Society that their business was to consider things pertaining to what had been called his "New Philosophy." The student of plants and animals was no longer primarily concerned, as he had been in the 15th century, with the opinions of Aristotle, Theophrastus, Dioscorides, and other ancient writers, as to the identity, structure and physiology of the organisms in question: he was not now to give his chief attention to the medicinal uses of the plants he studied, as had, almost without exception

the botanists of the 16th century. As mathematics had long been studied as the science of abstract number, so it was to be recognised that the anatomy and functions of plants and animals were to be studied by direct observation and experiment, apart altogether from the authoritative statements of antiquity, and that a knowledge of them was worth having for its own sake, and not merely as a branch of pharmacology.

Of this seventeenth century renaissance, Ray was, so far as biology is concerned, by far the most illustrious representative.

John Ray was born at Black Notley, probably on 29th November 1627. As his father Roger Wray was the village blacksmith, I like to think that the existing forge may mark his birthplace. He was baptised, in the parish church no doubt, on 6th December 1627. In the Grammar School of this town, he was educated until he was more than sixteen, a Mr. Love being then the master; and, though Ray afterwards expressed his regret that the school was not a good one, we cannot but think—judging from the rapidity of his advance at Cambridge—that he must have been well grounded in mathematics and Latin. Recognised when at school, it is said, as a "lad of parts," he was sent to Cambridge at the expense of a neighbouring squire named Wyvill, a form of practical benevolence more frequent in the good old days than it is at present. In June 1644, he entered Catherine Hall, Cambridge; but, in 1646, migrated to Trinity College, apparently in order to be under the tuition of Dr. James Duport, Regius Professor of Greek, who in later years stated that no other pupils of his were comparable to John Ray and Isaac Barrow. The latter having come up to the University from Felstead, a year after Ray left Braintree, was destined to become Master of Trinity and to succeed Duport as Professor of Greek. Ray graduated B.A. in 1647 and, in September 1649, about seven months after the execution of King Charles, was elected, simultaneously with Barrow, to a Minor Fellowship of his College, and six months later to a Major Fellowship, apparently before proceeding to the degree of Master of Arts, which he did in 1651. He had, we are told, acquired great skill not only in Greek and Latin, but also in Hebrew, though, perhaps, the testimony to his eloquence as an orator and to the beginnings of his study of natural history belong to a somewhat later time. It is clear, however, that he had an accurate know-

ledge of plants soon after completing his thirtieth year. Chosen Greek lecturer of his college in 1651, Mathematical lecturer in 1653, and Humanity Reader—which meant, I believe, Latin Tutor—in 1655, not to mention other college offices held in the five following years, it has been stated that an illness—perhaps induced by his intense application—led to his taking up the study of Nature as a healthy relaxation.

The philosophical bent of his mind, a rationalised theism supported by a reverent but carefully worked out teleology, is seen in his *Wisdom of God Manifested in the Works of the Creation* and in the *Three Physico-Theological Discourses concerning the Dissolution and Changes of the World*, which, though not published until 1691 and 1692, were, in their original form, delivered as college exercises, or "common-places," as they were termed, before he took Holy Orders, *i.e.* before 1660. We have the contemporary testimony of Archbishop Tenison to the solid learning of these sermons. They achieved considerable success and may be said to have anticipated by nearly a century the methods of Butler and Paley. Paley made, indeed, considerable use of them. Incidentally, Ray argues in the former that the study of nature is a pious duty, one suited to a Sabbath day, and perhaps destined to be one of the main occupations of the endless Sabbaths hereafter. In the latter volume, amongst much interesting geological speculation, based upon many carefully observed facts and accurate views as to the nature of fossils, we have one characteristic criticism that is so typical of the man and of all that was best in his period that I cannot refrain from detailing it. Dr. John Woodward, well remembered, by name at least, as the founder of the Woodwardian Professorship, in his *Natural History of the Earth*, explained the occurrence of fossils in one stratum differing from those in another, by the suggestion that in the Deluge they sank in the order of their specific gravities. To this Ray simply replies that it is not the fact, for light and heavy fossils occur side by side. Similarly, during one of his interesting tours, he was informed of a spring near Llandaff that ebbed when the tide in the neighbouring sea was at flood and flowed when the tide ebbed; but this fact, which would have been so extremely interesting if true, he does not take for granted, but puts to the test of his own observation, with the result that he finds the

spring to ebb and flow simply with the tide. You will remember, doubtless, the anecdote of Charles II., wisest of the House of Stuart, asking the Fellows of the Royal Society, which he had incorporated, why, when a fish was introduced into a vessel full of water, the water does not overflow. Many excellent theoretical reasons were doubtless forthcoming, until the King solved his own problem by experiment. The water *does* overflow. This was the spirit of the age.

During the long vacation of 1658, Ray made the first of his botanical itineraries of which we have a record, travelling on horseback through the Midland counties and North Wales; and in 1660, when he was already thirty-three, he published his first work, a modest little duodecimo, of 285 pp., containing an alphabetical catalogue of the plants of Cambridge, with synonymy, notes on uses, and glossary. This was the first local list of plants, and a model for the scrupulously painstaking accuracy of its statements. "I resolve," writes Ray some seven years later, "never to put out anything which is not as perfect as is possible for me to make it." He was, however, as we know from his letters, many of which are preserved in the Botanical Department of the British Museum, already planning his Catalogue of British Plants and another of cultivated plants, when came the great turning point in his life.

In December 1660, he was ordained deacon and priest by Sanderson, bishop of Lincoln, in his lordship's London chapel in Barbican; but continued at Cambridge as a resident fellow for nearly two years. In the summer of 1661, he made his second botanical tour, in company with his pupil, Philip Skippon, going through Northumberland into southern Scotland and returning through Cumberland; and, in the following year, with another pupil, Francis Willughby, eight years his junior, who was for the next ten years to be his intimate fellow-worker, he traversed the Midlands, Wales, and the South-Western counties. The diaries of these journeys, full not only of botany, but of careful observations on many other topics, were published after his death. Then came the Bartholomew Act of 1662, which forced every cleric in the country to consider his position. Ray had never himself taken the Solemn League and Covenant: he even considered it an unlawful oath; and he had received, as I have just mentioned, episcopal ordination; but he declined to

declare—as the Act required him as a college officer to declare—that the covenant was not binding on those who had taken it. Accordingly, he threw in his lot with the Presbyterians, resigning his fellowship—as did 13 other fellows of colleges in Cambridge—and retired (as he expressly explained, both then and on his death bed) into lay communion with the re-established church, in which he could never bring himself to seek for preferment.

From his conversations on religious matters with Allen, badly reported as they are, we gather that he was inclined to criticise his church in such matters as the disuse of immersion in baptism and the use of the so-called Apocryphal books of the Old Testament; but we have also abundant evidence of the deep-seated reverence and piety of the man. It is, however, obviously inaccurate to speak of Ray as having been expelled from his college or university.

From this time, with apparently brief visits to his native village, Ray was largely with Willughby. They agreed to divide the description of the organic world between them, Willughby undertaking the animals, Ray the plants; and it was partly to collect material for this scheme that, in April 1663, they started, with Skippon and another pupil, Nathaniel Bacon, on their only continental journey, which occupied three years. They visited Holland, Germany, Switzerland, Italy, Sicily, and Malta; and, on the return, Willughby, leaving them at Montpellier, went on into Spain. The journal of these travels was published in 1673, the year following Willughby's too-early death.

The winter after their return (1666-7) was spent by Ray at Willughby's palatial home, Middleton Hall, in Warwickshire, which was to be practically the great naturalist's home for the next ten years. Here he was at first occupied in classifying Willughby's numerous collections, from which task naturally grew that of the joint compilation by the two fellow-students of synoptical tables of plants and animals. These tables were more particularly required by Dr. John Wilkins, the son-in-law of Cromwell, and afterwards Bishop of Chester, and one of the founders of the Royal Society, who was preparing an international scientific nomenclature or *Real Character and Philosophical Language* (published in 1668). They are of great importance in the evolution of Ray's life-work, since they are the

germ of all that subsequent systematic work upon which his fame mainly depends. Well-known as a writer of pure Latin, Ray was persuaded by Wilkins to translate this essay into Latin; but his translation has never been published, and is apparently lost.

On returning to London after a second tour into Cornwall, with Willughby, in the summer of 1667, Ray was persuaded to join the Royal Society, and it was for its *Philosophical Transactions* that, a year later, they began a lengthy series of valuable experiments on the motion of sap in trees. Willughby's marriage made no difference in the friendly collaboration of the two naturalists, save that Ray made two more summer journeys into the north by himself, or accompanied only by Thomas Willisel, an old Cromwellian soldier, who acted as assistant-collector to several of the botanists of the time. When, however, in 1672, Willughby died at 37, he left to his own old tutor the education of his young children and an annuity of £60, which constituted Ray's main income for the remainder of his life; while the completion of the works upon which they had been jointly engaged was made by Ray one of the main purposes of his labours. In 1670, he had published his alphabetical catalogue of English flowering plants, the first draft, so to speak, of his *Synopsis*, and his *Collection of Proverbs*, which the modern study of folk-lore has kept alive as a book still of interest to-day. After this, we read of no more journeys. An offer of £200 a year to accompany three young noblemen on the Continent has to be declined on the score of health; and a prodigious literary and scientific output fully accounts for the last thirty years of his life. Marrying in 1673, at 46, a young woman of 20, Margaret Oakeley, who seems to have been a nursery governess at Middleton, Ray published in that year the account of his foreign tour, with a catalogue of the plants of the countries visited, and in the following year a *Collection of English Words not generally used* (which is, in fact, a dialect dictionary), with lists of English birds and fishes and an account of English methods of mining and smelting metals. In 1675, he thought it opportune to prepare for his very-juvenile pupils a little tri-lingual dictionary or vocabulary of English, Latin, and Greek, which proved so useful that it went through five editions; and, by 1676, he had completed and published his friend's *Ornithologia*. This work was, says

Professor Alfred Newton, "the foundation of scientific ornithology," and it is impossible to separate in it the work of Willughby from that of Ray. "From the affectionate care with which Ray has cherished the fame of his departed friend, we are in danger," says Sir James Edward Smith, "of attributing too much to Willughby and too little to himself." The classification of birds by their claws and beaks was the first serious attempt of the kind since the days of Aristotle. It was adopted, in the main, by Linnæus, and can hardly be said to be superseded even to-day. Two years later, Ray published an enlarged edition of the work in English.

On the death of Willughby's mother, in 1676, Ray's pupils were taken from him; and, after a year's residence at Sutton Coldfield, he returned to his native county, living for two years at Falkbourne Hall, near Witham, probably as tutor to the son of the owner, Mr. Edward Bullock. Possibly, as tradition has it, the fine cedar alongside the Hall may have been planted at this time by Ray.

In March 1679, Ray's mother, Elizabeth Ray, died at the Dewlands, the pretty little home that he had built for her at Black Notley: thither he himself moved in the following June; and there he spent the remainder of his days, the twenty-five most productive years of all. We must all deplore the destruction by fire of this sacred shrine of English science, since last the Essex Field Club visited Black Notley!

Not till 1682 have we any other work from Ray's pen; but the *Methodus Plantarum Nova* of that year, an elaboration of the tables prepared for Wilkins fourteen years before, is not only one of the corner stones of his philosophical fame, but is also a landmark in the history of systematic botany. In it he describes the true nature of buds, speaking of them as annual plants springing from the old stock, recognises the division of flowering plants into Dicotyledons and Monocotyledons, and indicates many of the principal Natural Orders of which we now make use. He bases his system mainly, it is true, upon the fruit; but also upon characters derived from flower and leaf. As he always does, Ray fully acknowledges his indebtedness to his predecessors, to Cæsalpinus, a century before, whom he styles "the parent of system," and to his acute but less generous contemporary, Robert Morison, of Oxford; but the system here sketched out, though

destined soon to be overshadowed by the simpler artificial grouping of Linnæus, when altered and amended (as it was by himself in 1703), "unquestionably formed," as Lindley has said, the basis of that Natural System which is universally received to-day.

The accidental death of Morison in 1683 turned Ray's attention to an ambitious scheme that he had previously abandoned from unwillingness to seem to compete with the Oxford professor, viz., a general history of plants. Such was his industry that, in addition to Willughby's *History of Fishes*, a folio of 370 pages, more than half of which was Ray's work, the year 1686 saw the issue of the first volume of the *Historia Plantarum*, containing nearly 1,000 pages, the second—of equal bulk—following two years later—the whole being completed without even the help of an amanuensis.

The first volume contains a most remarkable summary of all that was then known in vegetable histology and physiology under the title "De Plantis in Genere"—"a general account of the science in 58 pages," says Prof. Julius Sachs, "which, printed in ordinary size, would itself make a small volume, and which treats of the whole of theoretical botany in the style of a modern text-book." "We believe," write Cuvier and Dupetit-Thouars, "that the best monument that could be erected to the memory of Ray would be the republication of this part of his work in a separate form." Sir James Smith, the profound admirer of Linnæus, speaks of Ray as "the most accurate, the most philosophical and the most faithful amongst all the botanists of our own, or perhaps any other times"; and Sachs, while insisting on Ray's indebtedness for his precise terminology to Joachim Jung (whose manuscript notes Ray acknowledges he had seen, probably through the agency of the learned Pole, Samuel Hartlib, as early as 1660), adds that Jung's work was "enriched by Ray's good morphological remarks." The completeness of Ray's work may be gauged from the fact that the first two volumes of the *Historia* describes 6,900 species, as against 3,500 in Bauhin's *History* of some 35 years before, and the third volume 11,700 species more, a total of over 18,000 species: his caution is seen in that he as yet only admitted Grew's discovery of the sexuality of plants as "probable."

To us to-day, it is interesting to note that, in the Preface to

the first volume of the *Historia Plantarum* in 1686, Ray first mentions the help he had received from Samuel Dale, then only 27, whom he describes as " physician and apothecary, our friend and neighbour, living in Braintree, who has carefully examined the synonymy, corrected errors and supplied omissions." In the preface to his *Pharmacologia*, first published in 1693, Dale expressly states—what Pulteney only infers—that he owed his initiation into botany to Ray ; and we can certainly say that, though 30 years Ray's junior, he was to stand for the remaining 20 years of Ray's life in much the same position that Willughby had occupied before.

In 1690, although some years before he uncomplainingly records that feeble health, accompanied by distressing ulcers in his legs, confined him to his house and its immediate surroundings, Ray made use of the classification, then made known by his *Historia*, to recast his alphabetical *Catalogus Plantarum Angliæ* into a systematic form. The result was that *Synopsis Methodica Stirpium Britannicarum*, the first systematic British Flora, which, with its two later editions of 1696 and 1724, was to be, for more than seventy years, the pocket companion of every British field botanist. We have now in the British Museum library a number of copies bound in green morocco enriched by the notes of the leading botanists of the eighteenth century, who received these volumes as prizes from the Society of Apothecaries. The *Methodus*, the *Historia* and the *Synopsis* may be said to form the triple tiara of Ray's botanical fame.

At the suggestion of friends, he next turned to the preparation on parallel lines of a *Synopsis of Quadrupeds and Serpents*, which he seems to have completed within the year 1692–3. His classification, based upon the digits and teeth, distinguishing much as we recognise them to-day the Solidungula, Ruminants Pachyderms, Proboscideans, and Primates, has been described as the first truly systematic arrangement of these groups since the days of Aristotle. Hallam praises his methods in that he first makes systematic use of comparative anatomy, describing in detail dissections made by himself and others ; while Cuvier terms his zoological work as a whole " even more important than his work for botany."

From about 1690, Ray's studies were largely devoted to insects, that group alone being wanting to complete his survey

of the then-known world of living beings. Here, again, he brought the study of anatomy and development to bear upon classification, practically adopting the modern division into Metabola and Ametabola—those which do and those which do not undergo metamorphosis—thus, as Kirby said, combining "the system of Aristotle with that of Swammerdam and clearing the way for Linnæus." Although, in his letters, he protested that this work should rather have been undertaken by the younger William Derham, to whose lot it fell to edit it, the *Methodus Insectorum*, published in 1705 and the *Historia Insectorum*, issued in 1710, were both practically completed by Ray before his death.

I must not omit to mention two carefully-edited volumes of travels, with catalogues of Levantine plants, a systematic rearrangement of his former European lists, and nearly all the English county lists in Gibson's editions of Camden's *Britannia*,which were published in 1693, 1694, and 1695 respectively, while the third volume of the *Historia Plantarum* was also in preparation.

But the end was come to the life of toil. He speaks of himself as a thin body, subject to colds, and whose lungs are apt to be affected, while his house was exposed to north-east winds; as early as 1693, he speaks of sleeplessness; and in 1704 he expresses his doubt if he will "over-live this winter." From October of that year, he was unable to work. On 7th January 1705, he wrote a brief farewell letter to Sir Hans Sloane: we have the record of the visit of Mr. Pyke, rector of Black Notley, to the dying man, who professes himself in death, as in life, a priest of the Church of England; and then we have Dale's letters to Sloane's apothecary, Petiver, on the 17th to say that he had paid his last visit to his friend the day before; and then —doubtless in the "hall chamber" in which his mother had died 25 years before—about 10 in the morning of 17th January 1705 (N.S.) the great naturalist passed away.

I have mentioned journeys, experiments, dissections, and collections to show that, in spite of his prodigious literary research, Ray was no mere compiler, no mere critic of the labours of others. I have quoted the opinions of zoologists such as Cuvier, Kirby, and Newton and of foreign botanists, such as Sachs, as testimony to the permanent value of his work. I need

add nothing to my bare enumeration of his chief works to prove his industry; but time has prevented me from doing justice to a conscientiousness and modesty which invariably gave to others full credit for their work and help. In the halting language of the recently-discovered first volume of Dr. Benjamin Allen's Note Book, we have an example of his reverence, which seems, I think, almost to anticipate the well-known stanza of Tennyson. "He said also," we are told, "that a spoyle or smile of grass shew'd a Deity as much as anything; nothing in it to raise, keep, or support it, but a Divine power by which it stands and grows." This is surely an anticipation of the poet's "Flower in the crannied wall."

To term Ray the father of natural history in this country is at once unfair to some earlier naturalists, and quite inadequate as expressing the scope of his work. If not worthy to be mentioned as a philosopher, he vastly surpasses Aristotle as a zoologist; and if not, like Cæsalpinus, the "parent of system," we need not hesitate to rank him, for his elaboration of a Natural System, with Linnæus or Jussieu.

No one would think for a moment of classing Samuel Dale in the same category of greatness with his master Ray; but in certain directions he surpassed his teacher. Ray was able, as we have seen, for a great part of his life, to devote himself exclusively to scientific research. Dale was engaged throughout his mature years in the practice of a laborious profession. To him, as to Allen, in the same profession, science could be but a hobby for hours of relaxation. Dale wisely, therefore, set himself simpler tasks than those accomplished by his illustrious master, and of three of these he only managed to complete two.

Few details are known of Dale's private life. What there is was either pieced together by me in 1883, largely from the tickets of his herbarium, or has been laboriously collected from local records by Mr. Miller Christy.

Samuel Dale was born in 1658 or 1659, possibly at Braintree, but more probably, I think, in Whitechapel. His father is described as "of the parish of St. Mary, Whitechappel, silk-throwster"; so that it has naturally occurred to me that he might have had trade connections with Braintree and may even have been of Huguenot family. In 1674, *i.e.* at about

16, Dale was apprenticed to Thomas Wells, an apothecary, for eight years, the end of which term would bring us within the period at which Ray had settled down at Dewlands for the final period of his life's work ; and the next fact we have concerning Dale is the acknowledgment of considerable assistance, made by Ray in the preface to his first volume of the *Historia Plantarum*, published in 1686, when, as I have said, Dale was only 27. Further acknowledgments of assistance occur in a little supplement to the *Catalogus Plantarum*, which Ray issued in 1688, in the first and second editions of the *Synopsis* in 1690 and 1696, and in the third volume of the *Historia* in 1704. These include the acknowledgment of a supplementary list of fungi received while the *Synopsis* of 1696 was in the press ; while Ray not only speaks of Dale as a thorough botanist and as one of the three men who had given him most help in his *Historia*, but can be shown from records in the books themselves to have, owing to his own feeble health and engrossing toil, relied upon Dale for plants even from this immediate neighbourhood. The earliest date borne by any of the specimens in Dale's herbarium, by any of his 84 extant letters to Sir Hans Sloane, or by any of his contributions to the *Philosophical Transactions* of the Royal Society, is 1692, the year before the publication of the *Pharmacologia*. The majority of the earlier letters to Sloane are enquiries as to the cases of his patients, Sloane having an enormous correspondence of this kind with country practitioners, or requests for suggestions as to the *Pharmacologia* ; but as, like Ray, Dale also writes to borrow books from Sloane and acknowledges his help in the Preface to his *Pharmacologia*, with that of Ray, Dr. Tancred Robinson, Plukenet, Dr. Martin Lister, Samuel Doody, keeper of the Society of Apothecaries' Chelsea Physic Garden, and others, it would seem that, perhaps, his intimacy with Ray, and the greater possibility of visiting London which a young and active man would enjoy, may have already secured for Dale the friendship of many men of science

The publication of the *Pharmacologia* in 1693—the same year as Ray's *Synopsis Animalium* and *Travels*—no doubt secured its author general recognition. The first systematic work on its subject as a whole—mineral, vegetable, and animal drugs being included—dedicated to the Royal College of Physicians, and reviewed at length in the *Philosophical Transactions*

for October in the year of its publication, its real merits of careful discrimination, and of succinct and accurate description, were bound to gain an acknowledgment of its value.

The preface contains the acknowledgment, to which I have already referred, that it was to Ray that he owed his first initiation into science; to which he adds "I have made progress and have laboured not without fruit. Witnesses of this are my Botanical Elucubrations, written in English and destined some day, if the fates permit, to see the light." These were, no doubt, "the History of English Plants," which, in a letter to Sloane of 1717, he says he had "many years ago began, and made considerable progress in it then, but have long discontinued it by reason of the death of Henry Faithorn," Faithorn being printer to the Royal Society.

Though he has often been described as a Fellow of the Royal Society, Dale never was one; but he contributed nine papers to its *Transactions* between 1692 and 1732 dealing with a variety of topics from medical cases, and bread made of turnips in the famine year of 1693, to the insects of Colchester, the sea-shells of Harwich, Saxon coins in Suffolk, and the fossil Mollusca of the Crag at Harwich, Bawdsey, and elsewhere.

This last was, perhaps, the most important of these papers. It is dated 1703 and describes 28 species of fossil Mollusca, while Dale was admitted by Woodward to have been the first to describe such deposits.

It is obvious from his herbarium, and from these papers, that Dale rode to considerable distances from Braintree, in the exercise, doubtless, of his profession, his journeys often extending into Suffolk, especially to Sudbury, where dwelt a fellow practitioner of kindred tastes, one Joseph Andrews. His visits to London seem to have become more frequent after the death of Ray, when, perhaps, he had more friends among London botanists.

In 1699 James Petiver, Sloane's apothecary, an ardent botanist and collector, and Rev. Adam Buddle, who was at one time at Southminster, and who was, perhaps, the most profound student of British plants of the age, paid a visit to Ray at Black Notley, and from this date onwards, we have, preserved with Sloane's MSS., a series of letters from Dale to Petiver, which include those announcing the final illness and death of the great naturalist. So, too, it is after the visit paid to Black Notley

in 1703 by Henry Compton, the celebrated Bishop of London, who planted the rare trees at Fulham and is known in history for the part he played in the Revolution as the tutor of the Princesses Mary and Anne, that we find Dale visiting the Fulham Garden.

We should remember to-day that the monument erected to Ray in Black Notley Churchyard was put up largely at the cost of Bishop Compton.

At the close of Ray's life, he handed over his herbarium to Dale: the catalogue of Ray's library—some 1,500 volumes—which was sold for the benefit of the family, was probably prepared by Dale; and he communicated to the Royal Society an account of the manuscripts left by Ray, and acted generally as his literary executor.

Sloane seems to have suggested that Dale should complete Ray's *History of Insects*; but Dale was fully sensible of his own limitations. "Were it only to finish the English part, I do not doubt," he replies, "but that with your assistance to do it (being better acquainted with Mr. Ray's insects than any man), but the exotic part I cannot fathom, it requiring more brains and time than I can give; nor am I master of so good language as anything joyned to Mr. Ray's would deserve." Ultimately, as we have seen, this task was accomplished, as Ray seems to have wished, by Derham.

While a supplement to the *Pharmacologia*, published in 1705 and almost equal in bulk to the original work, shows Dale's professional industry, his herbarium affords abundant evidence of his continuous interest in botany. Chelsea Physick Garden he visited almost yearly from 1709 to 1738; Oxford, then under Bobart, in 1709; Fulham and Uvedale's garden at Enfield in 1711; Fairchild's nursery garden at Hoxton (where his kinsman Francis Dale practised medicine) in 1714; Sherard's garden at Eltham in 1721 and several times afterwards; and Lord Petre's at Thorndon Hall in 1736. He received also many plants from Mark Catesby, whom he terms "my kind friend," from Virginia, Carolina, and Jamaica, and others from his kinsman Francis Dale, Junior, from the Bahamas. His herbarium labels show that these were studied with the same minute care as those he collected himself, their synonymy being discussed in a manner only possible to an accomplished botanist, and some of them are

said to have been grown from foreign seed in his garden here in Braintree.

In 1730, Dale published the second great work of his life, *The History and Antiquities of Harwich and Dovercourt.* The History and Antiquities, it is true, were from the manuscript of one Silas Taylor; but the Appendix by Dale, "containing the Natural History of the Sea-coast and country about Harwich, particularly the Cliff, the Fossils, Plants, Trees, Birds, and Fishes," is much the larger part of the book. Though in the preface Dale apologises in that "dwelling more than 30 miles from the place and being continually employed in his Profession" he "could not afford more time than perhaps one day or two in a year, and that in the summer months," he gives a full account of the mineral products, such as "copperas-stones" and "selenites"; describes 20 fossil gasteropods and 18 bivalves; gives an accurate geological section of the cliff; and enumerates 60 fishes, 47 birds, 36 shell-fish, and 94 of the less common plants. His work thus became a Natural and Civil history of the place such as is seldom produced even to-day.

To me, however, it is not mainly as a pharmacologist or as a local historian that Dale mainly appeals. I happen to have had an exceptional opportunity of gauging his merit as a botanist. Any one knowing his neat handwriting and looking through the British Herbarium in the Natural History Museum will see the painstaking work of a pre-Linnæan botanist. Synonyms from Gerard, Johnson, Parkinson, Bauhin, Tournefort, and Ray are not only quoted, but discussed I, however, in 1882, saw more than this. Dale's Herbarium, bequeathed by him, with that of Ray, to the Society of Apothecaries, had then been transferred to the Natural History Museum; but it was still by itself, in the fascicles as he had left it at his death in 1739. There I found specimens of Mints, Burdocks, Sea-lavenders, and other genera which the botanist terms "critical," such as *Atriplex* and *Artemisia,* in some cases unlabelled or at least unnamed, forms not then recognised as distinct and worthy of separate names, but separated, placed in distinct sheets and evidently recognised as distinct by the maker of the collection. This evidence is now destroyed by the collection having been incorporated in the general British Herbarium; but it is on the strength of this that I then claimed for Dale a rank with his

friend Buddle, as one of the first critical students of our British flora. Confining his attention to a far more limited field than did his master Ray, he was able to reach a higher degree of accuracy in detail.

Few further details of his private life are known to us. He was twice married, his first wife's name being Judah, and his second Sarah Finch. Mr. Christy has found the births of several children by the former in the Parish Registers here. He was a prominent member of "The Company of Twenty-four," the ancient urban council of this town, and he was one of the founders and first deacons of the Bocking Independent Chapel from 1707. He died between three and four of the clock on Sunday morning, 18th March 1739, in his 81st year, and was probably buried in the chapel burial-ground at Bocking. His will was proved on 6th April of the same year.

I have left myself but little time to speak of Benjamin Allen, the youngest and least eminent of the three friends, united by a common love of Nature as well as by their residence in this neighbourhood, whom we honour to-day. This, however, is excusable, since the papers in which Mr. Christy has, in a masterly manner, collected all that is known of Allen, are so recent as to be fresh in the memory of many of us.

Allen was born in Somersetshire in 1663, being the son of another Benjamin Allen, a physician, apparently of London but he was probably related to the Alleyns, of Little Leighs Black Notley, Thaxted, and other places in this county. He was sent to St. Paul's School and in 1681 to Queen's College, Cambridge, and it was, perhaps, to Dr. Thomas Gale, High Master of St. Paul's, that he was indebted for his interest in Natural Science.

While still an undergraduate he wrote much of his treatise on *The Chalybeat and Purging Waters of England*, which was not, however, published till 1699. He began to practise in 1686, probably as assistant to Dr. Joshua Draper, of this town, who died in that year, and whose daughter, Katherine, Allen married, about 1695. In 1688 he graduated as Bachelor of Medicine: in 1692 Ray writes of him as "our principal physician at Braintree, my acquaintace and friend," and in 1697 Mrs. Ray stood as godmother to his eldest son.

As his pupil Dale was recommended to Ray by their common love of botany; so, since, as we have seen, from about 1690, Willughby's unfinished work had directed Ray's attention very largely to insects, it was his studies in entomology that recommended Allen to his illustrious neighbour at Black Notley. In 1692 Allen observed that some glow-worms had wings and also discovered a Death-watch Beetle. The latter he showed to Ray, "while it was yet alive and did beat"; while from the former observation Ray correctly inferred that the winged glow-worms were male and the wingless ones female.

A little later Allen communicated to the Royal Society, possibly through Ray, theonly papers of his that were published in the *Philosophical Transactions*. These were one "On the Manner of Generation of Eals" (1698), which elicited some friendly criticism from Dale; one on the Death-Watch (1699), illustrated by figures drawn with the help of a microscope; and one on the bee observed in Aleppo Galls.

The friendship with Ray between 1692 and 1697 was destined to be interrupted. One of Ray's twin daughters, apparently an anæmic child, died while under treatment by Allen, although he alleges that a preparation of steel prescribed by him was not used; and the father thinking there had been want of care or of skill, a coolness arose between them. This breach was, however, healed before Ray's death; or, at least, it did not prevent Allen writing of Ray in his book on *Chalybeate Waters*, published in 1699, as his "honoured friend," or Ray writing of Allen in his *History of Insects* in similar terms. Ray seems never, however, to have been in the same degree intimate with Allen as with Dale.

In publishing his *Natural History of the Chalybeat and Purging Waters of England* in 1699, Allen excuses "the impertinences and imperfections of it" on the ground that it was, as we have said, largely written while he was an undergraduate—written hurriedly and never read over until printed; but, judging by the note-books drawn up by him in mature years, we cannot avoid admitting that Allen, though a careful and accurate observer and a not unskilful draughtsman, is singularly deficient in the power of writing clear English. The book itself is interesting as the first systematic treatment of our English medicinal waters, and to us in Essex, more especially, as describing eight

springs within the county. A rewritten edition, published in 1711, is decidedly improved ; but both Dale's *Pharmacologia* and this work of Allen's came at a time that was unfavourable for any lasting repute. Robert Boyle may have been "the father of chemistry" as well as "brother to the Earl of Cork" ; but, before the introduction of quantitative analysis by Black, Priestley, and Lavoisier, there can hardly be said to have been any science of chemistry. Allen's treatment of his subject is, as might be expected, largely medical and, like all the medicine of that day and for a long time to come, mainly empirical.

It was apparently in the year 1710 that Allen began the first of the two commonplace-books that have been so fortunately re-discovered of late, and upon the examination of which Mr. Christy has mainly based the interesting accounts of their writer which he has given us. The first of these two volumes is almost entirely medical, detailing the writer's experiences classified under diseases ; but contains numerous brief references to Ray, confused notes of conversations, etc. As to these it must be remembered that they were written from memory from five to fifteen years after the naturalist's death. Thus when he says that Ray spoke of having lived for seven years with Bishop Wilkins, I think that there must be some mistake. Most of Ray's life is too completely accounted for to admit of such a possibility.

The second volume, begun in 1723, is of a more miscellaneous character, though also largely medical. It contains several dreams which Allen regarded as warnings, notes on solar eclipses, the weather, the great storm of 1703, farming, etc., a 20-page calendar of events in the History of the World from A.D. 69 to 1736, and some 50 pages on insects, including under that comprehensive designation the oyster and the Common House Snail (*Helix aspersa*), with numerous drawings including nearly 150 Lepidoptera. Among these are the Apollo Butterfly "taken on the Alps by Mr. Ray," and the Linden Hawk Moth drawn from a description by Dale.

The last entry in this manuscript volume is dated November 1737, and on the 28th day of the following February Allen died. In addition to his published works on Mineral Waters, his papers in the *Philosophical Transactions* and these two manuscript volumes, the manuscripts of two other papers, communicated

to the Royal Society in 1729, one "A Further Account of the Generation of Eels," the other describing his dissection of a whale at Maldon 12 years before, neither of which appear to have been published, are preserved in the Society's library.

An industrious, painstaking, and successful physician (among whose patients it is interesting to notice not only Ray and his family, and Mr. Pyke, Rector of Black Notley, but also Sir William Dawes, Dean of Bocking and afterwards Archbishop of York, and one or more of the Earls of Warwick of the family of Rich) and a careful entomological observer, if a somewhat bewildering writer, Allen may be considered worthy to lie, as a humble satellite, beside a great luminary, in the quiet God's Acre at Notley by the side of Ray.

It is pleasant to think of the friendship of these three men, of that rarer single-hearted devotion to the search after truth, pleasant too to read how completely Dale and Allen recognized the transcendent genius of Ray, the greatest of English botanists, the greatest zoologist who had lived since Aristotle founded the science. Braintree may well be proud of three such sons: Essex that they lived and died within her boundary: England that they are hers.

In the words of the greatest of Athenian statesmen that appear on Ray's monument—

"Ἀνδρῶν ἐπιφανῶν πᾶσα γῆ τάφος."

"Of illustrious men the whole earth is the tomb," or as Mr. Overton rendered it:—

"Not in narrow cloture of churchyard obscure,
Repose the illustrious dead:
The earth's wide womb for them is the tomb
With the starry vault o'erhead."

An Editorial Appeal.

In order that the publication of the NATURALIST may be maintained with a reasonable expenditure of time and labour, the Editor most earnestly pleads for a greater meed of helpful co-operation on the part of the main body of the members, and naturalists generally, than has hitherto been afforded to him. Not only are longer and more important memoirs desired, but the greatest aid would be given by the communication of SHORT PAPERS, NOTES, and of books, periodicals, newspapers, etc. (*or extracts from the same*), containing matter (reports, captures, natural history, antiquarian or other "finds," topographical descriptions, news of the exposure of geological sections, etc., accounts of old industries, folk-lore, dialect, etc.) likely to be useful for the NATURALIST, or for the information of the council and officers.

The Editor will very gratefully receive promises from members and others of systematic searching of periodicals, etc., for such information as above. If extracts are sent, they should be in a form fitted as nearly as possible for publication. MSS. should be written on one side of the paper only, with wide spaces between the lines, and with wide margins.

Each member should take a lively interest in our little journal, and feel himself or herself personally responsible, in a measure, for its success and usefulness. *All* events in the county coming within the scope of the Club should find permanent record in our pages.

It is desired and expected that the CONDUCTORS OF FIELD MEETINGS and other Excursions *will themselves write a short report*, describing the country traversed, buildings visited, objects noted, etc., and giving the substance of any demonstrations given either in the field or in a museum, and will forward the same to the Editor as soon as possible after the excursion. The Editor finds the task of describing the excursions far too heavy, and besides, reports written by persons specially acquainted with the districts visited, or objects seen, will have a freshness and value necessarily wanting in a mere compilation.

It would greatly assist if EXHIBITORS of OBJECTS would themselves prepare short descriptions of them for publication, and hand the same to the Secretary, at, or soon after, the Meetings.

The Essex Museum of Natural History.

We venture again to call attention to the needs of our County Museum, in the hope that lovers of natural history will each and all do **something** to aid forward the work. We have in the Museum ample means of preservation, so that all collections and specimens entrusted to our care will always be available for study, and will be carefully and lovingly curated. Amongst our desiderata may be mentioned the following :—

MAMMALS.—Skulls or complete skeletons of Essex species —Pelts, particularly of Voles, Shrews, Mice and Bats.

BIRDS.—Similar specimens, and in particular we are in want of a **good** collection of **BIRDS' EGGS.**

MOLLUSCS.—Specimens (Land and Freshwater and Marine) from as many Essex localities as possible.

INSECTS.—We are greatly in want of **COLEOPTERA, HYMENOPTERA, HEMIPTERA, DIPTERA,** and obscure groups.

PLANTS.—Authentic specimens of plants, coming from as many Essex stations as possible, to aid in the preparation of a Botanical Survey of the County.

Any information and advice in our power will be gladly given.

During the Sessions, the Curator attends on THURSDAYS until 9 p.m. in order to welcome visitors and enquirers.

WM. COLE, Curator,
H. WHITEHEAD, Assistant-Curator,
THE ESSEX MUSEUM,
ROMFORD ROAD,
STRATFORD, ESSEX.

Parts X.—XII., Vol. XVII.] [APRIL—DECEMBER, 1913.

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BEING THE

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OF THE

ESSEX FIELD CLUB,

EDITED BY

WILLIAM COLE, Assoc.L.S.

Honorary Secretary and Curator.

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William Derham D.D.
Canon of Windsor.
F. R. S.

NINETEEN LETTERS (A.D. 1704-1710-1) FROM THE REV WM. DERHAM, D.D., RECTOR OF UPMINSTER, TO DACRE BARRETT, OF BELHUS, ESSEX.

With Plates XVI. and XVII.

COMMUNICATED, WITH NOTES, BY THOMAS BARRETT-LENNARD, M.A., J.P., &C.

[*Read 30th November* 1912.]

THE Rev. Dr. Derham, by whom the following letters were written, was born in Worcestershire in 1657, and died at Upminster in 1735. He took his degree at Trinity College, Oxford, and became private chaplain to the Dowager Lady Grey of Werke. In 1682 he was presented to the living of Wargrave, and in 1689 to that of Upminster, Essex. He became a Chaplain to the Prince of Wales, afterwards George II., and in 1716 was appointed a Canon of Windsor. He was elected a member of the Royal Society in 1702, and was a voluminous writer on scientific and theological subjects.

The titles of two of his chief works were respectively *Physico-Theology* and *Astro-Theology*.[1] He wrote a life of his friend, the celebrated John Ray, which is entitled *Select remains of the learned John Ray, M.A., F.R.S., with his life by the late W. Derham, D.D., F.R.S*[2] In 1718 he edited *Philosophical Letters of Ray*: and at the end of this book is given the last letter Ray wrote to Sir Hans Sloane, which Derham remarks "bears the marks of dying hand in every letter." He wrote a preface to the 3rd edition of Ray's *Physico Theological Discourses*; and a Latin preface to Ray's *Synopsis Methodica Avium et Piscium*. Derham also contributed over 40 papers to the *Transactions* of the Royal Society.

Probably the learned doctor wrote many more letters to his friend and neighbour, Dacre Barrett, who lived less than four

1 The full titles of these books are :—Physico-Theology: or, a Demonstration of the Being and Attributes of God, from His Works of Creation. Being the substance of Sixteen Sermons Preached in St. Mary-le-Bow Church, London. At the Honorable Mr. Boyle's Lectures, in the years 1711, and 1712. With large Notes, and many curious observations. By W. Derham, Canon of Windsor, Rector of Upminster in Essex, and F.R.S. [Cited from] The Twelfth Edition. London MDCCLIV.

Astro-Theology: or a Demonstration of the Being and Attributes of God. From a Survey of the Heavens. Illustrated with Copper Plates. By W. Derham, Canon of Wiudsor, Rector of Upminster, in Essex, and F.R.S. The Third Edition Improv'd. London MDCCXIX.

2 These were published in 1760 by George Scott, M.A., F.R.S., of Woolston Hall, Chigwell, Essex, the nephew of Dr. Derham.

miles from him, than are given here. These unfortunately have no doubt been destroyed during the lapse of time which has taken place since they were penned.

Dacre Barrett was the eldest and sole surviving son of the Honble. Richard Lennard, only son, by his second wife, of Richard Lennard, Lord Dacre. Dacre's father took the name of Barrett under the terms of the will of his kinsman, Edward Barrett, Lord Newburgh, on succeeding to Belhus, which house was built by Edward's great-great-grandfather John, who died in 1527. Dacre was born in 1653, and, succeeding his father in 1696, died in January 1724-5. He married, firstly, in 1680, Lady Jane Chichester, a daughter of the Earl of Donegal, by whom he had one son and three daughters, from the former of whom the writer is descended. In 1692 he married, as his second wife, Elizabeth, daughter of Thomas Moore, of Knockballymore, co. Monaghan, by whom he had only one child, Elizabeth, who survived infancy. Dacre's second wife dying in 1694, he married as his third wife, at Blackmore, Essex, some two years later, Sarah Saltonstall, a daughter of Sir Capel Luckyn, Baronet, of Messing, and widow of Philip Saltonstall, of South Ockendon. Esquire, and by this wife he had issue a daughter.

Dacre and his younger brother went to France with a tutor for their education for a period of nearly two years. He at one time represented Co. Monaghan in the Irish House of Parliament, and, when he succeeded his father and came to live at Belhus, he took a considerable part in local politics and county matters, and was High Sheriff for Essex in 1705. The following letters prove that Dacre Barrett was very far removed from the typical country squire of the period, who has been depicted by Fielding as " Squire Western." They show that he possessed a considerable library of the latest scientic books of the day, which the learned Doctor borrowed of him from time to time. And not only did the Doctor borrow books of him, but at times he also asked Dacre to correct his writings, and to give him the benefit of his opinion as to the identity of birds and plants.

Dacre was elected a member of the Royal Society, and on three occasions was one of the ten of their number elected to serve on the Council of that Society.

The end of the 17th and early part of the 18th century was a great period of renaissance in art, literature and science, and the

Royal Society was the centre of the activities of the latter. John Evelyn, R. Hook, A. Pittfield, John Ray, Sir I. Newton, Sir Hans Sloane, Sir C. Wren, John Lock, the Rev. J. Harris, and many other distinguished men were members and discussed at their meetings matters relating to botany, zoology, physical science, etc., etc., and also published papers called *Philosophical Transactions*, which contained the results of their researches.

