PROCEEDINGS

AND

TRANSACTIONS

OF THE

Croydon Microscopical and Natural History Club, K

FROM

FEBRUARY 16th, 1881,

TO

JANUARY 18th, 1882.

CROYDON:

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Crowley as President of the Club for the ensuing year. Mr. Long having seconded the motion, it was carried unanimously, and Mr. Crowley expressed his thanks to the members for the compliment which they had paid him.

Dr. Thompson proposed that Mr. John Flower be elected to the office of Treasurer, vacated by Mr. Crowley.

This proposal was seconded by Mr. Chisholm, and carried.

The President next announced the resignation by Mr. E. B. Sturge of the office of Honorary Secretary of the Club, and in doing so regretted that Mr. Sturge was prevented by indisposition from being present at that meeting. Mr. Sturge had acted for five years as Honorary Secretary of the Club, and during that time had discharged the onerous duties of the office most admirably and conscientiously. He had now resigned because he felt that he should not be able, in the year to come, to devote sufficient time to enable him properly to discharge the duties of Secretary.

Upon the motion of Mr. Manners, seconded by Dr. Thompson, Mr. K. McKean was elected Honorary Secretary in the place of Mr. Sturge.

The President read a letter from Mr. Henry Lee, announcing his wish, in consequence of his removal from Croydon, to retire from the Committee, but expressing his unabated interest in all that related to the Club. He also pointed out that as Mr. K. McKean had been elected Honorary Secretary there were thus two vacancies on the Committee.

It was proposed by Mr. H. M. Klaassen, and seconded by Mr. Long, and carried unanimously, that Dr. Carpenter, Mr. J. Chisholm, Mr. T. Cushing, Mr. J. S. Johnson, Mr. G. Manners, Mr. A. D. Taylor, and Mr. H. Turner (members of the old Committee), and Mr. H. T. Mennell and Mr. E. Lovett be appointed the Committee for the ensuing year.

Cordial votes of thanks were accorded to the retiring President and Honorary Secretary, and on the motion of the President, a vote of thanks was also accorded to the Local Press for their reports of the proceedings of the Club.

Mr. John Drage exhibited a white variety of the common Thrush (Turdus musicus) which was shot near the Lizard Point, Cornwall, in the autumn of 1880, and a specimen of the purple Sand-piper (Tringa striata) shot in the winter of 1880, in the same locality. The thrush was a remarkably white specimen, having only a few very faintly coloured feathers on the head and on the left wing.

Ordinary Meeting, 16th Feb., 1881.

PHILIP CROWLEY, Esq., F.Z.S., President, in the chair.

The minutes of the last meeting were read and confirmed. The following gentlemen were balloted for and duly elected :— Mr. Alfred Nicholls, Mr. W. A. Duncan, M.D., Mr. James W. Justican, and Mr. R. G. Hovenden.

The PRESIDENT announced that the following publications had been presented to the Club during the past month :— Procés verbal of the Belgian Microscopical Society ; a description of Diatoms from Nykjobing, Jutland, presented by the author, W. Prinz ; " Science Gossip," for February, from the publisher ; " Journal of the Royal Microscopical Society," by the Society.

Dr. STRONG read a letter from Mr. Charteris White, asking the President and Hon. Secretary to sign a memorial to the Home Secretary against the bill for the proposed extension of the line to Chingford through part of Epping Forest.

After some remarks in support of the memorial from Dr. STRONG,

The PRESIDENT stated that the matter had already been under discussion by the committee, and as there was considerable difference of opinion as to the benefit or otherwise of the proposed line, which was out of our district, it had been decided not to sign the memorial.

Mr. GELDART remarked that he feared that many localities well known to Entomological and Botanical collectors would be injured by the new railway, but at the same time it would be to numbers the means of enabling them to have a day in the Forest, and therefore he agreed that the committee had done wisely in deciding not to sign the memorial.

The PRESIDENT reminded the members that the soirée of the Hackney Club would be held on the 24th inst., and requested any who were desirous to represent the Croydon Club on that occasion to forward their names to the Secretary. He also announced that the next monthly meeting would be held on the 4th Wednesday in March, instead of the 3rd, on which occasion Messrs. Mawley and Corden would read the report of the Meteorological Sub-committee, and Mr. Eaton would make some remarks showing our members how they should record their observations in the various branches of Natural History which came before them, so that they may be useful, not only to ourselves, but to kindred societies.