No doubt at times their discussions and papers were of a puerile nature, and remind one of the paper written by the immortal Mr. Pickwick on "The Tittlebats of the Hampstead Ponds." This was alleged against the Society in 1751, by that remarkable and clever charlatan, Dr. J. Hill, who afterwards called himself "Sir John"; but however much of truth there was in his satire, it is unquestionable that many even of the early researches and discoveries of the Society were of the greatest service to infant natural science. Darwin and other writers have taught us that no fresh details accurately observed about the workings of nature can be too trivial to be of service in building up scientific knowledge. For this purpose the systematic observation and accurate recording of matters, which at first sight appear unimportant, may not unfrequently be a source of considerable utility to subsequent students of phenomena in nature.

In spite of the peaceful nature of the Society's objects, their meetings were not always characterised by that harmony which is proverbially said to be present in "nests of doves," and we get glimpses in the following letters of more than one of those breezes which from time to time ruffled the tranquility of their meetings, and which no doubt caused great jealousies and heart burnings among the learned members, some two hundred years ago.

Some of these letters are not dated; the one bearing the earliest date was written on 8th May 1704, and that with the latest in 1710–1. In addition to the dates an astronomical symbol is sometimes added. There are in these letters constant references to different books, etc., and rather than insert as many footnotes as would be necessary to give the names of their respective authors, and mention some details about them, I have thought it better to give my explanatory notes in a compact form at the end of each letter.

May 8, 1704.

S.r

I have here sent you your vol: of Transactions w^ch I last borrowed, & Scilla's Epist: I return you many thanks for them, & beg that you will be pleased to add to the favour the lent of the next vol: of Trans: I have sent you the last Transaction: & all the rest that I have shall be at your comand, or any other book y^t I have. And y^t you may know what Books I have, I will show you in a short time a catalogue of the small number I have of Books Mathematical & of Natural Philosophy. I have also presumed to trouble you w^th a few Plants, to desire the favour of you to tell me their names; because some of them I doubt of, others I have forgotten, & some I never knew. Be pleased to write their name on the paper they ly in, & excuse this trouble given you by

S^r

Your much obliged & most humble serv^t

W. Derham.

I beg the favour of my humble service to your lady, son & the young Ladies. If you have any of Dr. Wallis's Books, de Motu, I desire to borrow them a little while.

The Doctor in asking for Scilla's Epist was probably referring to a work of Augustine Scilla's published in 1697.

Note the use of the word "lent" where we should now say "loan."

The Rev. Dr. John Wallis, 1616–1703, was one of the earliest members of the Royal Society; he was an eminent divine and mathematician and a most prolific writer.

De Motu is the title of the first part of Sir Isaac Newton's great work, the *Principia*.

May 11. 1704.

S^r.

As I was this day viewing the sun, I perceived a bright golden spot on his Disk, which whether it ever appeared in Scheiner's time, is what I want to search after, & therefore desire the favour of borrowing Scheiner of you. I have sent you the Proposals for Mr. Ray's Book, which is now finished, all or very little being to be printed but the title-page. I spake to Mr. Smith about the Subscriptions, who promised me y^t either I, or any friend of mine, should have the benefit of y^e 7th book. But I believe any other person might have the same benefit, although the Book I hear is admirable. But he said y the Subscription-money must be paid very shortly before the Book is published. I thought fit to advertise you of this because you told me your intent of being a Subscriber. I was yesterday at London, where I saw Wilson's Microscopes: which are really very admirable, & I judge exceed all besides. The Author will be with me, w^th a set of them about a fortnight or 3 weeks hence, & if I could hope for y^e favour of your good company, I would send you word y^t you might have the pleasure of seeing them, & what they represent as well as I. A slice of

Spunge, Cork, Rush, the ffarine of Mallows, &c were admirable, as being what I never before so plainly saw. I am in great hast

S^r^.

Your much obliged & most humble servant

W. DERHAM.

Christopher Schreiner wrote several treatises in London on optical and astronomical subjects.

The Doctor alludes to the last vol. of J. Ray's *Historia plantarum.*

Upminr. Jun. 15, 1704.

S^r^

I here send you by this Messenger your two books w^ch^ I borrowed, for w^ch^ I give you many thanks. I beg the favour of borrowing the next vol. of your Transactions, & Dr. Plot's Hist : of Staffordshire, & Mr. Newton's Opticks if you can spare them.

I was yesterday at London, where I saw Mr. Newton's new Contrivance of Reflecting glasses. They were to have been tryed yesterday before the R.S. in the presence of Lds. Hallifax & Somers, &c., but the day did not favour us. We were however regaled by Mr. Hawkesby's Ex^pts^. in the Pneumatick Engine viz : 1. A very light Feather descended as swiftly as a piece of Lead in the exsucked Receiver. 2. Tepid water first gently rose w^th^ small bubbles, & as the Rec^r^ was emptied of Air the bubbles encreased, till at last (w^n^ quite evacuated) it boyled with the greatest violence. as if the greatest fire had been under. 3. A glass vial included, & by a certain artifice evacuated w^th^ in the Receiver, was broken into 1000's of pieces by y^e^ admission of the Air into the Rec^r^.

Having an hour's leisure, I also visited Mr. Petiver's Rarities, w^ch^ are indeed many, & exceeding curious. Among others I could not but admire the Huming-bird ; the true Dragon (a very ellegant Animal indeed), the vast Frog called by our Americans the Bull-Frog, from its bellowing noise ; the Nasicornes ; Mantes ; exotick serpents, Papilios, & hundreds of other rarities both English and exotick, : many of w^ch^ are described in his lecturies & more intended. I also there saw Hoefnagle's & Hollar's Tables of Insects both great Rarities, both for their Sculpture and to be come at. I presented him with a very rare Squilla aquatica w^ch^ I catched yesterday going to London in one of the Ponds on this side Stratford. I never saw the same before. I am very confident it was a Squilla,[3] but Mr. Petiver thought it to be the Aurelia of the Great Libella.[4] But y^t^ hath no forcipes as this had ; w^th^ w^ch^ it vehemently stroke Mr. Petiver divers times, as the Squillae do. He keeps it alive in water to see whether it will have any transmutation.

I here send you a Specimen of a very curious Table of Logarithms, w^ch^ they say will exceed Vlack's. The elegance of the Figures (whose stamps are made on purpose for this work) & the goodness of the Paper deserves praise. The book is pretty forward in the Press.

I saw Mr. Ray's last Vol : of Plants w^ch^ is now published &

3 The Squilla or "Mantes Shrimp" is, of course, a Marine Crustacean.
4 A great Dragon-fly, one of the Libellulidæ.

is well printed. I beg the favour of my humbel service to Your Lady, Son and Daughters, & am

Sr.

Your most humble servant

W. Derham.

I forgot to tell you yt a Bell hung in the Recr. of the Boylear Engine, gave a very audible sound before exsuction, but as the Air was pumped out the sound grew more languid, so at last we could scarce hear it at all.

The Doctor returns some books and asks for the loan of three others, viz., a number of the Royal Society's *Transactions* which it may be noted Dacre appears to have taken in before he became a member, and also Plot's *Natural History of Staffordshire,* and Mr. (after Sir Isaac) Newton's book on optics.

The Rev. Dr. Plot, 1640-1696, was born in Kent and educated at Oxford, where he obtained the degree of D.C.L. in 1671 and became keeper of the Ashmolean Museum. He is said to have been very witty and a *bon vivant.* E. Lhuyd, who succeeded him as keeper of the Museum, said "he had as bad morals as ever characterised a Master of Arts."

Plot wrote the *Natural History of Oxfordshire* in 1676; in 1682 he was appointed secretary to the Royal Society and in 1686 he published the above mentioned book, which Dr. Derham wanted to borrow, and which is a better work than his previously written history of Oxford.

Mr. Isaac Newton is too well known to require any remarks here, but it may be mentioned that his book on what the Doctor called "Opticks," which was written in Latin, was published only in 1704, so that if Dacre had obtained a copy as early as June, it shows how eager he must have been to obtain the most recent scientific works.

The decided, although erroneous, opinion of Newton that it was not possible to make any important improvement in refracting telescopes led him to turn his attention to reflecting ones; the largest telescopes now in use are constructed on the principle of refraction.

The Lord Halifax, 1661–1715, mentioned as being present at the meeting of the Royal Society, was Charles Montagu, created Baron Halifax 1700. One of the most prominent men of his time, he was Chancellor of the Exchequer and First Lord of the Treasury in the reign of William III. Although he was

impeached for fraud and was out of office during Queen Anne's reign, on the accession of George I. he again became First Lord of the Treasury. He took a great interest in literature and science, and was President of the Royal Society from 1695 to 1698. He was the patron of Rymer's monumental work, the *Foedera*.

Lord Somers—1651–1716—John Somers, Lord Chancellor, created Baron Somers 1697; was much connected in public life with Lord Halifax, and from 1699 to 1704 was, like that nobleman, President of the Royal Society. It has been said that William of Orange reposed more confidence in him than in any other Englishman.

The "Mr. Hawkesby" the Doctor speaks of, was Francis Hawksbee who was admitted Fellow of the Royal Society in 1705, having already attained a reputation as an experimentalist. In 1709 he dedicated to Lord Somers a book on *Physico-Mechanical Experiments*. The Pneumatic Engine, as the Doctor terms it, was the air pump, then comparatively recently invented by the Hon. R. Boyle, and was called the "Machine Boyleana."

Robert Boyle—1640–1696—son of Richard Earl of Cork, was a most distinguished natural philosopher and chemist. He appears while at Eton to have been a youthful prodigy of learning and industry. He employed Robt. Hooke as a chemical assistant and set him to contrive a less clumsy machine for exhausting air in a closed vessel than that already invented by Guericke. The result was the above-mentioned machine. Boyle took a leading part in founding the Royal Society, and wrote many books on scientific and religious subjects.

Mr. Petiver, whose collection the Doctor visited, was in many ways a remarkable man: born 1663, he died 1718. He was educated at Rugby, and 1683 was apprenticed to the Apothecary of St. Bartholomew's Hospital. He became in course of time Apothecary to the Charterhouse and obtained a considerable practice, although he was in his profession somewhat of a quack.

He was a particular friend of the celebrated John Ray, who in the preface to the 2nd Volume of his *Historia Plantarum* acknowledges the assistance he had received from Petiver, and in the course of that great work refers frequently to the latter's museum, and also to his writings.

Petiver corresponded with naturalists all over the world

and engaged captains and surgeons of ships trading with foreign countries to bring him on return from their voyages specimens of seeds, plants, birds, insects, and stuffed animals.

So highly was the collection thought of, that Sir Hans Sloane is said to have offered Petiver £4,000 (equal probably to £20,000 of our money) for it; he did not accept the offer, but Sir Hans purchased it after the collector's death; and it now forms a portion of the British Museum Collections.

The word "Nasicorne" is now obsolete; Sir Thomas Browne employed it and wrote "some unicornes we allow even among insects as those foure kinds of nasicornous beetles described by Muffetus."

"Papilios" is now obsolete in the sense then used to indicate all forms of Lepidoptera.

Jacob Hoefnagle was an engraver of natural history subjects of considerable reputation. He was born at Antwerp 1576, and died 1640.

Wencelaus Hollar was a very fine engraver; a catalogue of many of his engravings was made by Vertue.

A Vlacq or Ulaccus of Gouda, Holland, published the first complete treatise in Logarithms in 1628, which was founded on the work of an Englishman, H. Briggs, who died three years after Vlacq's book appeared.

Ray's *Historia Plantarum* was published between the years 1686 and 1704.

Upm^{r} Aug. 5.

I would have waited upon you my self, or sent before now, but the busy time of Harvest hath hindered. And now I have gotten an Ague y^{t} batters me bitterly, y^{t} I am Scarce able to get so far. When I was last at London I sought after Plott's Oxfordshire for you, but find I was plainly mistaken when I told you it was offered to me for 9s. or 10s. I doubt not but it was his Staff[or]dsh[ire]. I met wth his Oxonshire, fair & guilt and lettered on y^{e} back, but Brown would not sell it under 16s. And at other places they asked me 20s., so I did not buy it for you, till farther order. I saw there also Willoughbie & Ray on Birds cheap enough, but my Ague hath hurt my memory y^{t} I forget y^{e} certain price.

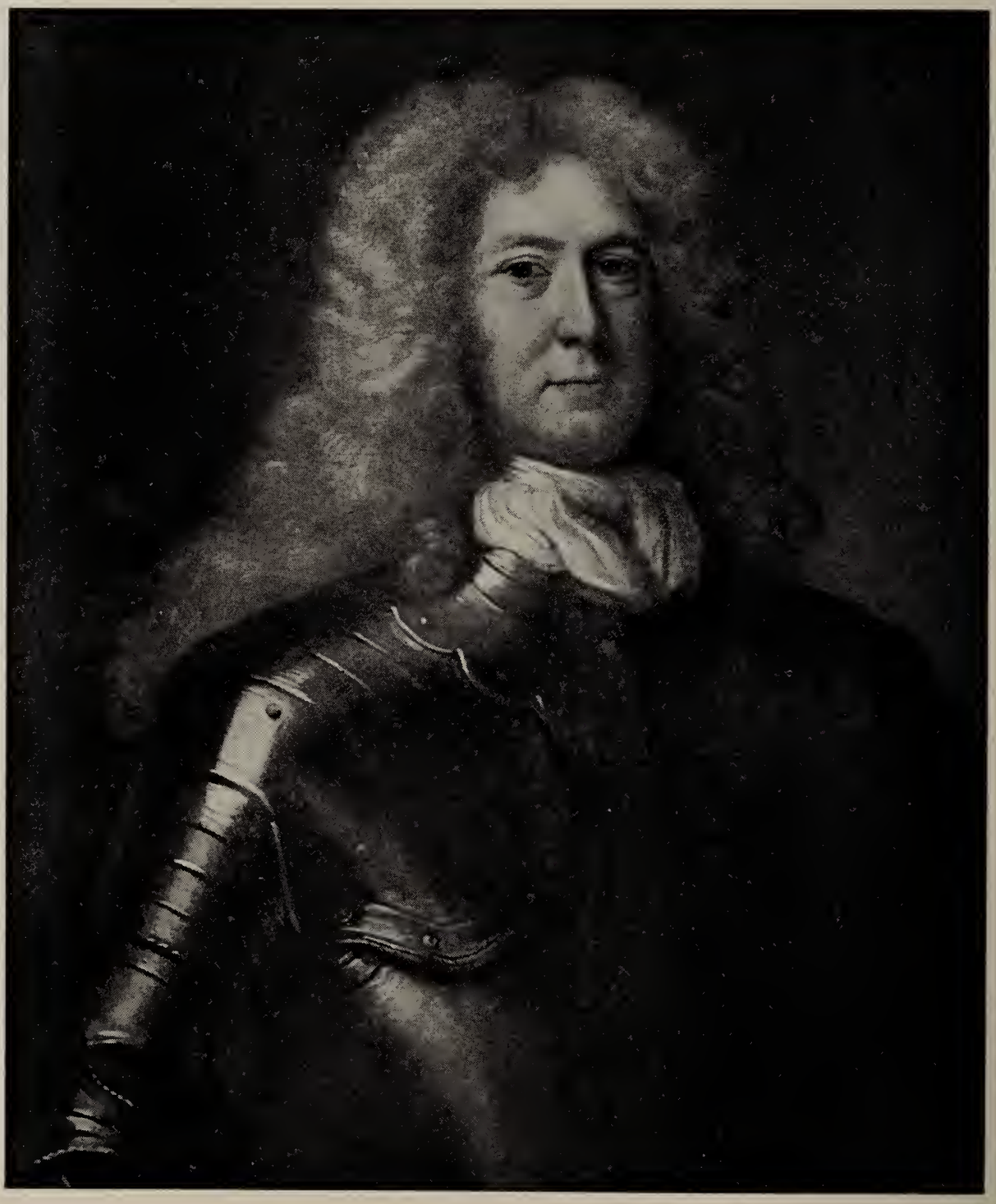
I have by this messenger sent your Plott's Staff[or]dsh[ire], & the last Transaction. The rest of your books are in safety, but not quite read yet; which I will return wth many acknowledg^{mts}. & thanks.

I desire my humble service to your Lady, Son & Daughters & wish both you & them all health & happiness, being

S^{r}.

Your much obliged & humble Serv^{t}.

W. Derham.



D. Barret

DACRE BARRETT, OF BELHUS, 1653-1724-5.

My head is so bad, y^t^ I hope you will excuse me for forgetting divers things I have to say, as I am sure I have done.

One thing I intended to say, but had like to have forgotten is, that I shall be glad to perswade you to be a Member of the Royal Society. That you may see how hon^ble^ & ingenious persons many of them are w^th^ w^ch^ you are to associate, I have sent you the last years List of them.

Derham, like most inhabitants in those times of the districts of Essex near to the Thames, appears to have suffered greatly from ague, as did also his correspondent, Dacre Barrett. I can remember when ague was common round Belhus, and my father when it was pretty general, but now a case is quite rare. The reason for its disappearance of late years is not easyto understand, as no fresh drainage has taken place in that district, nor has any special war been waged against the mosquitoes, which, according to recent discoveries, are the origin of that scourge. John Norden, in his description of Essex written in 1594, speaks of contracting while there "a moste cruelle quartene fever," while Arthur Young, writing nearly 200 years later, does not give the climate of the Essex Marsh country a much better character ; yet in their days the marshes were drained much as they are now. Indeed the word " Marsh " as applied to those broad stretches of meadows bordering on the Thames is a misnomer, as they are dry, and intersected with drains with no boggy spots. The word " Levels," as the late Rev. W. Palin[5] used to contend, would seem more appropriate to them than that of " Marshes."

The relative values of Plot's Histories of Oxford and Staffordshire appear to have been reversed since the Doctor wrote. In those days the former was evidently more costly than the latter ; whereas of late years the Staffordshire history has been sold at prices varying from £21 to £2 2s., and that of Oxford from £4 4s to £1 1s.

The proper title of the book he speaks of as " Willoughbie and Ray on Birds " is *Ornithologiae Libri Tres, Totum Opus Recognovit Digessit Supplevit J. Raius,* published 1767.

Francis Willoughby—1635–1672—was a Warwickshire Squire and, comparatively speaking, a rich man. A great friend of John Ray, with whom he travelled on the Continent.

They collaborated in writing the above work ; and Ray always acknowledged that he got much of the material for other

5 Author of *Stifford and its Neighbourhood,* etc.

of his books from the notes made by his friend. The annuity Willoughby left Ray was the chief source of the latter's means of livelihood during the last years of his life.

It appears from this letter that it was owing to the Doctor's persuasion that Dacre Barrett became a member of the Royal Society, to which he was elected in the following February.

1704.

Sr.

I have now gotten a Pneumatick Engine, & the maker will be with me to morrow, who is best able to try various Experiments. He will be going on Saturday. I have advertised you of this, yt you may have the pleasure of seeing the Expts as well as my self: and ye Honour of your good company will be a great favr to

Sr.

Your much obliged and most humble servt

W. Derham.

I desire my humble service to yr Lady, Son & Daughters.

Upmr. Sep: 22. 1704.

Sr.

According as I told you I expected, I have gotten a Pneumatick Engine, wch the maker was so kind to leave with me for a week or more longer than this present time. I have successfully tryed some Expts in it, & want to try more, particularly some of Mr. Boyles; & therefore if you have Mr. Boyl's Book of the Pneumat. Eng. or any other on yt Subject, I beg the favour of you to lend them me for a little while. I remember there are divers of such Expts in the Vol: of Transactions wch I last restored to you, or yt before. If you can find them out, & think them worth trying over again, I desire you will be pleased to send me yt Vol: again. And if you will be pleased, before I return the Engine, to assist in, & partake with me in the pleasure of some of these Curiosities it will be a great favour to

Sr.

Your much obliged and most humble servt.

W. Derham.

I am sure you will be much pleased wth ye Experimts, & therefore to save you the trouble of a short journey hither, I would send you the Engine, but it would be troublesome, & hazardous to ye glasses.

I desire the favour of mine & my wifes humble service to your Lady, Son & Daughters.

Boyle wrote so large a quantity of books on scientific subjects that it is difficult to identify the one the Doctor wanted to borrow. It may have been one indexed in the British Museum Catalogue as *New Experiments Physico-Mechanicall the touching the spring of the air, etc., etc., made in a new Pneumatical Machine.* Published in 1660.

What the Doctor says about sending the Pneumatic Engine from Upminster to Belhus being "hazardous to ye glasses" throws a side light on the dreadful state of the roads in those times.

♄

Feb : 3. 170$\frac{4}{5}$,

Sr.

You were pleased to promise me some Guns, & now the wind favouring I shall be glad of having them fired this evening precisely at 6 of clock. My Man hath my watch, by wch you may see when I account it 6 at Upmr. Be pleased to order them as before, viz : the first towards me, ye 2d Upright, the 3d fromward, and a 4th Upright. After the Guns I will make a Blaze by way of thanks for the favour.

When I was at London last Wednesday, I mat with Mr. Ray's Topographical &c Observations at 5s. His Voyages of Ranwolff, Dr. Spar, Huntingdon, Mr. Graves, &c., at 5s. The French Academists Anatomies translated by Mr. Pittfield at 8s. 6d. all I think pennyworths. Also I met wth Willughby of Fishes at 25s. wch I thought too dear atho' a great many cutts & good. But the cutts alone I met with at 15s. but I believe the Book seller would thank me to give him 10s. altho' they made a volume as big allmost as his *Ornithology*. I was unwilling to lay out your money without express order. And therefore if you like any of these at these prices, I will endeavour to get them when I next go to London.

I was present at the R.S. when you were proposed and accepted to be a Member, in a short time you will be elected Fellow, & when you go, & subscribe the Statutes, you will be admitted, & compleated. P : George hath done us the Honr to be a Fellow of our Society, & would have been chosen our President last S. Andrew's day, but yt it is contrary to the Statutes to elect one Presidt before he is a Fellow. He hath undertaken the Publication of Mr. Flamsteed's works, wch is now going on apace. The famous Mr. Ray hath been dead near 3 weeks. I would write more but yt I have taken Physich to day that puts me out of a writing condition and humour, & therefore wth our humble services to your Lady & children I conclude & am

Sr.

Your much obliged & most humble Servt

W. Derham.

I met also wth Ray's Synops : methodica Quadrapedum & Serpent : Genesis at about 4s. I think it was. Tis in 8vo & never had any Irons.

The Doctor was, together with Sir I. Newton and R. Hook, one of the pioneers of our knowledge in that branch of Acoustics which deals with the velocity of the transmission of sound. He contributed early in 1708 a rather long paper in Latin on this subject to the *Philosophical Transactions*, Vol. 26 In the course of this, he refers to Dacre Barrett as a witness for one of the

statements he makes. It was obviously for the purpose of obtaining data for this paper that he wished Dacre to have these guns discharged.

The Doctor when in London appears to have been on the look out for books for his friend Dacre ; of those he mentions the first is John Ray's *Observations Topographical, etc.*, published 1673 ; the next by the same author is entitled *A Collection of Curious Travels and Vogages containing D.L. Ranwolff's Itinery into Eastern Countries*, 1693.

I can find no book by " Dr. Spar " in the British Museum, but it is possible he referred to Joannes Caspar Sparr, who published two books on medicine in Latin in 1673, and 1674 respectively.

His allusions to " Huntingdon and Mr. Graves " I cannot follow.

In 1702 Alex Pitfield translated or, as he terms it, " Englished " from the French a book which he entitled *A Natural History of Animals.*

Willughby's book referred to is his *De Historia Piscium*, published at Oxford in 1686.

" P. George " is obviously George of Denmark, the Prince Consort.

The Rev. John Flamsteed, born 1646, died 1719, was the first Astronomer Royal. His catalogue and observations of the stars were published at the cost of Prince George. He suffered from constant bad health, the result of an attack of rheumatic fever in his youth. Flamsteed was a pious and conscientious man, patient in suffering, and very abstemious ; but his natural irritable temper would brook no rivalry, and he had constant disputes with Sir Isaac Newton and Halley, which embittered the end of a life worn out by worry and ill-health.

John Ray, whom the Doctor very properly describes as " famous," was born 1627, and died on 17th January 1705. The eloquent addresses by Professor Boulger on Ray's life and work, and on his domestic life, together with Mr. Fitch's paper on " John Ray as an Entomologist.[6] " renders it superfluous to say more about him here, beyond perhaps quoting from the

6 " The Life and Work of John Ray and their Relation to the Progress of Science " (TRANS ESSEX FIELD CLUB, vol iv , pp. 171-188) ; " The Domestic Life of John Ray at Black Notley " (PROCEEDINGS E.F.C. IV., clix.-clxiv), and " John Ray, Samuel Dale and Benjamin Allen : A Eulogy " (ESSEX NATURALIST, vol xvii., pp. 145-164). By Prof G. S. Boulger, F.L S., and " John Ray as an Entomologist," by Edward A. Fitch, F.L S. (PROC. E F.C. IV., pp. clxv.-clxix.)

former paper the Professor's dictum that Ray was "With one possible exception . . . . the greatest naturalist that England has ever produced."

The book by Ray referred to in the P.S. is his *Synopsis Methodica Animalium Quadrupedum et Serpentini Generis*, published 1693.

I suggest that when the Doctor said that this book "never had any irons" he was possibly alluding to its binding. A warm iron called a polishing iron is used to take the grain out of morocco leather, which is then known as "crushed morocco" or "polished calf."

♂

Feb : 6.

Sr.

I give you many thanks for the Guns you were pleased to give me ; by wch I made a very good expr, seeing them and hearing them very plainly. The Sound of the three last came precisely in 32 half seconds. The first Flash I saw, but being too eager to hear, I jogged my clock & made it stand, & so mist my Count. The Barometer being now very low, much lower than on the last it will be worth trying the Expt over this Evening, & therefore, if it will not be too great an imposition on your favour I would desire 2, or 3 guns more, precisely at 6 this evening as you did last. It is no great matter which way they are shot, for your Guns, & all others I have experimented by, come in the same time. But for variety sake you may be pleased to order them as last. I desire to know by the Messenger whether you saw my Fires, & yt you will be pleased to lend me Sr G. Wheeler's Travels, if you have them. Be pleased to accept our humble services to your Self, Lady & children, I am

Sr

Your much obliged humble servt

W. Derham.

Towards the end of the 17th century, the Rev. Sir George Wheler (not Wheeler), D.D., published an account of his travels in Greece, Dalmatia, etc. Sir George was, for those days when communications were so difficult, a considerable traveller. He was also a somewhat omnivorous collector, as plants, coins, classical manuscripts and antique marbles, all seem to have had an equal interest for him. Born 1650, he was knighted 1682, Canon of Durham 1684, and Rector of Houghton-le-Spring, Co. Durham, from 1709 until his death, which took place in 1723.

Sr

I have sent you your Harris's Lexicon &c. If you have dispatched either of the volumes of Sturmins, I desire you will be pleased to send it by the Bearer. But if you have not, I am not in any great

hast, but you may keep it longer till my affairs will permit me to wait upon you myself, & then I will bring Du Hamel, wch is full of a great variety of pretty things.

I have some Beer & Cider wch both want fining: For wch use I beg the favour of you to give me a Bough of your Green Beech, wch if I mistake not you said groweth in your park. I desire both our humble services may be accepted by your Lady, Son, & Daughters as being

Sr

Your much obliged humble servt.

W. Derham.

May 19. 1705.

The Lexicon the Doctor returned was the *Lexicon Technicum or Universal Dictionary of Arts and Sciences,* published in 1704.

The Rev. John Harris, D.D., 1667–1719, was a mathematician and author of many books, among which was an inaccurate History of Kent. He became a member of the Royal Society in 1699. He held several livings, but was culpably improvident and generally in distress. He died an absolute pauper, and was buried at the expense of an old friend and patron.

J C. Sturmis was a noted German Mathematician and Philosopher, of which science he was professor at Altdorf, where he died in 1703. He published a German translation of Archemedes, and also many scientific works of his own.

Jean Baptiste Du Hamel, born 1624, died 1706, was a French philosopher of great reputation ; he visited England and while there made the acquaintance of Boyle and they becane considerable friends. He wrote several books, of which, perhaps, the best known was *Philosophia Vetus et Nova,* etc., etc., which was so highly thought of that it was translated into the Tartar language, in order that a copy might be presented to the Emperor of China.

I am not able to find out anything about fining beer by use of beech boughs, nor can I identify the variety of beech which the Doctor called " green."

Sr

I here return wth many thanks your Willughby, wch you should have had sooner, but I used it for the Birds I had occation to mention in my History of the Great — wch I sent the Society but this week.

You may remr an acct I gave in the *Transactions* of an odd sort of Conical Light I saw in the Heavens one Evening, wch I have seen since, & can account for the Phenomenen. If I mistake not I have met wth in the *Leipsick Acta Erudit.* such an other appearance seen by Hevelius. I beg the favour of you to lend me that Volume

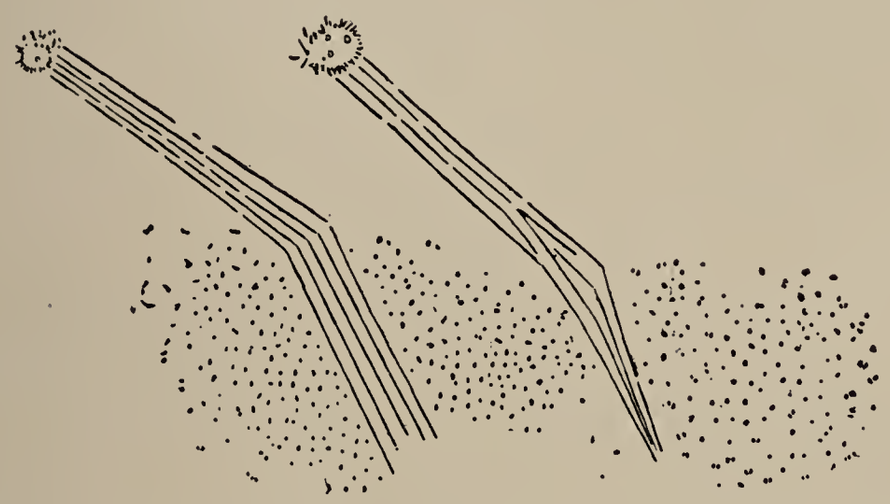
y^t^ contains it. There is I think a cut of it in the *Acta*, not very different from mine in Trans. N^r^: 310. If it will not be inconvenient I would beg the fav^r^ of you to lend me a vol: or two of the *Acta*, w^ch^ shall not be detained as your Willug: was. I believe I have perused one or two of the first vol: & should be glad then to see some of the rest. I am

S^r^

Your much obliged humble Serv^t^

W. DERHAM.

I am not able to read the word after "great." Among the forty odd contributions from Dr. Derham to the *Philosophical Transactions*, there is one by him on the migration of birds, but I can find no paper of his that I can identify with the one he refers to above.



The account he gave of the "Conical Light" in the Heavens is, no doubt, the one on p. 2,411, Vol. xxv. of the *Transactions*, written about 1708.

The *Leipsick Acta Erudita* is a scientific publication in 50 vols., begun at Leipsic in 1682, and carried on till 1731.

Its full title is *Acta Eruditorum.*

Hevelius of Dantzic, 1611–1687, was a very celebrated astronomer, who corresponded much with the members of the Royal Society, and had great controversies on astronomical matters with R. Hooke.

I cannot follow the Doctor in his reference to a "cut" or illustration by him in *Transactions* No. 310. This number is Vol. 26, viz., the one for April, May and June 1707, and contains "An Account of a Pyramidal appearance in the Heavens near Upminster," by the rev. doctor, but there is no illustration to this article.

Dec.: ♀ 9. 1709.

Sr

I here send you two lists of our R.S. for your self, & another for whom you please. You will see Mr. Flamsteed's name out, no doubt by some of his enemies means: but indeed he gave them grounds for it by refusing to pay the 12d p^r week. Dr. Harris is chosen secretary in the room of Mr. Waller, the rest of the officers are continued. I have marked one of your Lists with the number of Votes each man had that was continued, or chosen into the Council. There was a kind of tugging about the Secretary, some very pathetically solliciting for Mr. Waller, as others did for Dr. Harris. Dr. Harris had 23 Votes. Mr. Waller but 19. Dr. Harris being a person not only abundantly able, but also diligent, & living in Town, will, I hope, be a means to benefit the Society, & mend the *Transactions*, which some have (out of disrespect to Dr. Sloane) discredited more than they deserve.

I beg the favour of you to lend me your Willoughby of Birds, & your Microscopes, which shall be returned w^th great safety, & what convenient speed I can, w.h many thanks from

S^r

Your much obliged humble serv^t

Wm. Derham.

Our humble Services be pleased to accept of.

At the period when the Rev. John Flamsteed had to leave the Royal Society the entrance fee was 10s., and the subscription was 1s. per week. Now the subscription is £3, and the entrance fee, which at one time was fixed at £10, is remitted. Dr. Harris was only secretary for one year, and from what I have already said about him (ante p. 26), I should doubt if he was as suitable a person to fulfil that post as the worthy Doctor appears to have considered him.

Doctor (afterwards Sir Hans) Sloane, 1660–1753, was the distinguished Physician and Collector to whose industry and public spirit we owe the origins of the British Museum. He left his vast collections, which had cost him over £50,000, to the nation on condition that £20,000 should be paid to his family. He was greatly interested in Botany and Natural History and was an active member of the Royal Society, to whose *Transactions* he contributed several papers.

From 1693 till 1712, he was one of the two Secretaries of the Society, and on Sir Isaac Newton's death in 1727, he was chosen its president, which post he filled until 1741. He was created a Baronet in 1716. Sloane appears to have been an intimate friend of Dr. Derham, and he certainly was of Dacre Barrett.

Not only did he attend professionally the stepson, and also the son of Dacre, but the latter's daughter, by his second wife, married a nephew of Sir Hans, who was a trustee of their Marriage Settlement.

♀ May 24. 1710.

S^r^

I suppose I have told you I am drawing up a Survey of the Creation, & I can now tell you y^e^ I believe I may have occation to use it next year for Mr. Boyles Lectures. I am now about the vegetables, in which nothing to be done w^th^ out Mr. Rays help, & therefore I beg the favour of you to lend me that part of Mr. Rays Hist. Pl. w^bh^ you think will be most usefull to my design, y^t^ will acquaint me w^th^ y^e^ parts, Divisions &c. of Vegetables, w^ch^ I suppose his first part doth. If you led me one or more Volumes, I have given my man a strict charge not to bruise or any way injure them ; & I will take all care my self of so valueable Books. I hear send you one of your 3 Vol : of *Acta Erud* : the other two not being yet perused for want of time by reason I have been harrassid with journeys every week to y^e^ Council of y^e^ R.S. about the contest between DDs. Sloane, & Woodward, w^ch^ is as far from an end as at y^e^ first, & appointed to be ended this day, but I believe will not be so. I have not time at present, nor have had for a good while (my family having been very ill) or I would have waited on you, & acquainted you w^th^ our unhappy squabbles at Gresh : Col, w^ch^ are very prejudicial to the honour of our most famous Society, & I fear may be more so, if matters come to such extremities as I believe they will. I am w^th^ great respect.

S^r^

Your much obliged humble Servant

W. Derham.

John Woodward, born 1665, died 1728, was a geologist and physician. He served more than once on the Council of the Royal Society. He was author of several books, and his collections now form the nucleus of the Woodwardian Museum at Cambridge. He appears to have been a very bad tempered person. In 1710 at a meeting of the Royal Society, he grossly insulted Sir Hans Sloane, and in spite of the efforts of mutual friends he refused to apologise, and so was at last expelled the Society, against which body he then unsuccessfully brought an action. Some years after, in 1719, he had a fracas with Dr. Richard Mead when entering Gresham College, with the result that they both drew swords and were only separated by the intervention of the bystanders.

The Royal Society met for some years at Gresham College, near Broad Street, and afterwards at Arundel House. Then they returned to Gresham College, where they held their meetings

at the date the Doctor wrote this letter; however, towards the end of that year they purchased for their meetings a house in Crane Court, and so moved again. Later on the Society moved once more to apartments in Somerset House, but since 1857 they have been located at Burlington House.

S^r^

I would have sent you all or some of your Books before now, but I have not been able to dispatch with them what I take notice of relating to vegetables, having other Books to compare with them at y^e^ same time: & I have been so extreamly ill last week, y^t^ I could scarce look into a Book. I thank God I am well enough (tho' weak still) to venture to London to morrow to get S^r^ Hen: Ashurst's hand to my Diploma for Mr. Boyles Lect–, he being lately come thither for 3 or 4 days only; & I imagine it may be necessary to shew him what I have done, therefore beg the favour of you to send me those volumes of my Sermons you have. What you have not read you shall have again. & I will intreat the favour of you to run them all over, & to censure, correct, & improve them with all impartiality; w^ch^ will be a great act of friendship & favour to

Your much obliged humble Serv^t^

W. DERHAM.

Upm^r^. ☉ Aug 6. 1710.

The Doctor here alludes to his being selected to deliver the Boyle lectures. These lectures were instituted by the Hon. Robt. Boyle, who by his will, dated 1691, left a sum of £50 a year in order to provide that "some learned divine" should preach eight sermons in London every year upholding the truth of the Christian religion against notorious infidels, viz.: "Atheists, Theists, Pagans, Jews, and Mohometans." In the first instance he charged his house in the City of London with payment of this sum, but it was not an adequate security for the punctual payment of the annuity, as it was found that sometimes the house stood empty; and sometimes the tenant was unable to pay the annuity. By the efforts of Archbiship Tenison, this charge of £50 was in some way ultimately transferred to other property at Brill in Bucks, which had belonged to Mr. Boyle and which from its then greater annual value provided a much better security than the house in the City did.

The first trustees for the lectures were Dr. Tenison, Sir Henry Ashurst, Sir John Rotheram and the celebrated John Evelyn.

Judging from this letter, at the time the Doctor wrote, Sir

Henry appears to have been the trustee who took the leading part in the management of the trust. Created a Baronet in 1668, he was the eldest son of a leading merchant in London, who was an intimate friend of R. Boyle, and who (the *Dictiomary of National Biology* says in error, mistaking father for son), was one of the Trustees for Boyle's lectures.

These lectures are still delivered, but now the Bishop of London nominates the lecturer, who holds office for three consecutive years.

♀ Aug. 23. 1710.

Sr

Harvest being backward in our North-end, confines me as yet at home; else I would have paid my respects to you before now, & given you the trouble of these Papers I now send. To ease you of some trouble, you may begin at pag. 8 & I will beg the favour of you to note as you go along, in a square paper, anything y^t may any ways conduce to y$_r$ amending, or improving & enriching what I have done. If you will do me the favour to look over these 3, when I wait upon you in some short time I will bring you more. I am in the next succeeding volumes noting some things out of your Malpighi, else I would have troubled you with some of them. I shall add large notes all along in these Lectures, out of Authors, & from my own, or my friends observations, a specimen whereof I will shew you in relation to Plants, w^{ch} altho' the iast branch of my survey, yet is the only & best finished, by reason in drawing it up, I had Ray, Grew, & other the best Authors on y^e Subject; except Tournefort w^{ch} I have not seen, & knew not whether he hath any thing to my purpose: I beg the favour of you to lend me Dr. Sloanes Jamaica: w^{ch} wiith the rest of your Books I intend for safety sake to bring in my Chaise, when I wait upon you, if so large a number of Books will ly in that little room. I am

Sr

Your much obliged humble Servant.

Wm. Derham

In those times when rectors took their tithe in kind, it was incumbent on them, in order to avoid delaying the harvest, to be at hand to mark their tithe sheaves as soon as they were tied.

Marcello Malpighi, born 1628, died 1694, was a distiguished anatomist and physiologist; the founder of microscopic anatomy; one of his works was printed by the Royal Society.

Nehemiah Grew, born 1641, died 1712, was a prolific writer on botanical subjects, and at one period was Secretary to the Royal Society. The book the Doctor referred to was probably Grew's *Anatomy of Plants*, published 1682.

Joseph Pilton de Tournefort also wrote several books on

plants and drugs towards the end of the 17th and beginning of following century.

The book by Sir Hans Sloane, which Dacre Barrett was asked to lend, was the former's *Catalogus plantarum quae in Insular Jamaica,* etc., etc., published 1696.

S^r^

With many thanks I return you your Books. I forgot to ask you when you were speaking of it whether you observed the Sun rays in the Fog to converge or diverge towards (as in Fig. 2nd) or fromwards one another, or whether they appeared only parallel as in y^e^ figure 1. w^ch^ I conceive represents your meaning in some measure.)

If you do no use it I beg the fav^r^ of your Purchas's Pilgr: but only the first vol. & the 2^d^ too, if they will not be too heavy for the carriage at one time. I have long had a mind to run over ye laborious honest Author. Since I have considered your notion about the illuminations of our Region of the Atmosphere by the Refractions I believe we may give thereby a better account of the difference between the Sumer and Winter Warmth than w^t^ hath already thought of w^ch^ next time I can be so happy to see you, we will talk of, not having time at present (going to baptise a child in some hast) to say more than y^t^ I am w^th^ great respect.

S^r^

Your much oblig^d^ humble Serv^t^

W. DERHAM.

If it will not be to great a trouble, be pleased to send me a small fragment of your artificial Porphyrne.

The Rev. S. Purchas, born 1575, died 1628, was a native of Thaxted, Essex. He became curate at Purleigh in the same county, where he married a servant girl, then in the employment of his Rector. He became Chaplain to the Archbishop of Canterbury, and rector of a church in the City of London. He was a careless and inaccurate writer, and although he inherited the MSS. of Richard Hakluyt, he did not make as good use of them as he might have done. He is chiefly known for his book *Hakluytus Posthumus or Purchase his Pilgrims,* a work which is of greater value on account of its rarity than for its intrinsic interest.

S^r^

With many thanks I return you your Acta Erud. & beg the favour of you to lend me 3 or 4 vol. more of them, w^ch^ I will quickly dispatch.

This Bird I saw catching Flies from the top of my Pales w^ch^ I shot, as being a Bird I neither knew, nor ever before saw, y^t^ I

knew of. I desire you to tell me what the name of it is. With our humble Services to your family, I am

S^r^

Your much obliged humble Serv^t^

W. Derham.

This Bird is a Cock-Bird, as I saw by his Testes in taking out the Guts.