Mr. A. D. TAYLOR then read his paper, entitled " Moths and Butterflies, some remarks on their colours and variations."

Mr. LOVETT followed in some remarks, in which he said that insects would so adapt themselves to surrounding circumstances that it was quite possible to lose the original species, and get fresh ones. He also pointed out how moths and their larvæ were very similar in colour to the plants and trees on which they were found.

The Rev. E. M. GELDART touched upon the chemical action of light on colour, a subject which Mr. Lovett had also referred to. He pointed out that the reason why the best specimens of lepidoptera were put out of the way at the British Museum was that the chemical action of light would destroy their beautiful colours, although there were exceptions. Nearly all those whose colours were metallic were not affected by the light, such as, for instance, the "blue" and the "copper."

Mr. FLOWER explained that all the metallic colourings in birds, moths, and butterflies were due to the effect of light, as seen so well in the humming-bird. He pointed out the difficulty of finding some eggs, as showing the protective character of their colours.

The PRESIDENT exhibited a number of eggs and nests illustrative of the theory of protection by colours, among them being those of the spotted flycatcher, the grasshopper warbler, the sedge warbler, the willow warbler, the white throat, the Dartford warbler, the golden-crested wren, the yellow wagtail, and various other birds.

Several members placed their microscopes at the service of Mr. Taylor for the purpose of illustrating his paper.

The following exhibits were also made:—E. B. Sturge, wing of butterfly; J. S. Johnson, spiracle of larvæ of hawk-moth; E. Lovett, ova of Hyas coarctatus, also case of stalk-eyed crustacea of the genus Pisa; W. Ingrams, scales of Urania; W. F. Stanley, Hardy's vivarium, or improved pond-life trough; A. Warner, section of kitten's jaw, showing developing teeth.

The proceedings terminated with a hearty vote of thanks to Mr. Taylor for his paper.

Ordinary Meeting, 23rd March 1881.

PHILIP CROWLEY, Esq., F.Z.S., President, in the chair.

The minutes of last meeting were read and confirmed.

The Rev. H. Field Blackett was duly elected a member of the Club.

The PRESIDENT announced that the following publications had been received since the last meeting:—Laws of the Torquay Natural History Society; Report of Crab and

Lobster Fisheries, by the late Mr. Frank Buckland; History and Description of the Devon and Exeter Museum, presented by Mr. E. B. Sturge; "Science Gossip" for March, by the Publishers; Notes and Observations on British stalk-eyed crustacea, by Mr. Lovett, by the author; Procés verbal of the Belgian Society, by the Society; The Weather of 1880, by Edward Mawley, by the author; Eaton on the average height of Barometer in London, by the author; Eighth Annual Report of the New Cross Microscopical and Natural History Society, by the Society.

The PRESIDENT also announced that he hoped a room would shortly be engaged for the exclusive use of the Club. The matter was now in the hands of a sub-committee, and he hoped to report further next meeting. Also that at the April meeting of the Club Mr. W. J. Nation would read a paper on Gums and Resins. He also introduced to the members a publication by Mr. H. E. Dresser, "A List of the Birds of the Western Palæarctic Regions," which he considered would be of use to many members.

Mr. BALDWIN LATHAM then read his paper, entitled "Observations on Rainfall," chiefly referring to the Croydon district.

This was followed by a paper by Mr. H. S. EATON, on "The best method of applying Meteorology to Field Observations in Natural History," after which a general conversation ensued, in which the President, supported by Dr. Carpenter, Messrs. Mawley, Stanley, Mitchiner, and others took part.

Mr. LATHAM added some remarks in explanation of the extent to which our water supply would be affected by the Oxted Tunnel. He said that this tunnel has a fall from one of the Croydon water areas into the weald and cuts the water line, which was equivalent to taking two square miles out of the water area: the tunnel was cut down the lip of the gault which forms a basin, thus liberating the water of the drainage area. The tunnel was 2,500 yards long, and falls from north to south, while the beds fall from south to north, and the quantity of water flowing out of the south end of the tunnel into the weald was rather more than 1½ million gallons per day. He also said that the question of meteorology was one of considerable importance, and that his idea was to get more stations. There was, however, much difficulty in getting gentlemen to take the records. He thought that where a rainfall station was most required was at the Norwood Hill, for, no doubt, the rainfall was much greater there than in the valleys. He considered it most essential that rain gauges should be established on this hill and a proper record obtained, for he thought that meteorology was of much more importance than most people were aware of.

PRESENTATION TO MR. STURGE.

The PRESIDENT then rose and said that that would conclude their ordinary business that evening, but they had now the pleasing duty of making the presentation to their late secretary, Mr. Sturge. He had, however, thought it best to ask Mr. Flower, their late president, to make the presentation, as he had had the pleasure of working with Mr. Sturge, who resigned his office as secretary at the same time as he (the Chairman) was elected to the office of president.

Mr. FLOWER then said—Mr. President and gentlemen. The duty which has been entrusted to me, as indicated by our president, is to me, personally, exceedingly gratifying. Mr. Sturge was elected our secretary about five years ago, and during that time there is, probably, hardly a member of the club who has not personally become acquainted with him. All can speak, from personal observation, to the important services which Mr. Sturge has rendered to the club as secretary, and to his uniform and extreme courtesy to the members. In a club of this kind there is a large amount of work to be done, but of this the ordinary members see only the results; they do not see the labour which produces them. It is only those who have an official connection with the club who know how great this labour is.

During the last five years—I can speak more particularly to the two years when I was president—the laborious part of the work of the club has fallen to the secretary. Mr. Lee, one of our old presidents, would have been with us this evening in order that he might have borne his testimony to Mr. Sturge's work, but unfortunately a business engagement has carried him off to Lancashire, and he is, therefore, not able to be here. Dr. Carpenter, another past president, however, is here, and I have no doubt that he will bear me out when I say that there never was a more perfect glutton for work than our late secretary. (Hear, hear.) I saw him constantly during my presidency, and I know the amount of work he did. He was a most difficult man to help. He did the extensive work of the club, and he would not let any part of it go; he would do it himself. He would not be satisfied that it was well done unless he did it himself, and he did the work well. Addressing Mr. Sturge, Mr. Flower proceeded: I have now, on behalf of the members of the club who have subscribed, to present to you the microscope which stands upon the table. Of course in asking you to accept it, it is not intended for one moment to put it in any way in the light of a remuneration for the services you have rendered to the club, but rather as a sort of material recognition of those services, and as a token of our esteem and regard for yourself personally. We hope this instrument will not be put away and only brought out on state occasions, but that it will be used by you constantly in your hours of recreation; and that it will help to remind you, from time to time, of the many kindly feelings towards yourself, which are entertained by those who have presented it to you. (Applause.)

Mr. STURGE, who was received with loud applause, said he must first of all apologise for his absence at the annual meeting, which was held in January, and followed what was known as "that terrible Tuesday." At that time he was suffering from indisposition, which, combined with the extreme weather, prevented him from leaving his home. It was exceedingly gratifying to him to receive that testimonial. When he was appointed secretary he had serious misgivings whether he should be able to undertake the business of the club to their satisfaction. However the proceedings that evening satisfied him that he had done so. He received that testimonial as a proof that he had done the work of the club to their satisfaction. He had received valuable advice from Dr. Carpenter and Mr. Flower, during his position as secretary of the club. He should always take a great interest in the proceedings of the club, and should be glad to help as far as he could in anything that might be required. He thanked them heartily for the testimonial and for the list of members which accompanied it. (Loud applause.)

The testimonial consisted of a Binocular Microscope, by Ross, and an illuminated address signed by over 100 members of the club.

Ordinary Meeting, 20*th April*, 1881.

JOHN FLOWER, Esq., M.A., F.Z.S., in the chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were ballotted for and duly elected members of the club, viz.:—Messrs. Nathaniel Waterall, A. Washington Ranger, Charles B. Ingham, Ernest Holah, and Percy J. Rowlands. Mr. Edmond Collyer was ballotted for and duly elected an associate of the club.

The following donations were announced:—Third Annual Report, Erith and Belvedere Natural History and Scientific Society; Journal Quekett Microscopical Club; "Science Gossip;" Procés verbal Societé Royal Malacologique de Belgique.

The CHAIRMAN informed members that a letter had been received from the Geologists' Association inviting their presence at two excursions, one of which, under the direction of Mr. Logan Lobley, to the Addington and Shirley district, promised to be of great interest. The paper for next meeting would be "On the Anatomy of the Crayfish," by Mr. J. S. Johnson.