S^r^

The last time I was at London finding these Books & visiting Mr. Petiver at his own house, I borrowed them of him to enjoy the pleasure of perusing them, & have sent them you for the same pleasure your self. When you have looked them over be pleased to return them, as clean as may be, y^t^ the sale may not be hindered, unless you had rather keep them at a Guinnea price: for w^ch^ he in gratitude will dedicate a Plate to you, as you see he hath done to others. I would have visited on you my self this afternoon, but the preparations I am engaged in for a Funeral Sermon, will not permit to stir. I desire our humble services may be acceptable ot your self & family, being

S^r^

Your very humble serv^t^

W. Derham.

June 15

Mar: 28 $171\frac{0}{1}$

S^r^

I have lately made some considerable discoveries in the Eyes of Birds & Fishes, & the Ears of Birds, & my Glasses being not good enough, nor well enough rigged I beg the fav^r^ of you to lend me your Microscopes, w^th^ their furniture, to enable me to perfect my observations: w^ch^ relate to y^e^ Choroides of Fishes a pectinated, curious work, growing in the vitreous Hum^r^ to y^e^ optick nerve of Birds; & the Tympanum Labyrinth, & other very curious and observeable things in the auditory organ of Birds. I here send you all y^r^ Books except S^r^ Isaac's Opticks w^eb^ I beg the liberty of keeping longer: if you have the latin-edition, I should be glad to see it, because it hath some things w^ch^ this English Edit. hath not I fancy the Head of y^e^ Heron affords somw^t^ peculiar, their Flight being high, & occasions of looking in the water frequent. I wish therefore I had one, but can't desire such a mischievous trouble. With great respect I am

S^r^

Your much obliged humble Serv^t^

Wm. Derham.

The choroid gland is a vascular crescent-shaped body about the entrance to the optic nerve in the eye of a fish.

The tympanum in ornithology is the labyrinth of the bottom of the windpipe of certain birds.

S^r^

I am heartily sorry it is so late as half an hour after 6 or near 7, and that 2 Gentlemen my Friends are this minute dropped in, y^t^ I cannot have the pleasure of seeing the Flight of Ants as I now assuredly call them from your Specimen. I hope your health will permit you to observe nicely w^ch^ way they come from, & which way steer their course; or do you think that the Ant hills about you can afford a sufficient Number for such an appearance? Be pleased to observe all particulars possible, w^ch^ I know will be extreamly gratefull to y^e^ Society. The day I heard (by Dr. Sloane) you were in town, Mr. Pettiver & I dined w^th^ Dr., & had all of us a Contest what Species the vast Flight at London last year was of. They were enclined to think Ichneumons: but your Specimen proves the contrary plainly. I am very sorry to hear that you are not in the best circumstances of health, w^ch^ I heartily wish being

S^r^

Your much obliged humble serv^t^

W. DERHAM

Be pleased to order your serv^ts^ to look out for them to morrow morning.

The Ichneumon is a small parasitic hymenopterous insect.

SARSEN, BASALT AND OTHER BOULDERS IN ESSEX.

BY A. E. SALTER, D.SC., F.G.S.

[*Read 17th December*, 1910. *Revised*, 1914.]

WHILE studying the Drifts of East Anglia, it has been my custom for several years past to note the position, approximate size and composition of any large or interesting Boulders, which I came across during my many traverses in that region.

Prof. Bonney, in his Presidential Address to the British Association at Sheffield (1910), re-opened the question of the origin of the Drift. The evidence obtainable in East Anglia should have an important bearing upon this, especially that concerning large boulders, the present positions of which are in many cases far removed from their source of origin.

Recently, I gathered together all the evidence I could concerning the boulders in Hertfordshire. This paper concerns those already found in Essex, and it is hoped that the subject will be again taken up, especially in the outlying parts of the

county, and lead eventually to the publication of a map showing the general distribution of the various kinds of boulders.

Owing to the kind help of Mr. Miller Christy, Mr. Percy Thompson, Mr. Guy Maynard, Mr. A. G. Wright and others, my own list has been greatlyextended. My best thanks are due to them.

A knowledge of the character and general distribution of the boulders in the county would, I think, be interesting from both an antiquarian and a geological point of view.

The authority for the occurrence of a Boulder is indicated by the initial letter of the observer, thus Salter—[S.].

The following papers, etc., might be consulted by those who wish to become better acquainted with the subject :--

1835. J. Brown, "A synoptical table of some of the mineral substances and of the organic remains found in the Gravel at Stanway, Essex, and the neighbouring localities within a radius of 15 miles." *Mag. Nat. Hist.*, Vol. vi., ii., p. 349, article 9.

1837. J. Brown, "Observations upon the boulders of Trap rock, etc., which occur in the diluvium of Essex," *Mag. Nat. Hist.* (Charlesworth's) vol. i. (*new series*) p. 146.

1854. J. Prestwich, "The Woolwich and Reading Series," *Q.J.G.S.*, vol. x., p. 123 §5 "Druid Sandstones."

1864. W. Whitaker, *Memoir of the Geological Survey Sheet 7*, pp. 71, 72, "Greywethers and Puddingstones."

1886. Prof. T. Rupert Jones, "History of the Sarsens." *The Wiltshire Arch. and Nat. Hist. Soc. Mag.* Vol. xxiii. pp. 122–154.

1887. Rev. A. W. Rowe, "On the rocks of the Essex Drift" *Q.J.G.S.*, xliii. p. 351. See also by same author "Some Essex Boulders." *Essex Nat.* Vol. i, pp. 61, 117.

1888. *Report of British Association*, Bath, pp. 114–121.

1889. W. Whitaker, *Memoir of the Geological Survey Sheets*, 1, 2 and 7.

1893. Rev. H. T. Armfield, M.A., late Rector of Colne Engaine, "On some ancient Boulders scattered in the district of the Colnes." *Trans. of the Essex Archaeological Society*, Vol. iv. (*new series*) pp. 61–69.

1900. The Rev. A. Irving, B.A., D.Sc. *Proc. Geological Association*, Vol. xv. pp. 196 and 236; cf. also Vol. xiv. p. 395.

1901. Prof. J. W. Judd, Notes on the Structure of Sarsens," *Geological Magazine*, 1901, p. i

1901. Prof. T. Rupert Jones, "History of the Sarsens," *Geological Magazine*, 1901, pp. 54 and 115, where an extensive bibliography can be seen.

1903. F. W. Harmer and P. Kendal, *B.A. Report* (*Southport*), p. 238.

1904. H. W. Monckton, *Proc. Geological Association* Vol. xviii., p. 353.
1904. T. V. Holmes, "On the origin of the term 'Sarsen Stones.'" *Essex Naturalist,* Vol. xiii., p. 275.
1906. A. E. Salter, "On the Superficial Deposits of Central and Southern England." *Proc. Geological Assoc.,* Vol. xix p. 24.
1909. R. H. Rastall and J. Romanes, "On the boulders of the Cambridge Drift, their distribution and origin," *Quarterly Journal Geological Society,* Vol. lxv. p. 246.
1910. Rev. J. G. Geare, *Farnham, Essex, Past and Present.*
1911. A. E. Salter, "Sarsens and other boulders in Hertfordshire," *Trans. Hert. Natural History Society,* Vol. xiv., p. 135

I. BETWEEN THE LEA, WITH ITS TRIBUTARY THE STORT, AND THE RODING VALLEY.

With few exceptions the boulders found in this area consist of Tertiary sandstone or sarsen and Hertfordshire-conglomerate. No basalt boulders have been noted at present.

Epping Forest —Outside the Epping Forest Museum, Chingford, are two small sandstone boulders probably derived from the old gravel pits close by [T.] By the "Wake Arms" is a hard sarsen 3′ by 2′ by 1′ 6″ seen. It was obtained from the Long Running Pits, Theydon Bois. [T. and S.] In the pits between the "'Robin Hood" and Loughton some small sarsens were formerly to be seen [S.] *Cf. Proc. Geol. Assoc.* Vol. xiv. p. 394.

Holyfield.—1¾ miles north of Waltham Abbey and East of Cheshunt, on the East side of the Lea. Near the gateway leading to Monkhams' Hall and opposite the Mission Hall are a boulder of Herts-conglomerate 3′ 6″ × 2′ 6″ × ×1′ 6″, containing Tertiary flint pebbles and broken flint, and a rounded sarsen 2′ 3″ × 2′ × 1′ 6″. [S. and T.]

Rye Hill to the north of Epping Green and south of Maunds. Five sarsens, the largest being 1′ 6″ × 1′ 3″ × 1′ occur by the road side. [S.]

Epping Upland.—South of Epping Long Green at the entrance to Gill's Farm, south of Hunters' Hall, is an angular block of coarse, loosely coherent yellow quartzose sandstone. It is on end and used as a cartway guide. [T.] Lying by the roadside at Chambers' Manor Farm is a boulder of fossiliferous Neocomian sandstone 56″ × 37″ × 16″, exposed [T.] A cuboidal boulder of whitish buff sandstone 26½″ × 15″ × 15″ occurs by the roadside between Chambers' Manor Farm and Gills' Farm.,[T.]

Nazeing.—By the roadside in the village (Broadley Common), is a rounded block of Herts-conglomerate 3′ 3″ × 1′ 6″ × 1′ 3″ [T.] At the 'Coach and Horses' between Nazeing and Holywell, is an angular sarsen boulder 3′ × 2′ × 1′ 6″ [S. and T.]

Roydon.—By the roadside in the village and close to the church is a rounded block of Herts-conglomerate 2′ 6″ × 2′ 3″ × 1′ 9″. [T.]

Netteswell Cross.—By the road to Burnt Mill Station and close to the "Greyhound" are two small sarsens [S.]

Latton.—In a pit quartz blocks to 10″ × 7″ × 3″ were observed [S.]

Hatfield Heath.—In a pit a sandstone boulder 1′ × 10″ × 6″ and one of Herts-conglomerate 10″ × 6″ were seen. [S.]

Hatfield Broad Oak.—Sarsen seen [S.]

Takely Street.—At the "Old Mill" Inn are three sandstone boulders, the largest being 3′ × 2′ × 1′ 9″, and one of schist 2′ × 1′ 6″ × 8″ (exposed). At the "Four Ashes" is another boulder [S.] cf. *Brit Association Report,* 1903, p. 238.

Farnham.—A block of flint-conglomerate is to be seen in the Dane Meadow. It is known locally as "The Puddingstone." cf. *Farnham Essex, Past and Present* by the Rev. J. G. Geare, page 196.

Henham.—At the north side of the village is a sarsen by the road [S.]

Between Broxted and Elsenham.—By the side of the road is a large sarsen. [S.] At Elsenham itself is a block of hard sarsen [S.]

Elsenham.—By a farmyard gate is a waterworn boulder of hard sarsen. [T.]

THE VALLEY OF THE RODING.

Boulders of basalt and a few other igneous rocks are found in the lower part of the valley, in addition to sarsens, Herts-conglomerate, etc

Chigwell-Row.—By the side of the Post Office in a yard are the following:—Granite boulder 1′ 4″ × 1′ 2″ × 6″., an angular basalt boulder 1′ 6″ × 1′ 3″ × 1′., and rather smaller boulders of gneiss and sarsen. They have been in their present position for over thirty years. [S.] Many small boulders of granite, basalt, gneiss, sarsen, etc., are to be seen by the road leading from *Chigwell Station* to the village and also beyond the Grammar School. Others are to be seen south of the Grange Hill Station and at the gate of "Woodlands" between the station and Chigwell Row. [S.].

At the northern gate leading to Pettit's Hall near Chigwell Row are three boulders of basalt, gneiss, etc., the largest being 1′ × 9″ × 8″. [S.]

Some small boulders of basalt, etc., occur at the top of the hill between Chigwell Row and Romford. [S.]

Hainault Forest.—In a field about ¾ mile East of Cabin Hill is a boulder of white sandstone, stained by iron oxide. It is 4′ 8″ × 2′ 4″ × 1′ 3″. It is a subangular waterworn block lying on a hedge bank. [T.]

Theydon Bois.—At Blackacre is a large tabular boulder of soft yellow buff sandstone 4′ 7″ × 3′ × 9″. Its surface is deeply corroded into hollows. [T.]

Theydon Gernon near *Abridge.*—At Hill's farm is a boulder of Herts-conglomerate 1′ 6″ × 1′ 5″ × 1′ 1″. It was dug up from the field on the spot. In a field to the north of the church is a basalt boulder, 2′ 0½″ × 1′ 8″ × 1′ 2″, used to mark a field track. In a lane by the church is a boulder of Herts-conglomerate, 1′ 10½″ × 10½″ × 6″, embedded in the roadway. [T.]

North Weald. Lying at the gate of Wildingtree Farm, near Weald bridge at 283′ O.D., are the following boulders:—A block of hard white sandstone 1″ × 2′ 9″ × 1′ 6″ exposed; another similar 3′ 2″ × 3′ × 1′ 1½″; a block of Tertiary sandstone full of minute flint splinters, 2′ 8½″ ×

2′ 6″ × 1′ 1″; a block of sandstone 2′ 11½″ × 2′ 2″ × 5½″; and another of soft yellowish sandstone 1′ × 1 × 6″. [T.]

By a cottage to the north of the above are two subangular blocks of Herts-conglomerate, the larger being 2′ 4½″ × 1′ 6″ × 9″. [T.]

In the front yard of Newhouse farm, is a weathered block of soft white sandstone (3′ 6″ × 2′ 7″ × 1′ 1″.) [T.]

Cripsey Brook.—Lying across the bed of the brook, ¼ mile west of Weald Bridge at about 120′ O.D., is a large flat table of Herts-conglomerate 9′ 3½″ × 7′ 2½″ × 1′ 8″. This seems to be the largest Essex boulder. By the roadside 100 yards north of Weald Bridge is a smaller conglomerate boulder (1′ 9″ × 1′ 6½″ × 10″). [T.]

Moreton.—There is a water-worn block of yellow quartzose sandstone 2′ 9″ × 2′ × 1½″ exposed, and outside the 'White Hart' a water-worn sarsen 3′ × 2′ 2″ × 1′. [T.]

High Ongar.—At Wants' Farm is a small basalt boulder [C.] At "Witherspoons," four miles east of Ongar, Sarsens (2′ × 1′ 6″), Herts-conglomerate 9″ × 9″, and rough quartz blocks (1′ × 1′) were seen [S.] Sarsens also occur at Norton Mandeville by Norton Heath [C.] Between Ongar and Moreton by a farmhouse about 1¾ miles from Ongar are a sarsen and a Herts-conglomerate boulder. [S.]

Blackmore.—By the roadside at Fingrith Hall is a hard sarsen [C.], and at the village green is a boulder of hard white sandstone with its surface worn into hollows 2′ 4½″ × 1′ 5½″ × 1′ [S. and T.]. Small boulders of a red decomposed igneous rock, and of hornblendic granite also occur on the green. [C.] Between Blackmore and Writtle no boulders were seen. [C.]

Fyfield.—In the churchyard is a sarsen and by the roadside a sarsen, Herts-conglomerate &c., occur. [C.]

Willingale.—In the brook close to Torrell's Hall is a wedge-shaped sarsen 5′ × 3′ 8″ × 1′, and a septaria 1′ 6″. In a pit close by Warden's Hall, a triangular sarsen 2″ 9″ × 2′ × 1′ 3″ was seen *in situ*. In the farmyard at Warden's Hall are three sarsens [C.] At the corner of a lane oposite the "Maltsters' Arms" is a white sandstone boulder 3′ 2″ × 1′ 9½″ × 1′ (exposed). [T.]

About the village were seen a hard white sarsen and a boulder of green igneous rock (ash.)

Shellow Bowels.—By the roadside is a hard sandstone (or quartzite) block 2′ × 1′ 2″ × 10½″. [T.] In the farmyard at Shellow Cross Farm the following boulders were observed:—Hard-basalt, two sarsen and micaceous sandstone. [C.]

High Laver.—By the roadside, close to the church, is a water-worn block of yellow sandstone (3′ × 2′ 2″ × 1′). [T.]

Beauchamp Roding.—In the churchyard is a large flat triangular sarsen with a layer of flint pebbles (5′ 3″ × 4′ 3″ × 1′). Its surface is mammilated. [T.]

Leaden Roding.—Outside the "King William the Fourth" Inn is an cuboidal block of conglomerate much weathered (2′ 6″ × 1′ 6″ × 1′ 2″) [T.]

SOUTH ESSEX, EASTWARD OF THE RODING VALLEY.

Sarsens are the principal boulders found in this area. A few small basalt boulders have been noted in close proximity to the Roding Valley.

Romford.—A small basalt boulder occurs in front of the Workhouse gates. [s.]

Havering-atte-Bower.—In the private road near the church leading to Mrs. Mackintosh's stables, are three sarsens, the largest being 1′ 3″ × 1′ 1″ × 8″, and a rounded boulder of Herts-conglomerate (1′ 2″ × 1′ × 6″). Another congolmerate boulder occurs just south of the school and on the opposite side of the road (1′ 4″ × 8″). [s.]

Noak Hill.—About two miles east of Havering-atte-Bower. By the cottage at Wingate's Smithy is a basalt boulder 1′ 3″ × 10″ × 10″, and a smaller block of brown quartzite. [s.]

Brentwood.—At the top of King's Road, and near the main road is a sarsen (1′ 2″ × 1′ × 9″) [s.]

Mountnessing.—At "Benions," is a rounded fair-sized boulder of basalt. [c.]

Ingatestone.—By the road to Fryerning, and nearly opposite the "Anchor Inn" are two sarsens, the larger being 2′ 6″ × 1′ 2″ × 1′. Another can be seen in the Churchyard. c.f. *Proc. Geol. Association*, Vol. xix. p. 317. [s.] and [c.]

At Leez Priory near Ingatestone is a sarsen 3′ long [c.].

Beggars Hill.—East of Blackmore. In a pit were seen a quartz boulder (11″ × 10″ × 6″), and a block of rhyolite (9″ × 4″ × 4″). cf. *Proc. Geol. Association*, Vol. xix. p. 317. [s.]

Margaretting.—By the "Lion" is a boulder of Herts-conglomerate (1′ 4″ × 1′ × 8″). [s.]

Writtle Park.—By the farm is a sarsen with holes and rootlet markings (1′ 8″ × 1′ × 1′) [s.]

Orsett.—In the gravel pits at Socketts' Heath sarsens to 2′ × 2′ × 1′ occur.—[s.] c.f. *Essex Nat.* Vol. i. (1887), p. 8, and *Proc. Geol. Assoc.*, Vol. xvii., p. 142.

Grays.—cf. J. Morris on "Greywethers in Essex," *Geol. Mag.*, Vol. iv. (1867), p. 63.

Horndon on the Hill.—A sarsen over 3′ long, with a fine mammilated surface, is to be seen outside a cottage door. It is used as a landing stone. [T.]

Raleigh Hills.—Several sarsens occur about the village of Hadleigh, and one is built into the wall of the church. Near the water tower on the road to South Benfleet is a sarsen 2′ × 2′ × 10″.—At Dawes Heath, near Hadlei . three sarsens over 1ft. long were seen in a pit and several smaller ones; also a small smooth block of Igtham stone, cf. *Proc. Geol. Assoc.*, Vol. xix, p. 477). Near by, and close to Holly Lodge is another sarsen On the top of the hill leading out of Hockley towards Raleigh are two sarsens by a stile on the right side of the road, one rounded 2′ 6″ × 2′ 6″ × 8″ and the other which is used as a step 1′ 6″ × 1′ 6″ × 1′. Outside the "Paul Pry" Inn, Raleigh, is a sarsen 1′ 6″ × 1′ × 1′ 6″. [s.]

Kent.—On the opposite side of the Thames, sarsens occur at Higham

Station in the Drift. By the road to Gad's Hill from the station are several sarsens, one near the "Three Crutches" having a mammilated surface. Near the "Horse and Groom," Cooling, on entering Cliffe from the East and at Sharnell Street, others are found. Kits Coity, Coldrum Circle etc., in the neighbourhood, are made up of large sarsens. [S.]

CENTRAL ESSEX.

THE CAN VALLEY.

Writtle.—The following boulders have been noted in the vicinity of this village. Near the Brewery gates, are two rounded boulders of Herts-conglomerate about 2′ 6″ in diameter. [T.S.] In the garden at "Melbourne" are boulders of sarsen, millstone-grit and brown-sandstone of fair size. [S.] [C.] Beside Roslings' gate at "Melbourne" is a large sarsen with an irregular quadrangular base, the sides being 23″, 36″, 42″, and 42″ respectively. It was obtained from the pit at Writtle Wick in which another can be seen *in situ*. [C.] cf. *Proc. Geol. Assoc.*, Vol. xiv. p. 190. At Cook's Mill Green is a block of coarse-grained light granite 2′ 6″ × 2′ 6″ × 1′ 6″.—Between Newney Green and Oxney Green, a block of rhyolite 9″ × 6″ × 2″ was seen. [S.]

In the yard of Benedict Otes farm a sarsen and a boulder of Neocomian sandstone can be seen [C.] and [W.]. At Branston Hall boulders of sandstone, quartzite gniess, sarsen, etc., were found [C.].

Roxwell.—In the district around this village many boulders have been noted; *e.g.*:—In a gravel pit at Butt Hatch sandstone and rhyolite boulders were found. [C.] At Boyton Hall farmyard are boulders of Sarsen, ferruginous conglomerate (5′ to 6′ × 4′ × 3′), light grey limestone flint, breccia (18″ × 12″) and Neocomian sandstone. [C.] At "Dukes" farmyard boulders of fair size of sarsen, brown-sandstone, light grey limestone, Oolitic limestone, and green decomposed schist were found. [C.]

Standing in front of the mill is a flattish round, cheese-shaped stone 1′ 6″ × 1′ 3″ of coarsely crystalline light coloured granite. Two small boulders of brown micaceous sandstone, possibly Necomian and one of a different texture, possibly Carboniferous. [C.] A boulder of light grey limestone, probably of Carboniferous age, was dug up some years ago in a field at Boyton Hall. It is now set up as a monolith at the end of an avenue in the grounds of Mr. Robert Woodhouse. It is about 5′ high and 2′ 6″ thick. [C.] At Hill Farm is a small basalt boulder and at Chalk End several boulders of sarsen and brown and grey sandstone, some being of moderate size. [C.]

At *Newland Hall* is a small boulder of Neocomian sandstone.

By the roadside near the "Hare and Hounds" are two boulders, one a sarsen, and the other a sandstone with plant markings (sarsen ?). [C.]

At Boyton Cross is a boulder of basalt of moderate size. [C.]

By the road near Stonehill farm are two boulders, each about 1′ 8″ × 1′ 8″ × 9″, one a sarsen, and the other a block of Neocomian Sandstone with fossils. At Stonehill Farm itself is a block of Herts-conglomerate 2′ 6″ × 2′ 6″ × 1′ 3″., and by the mill, blocks of sarsen, red and brown sandstone, each about 1′ 6″ × 1′ × 9″, are found. [C.]

Good Easter.—At "Wares" boulders of sandstone, light grey limestone and brown sandstone, of fair size, were found. [c.]

Mashbury.—By the road near Gatehouse Farm is a triangular sandstone block 2′ × 2′ × 1′. [s.] [c.]

At Mashbury Hall farmyard is a boulder of Herts-conglomerate, (3′ 6″ × 3′ × 2′), one of light grey limestone (2′ 9″ × 1′ 10″ × 1′ 4″), a mounting block of breccia derived from the Bunter 2′ 2″ × 1′ 6″ × 1′ 2″, and a large flat flint [c.]

Chignal Smealy.—By the roadside near Langley's Farm is a sandstone boulder 1′ 7″ × 1′ × 11″. [c.]

Chignal St. James.—At Chobbins Farm are two small boulders of Neocomian sandstone with fossils. [s.] [c.]

At *Pengy Mill Farm* is a cheese-shaped basalt boulder 2′ in diameter and 6″ thick. [c.]

CHELMER VALLEY.

Broomfield.—By the roadside betwen Ayletts and Blasford Hall is an oval boulder of hard brown sandsone half buried in the ground, 2′ 6″ × 1′ 6″. By the roadside above the mill are boulders of red sandstone, sarsen, hard sarsen, and micaceous sandstone, all of moderate size. There are many sandstone boulders in this district. [c.]

Great Waltham.—By the "Windmill" Inn is a triangular, flat-sided sarsen boulder 1′ 7″ × 1′ 7″ × 10″, and in the farmyard at Walthambury is a boulder of Neocomian sandstone 3′ 2″ × 2′ × 1′ 6″, partly buried. [s.]

Pleshy.—At 'Pleshy Stone," the junction of three roads, are three boulders, one of these (2′ 6″ × 1′ 10″ × 1′ 9″ exposed), is a sarsen and another is a roughly diamond-shaped boulder of Neocomian sandstone (3′ 6″ × 2′ 4″) partly buried. [c.]

Little Waltham.—At Powers' farm is a sarsen (3′ × 1′ 6″ × 1′ 6″) and at Belsteads' farm are four boulders of sarsen and sandstone, the largest being 4′ × 3′ (partly buried). [c.]

Opposite the church are boulders of sandstone and basalt [s.]

Great Leighs.—At Alstead's farm is a sandstone boulder (3′ × 3′ × 2′ 1″) [s.] and at Lyons' or Lawn's farm are two boulders by the roadside, one is composed of basalt and the other of brown sandstone [c.] See also the "Melbournes" referred to in the *Essex Nat.* Vol. i., p. 117.

Barnston.—On the road to Dunmow, by a farm, are two sarsens and another occurs in the village itself. [s.]

Dunmow.—At the northern entrance to the town is a sarsen [s.] (3′ × 3′ × 1″). The Rev. A. Rowe has noted the occurrence of large Jurassic boulders in the railway cutting near Dunmow. (cf. *Quart. Jour. Geol. Soc.*, Vol. xiii, p. 351.)

Great Easton.—In the garden of the Hall Farm, which adjoins the church, are two large boulders and several smaller ones. The largest is a sarsen (3′ 6″ × 3′ 6″ × 1′ 2″), and the next is about half the size, and consists of Jurassic limestone with fossils. [c.]

Lindsell.—Lying about the farmyard at Lindsell Hall are several boulders consisting of sarsens, micaceous sandstone, septaria and Neocomian sandstone with fossils. [c.]

Little Dunmow.—cf. *Essex. Nat.*, Vol. i. p. 117, where boulders in a fernery at "Bouchiers" are noted.

Felsted.—In this district the Rev. A. Rowe has noted many boulders of sandstone, Herts-conglomerate, Carbonifeous limestone, Jurassic limestone, dolerite, basalt, etc. (op. cit., *Rept. Brit. Assoc.* 1888 pp 114–121). The largest boulders seen by him were a sandstone (77″ × 36″ × 20″) Herts-conglomerate (52″ × 23″ × 16″), and (52″ × 42″), Carbon ferous limestone (2′ 3″ × 2′ × 1′ 3″). Dolerite (3′ × 3″ × 1′ 4″) Mr. Miller Christy has noted a sandstone *in situ* in a gravel pit on the side of the river valley and also boulders of sarsen and sandstone in Absoll Park. [c.]

Many observers have noted the large straight-sided rectangular boulder (3′ × 3′ × 2′) in the yard of the "Sun Inn" Felsted. It appears to consist of carboniferous limestone. Several small boulders are used to form the curbing opposite the Inn. These consist of sarsens, sandstones, Carboniferous limestone, Neocomian sandstone, basalt. [s.t.c.]

Terling.—Lying about the village and parish are boulders of sarsen and sandstone of moderate size. [c.]

Great Baddow.—Near Chelmsford. Outside the "Beehive" Inn is a sarsen 3′ × 1′ 9″ × 1′ 6″ derived from the neighbouring pits where others occur, also quartzite boulders (10″ × 6″ × 6″), rhyolite (1′ × 9″ × 3″), conglomerate (2′ × 1½′ × 1′) containing quartz broken flint, &c., quartzite block to 1′ (s.] cf. *Proc. Geol. Soc.*, Vol. xix. p. 455.

Danbury.—Large quartzites (11″ × 8″) occur in the gravel here. [s.]

THE BLACKWATER VALLEY, ETC.

White Notley.—Conglomerate cf. *Essex Nat.* Vol. i. p. 8.

Braintree.—There are several boulders in and around this town. Among them may be mentioned:—A conglomerate boulder at the back of the station (2′ × 1′ 6″), a sarsen by the fountain near the cattle market on the Fairfield Road, a fine basalt boulder by Mr. R. Knights' Grocery Stores on the Bocking Road, opposite the King's Head [2′ 4″ × 1′ 8″ × 1′ 4″), and Herts-conglomerate and sarsens on the same road nearer the centre of the town. [s.]

Bocking High Street.—Outside the church are two sarsens, one rough and the other smooth and at the top of the hill and near the main road in a pit were several fair-sized boulders of quartzite, rhyolite, sandstone, quartz, sarsen, etc. [s.]

Rayne.—Boulders of sarsen and basalt can be seen here. [s.]

Stisted.—Many boulders occur in this locality and include sarsen, hard sarsen with plant markings, basalt (coarse and fine grained), Sandstones, Carboniferous sandstone, etc. At the Home-farm in the park, Stisted Hall, are boulders of basalt (the largest) sarsen, brown sandstone, Neocomian sandstone, Carboniferous sandstone. [c.]

Great Saling.—By the "Green Man" is a basalt boulder (2′ 9″ × 2′ 5″ × 1′ 6″). [s.]

Shalford.—By the "George" Inn is a boulder of Herts-conglomerate and in the lane leading from Shalford to Wethersfield, by a cottage, are boulders of basalt, etc. [s.]

Blackmore End.—Outside the "Red Cow" is a sarsen (1′ 6″ ×10″ ×7″). [s.]

Wethersfield.—1½ miles on the Nashes Green Road to Braintree is a boulder of micaceous sandstone (10″ × 12″) and ¼ N. of Wethersfield is a boulder of light grey limestone. [s.]

Radwinter, etc. cf. North Essex.

N.E. ESSEX (EAST OF THE BLACKWATER.)

The following boulders have been noted in this area :—

Great Totham.—There is a large sarsen on entering the village from Tiptree Heath. The gravel pits near the Post Office have yielded moderate sized blocks of sarsen, flint and quartzite. [s.]

Tiptree Heath.—Small sarsen. [s.]

Kelvedon.—Sarsens, cf. T. V. Holmes *Geology in the Field.* Part I. p. 57.

Stanway.— c.f. J. Brown's papers previously quoted.

Colchester.—Two large well-rounded boulders are to be seen by Green's fish-shop, opposite the Post Office. The Church Tower on Hythe Hill has several boulders built into it. [s.] In the inner court of the Castle are several igneous boulders 12″ to 18″ long, probably from old foundations. [c.]

Great Clacton.—Sarsen (4′ × 3′ × 1′).

Between Bures and Chappel.—By the road are five sarsens near a pond.

Chappel, in village street two sarsens. [c.]

Ardleigh "Crown."—By a farm near a sand pit to the south of the "Crown" are a few small sarsens.

Colne Engaine.—In this district the late rector the Rev. H. T. Armfield, M.A., has noticed several boulders (*op. cit.*). He describes them as being "very hard, very heavy and generally grey in colour," and states that those which he examined were all of the same character. As he includes Ingatestone and Pleshy in his list of localities they are all probably sarsen. In addition to these places he mentions the following :—

(a.) In front of Parley Beans Farmyard on the road from Colne to Halstead, where two boulders occur one being 6′11″ × 6′ 1′ × 11″.

(b.) At the S.E. corner of Twinstead Churchyard 3′ 11″ above ground and 3′ below by 3′ 4″ × 1′. apparently mammilated. Other stones occur at Bulmer.

(c.) Gestingthorpe. In the middle of a field is a boulder 6′ 4″ × 5′ 2″ × 1′ 8″). Others occur about the village, one by the church being 1′ 9″ × 2′ × 1′.

(d.) Little Maplestead. On the way to Gestingthorpe is a boulder 2′ 4″ × 1′ 5″ × 1′ 3″ (exposed.)

(e). Colne Engaine. Three boulders are recorded from this village, the largest being 3′ 2″ × 2′ × 1½″.

(f.) Pebmarsh. Inside Mr. Stuart's gate is a boulder.

(g.) Lamarsh. Near the church is an upright boulder.

(h.) High Easter and East Bergholt (Suffolk) are also given as localities for boulders.

Mr. Miller Christy and Mr. A. W. Wright report boulders from the following places in this district :—

Wakes Colne.—By the gateway of the Fox and Pheasant Farm, a

sarsen and a block of ferruginous sandstone. At Ford Street Mill are five boulders of sarsen and basalt.

Earls Colne.—Round Tile Kiln Farm boulders of quartz, quartzite, and hard sarsen were found. Built into the wall of the Priory ground, close to the bridge, is a sarsen 4′ 2″ long.

White Colne.—At the corner near the Post Office is a sarsen.

Greenstead Green.—Near Halstead, in front of Parley Bean's Farm, two sarsens (*c.f.* above). These hollows have formed probably by rootlets, and the larger stone is hollowed into a shallow pan in the top, which often contains water.

Fordham.—In roadside bank, sarsen, 3′ long.

NORTHERN ESSEX.

I am indebted to Mr. Miller Christy and Mr. Guy Maynard for much help in this area, which contains many large boulders of sandstone, basalt, Herts-conglomerate, etc., similar to those found in Northern Hertfordshire (cf. *Trans. Herts. Nat. Hist. Soc. vol.* xiv., *p.* 135.).

Littlebury Green or *Catmer End.*—There are many large sandstone boulders in and around this village, one by the roadside measuring (8′ × 4′ 6″ × 2′). This was obtained from an adjoining meadow, which is the bottom of a secondary valley. Many others are buried there. The "Sheepstealers' Stone" by a footpath near the village has disappeared.

Elmdon.—On the high ground in this district are many boulders of various kinds, *e.g.*, basalt, light grey limestone probably Carboniferous, sarsens, sandstone, Neocomian sandstone, septaria. A rounded boulder of fine-grained red granite was seen just beyond Elmdon on the road to Heydon.

At Elmdonbury Farm is a large sarsen boulder (3′ 6″ × 1′ 6″). It becomes pebbly in its lower part. At Lee Bury boulders of sarsen, sandstone, Carboniferous Limestone, and Neocomian sandstone occur.

Great Chrishall.—By the roadside near the church is a large block of calcrete and about the village may be seen boulders of rhyolite (2′ 6″ × 2′), micaceous and other sandstones, basalt, Carboniferous limestone, green mica schist.

Heydon.—Here boulders of basalt, Neocomian sandstone and various other kinds of sandstone were found. On the high ground round Heydon, Chrishall, etc., many basalts were found and numerous sandstone boulders. They were scarce on the bare chalk slope, but abundant when the clay capping the hills was approached.

Arkesden.—In the district around this village basalt boulders were very rarely found, but large blocks of flint conglomerate were numerous. Between Newport and Wicken Bonhurst, around the ancient chapel, boulders of basalt, sandstone, Oolite grit and Jurassic limestone were noted and in the large gravel pit between Wicken Bonhurst and Arkesden were many sandstone boulders, some being in situ in the gravel. Ferruginous sandstone, Herts-conglomerate, Carboniferous limestone, micaceous sandstone, and decomposed basalt also occur. In the stream by the

road in the village of Arkesden are several large blocks of flint-conglomerate, and about half a mile distant on the road to Woodhall is a large mass of the same material. This is not far distant from the Farnham mass previously noted. About Clavering and Berden no boulders were noted.

Cam Valley.—Just beyond the Essex border in a pit by the railway at Hinxton, many sandstone boulders occur. In the pits near the railway at Audley End a great variety of small boulders have been observed. They include :—sandstones (various), quartz, basalt, fine grained pink granite, rhyolite, pebbly-greywether, porphyry, Carboniferous sandstone, purple quartzite, etc. In the station yard is a fair-sized sandstone boulder.

About half a mile from the station, at a spot near the top of the left-hand slope of the valley of the Cam, is a large mass of calcrete, apparently in situ. It is made up of flints, hard-chalk pebbles, grits, sandstones, etc. By the main road from Audley End to Newport boulders of Neocomian and other varieties of sandstone are to be seen, and just before entering Newport from the north is the large " Leper Stone " (7′ × 6″ × 1′ 6″) composed of Neocomian sandstone (cf. *Brit. Assoc. Report*).

Saffron Walden.—Several boulders have been noted in this district. Sarsens occur about two miles out on the Ashdon Road [s.]. Between Saffron Walden and Little Walden, by the roadside, are boulders of basalt (decomposed), grit, sarsen, Neocomian and other sandstones. [c.]

Between Saffron Walden and St. Aylotts on the road to Ashdon, the following boulders were observed :—Neocomian and other sandstones, sarsens, Carboniferous limestone, two green igneous rocks, Jurassic limestone, septaria, Carboniferous sandstone, etc., Lying about the Cement works on the Thaxted road are boulders of Carboniferous and Jurassic limestone, purple sandstone, etc., probably derived from the Boulder Clay pit at Seward's End, mentioned below. At the bottom of the hill, leading from Seward's End to Saffron Walden, are three basalts, the largest being 2′ × 1′.

The section of Boulder Clay near Bean Hill, Seward's End, is interesting from our present point of view. The largest boulders range up to 3′, but the average is from 18″ to 20″. They consist of :—Large flints, rounded lumps of chalk, Carboniferous limestone, some being of a purple colour, Jurassic limestone, Red Chalk (with belemnites), Kimeridge Clay, Jurassic septaria, Jurassic fossils, jasper, rhyolite (the only igneous rock seen).

The difference between these and the boulders found connected with the clays on the higher ground is very noticeable.

Ashdon and Bartlow.—By the roads and in the farm yards in the vicinity of these places the following boulders have been found :—basalt, Neocomian sandstone, light grey limestone (Carboniferous ?), Jurassic limestone, Lincolnshire limestone, Carboniferous sandstone with casts of fossils. [s.]

South East Cambridgeshire.—Boulders similar to the foregoing are found on the high ground at Balsham, Weston Colville, Willingham, Brinkley, and Dullingham, and appear to connect the boulders of Hertfordshire and Essex with those of Norfolk and Suffolk. [s.]

Radwinter, Hempstead and Steeple Bumpstead.—Many basalt boulders

occur in this area, some being of considerable size. Boulders of Neocomian sandstone are plentiful. Other sandstones and boulders of Jurassic limestone are found. [C.]

Sible Hedingham.—Several sarsens are to be seen about the the village. Basalt boulders occur near the Church and close to the Brickearth pits. The latter is 1 ′6″ × 1½″ × 10″. A little further on is a boulder of Carboniferous limestone (1′ × 1′ × 4″).

SUMMARY AND CONCLUSIONS.

It will be noticed from the foregoing list that Sarsens are widely distributed in Essex. In the South East and East of the country these appear to be the only boulders present, and they occur further north in the Gipping Valley, Suffolk. They are prevalent also in North East Essex. In some cases these Tertiary Sandstones show evidence of rootlets, etc., showing that when formed they were at or near the surface.

Boulders of Herts-conglomerate do not extend so far South and East as the sarsens, etc., and are most frequent in the North East part of the county about Arkesden.

The distribution of the boulders of basalt and Neocomian sandstone is every interesting. There appears to be one stream of these running roughly East to West in the northern part of the county, connecting a similar line through South Cambridgeshire and Suffolk with that in North Hertfordshire and Bedfordshire. What is apparently a branch of this stream crosses the county diagonally, irrespective of the existing river valleys, through Sible Hedingham, Braintree, Felsted, Great Leighs, Shellow Bowels, High Ongar, Theydon Gernon and the lower part of the Roding Valley.

The recent discovery by Mr. P. Thompson of a large boulder of Neocomian sandstone at Chambers' Manor Farm, Epping Upland, seems to connect the stream with the Hertford district; boulders of this rock being found at Hertingfordbury, and Hatfield Hyde. Basalt boulders also can be traced to Bayford in Herts.

It is at once apparent that, if such an hypothesis can be sustained, much denudation has taken place since the boulders were transported to their present position, and also that in all probability earth movements of a regional character have taken place since their introduction.

The specimens of light grey limestone which have been found

are few in number, and although they are in all probability composed of Carboniferous limestone, yet the absence in most cases of crinoids makes the determination macroscopically somewhat doubtful.

The boulders of quartz and rhyolite found at Beggars' Hill, Great Baddow, etc., are similar to those found in Mid. Herts, and are probably derived from the west (cf. *Proc. Geol. Assoc. Vol.* xix p. 21).

More evidence is required before any more definite hypothesis can be formulated. I hope this paper will have the effect of arousing interest in the subject and leading to the accumulation of more evidence.

The specimens obtained while preparing this paper have been deposited in the Essex Museum.

THE COAST-FLORA OF THE CLACTON DISTRICT.

By F. SAXER.

WALKING along the sea-shore, it is easy for anyone to perceive that the plants offer both floristic and morphological peculiarities. Moreover, it will at once be noticed that they grow in certain sharply defined associations. Nothing could be more striking than the difference between the vegetation of the littoral sand dunes and that of the muddy flats and creeks. It is again a very pleasant and not at all a difficult matter to determine the constituent species of the varous associations. Nor is it any more difficult to find the chief conditions of soil and air which seem to determine the peculiarities of growth and structure. One cannot help perceiving, after this, that certain plants only grow within narrowly circumscribed limits, determined apparently by physical and chemical properties of the soil. Gradually the idea of zonation must press itself on an observer, even though he never in his life had heard of plant-œcology.

It is a much more difficult matter and a much more laborious task to determine accurately and in unimpeachable scientific terms the factors that govern the economy of every species or formation. Many things have to be taken into consideration,

whereas the ordinary observer will content himself by stating what seems to be the dominant fact. However, the importance of water and transpiration in plant-life is so transcendent that any amount of chemical analyses and microscopical research can do no more than amplify and render more precise the notions got by ordinary observation.

The study of the sea-shore vegetation, as of any other, falls naturally under two heads:

1. The floristic study, comprising the classification of the species into different associations.

2. The study of the economy of those species and associations, naturally subdivided into

   (*a.*) The study of the œcological factors: light, heat, atmospheric precipitation, physical and chemical properties of the soil, including water, and

   (*b.*) The study of growth-forms, morphological and anatomical peculiarities which must be regarded as adaptations to the action of the œcological factors mentioned.

The order in which I proceed is, perhaps, not strictly scientific; I shall treat first of the prominent œcological factors, soil, water and salt, and then describe the various associations, floristically and morphologically.

The soil of the coast is of two kinds: (1) sandy or gravelly soil, occurring both on the valley gravel cliff from Clacton to Holland and on the foreshores and low dunes on the coast stretching from Clacton to Colne Point and further. The particles composing this soil being large and loose, its power of retaining atmospheric precipitation is as small as its power of raising water from moister subsoils. It is well aerated. In the sun it is heated easily, but loses its warmth as easily at night: in no soil are the alternations of temperature so pronounced as in sand. The particles are small enough to be carried away by the wind; we observe the beginning of a dune at various places. Chemically the nutritive value of a pure sand is lowest of all soils. Sand mixed with gravel is not mobile, but more liable to be heated. On the cliff it forms an extremely unreliable support for plant-life, and is providing continually new surfaces by crumbling down. When artificially supported by a sea-wall, or the plantation of Tamarix, it becomes more

stable and gives rise to a different vegetaion more resembling that of the clayey cliff.

2. Muddy or clayey soil is in many respects the exact counterpart of the sandy soil. The particles are finer and more cohesive; its power of retaining water very great. When exposed to prolonged drought, however, it becomes as hard as stone, thus rendering absorption of water practically impossible. Like the sandy soil it occurs in different heights from the sea-level, *e.g.*, in the creeks and muddy flats, then on dams which have been erected against the inrush of the tide into the reclaimed land, and on the cliff itself.

Plants growing on sandy soil are called Psammophytes or Psammophilous (sand-loving) plants and those preferring muddy soil Pelophytes or Pelophilous (mud-loving) plants.[1]

Salt.—The physical nature of the soil does not, however, yield the only fundamental test by which to divide the coast-flora. The action of the salt contained in the sea-water is another. There are plants that are obviously dependent upon being more or less often reached by the tide, and whose soil and tissues contain a varying amount of chlorine. These are called Halophytes or Halophilous plants. There are Psammophilous and Pelophilous Halophytes. On the other hand plants grow on the shore that have no need or predilection for salt and might grow inland, if they found convenient soils. Thus *Salicornia* (Marsh Samphire) is a Pelophilous Halophyte, *Cakile* (Sea-rocket) a Psammophilous Halophyte, while *Psamma arenaria* (Sea Marram) is said to be a non-Halophilous Psammophyte, being able to grow quite well at a great distance from the sea, if it can find shifting, deep sand to grow upon.

The percentage of salt in different places varies according to the number of submersions by the tide, the number and violence of storm-splashes (on sea-walls and cliffs), the amount of fresh water introduced either by atmospheric precipitation or by the raising of ground-water and the facility of drainage. Obviously a depression at a high level, although reached only by an exceptionally high tide, may by evaporation become more saline than the parts exposed to the daily scour of the brine. It must be kept in mind also that the salinity varies, not only

1 This nomenclature is taken from the recent standard-book of Warming: *The Œcology of Plants.*

with different places, but that in the same place it is by no means stationary.

Most plants growing in the salt-area show definite alterations in their tissues, notably succulence, which may be either of the leaves or of the stem. Succulence must be regarded as a sign of lack of water: the saline soil, even when wet physically, is physiologically dry. The plants cannot absorb the sea-water plentifully, because they have no machinery to get rid of the salt, which has once entered their tissues, and must, therefore, render transpiration as slow as possible, which is precisely the case of xerophytism. This is the usual explanation of succulence: Halophytes are a type of Xerophytes. Against it it may be said that the Halophytes have neither fewer stomata than other plants, nor are those in any way protected. Diels asserted that succulence was a means by which the plant freed itself from an excess of salt; he held that, favoured by the frequently red-coloured cell-sap, certain organic acids were formed in the tissues which entered into volatile compounds with the chlorine. His analyses seemed to show that, when supplied with pure water only, a diminution of chlorine in the leaves actually occurred, no trace of salt being found in the water itself. However, later research appears to have disproved Diels' theory. What happens is that the plant withdraws the salt from the actively growing shoots and stores it up in the older leaves and in the stem.

Lesage made a series of very interesting culture experiments which established that increase in salt tended (1) to promote succulence (the palisade cell-layer becomes thicker, salt acting morphologically like sunlight), (2) to diminish the amount of chlorophyll (which accounts for the translucence of the leaves), (3) to decrease the size of the leaves, and (4) to dwarf the size of the whole plant. Reversing the argument, the degree of succulence, etc., may be said to be a good test of the degree of salinity of the soil.

The question whether the physical or chemical nature of the soil, including moisture, is of primary importance to the plant is the subject of a long-standing controversy among botanists. In the psammophilous shore vegetation, the physical properties of dryness, and looseness of particles, evidently co-operate with the chemical action of the salt and the poverty of nutritive substances in producing an extremely xerophytic vegetation.

On the other hand the physical constitution of mud, and its high nutritive value, are antagonistic to the action of salt. This may explain why the plants are frequently luxuriant in size, though xerophytic in structure.

The rain-fall at Clacton is usually below 20 inches a year, and is more or less distributed over the whole twelve months. Extreme drought for long periods does therefore not occur, as it does, for instance, in the steppe, where vegetative growth is entirely confined to the rainy season. There are, however, species growing on the coast whose term of annual growth lies in winter or early spring, and who pass the hot season in the form of seed or spore. Such is the case of some spermophytic annuals (*Cerastium*, and, to a certain extent, *Cochlearia officinalis* and *Lepidium ruderale*), but more particularly of the mosses which cover all the sandy shore in winter and early spring. Another effect of rain will be the washing away of salt in those higher parts of the littoral meadow that are only covered by an exceptionally high and stormy tide. There are places where the vegetation can scarcely be said to be Halophilous—so numerous are the invaders from the ordinary meadow, dune or waste land.

A factor of smaller importance (for our purpose) is light; like wind it tends to accelerate transpiration. There being no trees, there is little protection against light, and several plants show definite modifications against insolation, such as the assumption of profil-lie in the leaves of *Atriplex portalacoïdes*. Wind-sheltered places are conspicuous for the larger size of the plants; much of the dwarfing appears to be due to exposure to wind.

It is not always easy to determine whether a plant is a genuine Halophyte, whose life depends on the presence of salt, or a non-Halophilous inland plant which is able to endure the salt without danger to its existence. I propose, therefore, to follow the clearer division into Psammophytes and Pelophytes, irrespective of their relation to salt.

I. PSAMMOPHYTES.

I have already sketched the reasons why the vegetation of the sandy shore must be extremely xerophytic. It has been said, also, that psammophytes fall into two groups, the Halophilous and non-Halophilous.

On the outer edge of the dune, just above the high-water mark, sometimes on the shingly storm-beach, occurs *Cakile maritima* (sea-rocket), a succulent annual *Crucifer* with bright red flowers. In similar places, though generally less exposed, the prickly *Salsola kali* (Saltwort) may be found, which is also an annual species. This latter, however, is not a genuine Halophyte, having penetrated into the interior of the continent of America and there become a pestilent weed in the corn-fields. Then comes a region where grasses are dominant : *Triticum junceum*, whose leaves are frequently seen to be reduced to almost hair-like shape, extremely dwarfed forms (not more than a foot in height) of *Arundo phragmites* (Common Reed) alternate with *Carex arenaria* (Sand-Sedge) and *Festuca ovina* var. *sabulicola* (?) (Sheep's Fescue). On the lee-ward edge of the dune *Atriplex babingtonii* (Frosted Sea-Orach), whose protection against drought is afforded by a coating of scaly meal, becomes dominant. An occasional *Beta maritima* (Sea Beet) may occur in this connection. Both near Stone Point, at Walton, and on Colne Point near St. Osyth *Suæda fruticosa* (Shrubby Sea-blite) forms a kind of littoral bush-land, it being the only plant on the Clacton shore with lignified stem. Above the reach of the highest tides occurs *Artemisia maritima* (Sea-Wormwood) protected by a dense hairy cover. There appear to be two growth forms, one stout and erect, the other rather drooping, the former growing on the exposed edge, the latter on the more protected, though less saline, lee-side of the sea-wall. In shallow depressions just behind the dune, which are filled with salt-water, *Salicornia* and *Suæda maritima* (Sea-blite) become dominant. These pools are generally fringed by a zone of *Atriplex portulacoïdes* (Sea Purslane), like *A. babingtonii*, covered with a white scaly meal. I have already alluded to the fact that its leaves assume a profil-,lie and have become isolateral in consequence.

The bulk of the vegetation of the sandy shore is, however, not Halophilous. The plants grow on the coast, not because they have a liking for salt, but because they find on the dune the soil they most require, and have learnt to put up with the salt as an addition that does no more than accentuate the already strongly Xerophytic character of their station.

There is a pretty sharp division into two associations :—

(1.) The vegetation of the open, white dune, with the shifting sand ;

(2.) The vegetation of the grey dune, the "conquered land," where the sand is fixed by a continuous carpet of plants.

The representative plant of the white dune is *Psamma arenaria* (Sea Marram). It grows in scattered tufts, each of which gives rise to a small sand-hill, which is held together by a very extensive system of rhizomes. Thus it becomes itself one of the chief agents in forming the elevated dunes. Of course Clacton does not offer any high or extensive dune, but just enough to study the main characteristics of its vegetation. The chief dangers to which plants on such sites are exposed are: (1) drought, (2) being laid bare, *déchaussé* the French call it, (3) being buried, (4) being injured by the flying grains of sand or by the wind directly. It is a very striking lesson to notice with what diversity of means different plants meet the same difficulties. Here we find *Eryngium maritimum* (Sea Holly), unfortunately disappearing in those parts which are within reach of the more idle of the sea-side visitors; its immense stock in the sand, its stiff, coriacious, bluish leaves need no explanation. *Convolvolus soldanella* with its beautiful red flower, slightly winding stem, glossy leaves, and *Arenaria peploides* (another Sea-Purslane), a low succulent annual, I need only mention. Perhaps the most interesting of all anatomical peculiarities is the rolling-mechanism of the grass-leaves, notably in *Psamma*, but also in the other dune grasses, and in *Spartina stricta* (Bristle-grass).

However, the vegetation soon conquers the feeble dune, and the so-called grey-dune vegetation arises. Marram grass and Sea Holly disappear, choked apparently by too many competitors. The chief characteristics of this association are lowness of growth and continuity. *Plantago coronopus*, *Leontodon autumnale*, *Hypochoeris radicata* form rosettes, *Armeria vulgaris* (Thrift) becomes sometimes even a cushion-plant; its root is richly ramified and bears a rosette of narrow leaves on every branch, the whole forming a hemispherical cushion; the stem of *Silene martima* (Sea Campion) is decumbent; mosses and lichens, of course, fit in with the general character. The obvious cause of the clinging to the ground is the necessity of holding the sand together. Incidentally this growth-form protects them from the full force of the wind and keeps the moisture back in the soil. Rosettes are said to be caused by rapid altera-

nations of temperature, which doubtless occur in this sandy soil. Some other species whose position seems not so well defined, and which besides, are rare on the Clacton coast, are *Glaucium luteum* (Horned Poppy), *Euphorbia paralias* (Sea Spurge), *Filago minima* (Field Filago). The grey dune merges often imperceptibly into the higher littoral meadow, of which I shall speak later on.

II. PELOPHYTES.

I have dealt with the œcological factors, mud, salt and wind, whose action determines the morphology of the mud-loving plants. Besides those characteristics which may be explained by the physiological dryness of the soil there are one or two others. All pelophytes are glabrous, at any rate all those that are covered frequently by the sea-water; they may thus be protected somewhat from being choked by the mud. The deposition of mud may also tend to simplify the form of the plant. Leaves and complicated flowers disappear; *Salicornia* is the most perfect type of mud-plant. The same deterioration is favoured also by the movement of the water; but it is interesting to note that it is less due to chemical action of salt than to the mechanical influence of mud-deposition and tidal scour. *Aster tripolium* (Sea Aster) illustrates the deteriorating influence of the muddy, tide-swept stations very well. When exposed to the full force of the scour and consequently submersed twice every day for a considerable time, it is low, very succulent, small-leaved without the blue ray-florets of its composite blossom. In the sheltered creek it becomes erect, often two feet high, so that its corymb may be kept as long as possible out of the water,[2] whereas in higher stations it becomes again low and straggling, but has large thin leaves, and bees may be seen swarming round its pretty flowers, in which the blue ligulate florets are numerous.

The pelophytes occur in several zones:

1. Below the low-tide limit grows in company with a number of sea-weeds *Zostera marina* (Grass-wrack). This zone is purely hydrophytic.
2. The open vegetation in muddy creeks and basins daily submersed by the tide and exposed to tidal scour.

2 The flowers with very few or no florets.

3. The ordinary level of the marsh or "saltings."
4. The higher littoral meadow.

In zone (2) *Salicornia* (in very succulent and richly ramified forms) and *Spartina stricta* (Bristle-grass) are the dominant species. Of common occurrence, especially in the more sheltered creeks, is *Aster tripolium* (Sea Aster). *Spartina*, a stiff, erect gregarious grass, advances furthest against the tide, forming low elevations in the soil of the open beach or fortifying the exposed bank of some creek. All the three species mentioned are excellent defenders of the land against the encroachment of the sea, and in many places they are agents in adding to the land.

The sea-water rushes into the littoral marsh by a kind of inverse river-system, formed jointly by the backwash of the tide and the rain water. The vegetation of the level of the marsh varies considerably with its height. If it is low enough to be daily submerged in the tide, as it is the case with the Walton and Brightlingsea marshes, *Poa maritima* (the *Glyceria* or *Sclerochloa* of others) covers the soil with a dense tuft of its decumbent and floating stems. But sometimes the level is higher and only occasionally submerged. Then the vegetation is like that of the grey dune, characterised by its lowness, which dwarfing may be accounted for by drought, aggravated by a high degree of salinity and the exposure to wind: *Salicornia herbacea*, *Suæda maritima*, *Statice limonium* (Sea Lavender), *Aster tripolium*, *Inula crithmoides* (Golden Samphire), *Spergularia media* (Sand Spurry). A very slight rise of the level gives origin to the growth of *Atriplex portulacoïdes* (Sea Purslane), whose silvery grey leafage fringes very prettily shallow stretches of *Salicornia* and *Suæda*. In autumn, when the latter turn deep red or rich purple, a brilliant picturesque effect rewards the botanist who visits the marshes in that season.

The next zone is the least stable and the least defined. Lying at a level perhaps only a few inches above the former, flooding by the tide occurs still more rarely. There are several tracts of land on the Clacton coast which represent this zone. In ditches and muddy hollows occur *Salicornia*, *Aster*, *Triglochin maritimum* (Sea Arrow-grass). But then follow large patches of land occupied by *Scirpus maritimus* and *Juncus compressus*, both gregarious and excluding nearly all other plants, where

they grow. Among *Scirpus*, a very slender form of *Atriplex patula*, as well as a singularly frail form of *Suæda maritima*, may be found, indications that the soil is still saline, though only slightly. I found one circular dip where three zones were very distinctly visible: at the top *Agropyrum repens*, then a belt of *Juncus compressus* and in the centre *Glaux maritima* and *Plantago maritima* (Sea Plantain). On another depression of the soil *Juncus maritimus* could be seen in company with *Œnanthe pimpinelloides*. In the higher and drier parts such plants as thistles (*Carduus arvensis, C. lanceolatus*), *Senecio erucifolius, Trifolium arvense* (Hare's-foot Clover), grasses of the ordinary meadow, an occasional specimen of *Bupleurum tenuissifolium* (Slender Hare's-ear), which latter is said to be halophilous, *Silene maritima* (Sea Campion) and *Armeria vulgaris* (Thrift) may be met with.

Apium graveolens (Sea Celery), *Rumex maritimus* (Golden Dock), *Scirpus maritimus* and others grow in the ditches (behind sea-walls), filled with brackish water, often together with other plants that have no connection with the sea. The water, however, is still distinctly salt by filtration of sea-water through, and storm splashing over the sea walls.

It would require great labour and ingenuity to explain fully all these facts of minute zonation, and, perhaps, doubtful adaptations. Not only present œcological facts would have to be considered, but historical ones, as the development of the coast flora would have to be kept in view.

A few words may be added on the vegetation of elevated places, dams and cliffs, which are entirely out of the reach even of the highest tides, but are supplied with some salt by the spray on stormy days. There is not, as far as I can see, any clear zonation; but an increasing number of non-halophilous plants enter into competition and finally suppress halophytes altogether.

A distinction may be made between the vegetation on fixed soil, consisting of clay or artificially supported gravel and sand, and on the other hand the vegetation on the latter materials unsupported.

On the fixed soil and within reach of storm splashes we notice *Beta maritima, Atriplex portulacoïdes, Lepidium ruderale, Brassica muralis, Cochlearia officinalis* (Scurvy Grass), *Spergularia media* (Sand Spurry); among grasses the commonest are: *Agropyrum*

repens, *Hordeum maritimum* and *Arundo phragmitis*. The salinity is very considerable in some places, judging by the succulence of certain leaves, which attained a thickness of quite two millimetres (*Beta*, *Atriplex portulacoides*). Rarely a *Salicornia* may be found showing the interesting phenomenon of having lost its succulence, except in a few internodes of the stem. Luxuriant colonies of *Atriplex littoralis* accompanied by a particularly leafless form of *Polygonum aviculare* cover some sea-walls near Stone Point.

Other plants growing with preference on the cliff, though their connection with salt is doubtful, are *Solanum dulcamara*, *Rubus fruticosus* (Bramble), *Reseda luteola* (Weld or Yellow-weed), *Smyrnum olusatrum* (Alexanders), *Pastinaca sativa* (parsnip), *Sedum acre* (Wall-pepper), *Helminthia echioides* (Ox-tongue), etc.

On the loose valley-gravel cliff, I have not observed any halophilous plants. The vegetation is mainly composed of species from the land above, weeds of cultivation, meadow grasses. Besides these, plants with good seed-dispersal apparatus and a capacity for holding the soil together, such as *Tussilago farfara* (colts-foot), *Epilobium hirsutum* (codlins-and-cream), *Equisetum telmateia* (in wet places), form what may be described as a land-slide vegetation.

Mr. Shenstone, in his short account of the Essex coast-flora, mentioned the fact that certain littoral species occur on high mountains. Such is the case with *Armeria vulgaris*, *Silene maritima*, *Plantago maritima* and *Pl. coronopus* (which are obviously closely related to *Pl. alpina*) and *Cochlearia officinalis*. Œcologically this is not difficult to understand. The absorption of water is as difficult in the cold soil of high mountains as on the saline soil of the shore. The action of wind is strong in both cases, and rapid alternation of temperature causes in both cases rosette-formation. How they are connected historically, I cannot venture to say ; it seems probable that the coast-plants are relics from the glacial period, more or less modified.

It is remarkable that most true halophytes belong to a few families, notably the Chenopodiaceæ, Cruciferæ, and Graminæ. Many of our edible vegetables are descended from halophytes, *e.g.*, beet-root, celery, cabbage, kale, spinach, horse-radish ; some of the commonest weeds are also halophilous, *e.g.*, Orachs. This fact might find an explanation in the occurrence of a con-

siderable amount of soluble salts in the vicinity of the habitations of man and domestic animals. One might also suggest that early man was induced to eat halophytes because of their succulence. But this is pure conjecture.

The œcological study of plants leads finally to the problem of the origin of species. Many littoral species can be said to have a great plasticity, and to be able to adopt different forms in different situations. The genus *Atriplex*, for instance, seems at present to be actively evolving, witness the great variety of forms and the difficulty of classifying them

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THE ESSEX FIELD CLUB.—REPORTS OF MEETINGS.

SATURDAY, 25TH JANUARY 1913.

This Meeting was held, as usual, in the Physical Lecture Theatre at the Municipal Technical Institute, Stratford, Essex, the President, Mr. W. Whitaker, B.A., F.R.S., F.G.S., etc., in the chair.

New Members.—The following were elected Members:—

Mr. B. W. Bryan, *Woodside, Nelmes Park, Hornchurch.*

Mr. James Guest, 83, *Harold Road, Leytonstone.*

Mr. Walter Fox, "*Hispar*," *Harrow Drive, Romford.*

Mr. Joseph Ross, 18, *Queen's Grove Road, Chingford.*

Mr. Edgar S. Syms, 22 *Woodland Avenue, Wanstead.*

Congress of the S.E. Union of Scientific Societies.—Mr. D. J. Scourfield, F.R.M.S., the Club's Delegate, gave a verbal account of the proceedings at the Congress held at Folkestone in June 1912. The full report of the Congress will be found in *The South Eastern Naturalist* for 1912, which is the organ of the Union.

An Additional part of Ogborne's History of Essex.—Mr. John Avery said:—"In 1813 a prospectus was issued appealing for subscribers for the purpose of publishing the History of Essex by Mrs. Elizabeth Ogborne, the work being illustrated by numerous engravings from original drawings taken upon the spot by Mr. J. Ogborne. It was estimated that the work would be completed in twenty parts, forming four handsome quarto volumes. It was intended that the first part, comprising the Half Hundred of Beacontree, would be ready for publication in January 1814. Considerable delay appears to have taken place, and in a circular announcing the publication of Parts 2 and 3 it was stated that the fourth part was in a state of forwardness, and would appear in the course of the Spring 1818. But it was supposed that this fourth part never appeared. In 1900 I directed attention in the county press to a thin book in the West Ham Public Library, without any title page, which for the purpose of identification had been lettered "The History of Lambourne." It was printed by Maurice, the printer of Ogborne's Essex. In size of page,

size and style of type, it exactly corresponds, even to the extent of having the heading "Hundred of Ongar" continued on the top of each page. At the time I considered the copy to be unique, and probably the printer's proof pull of the contemplated fourth part. In November last I observed in the catalogue of a book-seller in the South West of England a book entitled "Lambourne Parish, Essex, illustrated by J. P. Neale." In response to a telegram I was able to secure the copy, and upon examination found it to be a duplicate of the so-called "History of Lambourne" in the West Ham Library, with two extra illustrations inserted.

"An examination of the contents proved that the publication is a continuation of Ogborne's "History of Essex" and forms part of the contemplated fourth number.

"I have made considerable enquiry and research as regards the Lambourne section, but failed to find that any other copy is in existence."

Mr. Avery exhibited the fourth part, together with three copies of the original book, possessing some special features, from his own collection.

Recent Museum Accessions.—Mr. Cole exhibited some recent donations to the Museum, amongst them being:—

A collection of 100 specimens of British Birds' Eggs, including some rare specimens—*Mr. J. E. Harting, F.L.S.*—A small Herbarium of about 80 species and varieties of British Mosses. —*Mr. W. R. Sherrin.*

Epping Forest Ferns.—Mr. W. Richter Roberts exhibited a collection of Epping Forest Ferns, and made some remarks on the same which are embodied in a short paper printed in the present part.

Daphia Magna.—Mr. D. J. Scourfield, F.R.M.S., exhibited living males of this Cladoceran from Epping Forest, and made some remarks on the same. (See "Notes.")

Deiopeia pulchella.—Mr. Cole exhibited the specimen of the "Crimson-speckled Footman," from Mr. E. A. Fitch's collection recently acquired for the Museum. This specimen was taken on the slope of the Martello Tower at St. Osyth on 6th June 1892. (See ESSEX NATURALIST, Vol. vi., p. 115.)

Mosses of Epping Forest.—Mrs. Percy Thompson presented to the Museum a collection of 86 specimens of the mosses of the Forest, preserved in "clumps" so as to show their natural form of growth. Mr. Percy Thompson explained the method adopted.

"Pigmy" Flints from Epping Forest.—Mr. Hazzledine Warren exhibited and described a collection of these and other "worked" flints, and made some remarks on the subject. (See "Notes.")

Worked Flints from the Valley of the Stour.—Mr. Wrigley exhibited and described some flints from a site on the Stour River. (See "Notes.")

Mr. W. H. Dalton, F.G.S., F.C.S., exhibited Crystals of Gypsum formed in loose sand on Lake Karatchungul, Uralsk Province, N.E. corner of the Caspian Sea. The lake occurs in Permian gypsum, surrounded by Cretaceous sandstones, which are disintegrated and shifted by wind. In spring-floods, the lake-level rises, filling the sand with saturated solution

of gypsum. As it falls again by evaporation, the sand is partially cemented by gypsum crystals, presently laid bare by the drifting-away of the loose sand.

Paper Read.—Mr. Guy Maynard communicated "Notes on a Human Skull found at Wenden, Essex, during railway excavations in 1864," which is printed in the present part.

MEETING FOR THE INSPECTION OF THE ROMAN WALL OF LONDON.

SATURDAY, 1ST FEBRUARY 1913.

By the kind invitation of our member, Mr. Bryan Corcoran, C.C., the members were enabled to take a tour of the parish of St. Olave, Hart Street, E.C., when several sections of the Roman and Mediæval City Walls were visited, and other interesting features of the parish inspected. The party assembled at half-past two o'clock at the church, one of the most ancient in the City. Mr. Corcoran took the utmost pains and care in demonstrating the fragmentary remains of the old Roman Mediæval Walls, having arranged for entry into the cellers of several warehouses and offices, where these could be seen. Owing to the multitude of places visited, and explanations given, the Editor has found it impossible without plans and photographs to give a consistent report. Fortunately this omission can be easily remedied by the perusal of Mr. Corcoran's excellent "Guide,"[1] which the reader will find a most interesting and instructive little book. On pages 53–56 is an account of the portions of the City Wall still remaining. Nearly all these remains were seen. It has been repeatedly stated that the Roman Wall was first erected after the middle of the fourth century. Besant says A.D. 360. Mr. Corcoran writes:—"Both these statements are now proved to be fallacious. Thanks to the latest researches of Mr. Philip Norman and Mr. Francis Reader, there is very strong grounds for believing that the Wall was built at least by the middle of the second century, when already the trade of St. Olave's and the surrounding parts of the city and the number and wealth of its inhabitants demanded and were worthy of amplest protection."

On completion of the perambulation, the party returned to the Church, where Mr. Corcoran gave an account of the very interesting building, and its monuments and associations. It dates to a great extent from the middle of the 15th Century. It is one of the eight surviving churches of about 20 that escaped the Great Fire of 1666. The most notable monuments are those to Samuel Pepys, the author of the celebrated "Diary," and his wife. The building and the monuments are fully described in Mr. Corcoran's brochure mentioned above. At the close of this enjoyable visit to one of the most interesting parts of London, a very cordial vote of thanks was passed to Mr. Corcoran for his most welcome kindness and the care he had taken in arranging the details of the meeting.

1 "*Guide to St. Olave's, Hart Street, in the City of London.* By Bryan Corcoran, Upper Churchwarden." Published by the Author at 31, Mark Lane, E.C. With very numerous illustrations and plan of Old London. Price 1s. 1d. by post.

THE 418th MEETING.

22ND FEBRUARY 1913.

This meeting was held at the Technical Institute, Stratford, the President in the chair.

New Members.—The following were elected:—

Mr. Cuthbert Bishop, c.o. *Mr. Thorogood, Coronation Avenue, Notley Road, Braintree.*

Mr. C. Chittock, Hon. Sec. of the Felsted School Scientific Society, *The Old School House, Felsted (on behalf of the Society).*

Mr. John W. Tayleur, B.Sc., *The Woodlands, Writtle, near Chelmsford.*

Vote of Condolence to Mrs. Oates.—On the motion of Mr. Avery, seconded by Dr. Graham, a vote of condolence with our member, Mrs. Caroline Oates, of Over Hall, Castle Hedingham, on the death of her son, Captain Oates, during the Scott Expedition to the South Pole, was passed, and the Secretary was requested to convey the same to Mrs. Oates. (See page 237).

Paper Read.—A paper by Mr. A. Bell, "On a new species of Fossil Ziphioid Whale from Walton-on-Naze" was read. The paper is printed in the ESSEX NATURALIST, Vol. xvii., p. 105.

Lecture.—A lecture was given by Mr. Edward Lovett (member of the Folk-lore Society), on "The Legendary Folk-lore of Amulets, Charms, and Mascots." The lecture was illustrated by a large number of lantern-slides, and by the exhibition of examples from Mr. Lovett's own collection. The subjects treated of were as follows:—Surviving Superstitions in Britain—Amulets 3000 years old—Hag-Stones and Devil-Stones—Thunder-bolts and Elf-Darts—The Evil-Eye—The "lucky" Horse-shoe, and why—The Mystery of Amber—Curious Cures for Cramp—Amulets still used in London. Considerable discussion was carried on by Mr. Shenstone, F.L.S., Dr. Graham, B.Sc., Miss Willmott, F.L.S., Mr. Dalton, F.G.S., Mr. Wrigley, Mr. W. Cole, the President and others, and Mr. Lovett was cordially thanked for a most interesting lecture.

At the end of the meeting, an exhibition of some special microscopic objects was made by Mr. Wilson, F.R.M.S., and Mr. D. J. Scourfield, F.R.M.S., in the Photographic Laboratory of the Institute.

THE 419th MEETING.

SATURDAY, 5TH April 1913.

This meeting was held at the Technical Institute, Stratford, at 6 p.m., the President, Mr. W. Whitaker, F.R.S., in the chair.

Exhibitions.—A living specimen of *Saxifraga oppositifolia* was exhibited by Mr. Percy Thompson on behalf of Mr. W. H. Dalton, who had gathered this rare Alpine plant high up on Cader Idris a few days before. Remarks on this interesting species were made by Miss Willmott and Mr. C. Nicholson.

Mr. Charles Sworder exhibited and presented to the Club some old microscopic slides of Aphides, which he had obtained at the dispersal

of the late Mr. Henry Doubleday's collections at Epping. On examination the slides appeared to have been made and labelled by the late Francis Walker, of the British Museum, as the localities given are mainly "Southgate," where Mr. Walker resided, and apparently in his handwriting. Mr. W. Cole made a few remarks on the subject and Mr. Sworder was thanked for the presentation.

Nomination of Council and Officers.—In anticipation of the Annual Meeting, nominations were made of new members of Council and the officers. [See Report of Annual Meeting on 3rd May.]

Lecture.—A lecture was then given by Mr. Fred. Enock, F.L.S., on "Fairy Flies and their Hosts."

During the past thirty-five years, Mr. Enock has been engaged in studying closely the life histories of these "Fairy Flies"—a family of microscopic insects, some of them so small that five of them could walk abreast through an ordinary pin hole. The result of Mr. Enock's life work has been his discovery of at least one hundred and fifty species new to Great Britain, which will be described in the monograph on the British Mymaridæ upon which he is now engaged. On the proposal of the President, a very cordial vote of thanks was accorded to Mr. Enock for his extremely interesting and original lecture.

VISIT TO THE BRITISH MUSEUM OF NATURAL HISTORY.

SATURDAY, 12TH APRIL 1913.

The members were received by Dr. Arthur Smith Woodward, F.R.S. (Keeper of the Geological Department). In the galleries, Dr. Woodward gave a most instructive demonstration of some of the Fossil Reptiles and Fishes, and afterwards, in his private room, exhibited and described the Palæolithic Human Skull and Mandible from a Flint-bearing Gravel overlying the Wealden (Hastings Beds) at Piltdown, Fletching, Sussex. This skull had been described by Dr. Smith Woodward under the name *Eoanthropus dawsoni* in honour of Mr. Charles Dawson, who, with Dr. Woodward, was the discoverer of the skull. The relic was regarded by Sir E. Ray Lankester and Dr. Keith as by far the most important human remains ever discovered in England. Dr. Woodward very fully described the skull by means of models and casts, and pointed out its extreme interests from an ethnological point of view.

The reader is referred to the very detailed and finely illustrated paper on the subject by Mr. Dawson and Dr. Woodward in the *Quarterly Journal of the Geological Society*, Vol. lxix., pp. 117–151 (March 1913).

A most hearty vote of thanks was passed to Dr. Woodward for his kindness, and for his most interesting and instructive demonstration.

VISIT TO GREAT WARLEY, BRENTWOOD (421st MEETING).

SATURDAY, 26TH APRIL 1913.

The object of this excursion was to visit again, by the kind invitation of our member, Miss E. Willmott, F.L.S., her beautiful gardens at Warley

Place, and so affording an opportunity of inspection under a different floral aspect from that seen on the occasions of our two former visits.

The members assembled at Brentwood Station a little before one o'clock, brakes being in attendance for the drive to Warley Place.

A very full account of the Gardens was given in the ESSEX NATURALIST by Mr. Shenstone (Vol. xvii., pp. 40–60), to which the reader is referred. Miss Willmott was again most kind and indefatigable in demonstrating the beauties of her truly wonderful gardens—the countless species and individuals of "Bulb-plants" were an unfailing delight to all fortunate enough to be present at the meeting. Tea was taken in the mansion, and Miss Willmott exhibited the parts already published of her beautifully, illustrated book on the *Genus Rosa*.

A vote of thanks was passed to our kind hostess amid every expression of pleasure and gratitude for the pleasure conferred for the third time in these "personally conducted" rambles over her famous garden. Miss Willmott replied.

Afterwards the members walked back to Brentwood station for the home trains.

ANNUAL MEETING AND 422nd ORDINARY MEETING.

SATURDAY, 3RD MAY 1913.

These meetings took place in the Physical Lecture Theatre of the Municipal Technical Institute, Stratford, at 6 p.m.

The ANNUAL MEETING was first held, the President, Mr. William Whitaker, F.R.S., in the chair.

The minutes of the last Annual Meeting, held on 1st June 1912, were read and confirmed.

In Mr. Howard's absence, the TREASURER'S STATEMENT was read by Mr. Avery, and approved.

The Secretary produced the account of the TEA FUND, which was accepted.

The Secretary read the REPORT OF THE COUNCIL, which was submitted to the meeting and approved.

This report and the Financial Statement will be found in the Supplement to the Year-Book.

Election of Members of Council and Officers.—The President intimated that at the meeting on 5th April the following Members retired from the Council in rotation:—Messrs. A. E. Briscoe, W. Ping, F. H. Varley, and Rev. A. C. Morris. They offered themselves for re-election, and were duly nominated.

As Officers, the following were nominated:—*President*, Mr. William Whitaker, B.A., F.R.S., F.G.S.; *Treasurer*, Mr. David Howard, J.P., F.C.S., F.I.C.; *Hon. Secretaries*, Messrs. W. Cole, B. G. Cole, and Percy Thompson; *Librarian*, Mr. Thomas W. Reader, F.G.S.; *Auditors*, Mr. F. Reichert and Mr. A. Wrigley.

As no other nominations had been made, the President declared the above named members duly elected as Council and Officers.

The President then, in lieu of an address, made some remarks on the

work of the Club. He particularly alluded to the position of the Forest Museum, and to the Photographic and Pictorial Survey of Essex. He was of opinion that the dead-lock at the Forest Museum should be removed at the earliest possible moment. He read a letter from the Treasurer, in which Mr. Howard said :—

"I would strongly urge that an appeal should be made for funds to clear off the adverse balance of the Forest Museum account, and to provide for its maintenance in its present state even—if we cannot place it on a more worthy level. Much as I should like to see it extended, it is so valuable as it is, that it is well worthy of support."

With respect to the Photographic and Pictorial Survey of Essex, the President said that the Council had that evening received a report from the Council of the Survey, in which it was recommended that that body be formally discharged, and that this recommendation had been unanimously agreed to by the Council.

But though the mode of procedure had thus been changed, the Survey and the collection of photographs and pictures was in nowise abandoned. The collection would form part of the Library, and would be under the care of the Curator precisely as were the books, etc., in the Library. Mr. Victor Taylor would act as Hon. Secretary, to aid in the collecting and arrangement of the pictures. The President said that, under the circumstances, he believed this would be the best plan to adopt, and he hoped that the members and all friends of the Club and Museum would work heartily to make the collection one worthy of the Club.

The President also expressed his satisfaction at the agreement which had been entered into between the Corporation of West Ham and the Essex Field Club, with respect to the Library. He fully anticipated that the plan would work well, both in the interests of the members and the progress of Education in the Borough.

On the motion of Dr. Graham, seconded by Mr. W. H. Dalton, the best thanks of the Club was accorded to the Council and Officers of the Club, and the Auditors for their services during the year.

This concluded the business of the Annual Meeting.

The 442nd Ordinary Meeting.

This immediately followed the Annual Meeting.

New Member.—Mrs. Joseph Wilson, *Hillside, Avon Road, Walthamstow,* was elected.

The late Mr. Fitch's and Mr. Threnall's Collections.—The Curator exhibited some cabinet drawers from both these collections which had recently been purchased for the Museum.—Mr. Fitch's collections consisted of a set of British Lepidoptera, including some interesting specimens, and also his collection of Ichneumonidæ. Mr. Fitch was for years the best-known collector and student of these insects, and the collection was therefore of scientific value. The cabinets also included a series of Gall-insects (Cynipidæ), mostly bred by Mr. Fitch, and serving to illustrate his paper in the Transactions of the Essex Field Club (Vol. ii., pp. 98–156).

Mr. Cole said that Mr. Threnall's collection of Pyralidæ, Crambi and Tortrices was the finest in the beauty and neatness of the specimens he

had ever seen. It comprised nearly all the British Pyrales and Crambi, and all the Tortrices with the exception of a dozen or eighteen species practically unprocurable. Each moth was set on a silver pin, and then mounted on little slabs of artichoke pith. These slabs were stuck again with a stouter pin so as to avoid damage on removal of the specimens. Every insect was accurately named, with full data. Mr. Cole added that the above collections were a valuable and instructive addition to the museum.

Dalyellia diadema Hoftsten.—Mr. Henry Whitehead, B.Sc., exhibited Essex specimens of this Turbellarian. The species appears to have been recorded only once before, viz., in the Bernese Alps. Mr. Whitehead gave some particulars of this interesting form. (See "Notes.")

A Lecture was given by Mr. Hazzledine Warren, F.G.S., on "Prehistoric Art." The lecture was abundantly illustrated by lantern slides.

A cordial vote of thanks was given to Mr. Warren for his exceedingly interesting lecture.

Dr. Alexander Graham gave a demonstration by means of actual specimens and drawings on the blackboard of points in the structure of the human skull, as compared with the skull of *Eoanthropus dawsoni* shown to the members by Dr. Smith Woodward, at the Meeting at the British Museum on 12th April last. The demonstration was of too detailed a nature to be reported upon without the aid of drawings.

The President pointed out the very interesting nature of Dr. Woodward's and Dr. Graham's discussions, and a vote of thanks was passed to Dr. Graham.

It was announced that our Member, Mr. Fred Enock, F.L.S., had presented to the Library over 300 pamphlets and reports relating to economic entomology.

VISIT TO CHESTERFORD, ICKLETON AND THE CAMBRIDGE BOUNDARY OF THE COUNTY (THE CHALK DOWNS OF ESSEX).

SATURDAY, 31ST MAY 1913.

This excursion was organised to enable the members to visit the chalk Lynchetts at Ickleton, the burial mounds of Bartlow and other interesting points on the Northern boundary of Essex.

The conductors were Mr. W. Whitaker, F.R.S., Mr. G. Morris, B.Sc., Mr. Guy Maynard, and others.

The assembly was at Audley End station at 9.45 a.m. Here a group photograph was taken, and entering brakes the party drove up the Cam Valley. Opposite Audley End House a halt was made, and, without alighting, Mr. Guy Maynard pointed out the ancient Guest House, British Camp, etc., and explained the original forward extension of the Mansion towards the water edge.

At Littlebury a stop was made to inspect the base of a church-yard or village cross now inserted in front of Gate House Farm. This showed a curious design of a flowering heart, the Tudor Rose, and two kneeling

figures. It was concluded that this base was probably of 15th century workmanship.

Proceeding up the valley for a mile, a halt was again made at the Bordeaux Gravel-pit. Here some time was spent and a short address given by our President, Mr. William Whitaker. The piping of the gravel by the infiltration of carbonated water with the removal of chalk and the deposition of ferruginous clay was noted. Boulders of quartzite, canon-shot gravel and other glacial *debris* were also examined.

Between Chesterford (the Roman station of Iceanum) and Ickleton, Mr. George Morris pointed out the zonation of the valley-flora. The succession was sedge, rush and meadow, which from narrow bands round the spring head expand into rough rush, meadow and fen (as one proceeds northward). At this point the expansion of the *Juncus* community was very evident, but time did not allow for a detailed examination.

Driving through Ickleton, just over the county boundary into Cambridgeshire, a dry valley was reached, along the sides of which extend a series of artificial terraces known as "Lynchetts." These are flat-topped grassy terraces cut one above the other into the slope of the hill and extending nearly half-a-mile (formerly quite ¾ mile) along the contour. Their purpose and age appear to be quite unknown, but they are probably of pre-historic date. A tumulus occurs on the opposite hill, half a mile distant. On the surface of the field above these terraces a large number of Neolithic flakes occur, characterised by a dense white patina which occasionally shows striation or scratching. Mr. Maynard had submitted a series to Dr. Sturge in view of the present meeting. After a number had been collected on the field, the party assembled on the sloping bank and Mr. Maynard gave a short address dealing with these implements.

Many of the specimens show resemblance of patina and surface to the well-known "Grimes Graves" and "Cissbury" type, around the dating of which discussion is still centred, but Dr. Sturge considers that they also strongly resemble a series of flakes which he obtained from a "floor" deposit in Suffolk, where they were associated with "dos rebattu" knives and long thick scrapers of undoubted "Cave" age.

One iron-moulded core found at Coploe Hill was definitely accepted by Dr. Sturge as dating from the "Cave" period, but he thought that the majority of the specimens sent to him were of the earlyNeolithic period, mainly coming into the heavily striated series called by him the "Old Whites." The blue-and-white mottled patina also occurs, and cases of re-chipping are found. No definite implements such as the "Cissbury" axe have yet been secured, but several cores with a striking platform at both ends and numerous flakes ranging from two to four inches in length and one to three wide, trimmed or truncated so as to form a sharp and almost leaf-shaped point, seem to be the dominant form in the collection. Certain specimens leave no doubt that this form was intentionally produced and had a definite use. There are also small blocks of flint covered with steep-sided chipping strongly suggestive of a rough form of "Tarte plane," a well known tool found in the Aurignacian period cave deposits. Other series recalling "bec de perroquet" forms of the cave period occur and a multitude of roughly chipped waste flakes.

A few pot-boilers and a piece of pottery, probably Romano-British age, were picked up.

Mr. Hazzledine Warren opened a brief discussion by remarking that although he admitted that Dr. Sturge had undoubtedly found implements of the "Cave" period in Suffolk surface deposits, yet in this case he failed to see any direct evidence for dating the Coploe flakes, etc., earlier than the Neolithic Period, while he thought it possible that many of them might be even later.

The origin and use of the Lynchetts were also discussed, and Mr. Miller Christy gave a short account of the meaning of the word. He remarked that a "linchet," "lynchett," or "lynch" (none of them words now in common use in Essex), is usually a strip of grass left as a dividing line between two pieces of ploughed land, or beside a road, or in some similar position. Used in the plural, the words generally denote the parallel banks or terraces made on the sides of hills—usually chalk hills, to allow of ploughing. Golf-links (the banks from or over which the game of golf is played) are so called in the same connection.