Mr. W. Topley, F.G.S. (Geological Survey of England), delivered his "Notes on the Geology and Physical Geography of the Weald," which he illustrated by numerous maps, diagrams and photographs. Mr. Topley referred to the past and present definitions of the term Weald, and the apparent method which had regulated the division and positions of the parishes lying around the Weald, and then went at length into the formation and the position of the different beds of clay, &c., and the inferences to be drawn therefrom, stating, in the course of his remarks, that it was beyond all doubt—how, he had not the time to state—that at one time a vast continent must have occupied the area which England now takes, and stretched far out into the Atlantic.

After a short discussion, in which the Chairman and two members joined, a hearty vote of thanks was passed to Mr. Topley for his very interesting lecture.

A list of exhibits is appended:—W. Low Serjeant, Alcyonella Fungosa, just emerging from the statoblast; E. B. Sturge, Fructification of Fern; K. McKean, Larva of Culex pipiens (first stage), in fluid; Ed. Lovett, Specimens of Wealden Rocks and the Hastings beds, also living specimen of Lacerta viridis, from Jersey; J. S. Johnson, Olfactory appendages in antennæ of Crayfish, also Lepisma saccharina; H. M. Klaassen, Piece of Sandstone from Weald, showing ripple marks; A. W. Rich, Living specimen of a South Australian Lizard. Mr. Flower brought for distribution a box of hybernating Helix Pomatia, with operculum attached.

Excursion of the Geologists' Association and of the Club, to Croydon, Shirley and Addington, Saturday, May 7th, 1881.

Directors:--J. Logan Lobley, Esq., F.G.S.; John Flower, Esq., M.A., F.Z.S.; and H. M. Klaassen, Esq., F.G.S.

At East Croydon station the members of the Association were joined by a number of the members of the Club. On leaving the station, which stands at the extreme eastern edge of the bed of valley gravel which was visited by the Club and the Association, on June 19, 1880, the party proceeded eastward along the Upper Addiscombe Road. The sands of the Oldhaven series were well seen in one or two excavations recently made in digging foundations for new houses.

Near the southern end of Ashburton Road the party left the Addiscombe Road, and, by the kind permission of the occupier of the land, H. Johnson, Esq., examined two very remarkable springs in the side of the hill, on the south side of the road, one at a point about 30 feet, and the other about 40 feet above the level of the road. The former of these, which is by far the larger of the two, is about 250 feet above the sea level. It has hollowed out for itself a considerable basin in the hill side, which has probably been increased artificially; and the stream, which flows from this, has cut out a considerable valley down which it passes. These features were here pointed out by Mr. Flower, who also explained the boundaries and general structure of the hill, and of the Oldhaven, and Woolwich, and Reading beds, of which it is composed. He also explained that there were numerous similar springs along the northern side of this hill, and that these form the sources of the rivers Wandle and Ravensbourne. The probable explana- of these springs is that they arise at points where clay beds, sloping to the north, come to the surface of the ground on the side of the hill, and then discharge the water which is received and absorbed by the large masses of pebble beds which are over the clay.

Returning to the road, another small valley, cut by similar springs, was seen close to Lady Ashburton's farm; and the party then proceeded to Shirley House. Near the lodge gate the water-shed ridge (here broad and flat) which divides the basins of the rivers Wandle and Ravensbourne was reached, and its course through the grounds of Shirley House, and along the edge of the fields on the west side of the Stroud Green Road was pointed out and described by Mr. Flower, who also pointed out a spot, on the water-shed ridge, in a ditch, about 40 yards from the Stroud Green Road, where, in winter, a spring rises, from which the water flows eastward into the Ravensbourne, and westward into the Wandle.

In the grounds of Shirley House, which were courteously thrown open to the party by F. Banbury, Esq., another fine spring, the water from which was received into a large brick tank, was inspected and described; and from this the party proceeded to the small lake, situated in a valley, which is cut through the pebble beds and Thanet sands down to the chalk, the lake itself appearing to rest, for the most part, if not entirely, on the sand, and to be fed by springs from the pebble beds. The overflow from this lake passes into the Ravensbourne, the valley in which it is situated, being the most western valley in this part of the river basin of the Ravensbourne. From the lake the party proceeded through the plantation to the Addington Hills, where the fine section of the lower beds of the Oldhaven series, at the back of the Sand Rock Hotel, was inspected, and was described by Mr. Lobley.