Mr. George Morris spoke of the chalk flora of the lynchets.[1] He pointed out that here was a small remnant of the primitive chalk flora which probably covered the sides of the valleys forming an open down-land belt or zone between the marsh of the valley bottom and dense Boulder-clay woodland. He also compared this flora with that of the Fleam and Devil's Dyke which had been recently studied by the Marshall-Ward Society of Cambridge, showing their essential similarity. The speaker also pointed out that this remnant-flora was in danger of extinction by the invasion of weeds of cultivation, such as the successive waves of *Bromus sterilis, Tussilago farfara, Sinapis arvensis,* having colonized the lower slopes—flats of the terraces—and were now threatening the remainder. Mr. Shenstone made some remarks criticising the speakers' conclusions in relation to a primitive vegetation within historic times.

Although the date was somewhat early for flowers, the following plants were recognised.—*Helianthemum chamaecistus, Viola hirta, Polygala vulgaris, Silene latifolia, Linum catharticum, Ononis spinosa, Anthyllis vulneraria, Lotus corniculatus, Hippocrepis comosa, Spiræa filipendula, Rosa eglanteria, Daucus carota, Asperula cynanchica, Blackstonia perfoliata, Cnicus arvensis, Centaurea scabiosa,* with *Orobanche elatior* parasitic on its roots. *Thymus serpyllum, Plantago media,* &c., &c.

Leaving the Lynchets, the party then drove back to Ickleton Church, which they inspected under the guidance of the Vicar. The Roman columns (supposed to have been taken from an earlier Roman building), with Saxon cushion capitals, Norman fresco work on the window recesses and the fine medieval oak pews were examined and commented upon.

Hence the brakes were driven to Chesterford Common, where, by the courtesy of Sir James Mackay, the party were enabled to inspect an interesting Boulder-Clay waste of some forty years standing. The characteristic open flora and hawthorn scrub was seen on the side of a dry valley, and among other characteristic plants the "Adder's-tongue Fern" *Ophioglossum vulgatum* was obtained. Further on a peculiar scrub of blackthorn was seen, among which ash and oak trees had taken hold,

1 Gibson in his *Flora* often refers to these banks near Ickleton, which in his time extended into Essex, but which since have been in part obliterated by the plough.

showing a tendency to return to the "Ash-Oak-Wood" characteristic of the clay. Here *Alchemilla vulgaris, Listera ovata,* and other flowers were obtained.

On leaving the waste, a large heap of stone gathered from the land surface was noticed, and numerous erratics of Neocomian sandstone, Jurassic limestones with included fossils,and other specimens were obtained. Mr. Hazzledine Warren gave an interesting demonstration on the manufacture of flint implements, and with the greatest ease produced "fakes" of characteristic types.

Thence the club drove to Hadstock. Here a halt was made at the church. This church (St. Botolph) showed interesting pre-Conquest architectural detail in the door arch and nave. The door once bore a human skin said to be that of a sacrilegious Dane. The fine Jacobean reading desk and medieval rood screen with its carvings of the fox preaching to the geese were also noted. The big sycamore growing before the church was admired, and its growth estimated.

A two mile drive over the intervening hill brought the party to Bartlow, where a substantial meat tea was provided at the "Three Hills Hotel."

In the Hadstock district a search was made for Lichens and Mosses. Time did not permit of an extended search for Cryptogams, but Mr. Percy Thompson has furnished the Editor with the following lists of species observed :—

LICHENS.

Ramalina calicaris.
Evernia prunastri.
Parmelia perlata.
P. borreri.
P. fuliginosa.
Physcia parietina, var *cinerascens.*
P. stellaris, sub sp. *tenella.*
P. lychnea.
Lecanora subfusca.
Squamaria saxicola.
Buellia canescens.
B. myriocarpa.

MOSSES.

Hypnum molluscum.
H. riparium.
Brachythecium purum.
B. rutabulum.
Eurhynchium confertum.
Neckera complanata.
Porotrichum alopecurum.
Orthotrichum sp.
Funaria hygrometrica.
Tortula subulata.
Amblystegium filicinum.
A. serpens.
Plagiothecium denticulatum.
Tortula muralis.
Camptothecium sericeum

A short formal MEETING (the 423rd) was held, the President being in the chair.

Miss Mary Champness, of 47, *Bulwer Road, Leytonstone,* was elected a member.

After tea at the invitation of Mrs. Brocklebank, the gardens of the Hall were visited. Here the full effect of the disastrous hail storm of 27th May was seen, the greenhouses, frames, etc., having suffered severely, and over 1,000 panes of glass destroyed.

The party then proceeded towards the hills, where Mr. Guy Maynard gave a short address on the excavation and antiquities of them. He said :—

"The Bartlow Hills are not only the finest group of tumuli in Essex,

but probably surpass in size and height all others in the Eastern counties. The largest hill measures 42 feet in vertical height and is believed to be the largest sepulchral mound in England. Besides the four large barrows there were originally at least three small ones which owing to recent alterations of the surroundings have been practically obliterated. The whole group was excavated by Lord Maynard, the owner, and rich deposits of Roman character discovered. The burials were by cremation and large glass vessels were employed in several cases as ossuary urns, each grave being also furnished with vessels of pottery, glass and bronze. The age of the deposits can safely be placed in the first half of the second century A.D., owing to (1) the presence of a bronze coin of Hadrian found in one of the bottles, (2) the cylindrical shape of the glass vessels, which are usually associated in Germany with burials of the Hadrianic period, (3) the shape of the sacrificial vessel of enamelled bronze, probably the finest article of its class ever found in Britain, which was discovered in the largest hill. This grave was richly furnished and contained a bronze and iron folding seat very similar to the modern camp stool; it was evidently the tomb of a very wealthy and important personage, probably a Romanised native chieftain. A Roman building was discovered close to the "hills" and excavated by Lord Braybrooke, but the finds were few and late in character, so that probably it had no association with the barrows."

The hills were then climbed and a considerable number of chalk-loving flowers were found growing upon them. A single plant of *Anemone pulsatilla* was found. The hills have been a noted locality for this flower, and it was feared that it had become extinct. In the neighbouring field *Salvia pratense* was obtained, and *Ranunculus parviflorus* was found on the road-side beyond.

After leaving Bartlow a halt was made at a wayside chalk pit to examine the point of contact of the Chalk with the overlying Boulder-clay. It was found that two or three feet of the clay above the chalk had become decalcified, and at the point of contact a bed two to three inches thick of redeposited carbonate of lime had been found. Mr. Whitaker gave a short talk on the formation of the bed, after which the party drove on to Walden, where they arrived at 8.30 p.m., after a most enjoyable excursion.

VISIT OF THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES TO THE EPPING FOREST DISTRICT.

SATURDAY, 7TH JUNE 1913.

The Union on the occasion of their Hampstead Congress made an excursion to Epping Forest, in conjunction with the Essex Field Club. The objects of the meeting were an inspection of the Museum at Queen Elizabeth's Lodge, Chingford, and making acquaintance with some of the beauties of the Forest, then in its spring verdure.

The Union Members came in a motor omnibus to the Museum, where they were received by the President and the Secretaries, together with members of the Club.

Mr. W. Cole, as Curator, gave some account of the structure and history of the building, and of the efforts of the Essex Field Club to establish a museum there. He explained the plan of the Museum, which at present was but very partially carried out, owing to want of funds, and more particularly of an annual income to obtain the help of an assistant to the Curator. On every hand the visitors expressed their warm approval of the objects and design of the Museum, and their desire that the plans could be fully carried out.

The party subsequently made a tour of the Forest, and after tea at High Beach proceeded to Abridge and Chigwell, where they visited the Grammar School and the Church and the "King's Head" Inn, famous for its memories of Charles Dickens and "Barnaby Rudge."

The Union members returned to Hampstead by road; the others went homewards from Loughton Station.

VISIT TO LEEZ PRIORY AND CHIGNAL AT JAMES (425th MEETING) AND TO MR. CHRISTY'S MUSEUM OF ANCIENT DOMESTIC APPLIANCES.

SATURDAY, 21ST JUNE 1913.

The assembly was called at Chelmsford railway station, about half-past ten, and brakes being in attendance, the party was conveyed by Broomfield, Little Waltham and Little Leez, to Leez Priory, a distance of about eight miles, through extremely pretty country. Several small pits in Glacial Gravel and Sand were seen: the shallow pit near Chatham Green (at about 193 feet O.D.) shows very coarse gravel and ferruginous sand, with Bunter sandstone and quartzite pebbles.

A halt was called at Little Leighs Church, small but very interesting; it was probably, in Mr. Chancellor's opinion, one of the earliest churches erected by the Normans after the Conquest. The most interesting monument is a beautifully designed canopy over a niche in the north wall of the chancel, in which lies the effigy of a priest, in Eucharistic vestments, cut out of a single block of oak. The architecture and vestments point to a period about the middle of the 14th Century. The figure is probably that of a much-loved rector of the parish, who added the chancel to the old Norman nave, and whom his parishioners wished to honour by this somewhat unusual form. There are other examples of a similar kind at Clifford, in Herefordshire, etc. A minute description of the monument is in the *Transactions of the Essex Archæological Society*, Vol. ii., by the Rev. F. Spurrell, M.A. Another very interesting object in the church is the font, which is Early English.

The company were then driven to Leez Priory, the home of our member Mr. M. E. Hughes-Hughes. The Priory is an extremely interesting and beautiful Tudor mansion, on the right bank of the little river Ter, nestling in a green hollow.

The existing buildings consist chiefly of the two Gatehouse Towers and domestic buildings, forming a portion of the greater courtyard of the immense Tudor mansion, built by Baron Rich in the early 16th century, and the present owner has spent much loving care and money in restoring

(in the true sense) this charming old Essex building, which, before his advent, had long been in a crumbling state of decay. Mr. Hughes-Hughes has also unmasked the foundations of the early 13th century monastic buildings and church, which were destroyed at the Reformation by Lord Rich, to provide a site for his baronial hall, and to-day the foundations both of the destroyed church and of the ruined mansion of the destroyer lie open to the sky in the grounds of the present owner. The site of an extensive series of fish ponds belonging to the original Priory (now drained) can also be seen in the valley of the little river Ter above the house.

The house contains a large collection of ethnographical, antiquarian and other objects, including many interesting relics discovered during the recent excavation of the site of the monastic buildings, and Mr. Hughes-Hughes possesses a fine collection of birds' eggs.

The company was most kindly received by Mr. Hughes-Hughes, and conducted to the many places of interest in his charming domain. Luncheon was served on tables in the open courtyard or lawn.

Afterwards Mr. Wickham Chancellor gave an account of the buildings and the works undertaken under his supervision, as architect, for the restoration, and also demonstrated the foundations of the old structures which had been traced out during the excavations. It is impossible to describe here the fine gatehouse and the most judicious restorations undertaken by the present owner. Everyone present was delighted with the work and taste displayed in preserving the remains of this beautiful historic mansion. The reader is referred to the excellent paper on the history and structure of the Priory by Miss C. Fell Smith, published with some very beautiful pictures in *Country Life* for 4th April 1914. Everyone interested in Essex should procure this paper.

Most cordial votes of thanks were offered to Mr. Hughes-Hughes for his delightful kindness and hospitality, and to Mr. Wickham Chancellor for his very interesting demonstrations.

The journey was then resumed via Hartford End, How Street, and Great Waltham, to Fanners Green, near which a large pit, some 30 or 40 feet deep, was inspected (Dannatt's Pit), at about 200 feet O.D. A large colony of sand martins (one of the largest in the county) have excavated their nests in the sandy seams of this pit.

Mr. W. H. Dalton, F.G.S., F.C.S., who was with the party, very kindly furnished the Editor with the following notes of points of geological interest noticed during the day:—

The region traversed consists of the following geological subdivisions:
Modern Alluvium.
Chalky Boulder-clay (Upper Glacial).
Coarse gravel, sand and loam (Middle Glacial)
Westleton Shingle (Pre-Glacial).
London Clay.

The London Clay extends downwards from its irregularly worn surface to about 170 feet below Ordnance Datum in Chelmsford, rising so gently northwards that at Felsted it is still some 12 feet below datum, a rise of not quite 22 inches per mile. The dip of the chalk surface, from which the London Clay is separated by the Reading and Thanet Beds, is considerably greater, as the Thanets, 30 feet thick at Chelmsford, are want-

ing at Felsted, and the Reading Beds there are but 44 feet thick, as against 83 at Chelmsford, so that 69 feet must be added to the descent of the London Clay to find that of the Chalk, which works out at 31 inches per mile.

The route from Chelmsford lay over Mid-Glacial Gravels (with two dips into the London Clay) until the left slope of the Chelmer valley was ascended beyond Little Waltham. Then followed two miles of Boulder-clay, to the right slope of the Ter valley, in Little Leighs parish. Here some shallow pits in the gravel were examined, the coarseness of the material and the irregularity of its deposition being pointed out. Many of the larger flints are but little worn, whilst the few well-rounded pebbles of quartzite, igneous and other rocks of the Midland Palæozoic inliers are in all probability derived from the Westleton Beds, largely removed by the Glacial denudation.

About a mile to the south-west of Great Waltham, a large and interesting pit showed nearly 40 feet of Westleton shingle, mostly fine (but with little sand) and strongly current-bedded. Amongst the larger stones were many of quartzite, slate, sandstone and igneous rocks. The uppermost ten or twelve feet were as finely stratified as the rest, but were greatly disturbed, and at one point turned over into wave-form. The cause was evident in the presence, close by, of the Boulder-clay, a mass of which shot from a melting or overturned ice-floe had reached the sea-floor with sufficient impact to effect the disturbance of the previously regular bedding.

At the rear of Mr. Christy's house, the Mid-glacial gravel rises to the surface, and has been partly used as concrete in the construction, the actual site of the house, though at a slightly lower level, being on Boulder-clay, which at Priors (eastward, beyond the gravel pit) extends to 40 feet below the surface. Here again the simultaneous irregular structure of the gravel was noticed, and the rarity of other stones than flint.

The route then lead to Chignal St. James, where, at Broom Wood Lodge, the party was most kindly received by our Vice-President, Mr. Miller Christy, F.L.S. Tea was served under the shade of the trees.

A short formal meeting was held (the 425th), the President in the chair. Mr. Charles R. Haig, of *Felix House, Chelmsford*, was elected a member.

The house, though far from finished, excited great interest among the members present, as it is an attempt to reproduce, in the purest possible form, the Elizabethan style of about the year 1550, as seen commonly in Essex; and most parts of the house were reproductions of parts of various houses of that period still existing in the vicinity, the parts reproduced having been congruously combined.

Mr. Christy said that his instructions to his architect (Mr. Fred Rowntree) had been that he was not to employ enough deal to make a match, not enough paint to cover a sixpence, and not enough wall paper to make a postage stamp. These instructions had been carried out practically, if not actually; and he was glad to think that the effort of himself and his architect to achieve their object seemed to have met with the general approval of competent judges.

The house is entirely of brick, oak, and elm—the last a wood used extensively at the period, for flooring and other purposes, though seldom

employed now. The bricks were specially made by Messrs. Brown and Son, of Brentwood, to resemble old Tudor bricks, in size, colour, and texture. The brick chimney-shafts had been reproduced from " Pryors," an Elizabethan house a few hundred yards distant, in which Mr. Christy lived formerly. The front of the house was of timber and brick-nogging-work—that is to say, brickwork between upright timber " studs," the bricks being set in ornamental patterns, often called " herringbone-work," in the manner seen in the older portions of " Moyns," at Steeple Bumpstead, in various other Essex houses of the period, and in some of the very fine Tudor barns in the Roothings. The carved oak staircase is a close reproduction of that at " Pryors." In the oak panelling of the hall, there is even a concealed " priest's hiding hole." The plaster-work design in the ceiling of the dining room is copied from an Elizabethan or Jacobean ceiling formerly in a cottage, now destroyed, at Colchester. In short, an attempt has been made to keep the whole of the house, and everything in it, including the furniture, as true as possible to the style of the period.

Afterwards the party adjourned to the Blue House (the residence of Mr. and Mrs. Gerald Christy), immediately adjacent, to inspect Mr. Miller Christy's Private Museum of Ancient Domestic Appliances (often spoken of as " Bygones "), which is housed in a barn there.

The Museum consists chiefly of an extensive collection of the appliances which were used formerly in connection with the old-fashioned " flat " or " open " hearth, burning wood logs on the floor of the hearth. This was in use practically everywhere until eighty or one hundred years ago, when the construction of railways allowed of the transport and general use of coal. Before that time, what we now call coal was used only in the vicinity of sea-ports, to which it could be transported cheaply by water, hence its old name of " sea-coal," ordinary firewood being then known as " coals." Before the days of railroads, what we now call coal was practically never used inland, unless in very grand houses.

Among those appliances pertaining specially to the burning of the fire itself, were the Andirons (vulgarly called " fire-dogs "), which held up the ends of the burning logs and aided combustion by allowing the access of air. Next, there was the fire-back, a heavy cast-iron plate, on the face of which was always an ornamental design, often heraldic. This was stood against the brickwork or masonry at the back of the hearth to protect it from the action of the flames. Then, too, there were the fire-tongs and the fire-fork, which were used for lifting the logs when making up the fire. The poker had no use in connection with this form of hearth. The poker is, primarily, a lever, and a lever requires a fulcrum, to be of use ; but the old kind of flat hearth possessed no fixed point which could serve as a fulcrum. The poker, though now the most familiar of all " fire-irons," is, in fact, a very modern appliance, having practically come into use with the modern coal-burning "fire-grate," the iron bars of which afford the necessary fulcrum. Then, there were the fire-shovel (which served then, as now, for gathering up the ashes) and the bellows. These latter were used formerly much more than now, a coal fire being less easily " blown up " by their aid than the older fire of logs. The purpose of the bellows was served, sometimes, by a blow-tube.

Other appliances, connected mainly with the boiling of food, were the fire-crane, often large and very ornamental in form, which hung in the hearth place. It was capable of many adjustments. By its aid the hanging pot could be raised or lowered, swung out in front of the hearth, or (in the most perfect forms) moved from one side of the fire to the other. From the fire-crane, hung the pot-hook (called the "trammel" in the Eastern Counties, the "cotterell" in the West and South of England, and by various other names in other parts), which supported the hanging pot, the boiler for hot water, or the kettle. Another contrivance, now wholly disused, was the kettle-tilter, which, hanging from the pot-hook, held the kettle. It had a projecting handle, by means of which it could be tilted, so as to pour hot water from the kettle, without the blackened kettle itself being touched with the hands. Then, there was the skillet, which was the fore-runner of our modern sauce-pan. As the old form of flat hearth had no bars, the skillet could be stood on bars like our modern sauce-pan. It was provided, therefore, with three short legs, on which it stood upon the hearth, just within the edge of the fire. The older skillets were handsome vessels, cast entirely in bronze, and often had the name of the owner or founder or a curious motto cast on the handle.

Yet another set of appliances were those connected with the roasting of meats. Chief of these was the spit or broche, a long steel rod, which was supported either by special spit-rests or by hooks on the fronts of the andirons. The spit, when charged with a joint or poultry, was caused to revolve slowly before the fire, either by hand or by some mechanical means—sometimes by a dog in a wheel, sometimes by water-power, sometimes by a weight which actuated a piece of mechanism known as the "jack", and, in later times, by clockwork. Below the joint, as it revolved on the spit, was, of course, the dripping-pan, to catch the dripping, from which the meat was basted continually by means of the basting-ladle.

Yet other appliances, connected chiefly with toasting, frying, and similar culinary operations, were the gridiron, the turning-grill, the girdle, the frying-pan, the gofre-tongs, and the salamander.

Of all the foregoing and of some other subsidiary appliances, the Museum contains, as stated above, a large series—probably by far the largest of its kind in existence anywhere. In most museums, the few objects of the kind shown are usually rendered quite meaningless to an ordinary visitor, by being hung on a wall. Mr. Christy has endeavoured to avoid this absurdity by displaying most of the objects in his Museum in imitation hearths, in which they are seen, each in its proper position, as though in actual use. This is very necessary now-a-days, when these appliances are so far obsolete that the ordinary person, seeing them, has no idea whatever of their former uses, or even of their names. These, however, Mr. Christy endeavoured to explain to the party.

The Museum contains also a smaller series of obsolete agricultural implements, such as flails, hayband-twisters, dibblers, and the like. Further, there are several fine examples of mantraps and spring guns.

A most hearty vote of thanks was passed by acclaim to Mr. Christy for his kindness, and for his demonstrations at his most interesting Museum, and the party was driven to Chelmsford to catch the 8.10 train homewards.

FIELD MEETING AT FYFIELD AND NORTON HEATH (426th MEETING).

SATURDAY, 19TH JULY 1913.

The chief object of this excursion was botanical, the district being one of the most interesting to botanists in the whole county, and to visit the twin churches of Willingale Spain, and Willingale Doe, both situated in one large churchyard, where the two parishes join. Some of the most local of Essex plants occur about Fyfield, the home of the "Fyfield Pea" (*Lathyrus tuberosus*), including *Bupleurum rotundifolium* and *Inula helenium*; while Norton Heath boasts, as its greatest rarities, *Bupleurum falcatum* and *Pulicaria vulgaris*.

The conductors were Miss Kate Skinner, Miss E. Willmott, F.L.S., and Mr. Percy Thompson.

In spite of adverse climatic conditions, a small but determined band of botanical members met at Ongar at the appointed hour, and made their way, through a steady downpour of rain, by way of field paths to High Ongar and Fyfield, practical proof of the clayey nature of the subsoil (Boulder Clay) being afforded by the muddy, slippery paths, along which the devoted band splashed and "skidded" with but little leisure to look for flowers; hence, perhaps, the reason why *Bupleurum rotundifolium* was sought in vain in the cornfields towards Fyfield, where it normally occurs. Arrived in Fyfield village, however, at a little past noon, the rain ceased, and thenceforth the day, though dull, was dry and comfortable.

Quite a number of interesting plants were found, and Miss Skinner has kindly furnished a list, which is printed at the end of this report. She informs us that the neighbourhood of Fyfield and Ongar is a capital hunting-ground, and had the weather been finer, many more of the interesting plants for which it is famed ought to have been seen, such as *Bupleurum rotundifolium* and *Inula helenium*. The "Sulphur Clover," *Trifolium ochroleucum*, was seen in many places in the fields, and along road-sides, with its pretty cream-coloured heads. A very tall specimen of *Conium maculatum* (Hemlock) with its curious spotted stem, seven feet high, was seen near the river.

After lunch, the party was conducted by Miss K. Skinner to a known spot where, in a low hedge bank between two fields, and fortunately out of sight from the road, two glorious masses of the Fyfield Pea (*Lathyrus tuberosus*) were met with, clambering wildly over the bank and even invading the ploughed land. Its pretty sweet scented flowers of pinky-purple made a bright patch even on this dull day, and when seen on a bright sunny morning they are even more beautiful.

Careful search was made for the Elecampane (*Inula helenium*) in a spot where it was known to have been growing some dozen years ago, but no trace of this conspicuous plant could be seen.

Along the roadside leading to Willingale, large patches of the local Sulphur-headed Clover (*Trifolium ochroleucum*) were observed, with numerous commoner plants of "chalk facies," such as *Melilotus officinalis*, *Plantago media*, *Ononis arvensis*, *Scabiosa arvensis*, *Cichorium intybus*, while Traveller's Joy (*Clematis vitalba*) wreathed the hedges.

At Willingale Spain, the party were received at the Church by Rector, the Rev. C. Lennard Payne, who pointed out in a short address the principal points of interest.

The nave is of Norman date, built of flints in courses, with Roman tiles to the quoins and round the door-openings; the chancel is later, of Perpendicular architecture. The holy table is the original altar-top of Barnack stone, worked by the Norman builders with the characteristic abacus-splay, and with the consecration-crosses still visible upon it.

One of the most interesting features of the church is a series of drawings, incised with thin lines in the stonework of the perpendicular windows and of the chancel-arch.* These drawings, possible the work of an acolyte or minor ecclesiastic in pre-Reformation times, are lightly and firmly cut into the surface of the stone, and betray alike a fair draughtsman and a familiarity with the objects represented, which latter comprise an archbishop in mitre and chasuble with Y-shaped orphrey and carrying his crozier (*not* a crook), repeated drawings of crossbows, a bishop with pastoral staff, a winged human face (said to typify "life"), a drawing of a skeleton with darts in either hand (to typify "death"), various undeciphered names or inscriptions in black letter character and cursive script, and a representation of the sacred monogram IHS. in tall upright Old English text. The last mentioned inscription is especially interesting, as it offers proof of the antiquity of the work. The rector, who discovered all these drawings, now nearly 20 years ago, stated that they were all hidden either by brick casing or by plaster, hence their good preservation. On the chancel arch jamb had been deeply cut in the plaster, which then covered the stonework, some initials and dates of the 18th century: these penetrated through the plaster into the stone beneath, and may still be seen now the plaster is gone: and it is noteworthy that one of these dated inscriptions cuts through IHS. in such a way as to show that the latter existed before the former.

The original Norman crescent hinges to the north door are now refixed, in their exact relative positions, on the inside of a new oak door to the modern vestry: new strengthening bars of iron have been added to the old hinges, but are easily distinguishable therefrom.

Tea was taken at the Bell Inn, Willingale, at about half- past four. And afterwards a short meeting of the Club was held for formal business.

New Member.—Mr. F. J. Bennett, F.G.S. (late of H.M. Geological Survey), *The Cottage, Hatfield Peverel,* was elected a Member.

A hearty vote of thanks was passed to the Rev. C. Lennard Payne, for his kind assistance during the afternoon.

The party was then driven to Norton Heath for further botanising.

The high ground of Norton Heath, at 325 ft. O.D., is formed by one of the smallest Essex outliers of the Bagshot Pebble Beds, which rise above the sheet of Chalky Boulder Clay and Glacial Gravels which elsewhere mantle the surface of the country for miles around in all directions. The surface of the small heath has been much disturbed by shallow excavations for gravel, which have largely worked off the thin capping of

*The description of these incised drawings is furnished by Mr. Percy Thompson, who took careful rubbings and notes about a dozen years ago. Mr. Thompson is not aware that these drawings have been described before.

Pebble-Beds, and the resulting swampy heath and shallow pools should prove happy hunting grounds for botanists and pond hunters.

On the heath another very local plant, *Bupleurum falcatum*, was found, but the blossoms were only just appearing; its yellow umbels looked very graceful and delicate peering above most of the other plants on the broad road-sides. Careful search was made on the heath for *Pulicaria vulgaris*, but in vain: probably the season was a little too early for it.

From the heath a drive of about three and a half miles brought the botanists to Ongar Station to take the home train.

The following is Miss Skinner's list of the plants observed, but, of course, it is by no means exhaustive :—

Ranunculus sceleratus
,, *flammula.*
Nymphæa lutea.
Viola tricolor.
Polygala vulgaris.
Spergula arvensis.
Hypericum hirsutum.
,, *quadrangulum.*
Melilotus officinalis.
Trifolium ochroleucum.
,, *fragiferum.*
,, *hybridum*
Vicia cracca.
Lathyrus tuberosus.
,, *pratensis.*
Agrimonia eupatoria.
Bupleurum falcatum.
Hydrocotyle vulgaris.
Conium maculatum.
Sison amomum
Æthusa cynapium.
Daucus carota.
Galium mollugo.
,, *saxatile.*
,, *palustre.*
,, *verum.*
,, *aparine.*
Dipsacus fullonum.
Scabiosa arvensis.
Senecio sylvaticus.
Arctium lappa.
Carduus palustre.
Centaurea nigra.
Cichorum intybus.
Sonchus arvensis.
Calluna vulgaris.
Lysimachia nemorum.
Myosotis palustris.
Solanum dulcamara.
Lycium chinense.
Veronica beccabunga.
,, *anagallis.*
Pedicularis sylvatica.
Lycopus europœus.
Prunella vulgaris.
Betonica officinalis.
Ballota nigra.
Teucrium scorodonia.
Plantago media.
Polygonum cuspidatum.
Euphorbia helioscopia.
,, *exigua.*
Alisma plantago.

EXCURSION TO MERSEA ISLAND (THE 427th MEETING)

SATURDAY, 20TH SEPTEMBER 1913.

The members of the party reached Colchester about 10.30, arriving from several districts, the Secretary and Mr. H. A. Cole journeying from St. Osyth. They were conveyed in a motor-omnibus to Mersea, a ten-mile journey through a very pleasant country.

The conductors were the President, Mr. W. Whitaker, F.R.S., Mr. Hazzledine Warren, F.G.S., the Rev. J. W. Kenworthy, Mr. Robert

Paulson, F.L.S., Mr. Edwin E. Turner and Mr. W. Cole and Mr. Percy Thompson, Hon. Secretaries.

On reaching the island at East Mersea, a visit was first made to the celebrated mound or Barrow, on the grounds of Mr. C. Brown. The mound is well known to the readers of the Rev. Baring Gould's wonderful story of *Mehalah* as "Grim's Hoe," where a poetic legend of its supposed Danish origin is related, but Mr. Gould has since stated that he had no genuine foundation for the story. The mound was opened by the Morant Club in 1912, under the direction of Mr. Hazzledine Warren, who in the *Transactions of the Essex Archæological Society* (vol. xiii. N.S. 116–139) has given a most interesting account of the discoveries then made. He is of opinion that the Barrow was the tomb of some important personage or petty ruler of British race, but living under Roman influence.

Preparation had been made for the inspection of the tomb. The interior was entered by a tunnel, and the chamber was found to be built up of seven courses of flanged roofing-tiles. The chamber is 18 inches square and 21½ inches high. In it was found a leaden casket, within which was a beautiful glass vessel containing cremated human remains. The only cover were two wooden boards still in good preservation. The urn and casket have been placed in the Colchester Museum, but carefully-made models of them have been placed in the tomb, and the tunnel, etc., has been made permanent.

Mr. Warren and Mr. Kenworthy took the greatest pains to inform the visitors of all particulars of the exploration, but it is quite unnecessary to repeat these here, as the reader should refer to Mr. Warren's excellent monograph mentioned above. The interment is one of the most interesting known in England, and few have been investigated with equal care. From the evidence both Mr. Warren and Mr. A. G. Wright (curator of the Colchester Museum) are disposed to put the approximate date at some time within the Flavian period, between A.D. 60 and 96.

A move was then made to the "Saltings" by way of the old Roman causeway known as the "Strood," which connects Mersea with the mainland, and some hours were spent in "herborizing" on this wild land. In *Mehalah* is an excellent word-picture of the district:—"A more desolate region can scarce be conceived, and yet it is not without beauty In summer the thrift mantles the marshes with shot satin, passing through all gradations of tint from maiden's blush to lily white. Thereafter a purple glow steals over the waste, as the sea lavender bursts into flower, and simultaneously every creek and pool is royally fringed with sea aster. A little later the glasswort, that shot up green and transparent as emerald glass in the early spring, turns to every tinge of carmine."

The excursion afforded an excellent opportunity for an ecological study. All the plants given in Tansley's *Types of British Vegetation*, as commonly represented in a general "Salt-Marsh Association," were growing abundantly on the saltings near the Strood, viz.—*Spergularia marginata, S. salina, Aster tripolium, Artemisia maritima, Limonium vulgare, Statice maritima, Plantago maritima, Atriplex portulacoides, Salicornia europœa, Suœda maritima, Triglochin maritimum*, and *Glyceria maritima*. *Atriplex portulacoides* grew on the drier banks of the creeks, and some very luxuriant specimens of *Inula crithmoides* were seen on the outer face of the sea-wall.

The much taller specimens of *Aster tripolium* which grew on the bare mud of the numerous creeks, as compared with those individuals growing on the general surface of the saltings, was remarkable. This is due to the necessity of the plants keeping their heads above water during the flowering stage in a position flooded several feet deep at each ordinary high tide. As the tide came in the flowers were seen standing out of the water, while the stems were wholly submerged.

The worn-down remains of a small "Red-hill" near the Strood, which rose like an islet some two feet only above the marsh level, was found to be covered by an entirely different assemblage of plants from that constituting the salt-marsh flora round about. The following plants were noted growing on this mound:—*Bupleurum tenuissimum, Cnicus lanceolatus, Galium* sp. (not flowering) *Lotus corniculatus, Artemisia maritimum, Atriplex littoralis, A. portulacoides, Plantago coronopus* and a Lichen, *Cladonia furcata.*

The undermentioned Lichens were noted by Messrs. Paulson and Thompson during the day:—

On oak stakes at high water mark:—

Ramalina calicaris.
R. farinosa.
R. fastigiata.
Physcia parietina.
P. polycarpa.
P. stellaris sub-sp. *tenella.*
Parmelia fuliginosa.
Lecanora expallens.
L. chlarona.
Buellia canescens, cum. fr.
B. myriocarpa.

On the sea-wall:—

Cladonia pyxidata.
C. furcata.
C. furcatca var. *racemosa.*
Peltigera canina.

On Roman foundations at West Mersea:—

Physcia pulverulenta.
Lecanora galactina.

A fine fruiting specimen of *Ramalina evernioides* was found growing on an oak post on the sea wall near the Strood, associated with *Lecanora umbrina.*

This is really a notable list of lichens observed on a day's ramble, especially as there probably exist no published records of lichens from the Essex coast.

A list of flowering plants observed, drawn up by Mr. Turner, is appended to this report.

Mr. John French, who was present at the Meeting, draws attention to a form of the Elm with a peculiarly small leaf which is to be found on the island. "This variety is more plentiful as Clacton is reached. The leaves, so far as I have noticed, never exceed 1½ by ¾ of an inch, and are not generally quite so large. When it attains to a forty-foot tree, of which I have seen a few specimens, its habit is that of the "English" or "hybrid" elm, but when the plant is sub-arboreal it much resembles the sallow."

Geologically, Mersea Island owes its existence to the fact that it is formed by an isolated patch of River Gravel, laid down by the ancient Thames at a time when that river, joined with the Medway, flowed to seawards of the present coast line and the sea was far to the north; this

River Gravel, originally continuous from Southend, through Burnham, Southminster and Mersea, to Clacton and Walton, has since been breached by the later rivers, the Crouch, Blackwater and Colne. The outline of the coast is now largely determined, save for the later accretions of alluvial mud, by the direction of this old River Terrace. The island, Mr. French remarked, is the limiting line south of a tract of land with some permanency, for all north, until Suffolk is reached, shew river valleys which have been cut by their present streams. This is not the case with the land to the south, or at any rate not anywhere near the sea margin. The ups and downs of that tract as far as the Kentish shore must have been manifold.

Under Mr. Whitaker's direction a small pit at just over 50 ft. O.D., was visited, which showed over 7 ft. of Pleistocene Gravel composed of small rounded and subangular flint pebbles, with intercalated sand seams, the upper portion exhibiting contortions (" trail ") due probably to grounding river ice. A considerable portion of the gravel is made up of black flint pebbles derived from earlier Tertiary beds, and Greensand chert also occurs.

West Mersea Church was interesting to many of the party. The square Norman Tower has quoins of Roman bricks and the coarse masonry is laid in herringbone fashion. Roman bricks are also used in here and there in the other walls of the Church, and some of the small squared ragstone facings, as in the north wall beneath the windows, are most probably Roman masonry re-used from an earlier building. The interior of the Church presents fewer features of interest, but the ancient font attracted special attention by its spacious bowl of Purbeck marble and its style of transition Norman, and the two chests in the tower are excellent examples of their kind (see Mr. W. H. Lewer's recently published book *The Church Chests of Essex*).

In the grounds of West Hall (inspected by kind permission of the owner, Mr. Reeves), the basement of the supposed Pharus, or Roman lighthouse, was an object of very great interest. It has been usually taken for a Pharus and may have been one ; but if so it certainly does not class with known ones at Dover and Boulogue, which still stand much above ground. No doubt, however, exists about its Roman construction out of Roman material. There were whole-sized bricks of that period laid in pink and white mortar, and patches of street Roman pavement—very suggestive of the ancient footways of the former inhabitants ; soldiers, sailors, and other denizens of a departed city by the sea.

Tea was taken in the old Tythe Barn, now transformed, and a short formal meeting (the 427th) held, with the President in the chair.

Mrs. Horace Egerton Green, of *Waldegrave Cottage, East Mersea*, was elected a member of the Club.

Thanks were accorded to all those who had contributed to the success of a very interesting excursion.

APPENDIX.— A LIST OF PLANTS OCCURRING IN MERSEA (NOT EXHAUSTIVE).

The following list has been prepared by Mr. Edwin E. Turner. Although by no means complete, it affords a good idea of the flora of the

island. An * indicates those species observed on the occasion of the foregoing meeting.

Myosurus minimum, L.
**Papaver rhoeas*, L.
Cochlearia officinalis, L.
**Brassica nigra*, Koch.
**Lepidium ruderale*, L.
,, *draba*, L.
Reseda luteola, L.
**Cerastium triviale*, Link.
Arenaria peploides, L.
Spergula arvensis, L.
Spergularia rubra, Pers.
* ,, *salina*, Prest.
* ,, *marina*, Leb.
**Tamarix gallica*, L.
**Althæa officinalis*, L.
**Malva sylvestris*, L.
Linium perenne, L.
Erodium cicutarium, L'Hérit.
Medicago lupulina, L.
**Lotus corniculatus*, L.
Lotus uliginosus, Schk.
**Vicia tetrasperma*, Moench.
,, *sepium*, L.
,, *sativa*, L.
Lathyrus pratensis, L.
Bryonia dioica, L.
**Conium maculatum*, L.
**Smyrnium olusatrum*, L.
**Bupleurum tenuissimum*, L.
**Apium graveolens*, L.
* ,, *nodiflorum*, Reichb.
Carum segetum, Benth.
Sison amomum, L.
Aegopodium podagraria, L.
Oenanthe lachenalii, Gmel.
**Aethusa cynapium*, L.
**Heracleum sphondyllium*, L.
**Daucus carota*, L.
**Caucalis anthriscus*, Huds.
Galium aparine, L.
Sherardia arvensis, L.
Dipsacus sylvestris, L.
Scabiosa arvensis, L.
**Aster tripolium*, L.
* ,, ,, v. *discoidens*.
**Inula crithmoides*, L.
**Pulicaria dysenterica*, Gaertn.
Anthemis cotula, L.
**Achillea millefolium*, L.
**Matricaria inodora*, L.
**Artemisia maritima*, L.
* ,, ,, v. *gallica*
**Tussilago farfara*, L.
**Senecio jacobæa*, L.
* ,, *erucifolius*, L.
**Arctium lappa*, L.
**Centaurea nigra*, L.
Carduus crispus, L.
* ,, *pycnocephalus*, Jacq.
**Cnicus lanceolatus*, Hoffm.
* ,, *arvensis*, Hoffm.
,, *palustris*, Hoffm.
**Picris echioides*, L.
Crepis virens, L.
,, *taraxicifolia*, Thuillier.
Hypochaeris radicata, L.
**Leontodon autumnalis*, L.
**Taraxacum officinale*, Web.
**Lactuca virosa*, L.
**Sonchus arvensis*, L.
* ,, *oleraceus*, L.
Tragopogon pratensis, L.
**Armeria vulgaris*, Willd.
**Statice limonium*, L.
,, *rariflori*, Drejer.
**Glaux maritima*, L.
Anagallis arvensis, L.
**Convolvulus arvensis*, L.
**Convolvulus sepium*, L.
**Solanum dulcamara*, L.
Plantago major, L.
,, *lanceolata*, L.
* ,, *maritima*, L.
* ,, *coronopus*, L.
Linaria vulgaris, Mill.
Scrophularia aquatica, L.
Veronica beccabunga, L.
,, *anagallis*, L.
Mentha aquatica, L.
,, *arvensis*, L.
Lycopus europaeus, L.
Prunella vulgaris, L.
Stachys sylvatica, L.
Lamium purpureum, L.
,, *album*, L.
Ballota nigra, L.

Scleranthus annuus, L.
Chenopodium album L.
**Beta maritima*, L.
**Atriplex patula*, L.
* ,, *angustifolia*, Sm.
* ,, *littoralis*, L.
,, *laciniata*
,, *babingtonii*, Woods.
**Atriplex portulacoides*, L.
**Salicornia herbacea*, L.
**Suaeda maritima*, Dumort.
,, *fruticosa*, Forsk.
Polygonum aviculare, L.
,, *convolvulus*, L.
Euphorbia exigua, L.
Mercurialis perennis, L.
**Ulmus montana*, Sm.
* ,, *campestris*, Sm.
Allium vineale, L.
**Juncus maritimus* Sm.
* ,, *gerardi*, Loisel.
Typha angustifolia, L.
Lemna minor, L.
,, *gibba*, L.
Alisma plantago, L.
**Triglochin maritimum*, L.
**Potamogeton pectinatus*, L.
**Zostera marina*, L.
**Scirpus maritimus*, L.
Carex divisa, Huds.
,, *arenaria*, L.
,, *muricata*, L.
,, *hirta*, L.
**Spartina stricta*, Roth.
**Alopecurus geniculatus*, L.
Phleum arenarium, L.
**Ammophila arundinacea*, Host.
Aira præcox, L.
Holcus lanatus, L.
Arrenatherum avenaceum, Beauv.
**Phragmites communis*, Tein.
Dactylis glomerata, L.
* *Glyceria aquatica*, Sm.
* ,, *fluitans*, Br.
,, *maritima*, Wahlb.
,, *distans*, Dumort.
Festuca ovina, L.
,, *duriuscula*, L.
,, *myuros*, L.
Bromus sterilis, L.
,, *mollis*, L.
Lolium perenne, L.
**Agropyrum repens*, Beauv.
* ,, *junceum*, Beauv.
Lepturus filiformis, Trin.
**Hordeum maritimum*, With.
* ,, *murinum*, L.

"FUNGUS FORAY"—THEYDON BOIS TO HIGH BEACH, EPPING FOREST.

SATURDAY, 18TH OCTOBER 1913.

The meeting as usual was constituted by a morning and afternoon party. The first assembled at Theydon Bois station at 11 a.m. The referees were Mr. George Massee, F.L.S., of the Royal Herbarium, Kew, and Miss G. Lister, F.L.S. (Miss A. Lorrain Smith was unfortunately unable to be present). A large number of our botanical members attended, and their aid in gathering and determining specimens was of the greatest service to the success of the meeting. Members of the Selborne Society and of the School Nature-Study Union were also welcomed.

The afternoon party joined in the woods. A long and close search was made for Fungi and a very considerable "bag" was secured, including 108 species. By kind invitation of Mr. Gerald Buxton, part of the ramble was taken through his wood at Oak Hill.

At 5 o'clock all re-united at the "Roserville Retreat," High Beach, in the large hall of which tables were arranged for exhibition of specimens. They were carefully examined by the experts present, and labels were

attached to each species. About 108 species were recognised, of which *Coprinus niveus*, *Stropharia worthingtonii* and *Flammula aldridgei* are believed to be new records for Epping Forest.