The Addington Hills themselves were next visited, and a pit excavated in the upper beds of the Oldhaven series was examined. These hills form the northern escarpment of the Oldhaven beds, which here attain a height of nearly 500 feet above the sea level, From their top the chief physical features of the country and the distant objects of interest, were pointed out by the Directors. Attention was particularly called to the small valley immediately at the foot of the hills, cut down into the chalk, and to the still larger valley between that and the South Norwood Hill, which is formed in the London clay; the two valleys being, together, about four miles across; and the way in which these valleys were probably formed was fully discussed. The water-shed ridge, which divides the basins of the modern rivers Wandle and Ravensbourne, crosses these valleys nearly at right angles, and runs from the Addington Hills in a direction about N.N.W., the lowest point of the ridge being about 150 feet above sea level. The exact course of this ridge was pointed out and described by Mr. Flower. Attention was also called to the deep valleys which run up into the hills, caused, probably, in times long past, by the action of springs similar to those already visited, and to South Norwood Hill, which is all London clay, the summit being nearly 400 feet above sea level.

By the kind permission of the Archbishop of Canterbury, Addington Park was next visited. A small lake, fed by springs from the pebble beds, and situated in a deep valley cut out of the pebble beds, was examined and described by the Directors; and the party then moved on to the Pinetum, where were seen some very fine specimens of Abies Douglassii, of Abies Menziesii, Pinus Nobilis, and other Conifers. The "Fir Mount," overlooking Addington village and the site of a hunting seat, much used by King Henry VIII., was the last point of special interest in the Park which was visited. From the Mount, which is situated on the top of the southern escarpment of the Oldhaven beds, fine views were obtained, and the high ground of Worms Heath, four miles distant, capped with pebble beds, which must once have been continuous with those in Addington Park, was pointed out and described by the Directors. The party next proceeded down the steep face of the escarpment to Addington village, situated on the chalk, where refreshment was obtained at the Cricketers' Inn.

The return home was by the road on the south side of the Park. A diversion was made to the footpath which runs from this road into the Selsdon road, opposite the Archbishop's stables, and from it Mr. Flower called attention to a remarkable echo, apparently from the woods in the Park, which he had accidently discovered. The evening being still, the echo was well heard. In the beautiful lane between Heathfield and Ballards the Wandle-Ravensbourne water shed was again crossed. At the Ballards Farm two remarkable blocks of sandstone, believed to be Sarsden stone, and lying on the chalk, were examined, by the kind permission of Chas. Goschen, Esq. From here the party returned across the fields to East Croydon station.

Ordinary Meeting, 18*th May*, 1881.

PHILIP CROWLEY, Esq., F.Z.S., President, in the chair.

The minutes of last meeting were read and confirmed.

The following gentlemen were balloted for and elected :—Dr. Franklin Parsons, Rev. A. Francis Allen, Robert C. Owst, Peter Hart.

The PRESIDENT announced that since the last meeting they had received the following donations :—Journal of the Royal Microscopical Society ; Annals of the Belgian Microscopical Society ; "Science Gossip" for May ; Report West Kent Natural History, Microscopical, and Photographic Society ; Procés verbal of Belgian Microscopical Society, from the respective Societies. Also, presented by Mr. Sturge, Students Natural History, by Baird ; Natural History of Birds, by Rymer Jones ; Text-book of Zoology, by Nicholson ; The Microscope, by Lane Clarke ; Manual of Geology, by Hampton ; Dictionary of Scientific Terms, by Buchanan. By Mr. Lovett—Notes on British stalk-eyed Crustacea. By Dr. Carpenter—Micrographic Dictionary.

The PRESIDENT announced that an excursion of the Quekett Club to Merstham would take place on Saturday next, and that any of the members were invited to join them.

Mr. J. S. JOHNSON then read his paper "On the Anatomy of the Crayfish," in which he entered very fully into its structure and habits. The paper was illustrated by numerous diagrams and some beautiful dissections, which Mr. Johnson presented to the club.

Dr. Carpenter, Mr. Turner, Mr. Rowland, and other members took part in the discussion which followed.