After tea, an Ordinary Meeting (the 428th) was held, Mr. W. Whitaker, F.R.S., in the chair.

Dr. H. Reynolds Brown, M.D., *Fairleigh, Maldon*,

At the request of the President, Miss Lister gave an account of the Myxomycetes noted during the day, and Mr. Massee summarised the observations made with respect to the other groups of Fungi. Miss Lister's notes will be found at the end of these reports.

Cordial votes of thanks were passed to the Referees and other experts who had contributed to the success of the Meeting. A conversazione followed for the minute inspection of the plants on the tables, and the meeting closed, the members of the party wending their way home.

THE "CRYPTOGAMIC FORAY" LOUGHTON AND THEYDON DISTRICTS OF EPPING FOREST.

SATURDAY, 8TH NOVEMBER 1913.

The arrangements were similar to former like meetings. There were two parties of investigators and ramblers—one assembling at Loughton Station, a little after 11 a.m., and the other at Theydon Bois station at about a quarter past two p.m.

The referees were:—

Mosses: Mr. H. N. Dixon, M.A., F.L.S.; Mr. L. B. Hall, F.L.S.; Mr. W. R. Sherrin.

Lichens: Miss A. Lorrain Smith, F.L.S.; Mr. R. Paulson, F.L.S.

Myxomycetes: Miss Gulielma Lister, F.L.S.

Much to the regret of all, Mr. E. M. Holmes, one of the Hon. Members, was absent owing to an accident.

Collecting was persistently carried on during the morning and afternoon, the two parties eventually combining at the Oak Hill Farm, Theydon Bois, the headquarters for the excursion.

Tea was served at 5 o'clock, and an Ordinary Meeting (the 429th) held, Mr. W. Whitaker, F.R.S., in the chair.

The following were elected members:—Mr. Charles R. Haig, *Felix House, Chelmsford;* Mr. Herbert J. Goodwin, *"Colintrave," Uplands Avenue, Loughton;* Mr. Norman Carruthers Gould, 3, *Endsleigh Street, W.C.*

The President alluded to the death, on the previous day, of their distinguished Hon. Member, Dr. A. R. Wallace, O.M., F.R.S., etc. Mr. Whitaker gave a brief sketch of Dr. Wallace's career, as the most consummate biologist, after Darwin, of the last century, and co-discoverer with Darwin of the principle of the survival of the fittest in the struggle for life on the earth. In addition to his claims for reverence as a naturalist, Dr. Wallace was eminent in the sphere of economics and social science.

The President proposed that the Secretary should be requested to convey to Mrs. Wallace and the members of the family on behalf of the

Club the deepest expressions of regret and condolence on the death of the great Naturalist and most esteemed Honorary Member.

The President also expressed the regret of the members and visitors at the news that Mr. E. M. Holmes had met with a somewhat serious accident, and the Secretary was requested to convey this to Mr. Holmes with the hope that he would be speedily restored to health.

The President also welcomed at the meeting the members of the Selborne Society, and those of the School Nature Study Society.

Miss G. Lister,[1] Mr. H. N. Dixon and Mr. Robert Paulson gave accounts of the observations of the day amongst the Myxomycetes, Mosses and Lichens.

Most cordial thanks were expressed to the conductors and referees, and to those expert visitors present who had aided in the collecting and identification of the species found.

Afterwards time was spent in the examination of the plants on the tables, and way homewards was made from Theydon Bois station.

THE 430th MEETING.

SATURDAY, 29TH NOVEMBER 1913.

This meeting was held as usual at the Municipal Technical Institute, Stratford, at 6 o'clock, Mr. Whitaker, F.R.S., in the chair.

New Members.—The following were duly elected members:—

Mr. Charles H. Bestow, *Melford House, Upper Clapton, N.E.*
Miss Jessie Bray, *"Colonsay," Theydon Bois.*
Miss Helen D. Dedman, 69, *Wellesley Road, Ilford.*

Pictorial Post-Cards of Essex.—In aid of the Pictorial Survey of Essex, the Curator reported that Mr. Walter Fox had presented an Album of Post Cards of all the Essex Parish and Ecclesiastical Parish Churches, comprising a total number of 460 views. The collection was commenced in the year 1905, and, with the exception of 12, each Church has been visited by Mr. Fox by means of the cycle. Space has been reserved in the album for church interior views, 150 being now in hand towards the collection, which it is hoped will be completed within the next two years. Other donations of post cards include the following:—Mr. B. G. Cole, 208; Rev. J. F. Cole, 9; Miss M. Cole, 11; Mr. W. Cole, 157; Mr. Bryan Corcoran, 6; Mr. Walter Fox, 133; Miss Skinner, 9; Mr. Tabor, 52; and 43 photographs taken by himself; Mr. Whitehead, 6.

Thanks were heartily accorded to the donors, and the Curator made a few remarks on the nature of the collection, and hoped that generous support would be accorded to the Pictorial Survey, now that an earnest effort was being made to further it.

The late Captain Oates.—With reference to the letter of condolence which the Secretary had been requested to send to our Member, Mrs.

[1] Miss Lister's notes are printed a separate paper in the present part, page 241

Caroline Oates, on the death of her distinguished son, Captain Oates, the following letter was read :—

Gestingthorpe Hall,
Castle Hedingham, Essex.
2nd October 1913.

" Dear Sir,

" I am extremely sorry that your kind letter should have remained thus long unanswered. I feel sure though that you will understand how only by degrees have I been able to reply to the vast number of letters which have reached me. May I ask you now, please, to convey to the members of the Essex Field Club my very hearty thanks for, and assurance of, appreciation of their kind message of sympathy and condolence. 'Tis really wonderful the goodness of people towards me. Letters, some very touching ones, have come to me from all parts of the world. In some cases the writers are entire strangers.

" Again my thanks. Sincerely yours,

CAROLINE A. OATES."

" To William Cole, Esq."

The late Dr. A. R. Wallace, O.M , F.R.S.—The following letter was read from Mr. W. G. Wallace, in acknowledgment of the letter of condolence sent by the Secretary to Mrs. Wallace :—

Old Orchard, Broadstone, Dorset,
20th November 1913.

" To William Cole, Esq.,
" Hon. Secretary of the Essex Field Club.

" Dear Sir,

" My Mother desires me, on her own behalf and on behalf of my sister and myself, to thank sincerely the members of the Essex Field Club for their kind message of sympathy for us in our bereavement, and also for the words of high appreciation in which you refer to my late Father's work in the realms of Natural and Social Science.

" Yours very truly,
W. G. WALLACE."

The President said that he had received a beautifully worded letter from Prof. Meldola on the death of the great Naturalist.—Mr. Whitaker read the letter, and it was resolved that it should be printed in full in the report of the Meeting :—

" 6 *Brunswick Square, W.C.*
" *20th November* 1913.

" My dear Whitaker,

" As I shall be unable to attend the Club Meeting on the 29th, I am writing to ask you to bring before the meeting the news (now of course generally known) of the death of Dr. Alfred Russel Wallace, O.M., F.R.S., the co-founder with Darwin of the theory of the origin of species by Natural Selection. Both Darwin and Wallace were Hon. Members of our Club almost from the foundation, and both took an active interest in our work, and in our early years as a Club I received many encouraging message from these illustrious naturalists. I may remind the Club that on 4th January 1881, Mr. Wallace did us the honour of bringing before us, in the form of a lecture, the outline of his views on Island Life, which were subsequently embodied in his great work bearing that title. Again on 2nd October 1886, Mr. Wallace favoured us with another lecture in which he brought before us his conclusions with respect to the range of variability in species from the point of view of what is now known as

'Survival value,' and this lecture formed one of the sections of his work on Darwinism. So far as I know the Essex Field Club is the only local Natural History Society that can claim to have been favoured by Wallace with personal expositions of his views. As a rule he disliked the reading of 'papers' before learned Societies—even the great London Societies, and preferred submitting his conclusions in print to a larger and wider public. It will be remembered that Darwin followed the same course. It may not be known to many of the present members of the Club that Wallace was unsuccessful in his candidature for the post of Superintendent of Epping Forest when the Forest was formally taken over by the present Conservators.

"Had I been able to attend the meeting, I should have moved, and hope you will move, a resolution of sympathy with Mrs. Wallace and the family in their bereavement.

"I attended the simple funeral at Broadstone as a representative of the Royal Society, and although I received no official mandate, I hope the Essex Field Club will consider that I also represented them on that occasion.

"Yours sincerely,

"R. Meldola."

Supposed unrecorded Portrait of Samuel Dale.—Mr. W. H. Dalton, F.G.S., alluding to the portrait of Dr. Samuel Dale, in the Essex Naturalist, said that Mrs. Dalton had recognised it as being similar to one of four old paintings bought by her father at a sale at Braintree when she was a child, three of these paintings being still in the possession of the Everard family at Witham. Mrs. Dalton had always understood that one painting represented a celebrated doctor, that the lady, his wife, was called Judy or Judith [Judah, the first Mrs. Dale], and the others two of his children. The painting in Apothecaries' Hall is of an older man, but recognisable. If the pictures are really of Dale's family, they are of great county interest.

Demonstration.—The Nannoplankton of Fresh-water Ponds and Lakes as revealed by the use of the Centrifuge.—Mr. Scourfield said that the study of Plankton, *i.e.* the microscopic plants and animals which live suspended in the open water of the sea, lakes and ponds, had been going on for a good many years, collections being obtained chiefly by nets of the finest silk gauze. It had been recognised from the first, of course, that these nets, although so fine, must allow some of the more minute organisms to pass, but the number and volume of these was considered to be almost negligible. It was not until Lohmann, in 1908, introduced the centrifuge specially for the concentration of these exceedingly small forms, for which he subsequently coined the term Nannoplankton (νανος = dwarf), that their importance was made apparent.

The use of the centrifuge for the collection of small aquatic organisms in general was first suggested by Cori in 1895, but the method had never been widely adopted, most likely because it was regarded simply as a substitute for the usual methods of collection by means of nets, etc. Lohmann showed, however, that the centrifuge was indispensable so far as the minutest forms of plankton were concerned, and now the instrument was commonly used for their collection.

As regards the methods of using the centrifuge and examining the nannoplankton obtained thereby, the first thing to be noted was that the water should be taken directly from the pond or lake into the col-

lecting bottle without the intervention of a net or other filtering appliance, and without any preservative being added, as it was most important that the organisms obtained should be examined alive. For a similar reason the sample should be centrifuged as soon as possible after collection. Very small quantities of water sufficed as a rule to give a fair idea of the nannoplankton organisms present and their relative abundance. The glass tubes commonly supplied with a small centrifuge holding about 15 cc., were ample for most fresh-water investigations, and Mr. Scourfield exhibited a modification of a "haematocrit" head for the centrifuge which he had had made to carry elongated vase-shaped tubes, holding only 1½ cc. These, he said, usually gave good results for small pieces of water such as ponds, but would scarcely be sufficient for the examination of large lakes in which the organisms were as a rule not so relatively abundant. After the actual centrifuging for a minute or two at speeds ranging up to as much as 10,000 revolutions per minute with the "haematocrit" head (two separate centrifugings being recommended for each sample, one at a comparatively low speed and one at the highest speed obtainable), all the water except a minute drop at the bottom should be pipetted off with a fine "Rousselet" pipette. This drop should be sucked up and expelled a few times with the pipette in order to detach any organisms adhering to the bottom of the tube and then a portion or the whole of it transferred to a glass slip, live-box or compressor and placed under the microscope for examination by the usual methods.

The tiny organisms so obtained were found to belong mainly to the groups of the Bacteria, Schizophyceæ, Desmids, Diatoms and Chlorophyceæ among the plants and Heliozoa and Flagellata among the animals. They ranged in size from about 1-1000″ downwards to the smallest Bacteria, and, strangely enough, very few, if any, seemed to suffer from the centrifuging process. Their very minuteness and close approximation to the specific gravity of water was no doubt a protection to them against the centrifugal pressure. Many of the forms appeared to be undescribed, but it was difficult to say at present how far this was really the case. Some were certainly new to science, and one which had been obtained from a pond on Leyton Flats had recently been recorded by Prof. G. S. West, as a new species and type of a new genus.

The proof of the great abundance of these very minute forms in most waters had come almost as a revelation, and had led to an increased appreciation of the important role played by living organisms in ponds and lakes and also in the sea. The significance of the nannoplankton as a source of food for many Entomostraca, Rotifera, &c., and thus indirectly for the still higher and larger aquatic creatures, had been amply demonstrated. And thus, as was indeed usually the case, a new method of investigation was found to lead to an altogether wider outlook upon matters about which all essential facts were supposed to be well known.

Lime-stone Deposit of the River Can.—Mr. Percy Thompson exhibited specimens of an impure limestone deposit formed by the small river Can, to the northwest of Chelmsford.

The deposit occurs in the bed of the river in various places from above Pengymill down to the Chelmsford-Roxwell road near the point where it is joined by the Roxwell Brook, a distance of about 1½ miles, and forms

a sheet some nine inches thick, which is coated with a growth of living *Pellia* and an aquatic moss *Hypnum riparium*, the moss having its stems and leaves thickly incrusted with the limy matter. A few broken fragments of freshwater and land shells, as *Unio* and *Helix nemoralis*, and an *Ostrea* washed from the Boulder Clay were found associated in the deposit, and a few decomposed leaves and what appear to be caddis-tubes were seen imbedded in it.

The mass is loosely coherent and readily falls apart when saturated with water, more consolidated portions being cemented with iron oxide; when dry it is more coherent. The deposit presents a more or less evident stratified structure, the re-deposited lime showing a minutely fibrous texture, some specimens are made up of small brecciated fragments of chalk, and a little sand occurs intermixed.

In a drainage ditch or "grip" above Pengymill the deposit was found as a white unctuous marl or highly calcareous clay.

The river Can during its eight-mile course from its source to the east of High Roothing down to Pengymill has a fall of some 133 feet, equal to one in 318, and flows exclusively over Boulder Clay, which, in the district, as is well known, contains large numbers of chalk fragments; the erosion of this calcareous matter by the stream provides the material for the deposit, any accidental obstruction to the free flow of the stream (still fairly rapid at the spot whence the specimens were dug from the bed of the river) probably forming a nucleus for the aggregation of the limy matter in a particular spot. In one specimen a flint is seen to have served as a nucleus.

Mr. Thompson has placed specimens in the Museum.

Papers Read.—In the absence of the author, Mr. Cole read a paper by Mr. C. E. Britton, entitled "Autumn Botany at Clacton, Essex." Mr. Britton very kindly presented specimens of some of the more interesting plants to the Club's Herbarium, which were exhibited, and a vote of thanks was passed to Mr. Britton for the paper and specimens.

Report of the Club's Delegate of the Conference of Local Scientific Societies, British Association, Birmingham, 1913.—Mr. Joseph Wilson, F.R.M.S., presented the following Report:—

The chairman for the year was Dr. P. Chalmers Mitchell, F.R.S., who presided at the first meeting held on Thursday, 11th September 1913, and gave an interesting address on *Utility* and *Selection*.

Sir George Fordham, the Vice-Chairman, informed the meeting that an invitation had been received from the French Association for the Advancement of Science, to hold next year's conference at Havre, while the Association met there, and by a majority of the delegates the invitation was accepted. The meetings will last for a week, commencing on 4th August 1914.

The second meeting of the Conference was held on Tuesday, 18th September, Sir George Fordham being in the chair. He reported the Council's approval of the decision of the delegates to meet at Havre in 1914.

Mr. A. R. Horwood, of Leicester, read an interesting paper on "Scientific

Societies and the Control of Plant Extermination," which gave rise to considerable discussion.

Mr. R. H. Whitehouse, of Belfast, afterwards read a paper on "The Best Means of Preventing the Extinction of Local Species." After discussion on this paper, the Chairman submitted the following resolution of the Council on the subject in these terms:—"That the British Association for the Advancement of Science deplores the rapid destruction of fauna and flora throughout the world, and regards it as an urgent duty that steps should be taken by the formation of suitably placed reserves or otherwise, to secure the preservation of examples of all species of animals and plants irrespective of their economic or sporting value, except in cases where it has been clearly proved that the preservation of particular organisms, even in restricted numbers or places, is a menace to human welfare."

This was seconded by Sir Edward Brabrook, and agreed to. The Chairman then drew the attention of the Conference to fresh evidence which it was desired to gather regarding the working of the Wild Birds' Protection Acts, and suggested that the various societies represented ought to be able to furnish valuable information to the Departmental Committee, which it was understood would shortly be appointed.

Cordial thanks were accorded to Mr. Wilson for the report, and for having represented the Club as Delegate.

Mr. Percy Thompson read a paper entitled "On the occurrence of Rhaxella-Chert in the Epping Forest Gravels" [Printed in the present part].

Very considerable discussion was carried on by the President, Mr. E. T. Newton, F.R.S., and Mr. Dalton, F.G.S.

Mr. Thompson presented specimens of the rock to the Museum, and he was heartily thanked for them and the paper.

Mr. S. Hazzledine Warren, F.G.S., read "Notes on the Plant-seeds found during the excavation of the Romano-British Barrow on Mersea Island, Essex."

The subject was illustrated by lantern-slides.

Mr. Warren was thanked for his communication and the meeting closed.

MYCETOZOA SEEN DURING THE CRYPTOGAMIC FORAYS IN EPPING FOREST.

[*18th October and 8th November* 1913].

By Miss GULIELMA LISTER, F.L.S.

THE expedition of October the 18th was taken from Theydon station, through the copses and meadows of the Birch Hall estate, and through the Forest from near Debden Green to Monk Wood and High Beach. During the ramble, nineteen species of Mycetozoa were found. The following is the list of their names, with notes on their habits, etc.

Badhamia utricularis Berkeley. The orange plasmodium was seen spreading in a fan-like network of veins over a fallen bough, but no sporangia were found.

Physarum nutans Pers. Both the typical form with nodding sporangia on slender stalks, and the subspecies *leucophaeum* with nearly sessile sporangia were obtained on dead logs.

Physarum viride Pers. A single gathering of immature golden-yellow sporangia was made on dead wood.

Fuligo septica Gmelin Only a single weathered aethalium was found of this common species, which in summer time is the most abundant and conspicuous of the Forest Mycetozoa.

Craterium leucocephalum Ditmar. Two gatherings were made on dead oak and hornbeam leaves.

Didymium squamulosum Fries. Both young and old sporangia were found in abundance on old horse dung in the Birch Hall meadows.

Colloderma oculatum (Lipp) G. Lister. Obtained in some quantity on moss, hepatics, and lichen on the trunks of oak and hornbeam. On one living tree it was found extending up the trunk for a distance of eight feet. Owing to recent rains, the outer mucilaginous investment of the sporangia was swollen and shining, otherwise this inconspicuous species might easily have been overlooked. If the mossy bark on which specimens have appeared is kept moist under a bell jar (allowing ventilation to prevent the growth of mould), it is found that fresh sporangia, varying in colour from dirty white to sulphur yellow, continue to emerge from the wood. At an early stage the pale mass of spores lies in the centre of a cushion of mucilage. As the sporangium matures, the darkening spore-mass sometimes rises up through the mucilage and comes out on to the surface, when the iridescent sporangium-wall soon breaks into fragments, and the spores are dispersed. If, as frequently happens, the mucilaginous envelope dries, enclosing the sporangium, the walls of the latter break either irregularly or by a well-defined lid.

Since the Rev. M. Cran called our attention to this species two years ago, by his Aberdeenshire gatherings, it has been found in many places, including New England and Japan. This year we have it from two new localities, viz., Shrawley Wood, Worcestershire, and Arosa in S.E. Switzerland ; indeed *Colloderma* now appears to be a fairly common species.

Stemonitis fusca Roth. Several gatherings were made on dead wood.

S. ferruginea Ehrenb. Three small tufts of sporangia were found on dead wood and bark, the longer stalks and pinker colour of the spores distinguish this species in the field from *S. flavogenita*.

S. flavogenita Jahn. Found in a mature condition, and in translucent yellow plasmodium on sticks.

Comatricha nigra Schroeter. Abundant on logs and fallen branches.

Enerthenema papillatum Rost. On a dead oak bough.

Lycogala epidendrum Fries is a summer species. Only one group of weathered aethalia was found.

Trichia varia Pers. Abundant on stumps of oak and hornbeam.

T. botrytis Pers. Found on the mossy trunk of a living hornbeam, in company with *Colloderma*.

Arcyria incarnata Pers. Frequent on fallen oak boughs.

A. denudata Pers. On old stumps.

A. cinerea Pers. One gathering only of this usually abundant species was found. Mr. J. Ross tells that he has seen *A. cinerea* far less frequently

this year in the Forest than the nearly allied and usually rarer *A. pomiformis*.

On the Cryptogamic Foray in the Loughton and Theydon districts of Epping Forest, 8th Nov. 1913, the following species of Mycetozoa were found :—

Badhamia utricularis Berk.

Physarum nutans Pers. ; the small typical form was found in some abundance, also the stouter subsp. *leucophaeum*, and the subsp. *robustum*, a striking form with much calcareous matter included in the sporangium-wall, in the capillitium and in the stalks ; the latter are either nearly white or brown according to the proportion of lime of refuse matter enclosed by their walls : the robust variety appears to be common in the Forest from September to November.

P. viride Pers. On wood.

Craterium minutum Fries. On dead holly leaves.

Didymium squamulosum Fries. On dead holly leaves.

D. nigripes Fries. In great abundance on holly leaves.

Colloderma oculatum G. Lister. Found on living trees and fallen logs. Sometimes the sporangia are on trunks well covered with moss (*Hypnum cupressiforme*) and liverwort (*Lophocolea heterophylla*), sometimes on trunks where there are no mosses or liverworts and only a little scattered lichen. (*Cladonia*).

Comatricha nigra Schroeter. On dead wood, abundant.

C. pulchella Rost. On dead holly leaves.

Enerthenema papillatum Rost. On oak boughs.

Trichia varia Pers. On dead wood.

T. botrytis Pers. On a dead stump.

T. decipiens Macbr. On dead wood.

Arcyria denudata Sheldon. On dead wood.

A. incarnata Pers. On oak boughs.

A. ferruginea Sauter. On dead wood ; the young rosy sporangia were just forming in serried ranks.

NOTES ON A HUMAN SKULL FOUND AT WENDON, ESSEX,

With Plate XVIII.

By GUY MAYNARD, *Curator of the Saffron Walden Museum.*

WITH A REPORT ON THE CRANIUM.

By A. KEITH, M.D., F.R.C.S., *Curator, Royal College of Surgeons.*

[*Read 25th January* 1913.]

IN a list of the craniological specimens belonging to the Saffron Walden Museum, written shortly before 1880, there occurs the following (page 553 Reg. A.) :

"Skull of an Early British Female, found 22 feet below the surface and amongst the roots of sedges and sandy gravel (without doubt the bed of an ancient stream) during the excavations for the Railway in 1864."

The figures 64 in the above date have been added in pencil at a later period, but there can be little doubt that the excavations were really those of the year mentioned, when the branch line from Audley End station to Saffron Walden was under construction. The late Mr. G. E. Roberts gave the following account of the section in the *Anthropological Review*, vol. ii., pp. lxiii., 1864, which is also quoted in the Geological Survey of the district, N.W. Essex, p. 72.

"In the course of railway works between Audley End and Saffron Walden it became necessary to divert the course of the River Cam into a part of the meadow land bounding the stream, which was traditionally known as 'the old river bed.'

"A cutting about 20 feet deep through this, necessitated for the foundation of a wide and deep culvert to give passage to the river through the railway embankment, disclosed the following section :

	Soil	1 feet
(Alluvium)	Clay	3 ,,
	Peat	12 ,,
	Gravel	?

"Near the bottom of this peat and at a depth from the surface of 16 feet, an astonishing quantity of mammalian bones were found . . . . out of the excavation—an area of not more than 20ft. by 60ft—*two cartloads* of large bones were taken away.

"The peat is more properly a blackish clay with numerous fragments of wood and a few large logs bedded in it. It is everywhere full of fluvatile shells of species common to the district and contains many naturally-formed chips, and flakes of flint and a few rolled pebbles."

"The bones which bear artificially made markings are the lower jaws of a small ox, probably *Bos longifrons*."

"A single tooth of the badger (?) was found at the same level in the cutting.

Prehistoric Skull found at Wendon, Essex *(Original in the Saffron Walden Museum).*

"A remarkably fine horn of the great elk, *Cervus megaceros*, was also found in association with these bones."

This antler, it may be mentioned, is also exhibited in the Saffron Walden Museum, together with a small series of other bones, etc., from this site, comprising the antler of a Red Deer, portions of the skull and lower jaws of Deer, horn core of a small ox, and pieces of drift wood.

The foregoing extract only gives a detailed section of 16ft.,

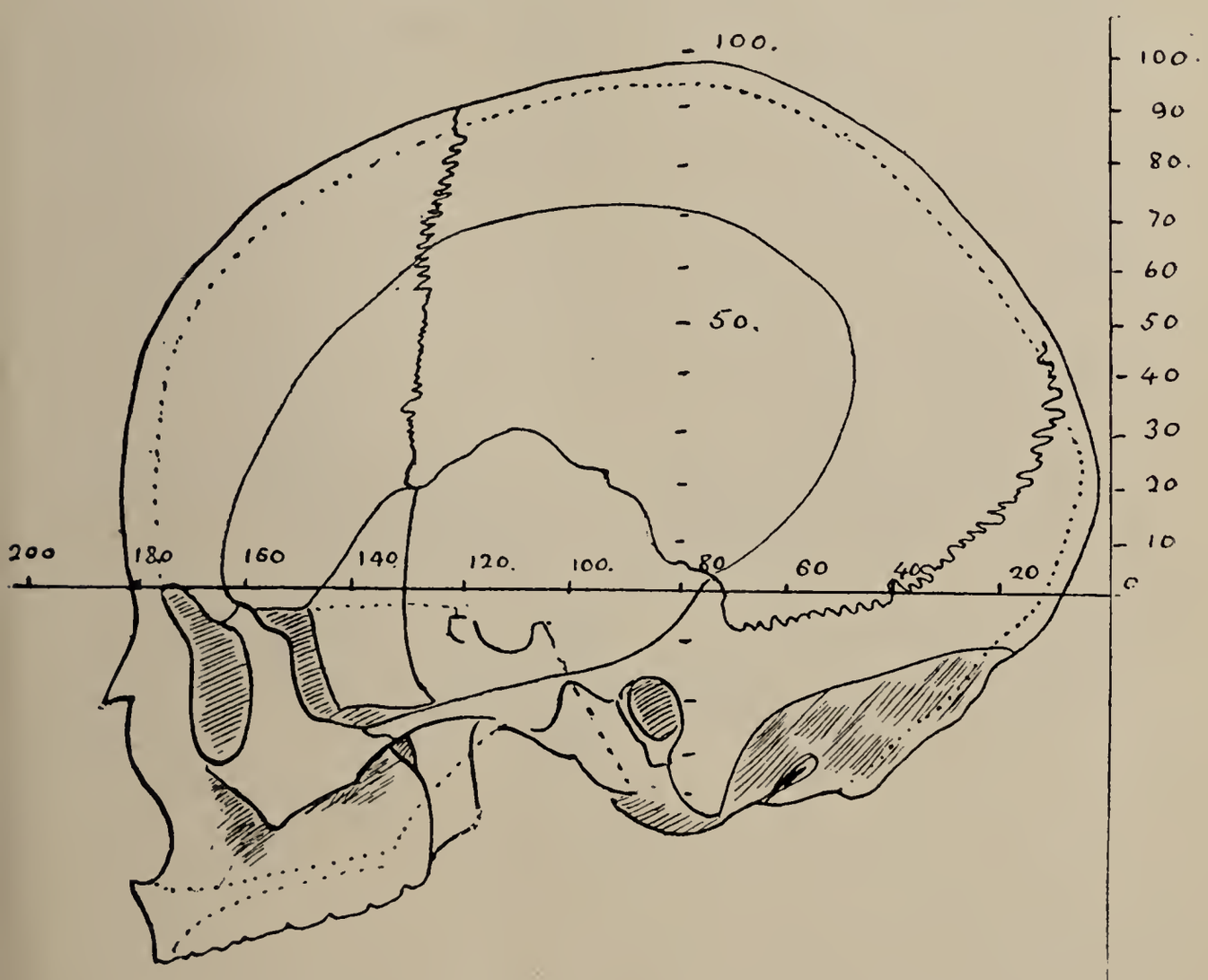


FIG 1.—SIDE VIEW OF THE WENDON SKULL
(*Copied by G. Maynard from a drawing by Dr. Keith*).

but the depth to which the gravel was excavated is not stated, although the great height and weight of the railway embankment at this point would require a deep and solid foundation to be obtained in the gravel bed, for the culvert. Therefore, the approximate depth of 20ft. given by Mr. Roberts is probably near the truth, and the 22ft. given in the Saffron Walden Museum list, as the depth at which the skull was found, thus receives some corroboration.

The skull has hitherto only been examined by Dr. W. L. H. Duckworth, D.Sc. of Cambridge, who said that it was probably Neolithic and was inclined to think it might be that of a female. As so much interest is now taken in all remains of prehistoric man, I thought that the discovery of this specimen should be

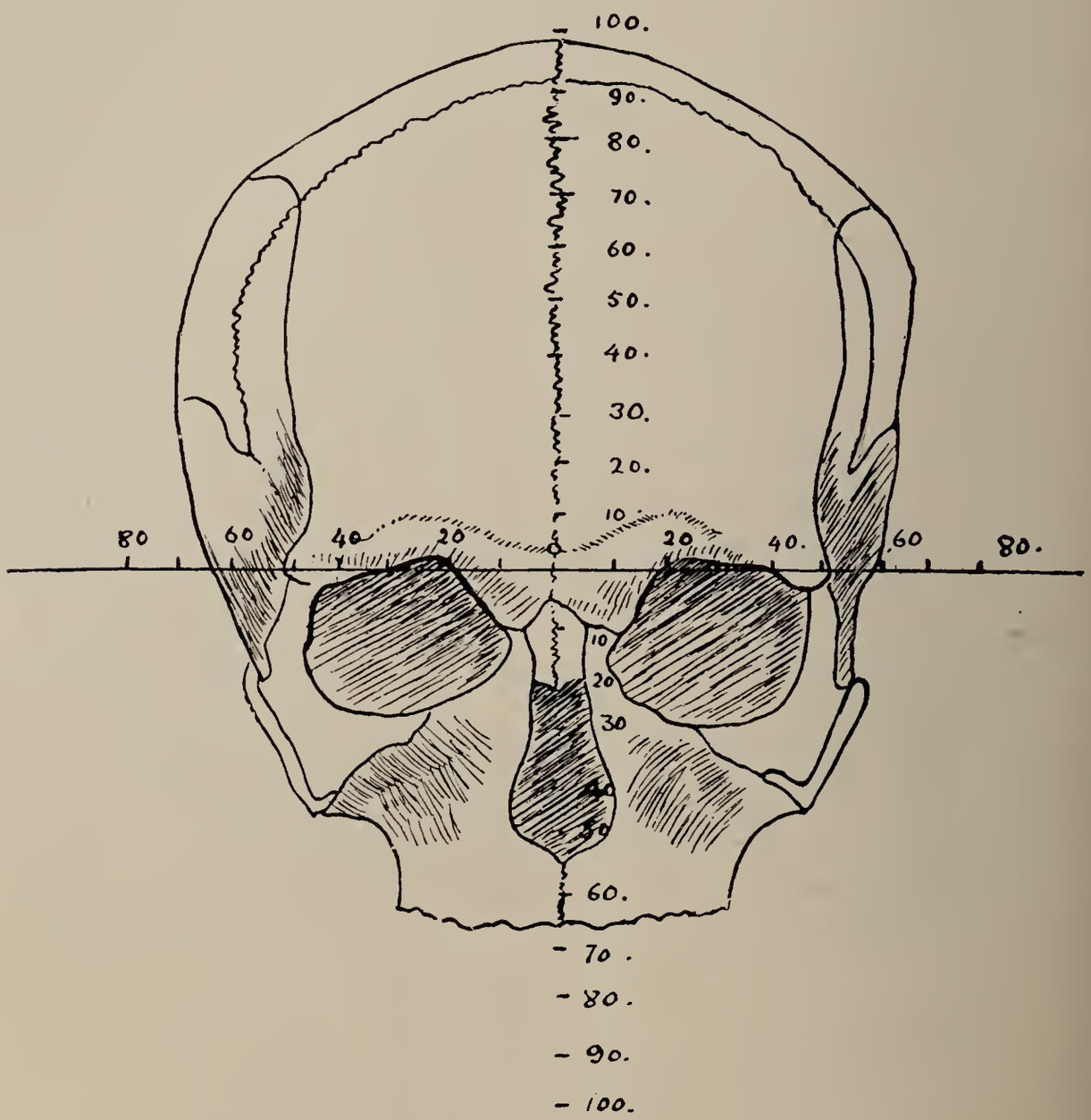


FIG. 2.—THE WENDON SKULL, FRONT VIEW
(*From a drawing by Dr. Keith*).

placed on record in the publications of the Club, as no account of it seems to have been published hitherto. Possibly Dr. Keith, or some other competent authority, may be induced to measure and report on the specimen before it is returned to Saffron Walden.

As bearing upon the probable age of the skull and of the

peaty bed *under* which it lay, I give the following notes on a similar deposit, discovered between Saffron Walden town and the eastern part of Audley End park, during sewerage excavations, in 1911 and 1912. Here, under what are known as the Swan Meadows, situated at present stream level, the trenches revealed a peaty deposit, containing numerous horse and cattle bones at a level of about 8 feet from the surface. At this level also were found two *pieces of Roman pottery* and several of the narrow lobed-edged horse shoes, said to be Late Celtic. Late Mediæval pottery, etc., occurred in the *surface layers only.* The peat was believed by the engineers to extend to a depth of over 20 feet, as their piles of that length were driven down to the head without difficulty. This deposit is also in the upper valley of the Cam or Granta, only about $1\frac{1}{2}$ miles from the Wenden deposit and at about the same level above O.D.

A comparison between the depth of the Roman level of the peat in the Swan Meadows and that of the Wenden skull would seem to suggest either that the latter is of pre-Roman age, which is supported by the megaceros antler, or that some fifteen feet of clay and peat accumulated in the upper Cam Valley between Roman and late Mediæval times.

Mr. E. T. Newton, F.R.S., has kindly examined the few other bones from this deposit which are preserved with the skull at Saffron Walden, and reports that they represent the following animals :—

RED DEER (*Cervus elaphus*). Antler and skull.
ROE DEER (*Capreolus caprœa*). Lower jaws.
OX, Longfaced—? (*Bos longifrons* ?) Horn-core.
PIG (*Sus scrofa*). Teeth.

There is also the large antler of *Cervus megaceros*, the "Irish Elk," the occurrence of which with the foregoing fauna is of interest.

A few specimens of drift-wood from the peat are as yet not positively determined.

REPORT ON THE WENDEN CRANIUM.

By DR. A. KEITH, 29th March 1913.

This skull is of importance because it is apparently of Neolithic date, and not from a tomb, as is the case with most known crania of that period, but from a river bed deposit. Its date may be at any time between 2000 to 5000 B.C.,

and we may suppose represents a native of Essex at that time. It is a good specimen of what Huxley named the River-bed type —so far as we know the majority of English people of Early Neolithic times were of this type. The staining of the cranium, and the fact that its recesses contained fine black sand, points to its being derived from the layer beneath the peat which contained the animal bones—amongst which were the Irish Elk, an animal which did not occur in England after Neolithic times. I enclose a profile drawing of the cranium half natural size—with attempted reconstruction. It will be at once seen that the outline is not of an unusual type.

The skull is that of a woman, probably of short stature, and of about 25–30 years of age. The teeth have fallen out after death, but the regular sockets, the well-spread palate, show that the masticatory system was better developed than in modern women. The brain was small—only 1,270 cubic centimetres, 100 c.c. below the mean. The length of the skull is 79 mm., its width 138 mm., its cephalic index 177.2%; the height of the roof above the ear holes 113 mm., a rather low amount. The face from the front was rather wide (123 mm.), for its length (63 mm.), but in profile the width is less apparent.

It may be mentioned that the specimen evidently belongs to the same race as the woman found at Walton-on-Naze by Mr. Hazzledine Warren. (See ESSEX NATURALIST, vol. xvi., pp. 198—208).

AUTUMN BOTANY AT CLACTON.

By C. E. BRITTON.

[*Read 29th November* 1913].

THE following notes relate to plants observed at Clacton-on-Sea and vicinity, during a stay there in late September and early October of 1912. Most attention was given to the botany of the coast; inland, at that late season of the year, the plant-life did not seem very noteworthy, though I was greatly interested in noticing that the usual hedge-row tree in the neighbourhood of Clacton was the small-leaved Elm, for which Dr. Moss has revived the name of *Ulmus sativa*, Miller. Among the more interesting plants seen were various Glass-worts (*Salicornia*), *Suæda fruticosa*, *Scirpus tabernæmon-*

tani, Spartina stricta, Inula crithmoides, Lactuca saligna, L. virosa, Rumex maritimus, R. limosus, Chenopodium glaucum, Onopordon acanthium, Cratægus oxyacanthoides, Quercus sessiliflora, etc.

In studying the shore vegetation, one notices that, where the concrete sea wall protecting the low-lying land west of Clacton ends, there commences, above high-tide limit, a line of low sand hillocks—miniature dunes—formed by the growth of the Marram Grass (*Ammophila arenaria*) and the Sea Couch Grass (*Agropyron junceum*), which are accompanied on the sea-ward side by *Honckenya peploides.* Other members of these miniature dunes are *Carex arenaria* and *Convolvulus soldanella.* Where the hillocks are less marked, a strand association consisting of Sea Rocket (*Cakile*), both white and lilac flowered, *Atriplex laciniata* and *Agropyron junceum,* occurs. Further on, the strand-association is reduced to *Agropyron junceum,* which also dominates the adjoining sandy ground, accompanied by Marram Grass and Sea Purslane (*Honckenya*). Here and there the reed (*Phragmites*) is a member of the association. On the inner side of these hillocks, muddy and sandy bare places, and shallow pools of salt water exist. The drier places are occupied by a closed vegetation consisting of *Agropyron pungens, Juncus gerardi,* and *Glaux maritima.* Where the ground is subject to occasional over-flows of salt-water, this society is reduced to the *Juncus.* Where the soil is more charged with water these species are associated :—*Honckenya peploides, Aster tripolium, Glaux maritima, Plantago maritima, Triglochin maritimum, Juncus gerardi, Carex arenaria, Agropyron pungens.* In and about the shallow pools of salt water, various species of *Salicornia* abound. Plants that also grow on the sandy shore here are, *Statice limonium, Salsola kali, Eryngium maritimum, Atriplex babingtonii, Festuca rubra* var. *barbata,* etc. Further inshore, where the soil is more compacted, the sea Couch-grass *Agropyron pungens* is dominant, accompanied by *Beta maritima, Suæda maritima,* various *Atriplices* such as *A. littoralis* and *A. portulacoides,* etc., *Artemisia maritima, Bupleurum tenuissimum, Spergularia marginata* var. *glandulosa, S. neglecta.*

The sandy ground, protected by the concrete sea wall, bears such plants as *Trifolium arvense, T. fragiferum, T. procumbens, Plantago coronopus, Juncus maritimus, Phragmites communis,*

Atriplex littoralis. The reed-swamp, near here, shows *Phragmites* as the dominant plant, *Scirpus maritimus, S. tabernæmontani, Sparganium ramosum, Rumex maritimus* (plentiful), *R. limosus, R. conglomeratus, R. nemorosus, Lemna minor, L. gibba, L. polyrrhiza.* Other plants found close here include *Potamogeton pectinatus, Œnanthe lachenalii* and *Glyceria maritima.* Proceeding along the shore towards Colne Point, there can be seen some rather interesting groupings of the species already mentioned. Thus by Lion Point is a muddy salt-marsh with an open vegetation consisting of *Salicornia, Aster tripolium, Juncus gerardi, Suæda maritima, Spergularia marginata* var. *glandulosa, S. neglecta,* and *Glaux maritima.* Further on is a rather striking association of *Juncus maritimus* (dominant) and *Phragmites communis;* then comes a community of *Agropyron pungens, Statice limonium,* and *Trifolium arvense;* the latter species is also seen co-dominant with *Carex arenaria,* in company with *Leontodon hirtus* and *Silene maritima* (scarce). Another area is occupied almost exclusively by *Spergularia marginata, Salicornia ramosissima,* and *Suæda maritima.* On the sandy shore near Lion Point are to be seen *Cakile maritima, Honckenya peploides, Eryngium maritimum, Hypochœris radicata, Leontodon hirtus, Artemisia maritima, Convolvulus soldanella, Rumex acetosella, Atriplex laciniata, A. littoralis, A. hastata, Beta maritima, Salsola kali, Carex arenaria, Ammophila arenaria, Phleum arenarium, Festuca rubra* var. *barbata, Agropyron pungens,* etc.

Suæda fruticosa. Fine bushes of this interesting shrub grow plentifully on the shore beyond the Martello tower west of Lion Point, forming a rather striking feature of the vegetation.

Eryngium maritimum is abundant here and was still in flower on 25th Sept. Proceeding further west, is an extensive salt marsh with such species as *Aster tripolium, Statice limonium, Suæda fruticosa, Salicornia perennis, S. ramosissima, Atriplex portulacoides, Spartina stricta.*

The saltings between St. Osyth and Brightlingsea yielded some interesting plants. The general salt-marsh vegetation consists of *Suæda maritima, Atriplex portulacoides, Glyceria maritima, Aster tripolium, Spartina stricta* (scarce), *Statice limonium,* various Salicornias, etc. The Sea Couch-grass *Agropyron pungens* grows so abundantly on the sea wall bordering

St. Osyth Creek, as to almost exclude all other vegetation. With it occurs, here and there, *Lactuca saligna* and *Atriplex littoralis*.

I have already mentioned how interested I was in observing that the usual hedgerow tree about Clacton is the small-leaved elm—*Ulmus sativa*, Mill. In Surrey, the usual elm is that species called by Dr. Moss *Ulmus campestris* of Linnæus. In my own neighbourhood I am acquainted with but one tree of *U. sativa*.

In addition to those previously mentioned, the following are the more interesting plants seen by me in the vicinity of Clacton :—

Erysimum cheiranthoides, L.—Clacton, near Coppens Green.

Brassica nigra, Koch.—Near Martello tower beyond Lion Point, Great Clacton ; about Blockhouse Wick, St. Osyth.

Diplotaxis muralis, D.C.—Clacton, both annual and forms of longer duration.

Lepidium ruderale, L.—Seen as a plant of waste places, between Great Clacton and Little Holland, and as a member of the sea-wall vegetation by Brightlingsea Creek.

Thlaspi arvense, L.—Remarkably abundant in cultivated fields about Clacton.

Reseda lutea, L., and *R. luteola*, L.—Clacton.

Arenaria leptoclados, Guss.—Field near Rush Green.

Spergula sativa, Bœnn.—Cultivated field above Clacton Cliff.

S. vulgaris, Bœnn.—Clacton ; field, Blockhouse Wick, St. Osyth.

Medicago arabica, Huds. (*M. maculata*, Sibth.).—Sandy shore near Lion Point ; between Great and Little Clacton.

Prunus avium, *L.*—Great Clacton.

Rosa comosa, Rip. (Sweet Briar).—Coppens Lane.

R. arvensis, Huds.—Between Coppens Green and Bocking's Elm.

R. ovata, Desv.—Between Little Clacton and Bocking's Elm. (I am under the impression that wild roses of any kind are scarce in the immediate vicinity of Clacton.)

Cratægus oxyacanthoides, Thuill.—Seen between Great Clacton and Little Holland Common.

Conium maculatum, L.—Between Great Clacton and Great

Holland Common and between Little Clacton and Bocking's Elm, etc.

Bupleurum tenuissimum, L.—St. Osyth Creek, etc.

Caucalis nodosa, Scop.—Sea wall opposite Brightlingsea.

Filago germanica, L.—Field between Clacton and St. Osyth.

Inula crithmoides, L.—By St. Osyth and Brightlingsea Creeks.

Anthemis cotula, L.—Field between Clacton and St. Osyth. Clacton.

Chrysanthemum parthenium, Bernh.—Great Clacton; presumably of garden origin, as usual.

Artemisia maritima, L.—As is well known the Sea Wormwood occurs in two forms; in one, with loose more or less spreading and drooping panicle branches, and in the other with more clustered and rather erect-growing panicle branches, and with the heads on shorter stalks, this form is, besides, less cottony than typical *A. maritima,* L. British botanists distinguish the second form as var. *gallica* (Willd.). Rouy (*Flore de France* 8, p. 300), however, considers this an error, and names our plant *Artemisia pseudo-gallica,* and is of the opinion that the true *Artemisia gallica* of Willdenow is a Mediterranean plant that does not reach the shores of northern Europe. *Artemisia maritima* and the *forme* (or race) *A. pseudo-gallica* of Rouy grow together at Clacton.

Petasites fragrans, Presl.—Established near Little Clacton.

Onopordon acanthium, L.—Beacon Hill, St. Osyth.

Lactuca virosa, L.—Clacton. Lane near Rush Green. Near Blockhouse Wick, St. Osyth.

Anagallis arvensis, L.—A form of the Pimpernel, grows at Clacton, with scarlet flowers and upper leaves in whorls of three. It may, perhaps, be referred to the var. *verticillata,* Diard.

Linaria elative, Mill. and *L. spuria,* Mill.—Field near Rush Green.

Antirrhinum orontium, L.—West Clacton, and field near Coppens Green.

Bartsia odontites, Huds. var. *serotina* (Dum.).—Lane south of Sladburys.

Stachys palustris, L.—Great Clacton.

S. arvensis, L.—Clacton. Near Coppens Green. Field towards St. Osyth. Towards Great Holland.

Lamium amplexicaule, L.—Field, Beacon Hill, St. Osyth.

L. hybridum, Vill.—Seen with flowers much larger than usual, in a potato field near Coppens Green. Very much like plants that I have seen in Surrey, and I identify both[1] as the var. *dissectum* of Mutel. After seeing this larger-flowered form with its corollas in shape and size recalling those of *L. amplexicaule*, I can appreciate the point of view of those botanists who regard the cut-leaved Dead Nettle as a species derived from a hybrid between *L. purpureum* and *L. amplexicaule*. British botanists do not appear to be acquainted with the variations of L. *hybridum*. On the other hand, French botanists recognise three varieties, *commune*, *decipiens*, and *dissectum*, all probably occurring with us.

Chenopodium polyspermum, L.—Near Sacketts Grove.

C. rubrum, L.—Roadside near Blockhouse Wick.

C. glaucum, L.—This rare Goose-foot was exceedingly abundant on a site where manure had formerly been deposited near Sacketts Grove.

Atriplex littoralis, L.—var. *marina* (L.).—The only place I saw this, was on the sea-wall opposite Brightlingsea. Elsewhere the typical plant was the usual form.

A. angustifolia, Sm.—Clacton.

A. hastata, L.—Sandy shore west of Clacton.

A. deltoidea, Bab.—Near Little Clacton. Sandy shore west of Clacton.

A. babingtonii, Woods.—Sandy shore west of Clacton.

Salicornia.—I paid a great deal of attention to this genus, collecting a great many plants, examples of which have since been seen by Dr. Moss, the curator of the university herbarium at Cambridge, who, in recent years, has been engaged in elucidating the many puzzling forms of this difficult group, and is still working at these plants.

The *perennial* Glass-worts to be found on the shore towards Lion Point, and beyond, are *Salicornia perennis* Mill. var. *radicans* (Sm.) Moss, and *S. perennis*, Mill. var. *lignosa* (Woods) Moss. Nearer Clacton, two *annual* Glass-worts grow in company. They are much-branched plants and I could see nothing but *habit* to separate them. The erect growing form is *S. ramosissima* Woods, and the recumbent plant Dr. Moss names

1 *Journ. of Bot.*, Aug. 1913.

S. ramosissima forma *prostrata* or *S. appressa*, Dum. I incline to the belief that the plant is the first of Dr. Moss's alternatives. Another Glasswort is considered to be either *S. appressa*, Dum. or *S. smithiana*, Moss. By St. Osyth Creek, some interesting Glassworts grow. One, marked by the extreme facility with which the segments separate at maturity, and by the fact that the flowers are *solitary*, instead of being in groups of three, I am confident is *S. disarticulata* Moss, described as a new species in 1911. Unfortunately, the only example that Dr. Moss has seen is suggested by him to be a hybrid—*S. disarticulata* × *gracillima*. On the other hand, the Revd. E. S. Marshall, who knows the genus well, and has seen other examples of the same gathering, considers them to be excellent and very typical specimens of *S. disarticulata*.

Another Glass-wort from this locality is identified by Dr. Moss as his *S. dolichostachya*, published as a new species in the *New Phytologist*, Dec. 1912.

Suæda fruticosa, Forsk.—Clacton Cliff. Saltings, Brightlingsea Creek. Shore below Beacon Hill, St. Osyth.

S. maritima, Dum.—Shore west of Clacton, etc.

Ulmus major, Sm. (The so-called "Dutch" elm).—The very fine elm that stands near the hamlet of Bocking's Elm, by the road leading to Little Clacton, belongs to this species. Is this tree "Bocking's" Elm itself?[2]

Occasionally, the Dutch Elm is seen as a planted tree about Great Clacton.

U. glabra, Mill. (The smooth-leaved elm).—Seen in many places about Great Clacton, etc., but as before noted, *U. sativa*, Mill (the small-leaved elm) is the prevailing hedge-row tree.

Humulus lupulus, L.—Near Sacketts Grove. Great Clacton to Little Holland.

Salix fragilis, L.—Near Little Clacton. Great Clacton.

S. alba, L.—Great Clacton to Little Holland.

S. cinerea, L. and *S. caprea*, L.—Great Clacton.

Populus tremula, L.—Great Clacton.

Quercus pedunculata, Ehre., is the common Oak of the district.

2 On the authority of Mr. F. Archer, of Block-house Wick, I can state that this is so. The local tradition is that the tree grew from the stake thrust through the body of one Bocking who had committed suicide, and was in consequence buried at the cross-roads. Stakes from the commoner elm of the country-side do not readily take root and grow.
—W. Cole.

There is a well-grown tree of the sessile-fruited Oak *Q. sessiliflora*, Salisb., in a hedge near Sladburys.

Sparganium ramosum, Curt.—Reed swamp, West Clacton.

S. neglectum, Beeby.—Ditch between Little Clacton and Bocking's Elm.

Zannichellia pedicellata, Fries.—Roadside pond near Cross House.

Alopecurus myosuroides, Huds.—Field between Great Clacton and Great Holland.

Festuca rigida, Kunth.—Cliffs.

Hordeum marinum, Huds.—Brightlingsea Creek, etc.

Polypodium vulgare, L.—St. Osyth.

Equisetum maximum, Lam.—Cliffs from Clacton Cliff to Holland Cliff.

NOTE.—Since the above was written there has been published the first volume of the *Cambridge British Flora*. In that work Dr. Moss places, as he says with some misgivings, under the name of *Salicornia prostrata*, Pallas, the prostrate herbaceous Glass-worts. From the description and figure, *S. prostrata* is the name which must be used for my much-branched prostrate plant that Dr. Moss called *S. ramosissima* forma *prostrata* or *S. appressa* Dum. In the same work is described the hybrid *S. disarticulata* × *gracillima*, which Dr. Moss has recognised among plants collected in Dorset by the Rev. E. F. Linton, and among a gathering of *S. disarticulata* made by myself in Essex (*i.e.*, St. Osyth). It is noted that the hybrid is "very rare. Dorset and Essex. Not known elsewhere."

Salicornia herbacea, L., the common Glasswort, that I omitted to mention, was collected by myself at Brightlingsea Creek.—C. E. B.

ON THE OCCURRENCE OF RHAXELLA-CHERT IN EPPING FOREST GRAVELS.

By PERCY G. THOMPSON.

[*Read 29th November* 1913.]

SOME years ago I devoted a considerable amount of attention to the rock-constituents of the gravels of the Epping Forest district, with a view to obtaining some light on that fascinating geological problem—the places of origin of the heterogeneous pebbles which occur, in greater or lesser numbers, in all the surface drifts of southern England. I gave special attention to a gravel-pit in the Forest, lying to the south of Monk Wood, from which the Loughton Urban District Council dug road-metal from time to time, and my almost constant watch upon this pit during the years 1906 to 1908 was rewarded by a very respectable assemblage of "travelled stones" from diverse beds.

The Monk Wood gravel is a remnant of the highest terrace of the Roding Valley Drift, at about 280 feet above O.D., laid down prior to the invasion of the district by the Chalky Boulder Clay, which latter occurs (within three miles), lying *on the slopes* of the river valley at various levels down to about 150 feet above O.D. The pit shows inconstant layers of current bedded sand interbedded with the gravel, and a capping of some two feet of brick-earth containing a few stones occurs wherever the original surface has not been disturbed by shallow diggings for sand and ballast—a common practice in the past all over the higher portions of the Forest.

The constituents of the Gravel in this pit include various igneous and metamorphic rocks, usually in a very friable and decayed condition, such as granites, mica-schist, garnetiferous schist, vesicular purple trap, and a few basalt fragments. Carboniferous sandstones and chert containing *crinoid-casts* are frequent, many Bunter-Sandstone and quartzite pebbles occur, but there is an almost total absence of Jurassic rocks or of fossils derived from them. Radiolarian chert and rhyolite of unknown derivation are found. Cretaceous *débris* is represented by nodular, unworn chalk-flints (the largest being over 13 inches long), which cannot have been exposed to much rolling during their journey from the nearest outcrop of the Chalk to the north-west. Various kinds of chert occur in this gravel, but

little (if any) that can be labelled as from the Lower Greensand. Eocene rocks are represented by small sarsens, by siliceous sandstones containing flint-splinters, and by rounded flint pebbles derived from Lower Tertiary beds. A small decayed *Belemnite* (possibly from the Chalk), and some fragments of shells of *Inoceramus* (certainly from the Chalk), are practically the only derived fossils noted, other than the crinoids and sponge-spicules preserved in some of the chert fragments; and of contemporaneous fossils, or of unquestioned human implements, no trace has been found. The workmen state that neither bones nor shells have ever been seen by them in this gravel.

The above assemblage of rock-fragments points to derivation approximately from the north-west, but as this Monk Wood Gravel is certainly Pre-Chalky Boulder Clay (which by no means implies Pre-Glacial) the agency by which these far-travelled rocks reached the gravel, in common with some high-level gravels of the Thames Valley (as, for instance, that at Dartford Heath, in Kent, where a very similar set of rock-constituents is met with), remains open to debate.

No signs of contortions or "trail" have been observed in the Monk Wood gravel, and the overlying brick-earth rests with perfect conformity upon it, but, in September 1907, I found one waterworn piece of a crystalline felspathic rock which showed faint but certain striæ and polish.

One remarkable rock which occurred not infrequently in the Monk Wood gravel interested me greatly, both from its beauty when viewed with a pocket-lens, and also because one or two fragments contained casts of fossil shells. It occurred usually as angular or cuboidal pieces, the angles rounded, but otherwise little rolled, up to five inches by $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches, but sometimes as fully rounded pebbles. Fractured surfaces show an uniform buff colour, but weathered exterior faces may be bleached white, or stained deeper yellow by iron. When examined with a lens, a regular minutely vesicular structure is apparent, resembling delicate lacework.

Not until the present year (1913) was the identity of this interesting rock made known to me. Last spring I attended an excursion of the Geologists' Association to Dartford Heath in North Kent, and there, in high-level gravel at 130 feet above

O.D. (the highest terrace of the Thames Valley Drift), I found a typical pebble of my Monk Wood rock, containing casts of an *Ammonite* (probably a juvenile specimen of *Cardioceras cordatus* ?) and of a bivalve shell (? *Lucina*); and Mr. A. L. Leach, F.G.S., who conducted the party, was able at once to identify the specimen as being Rhaxella-Chert, derived from Jurassic rocks of Corallian age.

This chert occurs *in situ* over a limited area at Arngrove, near Brill, in Buckinghamshire; and has also been described from the neighbourhood of Scarborough, Yorks. In both localities, the geological horizon is the lower portion of the Coral-Rag, *i.e.*, the Lower Calcareous Grit, immediately above the Oxford Clay. The minute coral-like structure is due to myriads of globate spicules of a tetractinellid siliceous sponge to which Dr. G. J. Hinde gave the name of *Rhaxella perforata*; alike in the parent rock and in my Valley Drift pebbles many of the spicules have disappeared by solution, leaving minute spherical cavities surrounded by a delicate meshwork of the cherty rock.

A full account of the rock and its mode of occurrence in Bucks is given by Dr. A. M. Davies, F.G.S. (in *Quarterly Journal of the Geological Society*, 1907), who describes it as a thinly bedded stone broken up *in situ* into roughly rectangular blocks, sometimes as much as four inches square and 1½ inches thick, but often smaller: and Mr. E. T. Newton, F.R.S., contributed a Note on the few Drift specimens of this chert in *Proc. Geologists' Association*, xx., 1907, p. 127.

Dr. A. E. Salter found fossiliferous pebbles of Rhaxella-chert in the Cromer Drift, and Dr. A. Irving writes me that he has it rather frequently in the Upper Rubble Drift of the Stort Valley at Hockerill, near Bishops Stortford, at about 200 feet above O.D.

I have myself met with this Chert, in addition to the places already mentioned, at Coopersale Common, one mile east of Epping, in high level gravel (at about 340 feet above O.D.) included by Prestwich in his "Westleton Beds," but which is not improbably, in my opinion, a continuation of the highest terrace of the Roding Valley Gravel referred to above. Recently (September to November 1913), a small temporary gravel-pit on the Uplands Estate at Loughton, opened for road-ballast, together with the adjoining Loughton Cemetery, has yielded

several pieces of the same rock, containing partial casts of a *Trigonia* (perhaps referrable to *T. clavellata*), of *Pecten fibrosus*, and of (?) *Ostræa*, associated with basalt, Millstone Grit, Bunter quartzites and sandstones, and crinoidal chert fragments, this exposure, at just under 250 feet above O.D., being in a somewhat lower terrace of the Roding Valley Gravel than is the Monk Wood pit. I have also found fragments of Rhaxella-chert in low-level Roding Valley Gravel at Bonner's Pit, near Abridge, at about 80 feet above O.D., and near Hill's Farm, in Theydon Garnon parish, at under 100 feet above O.D.; and I have a specimen taken in 1906 from mid-Glacial Gravel at Netteswell, at about 230 feet above O.D.

It is therefore clear that this distinctive and easily recognisable Chert, which occurs as pebbles in Valley Drifts at Dartford Heath, in Epping Forest, at Loughton, at Coopersale, at Abridge, and at Theydon Garnon, as well as in (presumably) Glacial Drift at Cromer, and certainly at Netteswell, has been derived by some agency from rocks of Corallian age which are *in situ* to the west or north-west of the places mentioned, their nearest occurrence to the Epping Forest district being over 50 miles distant in a straight line. Whether the pebbles actually came from the Arngrove district in Bucks, or from some other, more northerly, point of the long and almost continuous strip of Corallian rocks which outcrop across England from Weymouth to Scarborough, but where as yet Rhaxella-chert has not been recognised *in situ*, must remain for future determination.

One of two hypotheses is tenable. Either the Rhaxella-chert, and the associated Triassic and Carboniferous debris, together with the igneous and metamorphic rock fragments, reached the Roding gravels, indirectly, by ice-agency in the earlier stages of the Glacial Period, prior to the period of maximum glaciation of this country as represented by the Chalky Boulder Clay, or, alternatively, the Roding must once have had its head waters farther to the north-west, beyond the present Chalk escarpment, so as to derive its materials from the Jurassic plain beyond. The latter hypothesis is, however, exceedingly unlikely, in view of the fact that the parent rock at Arngrove lies at under 350 feet above O.D., whilst at Coopersale, more than 50 miles distant, Rhaxella-chert pebbles have been found at 340 feet, and in Monk Wood at 280 feet above O.D., a gradient

much too slight to permit of the transport of large pebbles by fluviatile action alone ; and I am strongly averse to postulating differential earth movements of comparatively late date in order to give a greater declivity. This old gravel is certainly water-laid, and seems to be a Valley Gravel laid down by an ancient river following approximately the same course as the modern river Roding ; it is nevertheless not a post-glacial deposit, but interglacial, and earlier than the Boulder Clay ; and so may rightly be classed as a " Glacial Gravel."

On the evidence, we may reasonably conclude that this old river-gravel is largely made up of materials re-sorted from an earlier Glacial-gravel. The so-called Glacial Period is known to have been an immensely long epoch, or, rather, a series of epochs, broken by several mild interglacial periods, themselves of very long duration.[1] During one of the earlier interglacial periods, and before the advent of the glacier-borne Chalky Boulder Clay, the older Roding gravels were laid down from materials brought by ice-action from distant sources lying to the north-west into the catchment area of the river.

At the time the Roding was laying down its higher terraces, its lower course would appear to have been quite different from what it now is. It then probably flowed in a south-westerly direction between Loughton and Buckhurst Hill and to the *north* of the latter place,[2] thence taking its course across Fairmead and Chingford Plains to ultimately join with the Lea, which, like itself, is older than the Chalky Boulder Clay. The small isolated gravel-patches at Strawberry Hill and Earls Path (at 244 feet above O.D.), at Hill Wood (at 267 feet above O.D.), at Warren Hill, Loughton (at just over 200 feet above O.D.), by Queen Elizabeth's Lodge (at 189 feet above O.D.), at Cuckoo Pits (at something under 200 feet above O.D.), at Bury Farm, Sewardstone (at just over 200 feet above O.D.), at Yardley Hill (at 218 feet above O.D.), and at Friday Hill, Chingford (at 190 feet above O.D.), are, if my view is correct, the still remaining evidences of the Roding's earlier course.[3]

In conclusion, I have to express my indebtedness to Mr. E. T. Newton, F.R.S., for very kindly confirming my provisional identifications of the fossil casts in the Rhaxella-chert.

1 It is even possible that the Recent Period in which we live may be itselt but an under-glacial phase, destined to be followed by a return of Glacial conditions in due course.

2 This might account for the different character of the Buckhurst Hill gravel (which is stated to contain no northern rocks) if we assume that a southern tributary of the ancient Roding brought down the gravel at Buckhurst Hill, then lying to the south of the latter river ; but I have no personal acquaintance with the Buckhurst Hill gravel constituents, so cannot confirm the statement.

3 Mr. Hazzledine Warren has already suggested this in *Proc. Geol. Ass.* xxi. (1910), p. 454.

ON CERTAIN BOTANICAL AND GEOLOGICAL OBSERVATIONS MADE DURING THE OPENING OF THE ROMANO-BRITISH BARROW ON MERSEA ISLAND.

By S. HAZZLEDINE WARREN, F.G.S.

[*Read 29th November* 1913]

BEING the Report on an Investigation undertaken by the Morant Club, with a Contribution by Mr. G. M. Davies, F.G.S., and a Prefatory Note by the Hon. Secretaries of the Club.

(1.) *PREFATORY NOTE.*—During the summer of 1912, the large Barrow (22 ft. 6 in. high and about 110 ft. in diameter) which stands prominently on the northern edge of the small central plateau of Mersea Island, about half-a-mile south-east of the Stroodway, was opened by this club, with the permission of the owner, Mr. Charles Brown, and under the personal superintendence of our member, Mr. Hazzledine Warren.

The result was the discovery of a very interesting Romano-British Interment, apparently of the second half of the first centrury A.D., and evidently that of some person of great importance—probably a British Chieftain ruling under Roman suzerainty, rather than an actual Roman.

The tomb consisted externally of a cist or chamber, substantially constructed of Roman tiles, mortar, and boulders. This contained a leaden casket, about 13 in. square, within which was a beautiful globular urn, of sea-green glass, nearly thirteen inches in diameter, having a broad flat recurved rim. This glass urn held the incinerated remains of an adult. The contents of the tomb are now in the Colchester Museum.

A full account of the results achieved from the archæological point of view has been published already[1]. The present report deals only with certain incidental results which are of botanical and geological interest. These could not be included appropriately in the archæological report and are, therefore, now treated separately here.

We wish to repeat our statement, made in the general report,

1 *Trans. Essex Archæol. Soc*, n.s. vol. xiii., pp. 116-139 (1913).

that the Morant Club is under a deep debt to Mr. Hazzledine Warren for the very great amount of time, care, and skill he devoted to the supervision of the work of opening the barrow.

MILLER CHRISTY,
FRANCIS W. READER, } *Hon. Secs.*

(2.) *BOTANICAL OBSERVATIONS.*—Towards the completion of the digging, when the workmen had reached the original level of the ground beneath the centre of the barrow, I noticed that the soil which had formed the original surface was rich in the seeds of plants; and it occurred to me that the examination and identification of these seeds might prove of much interest as throwing light upon the flora of the district in Roman days.

Accordingly, I washed out a large quantity of the soil which had formed the original surface (it must have amounted, I think, to a hundred-weight or more in all) and made an extensive collection of the seeds contained in it. These I submitted to Mr. Clement Reid, F.R.S., who kindly undertook their determination.

The result proved that the species present were neither very numerous nor particularly interesting. Indeed, the result hardly repaid one for the amount of labour that had been bestowed upon the collection. The following is the list of species identified:—

Ranunculus bulbosus
Fumaria officinalis (*abundant*)
Raphanus raphanistrum (*abundant*)
Spergula arvensis? (*badly preserved*)
Montia sp.
Lycopus europæus
Galium sp.
Scrophularia sp.
Stachys betonica
Chenopodium bonus-henricus
Chenopodium sp.
Polygonum aviculare
Rumex acetosella? (*nut only*)

In addition to the above, there were seeds of two or three other common wild plants which Mr. Reid hesitated to identify.

Mr. Reid remarked that the assemblage is that of plants which grow habitually on wet meadow land. One noticeable feature of the list is that it includes no cultivated plants. The abundant remains of Fumitory and Wild Radish were rather suggestive of former cultivation ; but, as both these plants have been found fossil in British Pleistocene deposits, their evidence is inconclusive on the point.

Further, I washed out samples, selected from various levels, of the grey material which composed the core of the barrow. These yielded seeds which appeared to me to represent the commonest species in the above list ; but, as those seeds actually identified gave so little information of interest, these others have not been determined in detail.

The original surface beneath the barrow likewise yielded a little moss, and the elytra of beetles. These have not been determined ; but, together with a series of the seeds, they have been placed in the keeping of the Essex Museum of Natural Histroy at Stratford.

(3.) *GEOLOGICAL OBSERVATIONS.*—I submitted five samples of the material of which the barrow was built to Mr. G. M. Davies, F.G.S., of the Imperial Institute, South Kensington, and I am indebted to him for the following report upon them :—

(1.) *Ironstone at* 10ft. 6*in. from top of mound.*

Two pieces of coarse sand and earth cemented by hydrated oxide of iron. A film of black or dark red limonite is generally visible near the centre of the slab, and the degree of cementation diminishes above and below this, giving a fairly-compact slab about ¾ inch thick.

The less-ferruginous outer portions can be crumbled and washed clear in water, the binding material being little more than ochreous clay. A clean quartz-sand results, with a little flint in the form of pebbles and splinters. Small pieces of black coaly matter are present, probably charcoal. On heating, the ironstone produces an "organic" smell, and results in reduction to magnetic oxide of iron.

The heavy minerals in the washed sand, apart from abundant spheroidal concretions of impure limonite, are ilmenite, garnet, zircon, tourmaline, rutile, staurolite, hornblende, epidote, kyanite, and andalusite.

(2.) *Grey Material at* 11 *feet.*

Grey loamy sand with flint pebbles. Two fragments of red chert were also noted. Under the microscope these appear rather coarse in texture, with cylindrical inclusions of iron oxide. These appear to represent sponge spicules, one example in particular resembling part of a tetractinelled spicule. Small fragments of charcoal and numerous rootlets

are noticeable on panning. The washed product is a coarse white sand, mostly quartz with a little flint and felspar. The heavy residue is mainly limonite, but garnet, ilmenite, zircon, kyanite, rutile, tourmaline, staurolite and hornblende are also present.

(3.) *Grey Material at* 19 *feet :*

Very similar to the last sample. Pebble other than flint rather more numerous. They include coarse spicular cherts, red and white ; a spiculiferous sandstone (? Upper Greensand) ; brown sandstone ; bits of ironstone bands ; and two pebbles of white quartz. Fibrous rootlets, small fragments of charcoal, and a beetle's elytron were noticed.

The heavy residue, as usual, is chiefly earthy limonite, with small amounts of garnet, ilmenite, tourmaline, zircon, rutile, staurolite, kyanite, hornblende, and probably andulusite.

(4.) *Red Stratum at* 22ft. 6*in.*

Lumps of red and brown earthy material. On washing, much coarse material and sand are left, the former consisting largely of irregular lumps of burnt clay. There are also flint pebbles, spiculiferous cherts, chalk, yellow ochre, and calcareous lumps containing bits of burnt clay (? mortar). Rootlets and lumps of charcoal are fairly abundant.

The heavy residue is chiefly limonite with small amounts of garnet, tourmaline, staurolite, zircon, ilmenite, kyanite, rutile, epidote, and hornblende. Splinters of organic (?) material were also seen ; they had a high refractive index and low bi-refungence—like apatite. These may have been present also in the other samples, but HCl was used in these cases to eliminate limonite before the heavy residue was examined.

(5) *Samples from washings of the original surface at* 23 *feet below the top of the mound* :

About a dozen fragments, mostly burnt clay, red and whitish chert with cavities (? are these due to solution of the ferruginous oasis of spicules), and earthy aggregates with slight ferruginous cement.

G. M. DAVIES, 27th June, 1913.

The most important result arising from Mr. Davies' examination of these samples lies in the light his report throws upon the constitution of a certain remarkable stratum of red material which was met with in the lower portion of the barrow. This stratum consisted chiefly (as is stated fully in the general report) of crushed red Roman tile and yellow ochre. The materials of which it was composed had clearly been strewn over the tomb after this was closed, the stratum being as much as two inches thick at the centre, and gradually thinning out to nothing at 15 or 20 feet from the tomb. I have found that, if the Red Stratum material be examined as a solid object under the microscope, without washing, the proportion of ochre is seen to be much greater than appears from the washed residue.

Indeed, it is essentially to the ochre, and not to the fragments of crushed red tile, that the band owes its colouration.

The origin of the ochre is discussed in the general report, but it may be desirable to state here that the only explanation of its presence I can suggest is that it was associated with the ceremony of the interment. The association of ochre with funeral ceremony is a widely-spread custom. Sometimes it is used for painting the bodies of the mourners: sometimes it is placed with, or over, the interment itself. It certainly appears that some such custom is indicated by the evidence of the Mersea barrow.

Immediately overlying the red stratum, a considerable amount of wood charcoal was found upon the eastern side of the tomb, the other sides not having been excavated. This is probably another relic of the funeral ceremony, although it cannot represent the pyre on which the body was cremated, because the red stratum, which underlies it, was itself deposited subsequent to the closing of the tomb.

NOTES ON ESSEX GEOLOGY AT THE LATTER END OF THE NINETEENTH CENTURY, AND AFTER.

Being the Presidential Address, delivered on 28th March 1914.

By W. WHITAKER, B.A., F.R.S., F.G.S., etc.

I STARTED these notes with the ambitious intention of making them supplementary to the five Geological Survey Memoirs that describe the ten sheets of the old map illustrating Essex.

These Memoirs, however, vary greatly in their date of publication, ranging from 1877, in the case of the little Memoir on Walton, to 1889, when "The Geology of London, etc." appeared, in two vols. I have not had time to undertake the task suggested; but have had to limit my work to what has been done after the year of the last named Memoir; so that we begin with 1890, and by doing this we are able to start with our great Tertiary geologist Prestwich, in whose steps I have been proud to follow.

Then I have had to impose other limits: Firstly by ruling

out our own publications, which ought to be known to all our members. These notes are really done for the Essex Field Club and not for the world at large, which latter body, of course, should take into account the work of the former. What I have sought to do is to give you some sort of idea of what geologic work has been done on our county from outside the Club.

Papers on Essex geology have mainly appeared in three publications, the *Journal of the Geological Society*, the *Proceedings of the Geologists' Association* and the *Geological Magazine*.

Secondly, I have had to neglect the accounts of the various Excursions of the Geologists' Association, in which there is much relating to Essex.

Thirdly, papers dealing essentially with questions of water-supply have been neglected, for the good and sufficient reason that they are being dealt with elsewhere, in a Memoir on the water-supply of the county.

Fourthly, various short notes and incidental references have been passed over. But I trust that nothing of importance has been missed.

Considering the length of this address, I think that you ought to be grateful to me for the above-noted omissions, and I hope that you will bear with a few remarks made on some of the works noticed.

Of course the following notes are only indications to workers in various geologic fields as to where they must look for information. They may be enough or more than enough for most of you, but the specialist must labour for himself.

1890.

In his paper on the Westleton Beds (part ii.) Sir J. Prestwich devotes some pages to Essex.[1] He classes with these beds the gravel of Walton-on-Naze, with doubt part of that of the cliffs westward from that place to Clacton, some in the Sudbury district and near Marks Tey, near Witham, Braintree, Thaxted etc. But in all these cases, despite the pebbly character of the gravels, I am inclined to adhere to the classification of the beds with the gravel below the Boulder Clay (generally known as Middle Glacial) rather than with the older gravels

1 *Quart. Journ. Geol. Soc.*, Vol. xlvi., pp. 128-136, 144, 245.

of Westleton, etc. In the case of Clacton the gravel may be still newer.

Our nearer neighbours, the gravels of High Beach and Jacks Hill, I have practically classed, as Prestwich does, with the Westleton Beds, although not using that name, but being content with "pebble-gravel," on the Geological Survey Map 1 N.W.

The conclusions drawn as to the relation of the Westleton Beds to the Glacial Drift of the Thames Valley depend so largely on the correctness of the classification, as given above, that I think we should be cautious in accepting them until we can be more certain, and certainty in the classification of gravels seems often to be far off.

Part iii. of this set of papers treats of the Hill Gravels of the Warley and Brentwood Groups, including those of Rayleigh and Langdon Hill. Whilst saying that "there can be no doubt of the Pre-Glacial age," the author hesitates to include them with his Southern Drift (to which this part chiefly refers), though he does not class them as Westleton Beds.[2] I cannot but think that not only have some of these gravels "the essential character of a Bagshot pebble-bed," but that they are such, and not Pre-Glacial Drift.

The relation of these various beds to the erosion of the Weald is really beyond our Essex view; but in the genesis of the Thames we are concerned (though topographically more with its latter end). The author (who thinks that this origin dates "from late Pre-Glacial or early Pleistocene times"), well says: "This is a branch of geology which opens some very large and interesting problems. . . . Owing to the vast erosion of the surface, the evidence respecting the older Drifts is generally very fragmentary, and has often been entirely swept away. Some speculation is therefore unavoidable, though it is essential that the consequences that may result from hypothetical assumptions should be in harmony with the results of observation." (pp. 179, 177).

In this year I gave some details of the deep channel of Drift in the head-part of the valley of the Cam, which channel had been proved to a depth of 340 feet, without reaching the bottom, carrying the Drift to considerably below sea-level.[3]

2 *Quart. Journ. Geol. Soc.*, Vol. xlvi., pp. 162-165, 177.
3 *Quart. Journ. Geol. Soc*, Vol. xlvi., pp. 333-340.

This is now alluded to because, although no classification of the Drift beds was given (either in the paper or elsewhere), I was disposed to regard those beds as belonging to the lower division of the Glacial Drift, that is as being older than what is generally known as the Great Chalky Boulder Clay. P. G. H. Boswell, however, as the result of much good work in the eastern counties, regards the various infillings of such channels (as at Sudbury and the opposite part of Essex) as belonging rather to the Boulder Clay.

I have never liked the name given to that clay : it is certainly great ; but, as far as I know, other Boulder Clays are just as chalky. As a rule adjectives are awkward things in geologic nomenclature, and I have generally been content to honour this particular clay as *the* Boulder Clay, leaving the various other and much smaller beds of like character in the position of poor relations, more or less without a local habitation or a name.

Since this date further sections have given further proof of this channel.

B. B. Woodward's long paper on " Pleistocene Non-marine Mollusca,"[4] deals with those from the Alluvium at the Royal Albert Dock, Tilbury Dock, and the Lea Valley at Walthamstow, and from the River-Drift at Grays, West Thurrock, and Ilford, with notes on some of the species and a full list.

In his " Notes on Pleistocene Sections in and near London " W. J. Abbott describes a section[5] at West Thurrock (pp. 476-478) which, however, is wrongly given as four miles west of Grays, being really less than three. It shows the Drift banked up against a chalk-cliff (*not* escarpment as it is termed). The precise site is not given ; but the author is not right in suggesting that no section (of the kind) so far west had been published : it may be that it is really the same as one of the two described in 1889 in the *Geology of London*, etc., vol. i, p. 418, which work apparently the author had not seen. He gives more details, however.

C. Reid's monograph on the " Pliocene Deposits,"[6] is of course chiefly concerned with other counties, Essex being specifically referred to only on pp. 82–85 and in most of the voluminous lists of fossils. Of the Upper Crag he says :—

4 *Proc. Geol. Assoc.*, Vol. xi., No. 8, p. 335, etc.
5 *Ibid.*, p. 473, etc.
6 *Geological Survey Memoir*, pp. viii., 326, 5 plates.

"What appears to happen is, that successive stages . . overlap each other as they are followed northward. At the southern extremity of the area, at Walton, we find the oldest Red Crag, a deposit yielding a fauna closely allied to [that of] the Coralline Crag. A few miles northward this is lost," in Suffolk.

1891.

H. W. Monckton and R. S. Herries described Hill Gravels north of the Thames[7] and largely in Essex. They describe (pp. 109–111) sections at Billericay (chiefly of flint-pebbles), Norton Heath (to a great extent of flint-pebbles), and the Epping Hills. They criticise some of Prestwich's views.

1892.

In this year our Past President, T. V. Holmes, contributed a paper on the railway from Grays to Romford, which is of importance to Essex geologists,[8] because it records the presence of Boulder Clay in the Hornchurch cutting, in a slight hollow of London Clay and overlain by gravel, which spreads over it on to the London Clay, at either end. The gravel belongs to the highest terrace of the old Thames Gravel, that often described as the 100 foot terrace, and were it not for this cutting the existence of Boulder Clay beneath the gravel would not have been seen.

I visited the section when it was clear and not overgrown, and I want no better evidence that the highest and oldest terrace-gravel of the Thames Valley is newer than the Boulder Clay, a conclusion inferred only beforehand.

It follows therefore, that the erosion of the valley is Post Glacial, to a large extent at all events.

1894.

T. V. Holmes supplemented his paper of 1892 with notes on the railway from Romford to Upminster[9] and described the Romford cutting as showing at one part a slight hollow of silt with sand and pebbles, between the gravel and the London Clay. This material seemed "to be a fragment

7 *Proc. Geol. Assoc.*, Vol. xii., pt. 4, p. 108, etc.
8 *Quart. Journ. Geol. Soc.*, Vol. xlviii., pp. 365-372.
9 *Quart. Journ. Geol. Soc.* Vol., l , pp. 443-452, 460-462.

of the silted-up channel of an ancient stream-course," and he thought "that the contents of this old silted-up channel had been very largely derived from the Boulder Clay."

At a later date, when I had the pleasure of being with him, we found, in another part of the cutting, a mass of Boulder Clay on "the same level as that at Hornchurch and similarly covered by gravel belonging to the Thames Valley system."

The author concluded that the Boulder Clay of Hornchurch and Romford, beneath the old River Gravel belongs "to some drainage-system more ancient than that of the present Thames," and he concludes that in the valleys of the Roding, near Romford, and of the Blackwater and its tributaries, around Chelmsford and Maldon "we have evidence of their excavation, to some extent, before the deposition of the Boulder Clay." As that evidence consists of the occurrence of Boulder Clay at comparatively low levels in places, I feel bound to say that I am not greatly impressed by it. The Boulder Clay so generally rests in a very uneven manner on underlying beds that one is almost bound to find it at a low level in some part of any valley that cuts through it. At the same time I am ready to allow that many of our valleys were started in pre Boulder Clay times.

1896.

F. W. Harmer, in treating of the Pliocene beds of Holland and their relation to the English and Belgian Crags, refers at some length to the Walton Crag, and gives a list of Mollusca found in it, and in the Scaldisian and Poederlian of Belgium. The conclusion he comes to is that the two Belgian deposits "are equivalent to the Walton stage of the Red Crag, and not to the whole of that formation," as had been supposed.[10]

Dr. A. E. Salter's paper on Pebbly Gravel[11] is of a general character. Our Essex examples come in under all the five types into which he divides the High Level Gravels of the Thames Valley (based on the constitution of the beds), and then those of N.E. Essex and of Essex Naze, are separately treated. I must own to some difficulty in following the author's somewhat complex arrangement.

10 *Quart. Journ. Geol. Soc.*, Vol. lii,. pp. 754-758.
11 *Proc. Geol. Assoc.*, Vol. xiv., pt 8, p. 389.

1897.

C. Reid gave us a list of "Pleistocene Plants from Grays," got from material collected by Prestwich many years before.[12] "The plants occur associated with, or below the remains of, mammoth and *Corbicula fluminalis*. They point distinctly to a temperate climate and mild winters." 15 kinds of plants were determined; amongst them ivy and poplar, which had not been recorded before as British fossils.

H. B. Woodward's Memoir on "Soils and Subsoils," was published in this year; but it is better to notice the second edition, of 1906.

1898.

Dr. A. Irving's paper on the geology of the Stort Valley[13] refers mainly to Hertfordshire, but touches on Essex, and the author thinks that "the Stort-Cam watershed about Elsenham may . . date from the Glacial Period," and that "the head-waters of the Cam (which are in our county) no doubt represent some reversal of drainage since Tertiary times."

In the Memoranda chiefly on Drift Deposits of Sir J. Prestwich,[14] we have a section at Victoria Docks, a section of Mr. Meesons [brickearth] pit at Grays, and notes of pits at Chadwell and Braintree (pp. 409, 410), varying in date from 1847 to 1855.

T. V. Holmes treated of deneholes[15] enforcing the arguments advanced in our own report on the subject, which really belongs to the domain of archaeology rather than to that of geology.

1900.

The second part of F. W. Harmer's essay on the "Pliocene Deposits of the East of England," is devoted to the Essex Crag, to which he gives the name Waltonian.[16] This is taken to be the oldest division of the Red Crag and is confined to Essex. These beds are distinguished "by the strongly marked southern facies of their molluscan fauna." The author divides the Waltonian into two zones, that of *Mactra obtruncata* above (at Beaumont, Oakley, Dovercourt and Harwich), and that of

12 *Quart. Journ. Geol. Soc.*, Vol. liii., pp. 463, 464.
13 *Proc. Geol. Assoc.*, Vol. xv., pt. 6, p. 224, etc.
14 *Geol. Mag*, dec. iv., Vol v., p. 404
15 *Ibid.*, p. 447.
16 *Quart. Journ. Geol. Soc.*, Vol. lvi., pp. 705-744.

Neptunia contraria below (at Beaumont and Walton-on-Naze), the two being also named as the Oakley Horizon and the Walton Horizon, a generosity of nomenclature that is hardly to be recommended.

A list of the mollusca "most characteristic of the Walton Crag" is given, with 66 entries, and it is followed by another list "of northern or recent species . . absent or rare at Walton," with 28 entries. This seems to be an important point, and it is one that does not always occur to the compilers of lists of fossils.

The richness of the Red Crag in fossils is well illustrated by the work done by Harmer at Beaumont. Many years ago John Brown, of Stanway, one of the old Essex geologists, got about 100 species of mollusca there, from a pit that was closed years ago; but was luckily re-opened in time to absorb some of the abundant Crag-hunting industry of the author, who succeeded in finding more than 260 species, including with very few exceptions, those listed as characteristic of the Walton Crag; but also including a few northern shells which are absent or rare at Walton.

At a new opening which he made at the south-western end of the Beaumont outlier Harmer got several species that were not found at the old pit, at the south-eastern end of the outlier, but which "are all characteristic of the still newer deposit at Little Oakley."

Five sections in the Little Oakley outlier are marked on Harmer's map, but apparently from one only, near Poulton Hall, did he collect, making up, however, for this by fairly exhaustive work. He says:—"As the Crag of Little Oakley appeared to be different in age from anything previously known, I determined to work it out as thoroughly as I could," and when such work has been done by Harmer there can't be much left for any one else to do.

He succeeded in getting "more than 350 species and well marked varieties of fossils, some of them new to science, and many of them known to Wood from the Coralline Crag only. The presence of so large a number of distinct forms in one seam, little more than 12 inches thick, and only 10 yards long, constitutes a striking illustration of the extraordinary richness of the molluscan fauna of the North Sea at that period." This

small section indeed has yielded far more species than those that make up the present molluscan fauna of that sea. We have here a fine example of what may be done by careful and systematic examination of a pit that seems to be insignificant, and this is a sort of work that is open to many who are prevented from going far afield.

The latter part of this paper (pp. 719–738) is of more general character and refers chiefly to Suffolk and Norfolk, in which the Crags are much more largely developed than in Essex.

J. Lomas' Appendix deals with the inorganic constituents, including the effect of percolating water, one case of which at the base of the Beaumont Hall section, is noteworthy here, The Crag rests on London Clay, " the sand and shells are black, and so thick is the encrusting material that no part of the original fragments can be seen." An analysis of the encrusting material is given, from which it is seen to differ little from other material in the pit, the notable points seeming to be the presence of a very small amount of manganese and phosphorus, ·21 per cent. of each. The rarer constituents of the Beaumont Crag are zircon, rutile, cyanite, andalusite, corundum, garnets, ilmenite, leucoxene, tourmaline, biotite, muscovite, and felspars.

M. A. C. Hinton dealt with the " Pleistocene Deposits of Ilford and Wanstead,"[17] describing sections in the High Terrace and in the Middle or Low Terrace, with figures of contorted beds at Ilford, from which place comes a list of 26 Vertebrata, chiefly Mammalia. He says that the high level Drift of this district " gives strong evidence of the rigorous nature of the climate during the earlier part of the Palæolithic period." But with the lower level Brickearth it is different, and we have a rich fauna, with southern forms. I am rather at a loss, however, when the author suggests that we should " regard these deposits as belonging to one of the interglacial periods since the formation of the great Chalky Boulder Clay," as I regard that as the latest truly glacial deposit in Essex.

The above-noted paper is followed by one on the " Pleistocene non-marine Mollusca of Ilford," by A. S. Kennard and B. B. Woodward.[18] Besides the lists given, from examination by the authors, there are nine recorded species of which they could

17 *Proc. Geol. Assoc.*, Vol. xvi., pt. 6, pp. 271-281.
18 *Ibid.*, pp. 282-286.

find no examples in the collections referred to. *Vitrea nitidula* was recorded for the first time, and fourteen other new records were made from a collection which was examined after the paper was read : a notable haul.

The first volume of A. J. Jukes-Browne's great monograph on the Upper Cretaceous rocks,[19] deals with the underground Gault of Essex on pp. 370, 372, 373, from the results of four deep borings. Of course we are bound to protest at Saffron Walden being placed in Suffolk, and I am not disposed to agree with the view that either from the total depth having been overstated, or from boring having gone askew, the Gault was not pierced there ; but of that I shall speak elsewhere.

1901.

The sixth and last edition of my little *Guide to the Geology of London*,[20] appeared in this year, and it has been long out of print. The new map of the London District having been issued, H. B. Woodward wrote in illustration of it " The Geology of the London District " (1909), and this being fuller and newer than the Guide, and at the same time no dearer, it has taken the place of the earlier work.

1902.

F. W. Harmer's " Sketch of the Later Tertiary History of East Anglia,"[21] covers much the same ground as his paper of 1900, so far as Essex Crag is concerned (pp. 430-442), and Essex Drifts are not dealt with.

1903.

In the " Summary of Progress of the Geological Survey for 1902," there is a short paragraph on Essex (p. 24), a note on the Woodford and Ilford Railway (p. 194), and an essay on the Drifts of the Thames Valley near London, by T. J. Pocock (pp. 199–207), in which a section at Upminster is noticed, as showing Boulder Clay beneath brickearth and said to be underlain by sand. This is no great way from the sections described by Holmes (1892, 1894). The author regards the brickearth

19 *Geol. Survey Memoir*, " The Cretaceous Rocks of Britain."
20 *Mem. Geol. Survey*, pp. x , 102.
21 *Proc. Geol. Assoc.*, Vol. xvii., pts. 9, 10, p. 416, etc.

as perhaps "part of an old glacial lake deposit," and is "led to the conclusion that the greater features of the Thames valley were formed before the climax of the Ice Age." But he adds that "there can be no doubt that much denudation of the Cretaceous and Tertiary formations was effected by the Thames and its tributaries long after the dissolution of the ice sheet." The various gravel-terraces are noticed and their formation discussed

Chapter xxxviii. of Jukes-Browne's *Cretaceous Rocks of Britain*, vol. ii.,[22] treats of the Middle Chalk of Cambridgeshire and North-east Essex; but the references are all to the former county. Clearly there is here an opening for observers. There is an error in the Index, where Essex is credited with something on p. 193.

What is presumably the best general account of the geology of Essex (up-to-date), was given by our Honorary Member, H. B. Woodward, in the *Victoria History of Essex*. In this essay the author discusses the question whether Coal Measures occur at a workable depth, but wisely refrains from giving a definite opinion. I take this chance of recording the loss to geology from the death of my old friend and erstwhile colleague in February of this year.

A short account of the Palæontology (Vertebrates only) is given by R. Lydekker, and under Early Man the Palæolithic Period is noticed.[23]

1904.

Dr. A. Irving, in dealing with "Plateau Gravels on the North Side of the Tamisian Area,"[24] supplements former papers. He notices the rock-constituents of the gravels, the chief characteristic of which is the abundance of quartzite-pebbles, etc., from the Bunter of the Midlands. "Not only are these gravels much older than the Boulder-clay. . . superimposed upon them, but their relation to the present river-drainage shows that they are older than even the pre-Glacial valleys of erosion in the Chalk." This argument may hold if the Glacial infilling of those valleys is not older than the Boulder Clay, as has been suggested of late years.

I must own to being staggered by the author's reference

22 *Mem. Geol. Survey.*
23 Vol. i., pp. 1-23, Geological Map, pp. 25-30, pp. 261263, plate of implements.
24 *Geol. Mag.*, dec. v., vol. i., p. 497.

to "a considerable outlier (of Bagshot Beds) near Sudbury in Suffolk," and hope that this is not on the Essex side of that border-town.

In his paper on "Minor British Earthquakes in 1901–1903,"[25] Dr. C. Davidson records two at Saffron Walden on 1st and 6th Nov., 1903, from information given by our member G. Maynard (p.541). These were distinct from the "spurious earthquake," also noted by our member, which was merely loud reports caused by the explosion of fireworks or dynamite by an army officer.

The Upper Chalk of Essex is alluded to in Chap. xviii. of the third vol. of Jukes-Browne's *Cretaceous Rocks*, where it is avowed that little is known yet. Unfortunately the sections of the Chalk Rock described under Essex on pp. 236, 237, except for the two at Great and Little Chesterford, are not in our county. A small list of fossils from the *Micraster coranguinum* zone at Saffron Walden is given on p. 239. Our southern outcrop, at Grays, is unnoticed. Here again is a field for our workers.

1905.

Dr. A. E. Salter's general paper on Superficial Deposits,[26] refers to Essex on parts of pp. 24–35 with a description of the rock-constituents of the gravels of Epping Forest, and other Essex hills eastward, and his conclusion, as far as Essex is concerned, is that the Lower Thames, the Lea, etc., must "be of recent formation; geologically speaking," by which I understand Post Glacial. In a like way are treated the gravels of the more northerly parts of Essex, under seven heads, with others, reaching across to the south-east, also under seven heads.

The paper on "The Relative Ages of the Stone Implements of the Lower Thames Valley," by M. A. C. Hinton and A. S. Kennard,[27] refers of course to our county, though very much more to Kent; indeed the paper may be described as general and Kentish.

In part x. of the *Final Report of the Royal Commission on Coal Supplies* reference is made to the deep borings at Weeley and Harwich, in the "statement" included in my evidence,

25 *Geol. Mag.*, dec. v., Vol. i., p. 535.
26 *Proc. Geol. Assoc.*, Vol. xix., pt. i., p. 1.
27 *Proc. Geol Assoc.*, Vol. xix., pt. 2, p. 76.

and it is suggested that we are "warned off this district (East Anglia) for trials for coal, at all events until more favourable evidence turn up." The reverse has happened so far.

1906.

The second edition of H. B. Woodward's *Soils and Subsoils* is a work that should be in the hands of everybody who has the faintest interest in the geology of the neighbourhood of London, dealing as it does with so many matters of general interest; sites for houses, water-supply, drainage, cemeteries. The various Geologic formations are described in groups according to their general composition: Gravel and sand, Mixed Subsoils, Clay, Limestone, and on the map they are grouped under Gravelly Series, Sandy Series and Clayey Series. This map alone is worth the price of the Memoir.[28] I leave you to appreciate the work for yourselves.

1907.

M. A. C. Hinton figures a molar of the Alpine Vole (*Microtus nivalis*) from the brickearth of Grays. The specimen was the first found "as a former inhabitant of Britain."[29] The species is here recorded also from Kent and Somersetshire. But see under 1910.

Vol. i, pt. ii of the *Report of the Royal Commission on Coast Erosion* contains some references to Essex (besides a good many of a general character), for which I am answerable, but I fear that they add nothing to what was known before (Evidence pp. 114, 116, 117. Appendices p. 144). The latter was thought worthy of reproduction in the *Geological Magazine* of 1909.

The Port of London and the Thames Barrage. A Series of Expert Studies and Reports,[30] though a book of a general character, refers to Essex. The geological conditions in the Tidal River are noticed, with a coloured geological map (from London to the sea). C. Beadle goes into the question of possible infiltration from the river (if a barrage were made), discussing the geological characters of the bed of the river and of the bordering marshes. The book should find a place in an Essex Library.

28 *Mem. Geol. Survey*, pp. vi., 82, coloured map. Price 1s. 6d.
29 *Proc. Geol. Assoc.*, Vol. xx., pl. i., pp. 41, 45.
30 Pp. vi., 193. 4to., Lond., many plates.

1908.

J. H. B. Jenkins gave us a rather rare thing, a chemical analysis of London Clay.[31] The sample was from a boring at East Ham, which, on being heated to 120°C. lost 20.7 per cent. of its weight, with a further loss of 6.3 per cent. on ignition. The residue consisted chiefly of silica, 67.9 per cent., with alumina 18.3

M. A. C. Hinton did us a service in discussing fossil monkeys, with reference to a specimen said to come from the Grays brickearth.[32] It had been doubted whether the specimen came from Grays, and it had been suggested that *Macacus* ought not to occur at Grays. But the author, discussing these questions, says that the Grays brickearth alone, amongst the Middle Terrace deposits, yields a southern fauna, and that for this reason and because the "mineral condition of the fragmentary jaw agrees with the other fossil bones from Grays," he regards "the only known specimen of *Macacus pliocœnus* as a genuine Grays fossil." So Essex keeps its monkey.

1909.

In this year the Geologists' Association celebrated its Jubilee in a remarkable way, said celebration for the most part extending over into the following year. The Jubilee volume *Geology in the Field* consists of a set of essays, mainly describing the geology of various counties or districts, as seen during various excursions of the Association ; but a good deal of other geologic matter was wisely included. Twenty-nine authors took part in the work, all of them of course well up in their special districts.

Essex is described by our old friend T. V. Holmes and his paper consists mostly (pp. 58–85) of a description of excursions that had been made to the following districts, many of which had been often visited: Grays Thurrock, Upminster, Ilford, Brentwood, Laindon Hills, Ingatestone, Rayleigh Hills, Chelmsford, Danbury, Kelvedon, Walthamstow, and Epping Forest. It will be seen therefore that it mainly deals with the southern and central parts of the county, the northern parts being alluded to only in the general account (pp. 51–57).

The veteran Norwich geologist, F. W. Harmer, contributed

31 *Geol. Mag.*, dec. v., Vol. v., pp. 265, 266.
32 *Ibid.*, pp. 442-444.

two papers "On the Pliocene Deposits," and on the "Pleistocene Period of the Eastern Counties." He re-states his classification of the Red Crag (1900, 1902), criticizing Prestwich's conclusions. Essex is referred to on pp. 89–91, 94–96. The second paper does not specifically refer to the county.

I take some credit to myself in regard to this great memorial volume, which was finished in 1910; firstly because I successfully avoided writing any contribution thereto, and secondly because I suggested and fought hard for the simple title *Geology in the Field*, under which it appears.

H. B. Woodward's *Geology of the London District* is one of the cheapest geologic works, and it certainly cannot be called by the other adjective usually associated with cheap; 150 large 8vo. pages and a coloured map are offered for one shilling. The Memoir is descriptive of the four sheets of the new Geological Survey Map of the London District (published in 1904) and gives us an account of the tract, brought up to the latest knowledge from the underground geology and the Chalk up to the Recent beds, with information on water-supply and other economic questions. With this and the work by the same author noticed under 1906 in their possession most people will be able to know as much about the geology of an area of something over 800 square miles (including the south-western corner of Essex) as they are likely to want.

1910.

M. A. C. Hinton, in a paper on "British Fossil Voles, etc.,"[33] had to revise his determination of a Vole from Grays. He says:—"The result of my study of the Grays fossils is that I am now unable to refer any of the voles from this locality to recent species." He notices five forms.

1911.

After 1900 the Geological Society left Essex alone for seven years, except for mere casual notices, and then we start again with a paragraph by S. H. Warren on a piece of worked wood from the freshwater deposit of Clacton.[34] The specimen has also been shown to us.

M. A. C. Hinton, whose industry and skill in working out the

33 *Proc. Geol. Assoc.*, Vol. xxi., pt. 10, p. 489, etc.
34 *Quart. Journ. Geol. Soc.*, Vol. lxvii., p. xcix.

smaller Mammalia is most praiseworthy, treated of "British Fossil Shrews."[35] He records one specimen from the brickearth of Grays, but refrains from naming it: it had previously passed as *Sorex vulgaris* (p. 533). The new species (*Neomys browni* also comes from Grays, and is known only from there. (p. 535.)

1912.

The Rev. E. Hill's paper on "Glacial Sections around Sudbury,"[36] deals with Essex as well as with Suffolk, as Ballingdon, on the right side of the Stour opposite Sudbury, is in our county, and is referred to on pp. 24, 26, 27. The author concludes that the Stour Valley is pre-Glacial, that a great mass of Boulder Clay has been removed, and that some of the low lying masses of Boulder Clay, which are in peculiar positions, were not formed in place, but "are as much boulders as any mass in the gravel; plainly they have been transported." All of them are below the level of the base of the great mass of Boulder Clay and are on the slopes of the valley and "clay can slip down very moderate slopes."

When, long ago, I first saw and recorded many of these most interesting sections (the finest set of inland sections of Glacial Drift that I have seen), I was greatly puzzled by them, and was disposed to regard these anomalous beds as belonging to the Lower Glacial of Wood. Mr. Hills' ingenious explanation is accepted by P. G. Boswell, who is working so well at East Anglian geology; but I think that the question can hardly be looked on as definitely settled; the infilling of our deep channels of Glacial Drift consists of other materials besides Boulder Clay.

S. H. Warren's paper on a Late Glacial Stage in the Valley of the Lee (with its various appendices by other authors) is based on sections just over the border, in Middlesex,[37] and does not deal specifically with Essex. Though therefore I may spare myself from noticing it, I am bound to add that no geologist has any business to deal with the valley that forms the border of our county without studying this elaborate work of our new President.

In this year there was a correspondence on the subject of

35 *Geol. Mag.*, dec. v., Vol. viii., p. 529, etc.
36 *Quart. Journ. Geol. Soc.*, Vol. lxviii., p. 23.
37 *Quart. Journ. Geol. Soc.*, Vol. lxviii., pp. 213-251.

the Red Crag shell with an incised face from Walton to which I refer readers who wish to enter into the controversy.[38]

1913.

In his Presidential Address Dr. A. Strahan dealt with the Palæozoic platform beneath the Secondary rocks[39] and Essex is in evidence on two maps, the first of which shows contour-lines of the Palæozoic Platform, only that for 1,000 feet below Ordnance Datum being drawn in our county at the south western and north-eastern parts : the second shows the contour-line of the base of the Gault, which is practically the same in Essex.

And now, having taken you along what I fear is a somewhat wearisome road, let us see if there are any general conclusions to be got from our journey.

In the first place we may congratulate ourselves that Essex geology has not been neglected by outside authorities ; for in the 24 years treated of, 1890–1913, only three times do we draw a blank (1893, 1895, 1899), and that perhaps is owing to some omission on my part. Were it not for the intentional neglect of certain matters (see above), there would certainly be an unbroken record.

Secondly if we roughly classify the subjects of the works noticed above we find about a dozen of a general or miscellaneous character. Our Chalk has but three short notices to its credit, and our Eocene beds only one little note. The Red Crag, of which we have but a small quantity, is dealt with in five papers. Coming, however, to the top of the geologic scale, the Drifts and the Recent beds are dealt with in twenty five papers, etc., some of considerable length, besides being referred to in general works.

Why is this ? It seems to me that there are five good reasons, and perhaps some of you can suggest more : 1, The wide-spread occurrence of the various deposits of late geologic age. Essex is essentially a Drift County, with a fair allowance of Alluvial marshes. 2. The fact that the study of the Drift was not taken up seriously until long after the earlier Tertiary beds,

38 *Geol. Mag.*, dec. v., vol. ix., pp , 95, 141 285, 334.
39 *Quart. Journ. Geol. Soc.*, Vol. lxix, p. lxx., etc.

and the Cretaceous beds were fairly well understood: indeed of old the Drifts were looked on as more or less of a nuisance, because they hid underlying formations, and were therefore, neglected. 3. Because of the varying characters and the irregular arrangements of the Drifts (not realised until the study of these beds was started), which give so wide a scope for opinions as to their age and origin and so full a chance for that controversial element that appeals so strongly to the geologic mind. 4. Because these late deposits bear so largely on past geographic questions, the origin of our rivers and valleys, the evolution of the present surface and its scenery. 5. Lastly, there is the fact that some of these deposits are more or less intimately connected with the life, both animal and vegetable, that now exists, and especially with the advent of man and the history of his early tools and weapons, subjects which seem to admit of almost boundless discussion, for we never tire of hearing of ourselves.

APPENDIX.

Since reading the above it occurred to me that it would be useful to give a list of the Geologists' Association Excursions in our County, especially as some of these refer to our somewhat neglected Chalk and Eocene beds.

Then it seemed that it would be useful, at all events to our new members, who may have only the late volumes of the Essex Naturalist, to have some reference to the papers in that Journal: so I have added shortened titles only of these (93), in chronological order, again excepting those relating to water-supply, as well as a few short notes. These also show an excess of work on Drift and Recent beds, adding but little matter on Chalk and Eocene beds; but they introduce papers on deep underground geology, on physiographic subjects, on earthquakes, subsidences and coast-loss: they therefore fill up gaps in the outside literature, and they certainly give further evidence of the activity of our members.

EXCURSIONS OF THE GEOLOGISTS' ASSOCIATION IN ESSEX.

Reported in their Proceedings 1890–1914. *Arranged in alphabetical order of the place or district visited.*

Ballingdon (under Sudbury), 1914; Chelmsford, 1891, 1895, ? Chingford, 1911; Epping Forest, 1896, 1910; Essex Museum; 1906; Grays, 1891 (and railway to Upminster), 1893, 1901, 1903, 1911; Ilford, 1893, 1899; Laindon Hills, 1907; Rayleigh Hills,

1906; Royal Albert Dock, 1914; Stanstead, 1905; Upminster (with Grays 1891); and Romford, 1892; and Warley and Brentwood, 1904; ? Walthamstow, 1892; Walton Naze, 1890; Wenden and Saffron Walden, 1911.

SHORT TITLES OF GEOLOGICAL PAPERS IN THE "ESSEX NATURALIST,"

Published 1890–1913.

1890. Relation of Natural History and Physiography of Essex to its Geology; Geological Rambles in the Braintree District; Sections between West Thurrock and Stifford; The Upminster Brickyard; The Boulder Clay in Essex (and in 1891, twice); Fossil Mammalia at Clacton.

1891. Undulations of the Chalk in Essex; Glacial Formation near Chelmsford; Geology and Scenery, Maldon to Chelmsford; Westleton Beds in N.W. Essex.

1892. Microscopic Fossils from Colchester Chalk; Earthquake Shock; Plateau Deposits at Felstead and Stebbing; Geology of District around Dagenham Breach.

1893. Railway between Upminster and Romford; Geology of the Neighbourhod of Chelmsford; Gravel in Epping Forest; Notes in the Neighbourhood of Ongar; Gravels near Barking Side, Wanstead and Walthamstow.

1894. Question of Workable Coal Measures; Coal under S.E. England; Pleistocene Mollusca, Walton; Geology of the Lea Valley.

1895. Geological Section at Chelmsford; Remains of Pleistocene Mammals, neighbourhood of Chelmsford; shells from Brickearth, Chelmsford.

1896. Geological Nature of Land fallen out of Cultivation; Notes on a Geologic Map; Mammalian Remains at Great Yeldham; Geology of Epping Forest; Ancient Physiography of S. Essex; Coal under S.E. England (two papers); Earthquake at Mersea and the Colchester Earthquake of December 17.

1897. Boring in Search of Coal (two papers); Post-Pliocene Non-marine Mollusca; Sections at Tottenham; Mollusca, Post-Pliocene, Felstead.

1898. Manganiferous Conglomerate; Fresh-water Chalk at Halstead; Subsidence of Cliff at Walton; MS. of J. Brown; Encroaching Sea; Effects of Great Tide of November 1897.

? 1899. Supposed Neolithic Settlement (Notes on Geology of Braintree District).

1900. New Section, etc., Ilford; Pleistocene Deposits of Ilford and Wanstead.

1901. Additions of Palæolithic Fauna, Ilford; Post-Pliocene Non-marine Mollusca of Ilford; Non-marine Mollusca of

Walton Crag; Pleistocene Non-marine Mollusca, Clacton; Eocene Fauna and Flora of Walton; Pleistocene Geology of Grays Area; Geologic Notes on Reservoirs near Walthamstow; Palæolithic Implements from Low-level Drift, Thames Valley.

1902. Manganiferous Seam in Drift at Ilford; Manganiferous Nodules in Boulder Clay; Excavations at Reservoirs, Walthamstow (two papers); Dug-out Boats (section); Railway between Ilford and Woodford; Walton and Frinton in 1902; Teeth of Rhinoceros from Ilford.

1903. Non-marine Mollusca of Alluvium at Walthamstow; Sections at Canning Town; Palæolith from Grays; Seeds in Alluvium at Walthamstow.

1904. Greywethers at Grays; Geology of Hainault Forest; Railway between Kelvedon and Tollesbury.

1905. Sulphate of Lime in Soils and Subsoils.

1906. Pile-dwelling near Braintree (sections).

1907. Subsidence at Mucking; Sections at Witham; Pelvis of Mammoth from Barking; Pleistocene Geology, Grays Area; Mammoth at Wrabness.

1908. Post-glacial Beds in Mersea; Subsidence at Grays.

1909. Palæolithic Implements of E. Essex.

1910. Subsidence of E. England; Geology of Grays District; Calcrete near Audley End.

1911. Prehistoric Floor (geologic references); Zonal Stratification of Pliocenes; Stony Beds underlying Harwich Harbour.

1912. Palæolithic Remains from Clacton.

1913. New Fossil Whale from Walton; Section at Temple Mills, Leyton.

EPPING FOREST FERNS.

By W. RICHTER ROBERTS.

MR. Roberts, in exhibiting at the meeting on 25th January, 1913, a set of the Ferns of Epping Forest, made the following remarks on the existing fern flora of the district:—

No doubt some of our members read with some scepticism the line on the agenda paper announcing my exhibit; there are few people, I believe, who know of the various species of ferns which still linger in the forest, although they are now fast disappearing. The climatic conditions of Essex are not favourable to luxurious fern growth and what growth there is seems often to be negatived by vandalism. I will, however, give a short account of the various species which I and my friends have found in the forest.

Bunches of Teasel-heads tied upon poles, so as to dry in the sun. Coggleshall, 1913.

Pteris aquilina (Brake or Bracken).—Very common and abundant.

Polypodium vulgare (Polypody).—A Fern found on pollarded hornbeams and old stumps. Used to be abundant, but has been reduced in numbers by the continued removal of the roots.

Ophioglossum vulgatum (the Adder's-tongue).—This species is not well known, as it dies away early in the summer and is only to be found by careful searching. Very abundant in places, and, I am glad to say, increasing in numbers.

Lastrea filix-mas (Male-fern).—A fairly common plant, but does not grow in the forest to any great size. I have found only one really fine specimen.

Athyrium felix-fœmina (Lady-fern).—Not quite so common as the Male-fern, but there are some fine plants still existing.

Lastrea dilatata (Broad Buckler-fern).—This is found often in the forest, but all the finest specimens have been removed one by one, and consequently the plants remaining average small size, with but few exceptions.

Lastrea oreopteris (*montanum*) (Mountain Buckler Fern), and

Blechnum spicant (Hard Fern) grow together in one or two places, but are not common.

Polypodium dryopteris (Oak-fern) and

Asplenium trichomanes (Maidenhair Spleenwort).—Both these have been recorded in one or two places, but have now disappeared.

These are the species which I have found actually growing in the forest, and I have photographs and preserved fronds of most of these for members to examine. I have also found *Polystichum aculeatum, Asplenium ruta-muraria* and *Asplenium adiantum-nigrum* in the neighbourhood of the forest, but not actually within its boundaries.

CULTIVATION OF THE FULLER'S TEASEL IN ESSEX.

By ALFRED W. DENNIS.

(*With Plate XIX.*)

IN August, 1909, while staying at an old farmhouse called Don John's, near Halstead, Essex, I was much surprised to find the Fuller's Teasel, *Dipsacus fullonum*, in cultivation at Burton's Green, a hamlet near by. I had sup-

posed it was entirely superseded by mechanical contrivances and had gone quite out of cultivation. It did not occur to me at the time that it was a desirable thing to be photographed, and the following year I was much disappointed to find the grower had moved away. It was, therefore, with great pleasure that I in the course of a ramble to Coggeshall in 1913 again came upon the teasels. In conversation with some men in an adjoining field, I learned that the grower was the same man who formerly grew them at Burton's Green. A biennial, like the wild teasel, of which it is usually regarded as a sport, in the second year it is planted out in rows about three feet apart, and in August the primary heads are ready to cut. They are tied up in bunches of about twenty, and not laid upon the ground, but hung upon any of the plants which happen to be convenient, as shown in the photograph. At one end of the ground is the drying shed, a rough structure, with open sides and thatched roof. Here the bunches are tied upon poles which in fine weather are stood out on the sunny side, but if there is any chance of rain they are placed inside, as it is considered undesirable that they should be wetted after being cut. As far as I could learn, no one else in the neighbourhood was engaged in teasel growing, so it is quite a small industry.

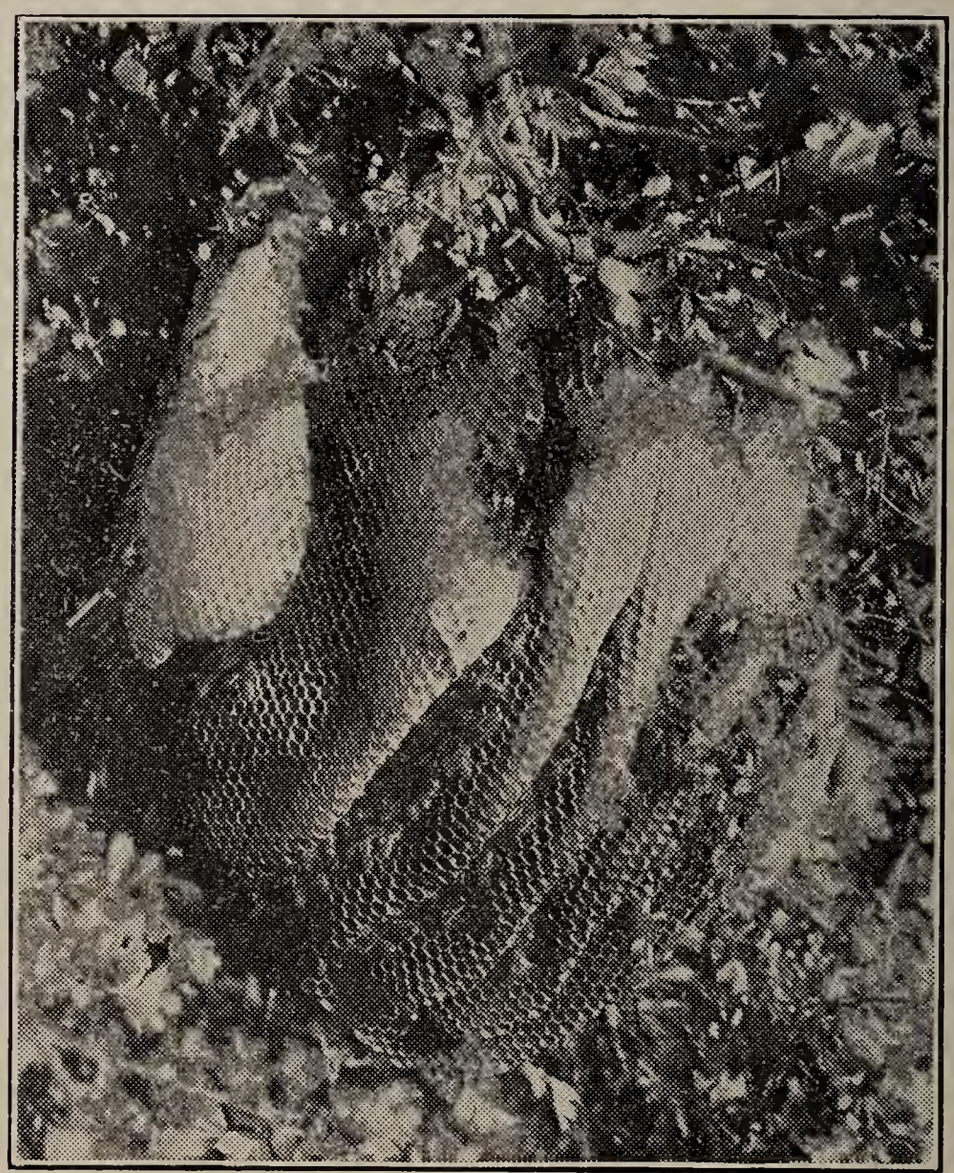
NOTES.—ORIGINAL AND SELECTED.

ZOOLOGY.

Honey Bees' Nest in a Hedge—In the *Essex County Standard* for 18th October 1913, the following interesting note appeared. "This shows a bees' nest discovered in a hedge at Upper Braiswick Farm, Mile End, Colchester, in the occupation of Mr. Strowlger. The nest is in the hedge of a private meadow adjoining Mr. Strowlger's house, and was not found until October 9, when Mr. Strowlger's son, who was in search of blackberries, discovered it. As a rule the scent of honey and the starting of a comb in an exposed position attracts wasps or other bees, with the result that the builders of the nest are destroyed. How these bees escaped is a problem. It must be added, however, that the nest was very much hidden by foliage, which had to

FULLER'S TEASEL GROWING AT COGGESHALL, AUGUST 1913.

be cut away (with some difficulty) to enable the photograph to be taken. Mr. Strowlger saw a swarm of bees, early in June, over his farm, but they went up high in the air and disappeared. It is supposed that these are the same bees. The comb is



BEES' NEST FOUND AT MILE END, COLCHESTER.

estimated to contain from 25 to 30lb. of honey." The photograph is by Mr. J. E. Stutter, Errington Road, Colchester, and the block is kindly lent by Mr. C. E. Benham.

Daphnia magna in Epping Forest.—At the meeting on 25th January 1913, Mr. Scourfield in exhibiting a living male *Daphnia magna*, said the specimen was noticed a week or two previously in a bottle containing water taken near Hunstanton in the summer, and in which females of the same species had lived continuously ever since. The males of the Cladocera

(Water-fleas) were by no means very common as, speaking generally, they were only produced for two comparatively short periods each year. In the case of species living in small ponds liable to be dried up in summer, males and ephippial females usually occurred in May or June, whereas in larger ponds and lakes the sexual period occurred normally in the autumn. It was most unusual to obtain males in mid-winter, but in this particular instance the artificial conditions under which the animals were living, namely in a small bottle in an ordinary room, may have been responsible for the production of the specimen shown.—D. J. SCOURFIELD, F.R.M.S., F.Z.S., *Leytonstone.*

Dalyellia diadema, Hofsten ; a rare Turbellarian Worm new to Britain.—A note in the present volume of the ESSEX NATURALIST (*ante* p. 142) records the occurrence of an interesting Turbellarian Worm, *Dalyellia viridis,* in a pond at Chigwell Row. Some water and aquatic vegetation were taken from the same pond in June 1912, and on allowing this to stand for a few days four or five specimens of a tiny species of *Dalyellia* were discovered. Notes and sketches of the characters were taken at the time and three specimens were preserved, but nearly a year elapsed before they were identified as *Dalyellia diadema,* Hofsten. Subsequent search in April 1913, resulted in the capture of one specimen, but this was sufficient to establish the identity beyond all doubt.

D. diadema was first described by Dr. Nilo Von Hofsten [*Zeitschrift für wissenschaftliche Zoologie* Bd Lxxxv (1907)], who found it in the Bernese Alps. It is about 1 mm. ($\frac{1}{25}$ inch) in length. The animal when swimming is spindle-shaped, the anterior being blunter than the posterior region. The length is about four times the breadth. The specimens obtained by the writer each contained a single egg. In *D. viridis* the number of eggs carried in the body cavity may exceed forty. *D. diadema* is almost colourless, there being no signs of " zoochlorellae " or algal cells.

Dr. Hofsten in a letter to the writer stated that he has not seen any specimens of *D. diadema* since 1907, and has not found any records of their occurrence since. Truly as Mr. Whittaker remarked " Even a worm will turn (up)—if searched for."—H. WHITEHEAD, B.Sc., *Essex Museum of Natural History, Stratford.*

BOTANY.

Lathyrus tuberosus at Dunmow.—On 3rd August, 1913, I found at Dunmow a species of *Lathyrus* which I identified as *L. tuberosus*. Not having heard of this plant ever being found in this neighbourhood, I sent it to the East Anglian Institute of Agriculture at Chelmsford for verification. The Principal, Mr. A. Malin Smith, M.A., very kindly wrote me that the specimen I sent *was certainly L. tuberosus*, and that he had never heard of it being found so far away from Fyfield as Dunmow. I found it growing in some grassland on a light clay soil about one hundred feet distant from the railway line, and about half a mile from High Street, Dunmow, in a S.W. direction. There were only about four or five plants spread over a patch some three or four feet square. I carefully covered over the remaining flowers before leaving, in order to preserve the plant to this neighbourhood. My son also found this plant in the same situation a week previously, but I lost the specimen he gave me before I had had time to identify it. He thought it a dwarf kind of the Garden Everlasting Pea, which it somewhat resembles. On the eighth of August I also found growing in a wood near here two specimens of *Epipactis latifolia*.—Wm. J. FARRINGTON, *High Street, Dunmow.*

Anomalous state of Spartina stricta near Brightlingsea.—Mr. B. F. Barnes, of Ilford, sent me in August, 1913, a specimen of the grass *Spartina stricta* (Roth.) recently gathered at Brightlingsea. It presented peculiar features, so I sent it to the Curator of Kew Gardens, and the Keeper of the Herbarium has replied as follows: "The specimen is an anomalous state of *S. stricta*. The anomaly is not confined to the disposition of the spikelets, but extends to some degree to the latter in so far as I found the lowermost spikelet of the lateral branch imperfectly 2-flowered. The lower floret had three imperfect stamens and a pistil with two stigmas, the upper lacked the palea and had only one stamen, and a rudimentary pistil with one bristle-like stigma, while the other was replaced by a delicate subulate membrane."

The specimen, which was unfortunately scrappy, has been placed in the Kew Herbarium. The rest of the gathering sent was normal. The point that was at once obvious was

the disposition of the spikelets in four rows instead of two. Collectors in the neighbourhood of Brightlingsea will be well advised in looking out for this abnormal state.—(Rev.) A. C. Morris, M.A., *Exbourne Rectory, North Devon.*

Scirpus maritimus and Melampyrum arvense in Essex.—Botanical readers will doubtless remember that, in Gibson's *Flora of Essex, Scirpus maritimus* Linn. is recorded for Oldfield Grange, near Coggeshall, in a pond, "with *S. tabernaemontani*," where it still persists. But, to my surprise, I have only lately turned it up in a pond at Cressing, at a place known as Lanham's Green, where there is quite a lot of it. This would be some three miles south of Holfield Grange. I usually visit this spot several times in a year, but the probable reason for my not having seen it before may be that it has not flowered—there is more water in the pond this year, so that it is more luxuriant.

I have a fresh station for *Melampyrum arvense* Linn. in Essex, namely, near Cressing Temple, on the roadside between Witham and Braintree.—Edwin E. Turner, *Grange Hill, Coggeshall, July 5th*, 1914.

The Water Speedwell.—Following continental usage, British botanists have recently recognised two forms or species of the plant that appears in the last edition of the *London Catalogue of British Plants* as *Veronica anagallis-aquatica*, Linn. The more common plant is *Veronica aquatica*, Bernh., distinguished by the flowers being pinkish or white with deep pink stripes, and with the flower stalks (pedicels) ultimately becoming widely spreading after fertilisation. The second or less common plant is what is considered to be the true plant of Linnæus—*Veronica anagallis*, Linn. It is readily known by its blue flowers, borne on flower stalks that always ascend and never become divaricate or widely-spreading.

Besides these characters there are other alleged differences with regard to the form of the capsules, which I have failed to recognise, but I have noted that *V. aquatica* is a coarser plant with larger bracts than *V. anagallis*. Both species occur in Essex. I have gathered *V. anagallis*, Linn., along the Lea above Broxbourne and on Nazeing Mead, where, also, I have gathered *V. aquatica*, Bernh. I send examples for the herbarium of the Essex Field Club.—C. E. Britton.

MISCELLANEOUS.

"Pigmy Flints" in Epping Forest.—At the meeting on 25th January 1913, Mr. Hazzledine Warren, exhibited some Pigmy and other Flint implements from a Prehistoric site in Epping Forest. He said—Upon this site a very large number of small and beautifully made flakes, many of them of pygmy dimensions, had been found, together with cores, hammer-stones, fabricators, and one or two small fragments of prehistoric pottery. Associated with these were true pygmy implements, with trimmed edges, mostly of the long narrow scalene, or of the 'à dos rebatter' form. In my opinion these pygmy flints were not to be looked upon as implements complete in themselves, but a number of them would be used to form the armature of a single implement. I have recently seen a knife made by the aborigines of Australia, which illustrates this principle. This was a wooden stick with a great number of small splinters of European glazed porcelain, set in gum end to end, in order to form a jagged cutting edge. Such tools must seem to us very awkward and inefficient; still the fact remained that they were made by modern savages, and that they contrived to do very good work with them.

It has also been suggested that pygmy implements might have been set in a piece of wood for the purpose of softening leather. Indeed, this has actually been tried and found to give excellent results. Others again may very probably have been barbs, set in the heads of javelins or harpoons. There are five prehistoric harpoon-heads from Denmark in the British Museum, made out of the antler of deer, set along both sides with pygmy flint barbs. Mr. F. M. Haward believes that the long narrow scalene pygmy forms were in reality arrow-points, but this explanation certainly could not apply to all pygmies.—S. Hazzledine Warren, F.G.S., *Loughton.*

END OF VOLUME XVII.

An Editorial Appeal.

In order that the publication of the NATURALIST may be maintained with a reasonable expenditure of time and labour, the Editor most earnestly pleads for a greater meed of helpful co-operation on the part of the main body of the members, and naturalists generally, than has hitherto been afforded to him. Not only are longer and more important memoirs desired, but the greatest aid would be given by the communication of SHORT PAPERS, NOTES, and of books, periodicals, newspapers, etc. (*or extracts from the same*), containing matter (reports, captures, natural history, antiquarian or other "finds," topographical descriptions, news of the exposure of geological sections, etc., accounts of old industries, folk-lore, dialect, etc.) likely to be useful for the NATURALIST, or for the information of the council and officers.

The Editor will very gratefully receive promises from members and others of systematic searching of periodicals, etc., for such information as above. If extracts are sent, they should be in a form fitted as nearly as possible for publication. MSS. should be written on one side of the paper only, with wide spaces between the lines, and with wide margins.

Each member should take a lively interest in our little journal, and feel himself or herself personally responsible, in a measure, for its success and usefulness. *All* events in the county coming within the scope of the Club should find permanent record in our pages.

It is desired and expected that the CONDUCTORS OF FIELD MEETINGS and other Excursions *will themselves write a short report*, describing the country traversed, buildings visited, objects noted, etc., and giving the substance of any demonstrations given either in the field or in a museum, and will forward the same to the Editor as soon as possible after the excursion. The Editor finds the task of describing the excursions far too heavy, and besides, reports written by persons specially acquainted with the districts visited, or objects seen, will have a freshness and value necessarily wanting in a mere compilation.

It would greatly assist if EXHIBITORS of OBJECTS would themselves prepare short descriptions of them for publication, and hand the same to the Secretary, at, or soon after, the Meetings.

The Essex Museum of Natural History.

We venture again to call attention to the needs of our County Museum, in the hope that lovers of natural history will each and all do **something** to aid forward the work. We have in the Museum ample means of preservation, so that all collections and specimens entrusted to our care will always be available for study, and will be carefully and lovingly curated. Amongst our desiderata may be mentioned the following :—

MAMMALS.—**Skulls** or complete skeletons of Essex species —Pelts, particularly of Voles, Shrews, Mice and Bats.

BIRDS.—Similar specimens, and in particular we are in want of a **good** collection of **BIRDS' EGGS.**

MOLLUSCS.—Specimens (Land and Freshwater and Marine) from as many Essex localities as possible.

INSECTS.—We are greatly in want of **COLEOPTERA, HYMENOPTERA, HEMIPTERA, DIPTERA,** and obscure groups.

PLANTS.—Authentic specimens of plants, coming from as many Essex stations as possible, to aid in the preparation of a Botanical Survey of the County.

LIBRARY.—The Museum Library now consists of about 2,500 vols. of carefully selected Monographs, etc., and Transactions and Proceedings of Local Scientific Societies. It is available for reference, and donations of suitable works are solicited.

Any information and advice in our power will be gladly given.

During the Sessions, the Curator attends on THURSDAYS until 9 p.m. in order to welcome visitors and enquirers.

WM. COLE, Curator,

H. WHITEHEAD, Assistant-Curator.

THE ESSEX MUSEUM,
ROMFORD ROAD,
STRATFORD, ESSEX.