Mr. E. LOVETT described a species of marine stalk-eyed

Crustacea which had been added to the British fauna by himself and Mr. John T. Carrington, F.L.S. The animal, Stenorhynchus ægyptius, is described by Milne Edwards as a Mediterranean form, occurring on the shores of Egypt and Sicily. Mr. Lovett illustrated the specific characteristics of this new British decapod by specimens and diagrams. The locality whence it was obtained is the English Channel, off the Sussex coast, at a depth of about five fathoms.

The President requested Mr. McKean to read the rules which had been drawn up as to the use of the new room, which was now furnished and ready.

Mr. Wormald exhibited, and Mr. Flower made remarks upon, five hybrids between the common hen and a cock Pheasant, one of which weighed 6lbs., or nearly 20 per cent. more than the united weight of its parents. These birds were bred by Mr. Edward Wormald, at Woodcote, in the season of 1880. There were others hatched, but only seven reared, four of which showed a strong family likeness to the small black hen, and the other three to a golden Hamburg. The two hens, the mothers of the hybrids, were also exhibited.

The President exhibited and described a specimen of the Rough Legged Buzzard (Arch. Lagopus) Immature Female ; and two specimens of the Hen Harrier (C. Cyaneus) male and female birds of the year, all recently shot in the neighbourhood of Croydon. These three birds were seen from time to time about Selsdon, Chelsham Court, and Beddlestead, all through the summer of 1880. The female Hen Harrier was shot by Mr. Henry Chasemore's keeper at Selsdon in the autumn of 1880, and the male by Mr. A. J. Lambert's keeper at Chelsham, during last winter. The Rough Legged Buzzard was trapped in February by Martin, Mr. Alfred Eastty's keeper in a small shaw near Chelsham Court. This bird was seen repeatedly in the neighbourhood of Chelsham Court, and was caught at last in a gin baited with a rabbit which it had caught and left half eaten, and to which it returned.

There were also exhibited three black Rats, caught in the neighbourhood of Torquay. Some flowers preserved so as to keep their colour, by Mr. English, of Epping ; by Mr. J. S. Johnson, Branchiæ of Crayfish, showing hooked setæ of lamina ; by Mr. W. T. Fuller, locomotive spores of Equisetum Arvense ; by Mr. E. B. Sturge, Gypsum from Homefield, Sussex ; by Mr. Edward Lovett, fresh water Crayfish, alive, Tray of the genus Stenorynchus ; by Mr. Low Serjeant, Double Egg of domestic fowl, also living fry of Anodon Cygneus ; by Mr. A. Warner, sundry mounted objects ; by Mr. J. Epps, jun., leaf of Deutzia scabra ; by Mr. H. M. Klaassen, living Sertulariæ.

Ordinary Meeting, 21*st September*, 1881.

Philip Crowley, F.Z.S., President, in the chair.

The minutes of last meeting were read and confirmed.

Mr. John Alexander, of St. Peter's Road; Mr. James Curtis, of Canning Road; Dr. J. M. Hobson, of Addiscombe, were ballotted for and duly elected members of the club.

The President announced the receipt of the following works since the last meeting:—Journal, Royal Microscopical Society, parts 3 and 4; Journal, Quekett Microscopical Society, No. 47, July 1881; East Kent Natural History Society, 23rd Report; Lewisham and Blackheath Scientific Association, 2nd Annual Report; Guide to the Natural History Clubs of London, presented by Henry Walker; South London Microscopical and Natural History Clubs, 10th Annual Report; Societé Belg. de Microscopie, procés verbal; Societé Malacologique de Belgique, procés verbal; Eastbourne Natural History Society, 13th Annual Report; "Science Gossip" for June, July, August and September; Lambeth Field Club, Report; Lewisham Scientific Association, report on Subsidence; two parts of *Zoologist*, containing Mr. Lovett's articles on Crustacea.

The President alluded to the death, since the last meeting, of Professor Rolleston, one of our hon. members.

He announced that the annual soirée would be held on the 23rd November.

The President drew attention to the proposition in committee, before the publication of the last number of the report, that, in consequence of the great cost of printing in full the papers read before the club up to December 1880, no papers should be printed in future except those relating to local subjects, or embodying original observations. It was desired that the opinion of the club should be taken as early as possible as to whether that principle should be followed, and he now submitted it for their consideration.

Dr. Carpenter thought it was a very proper resolution; but, although in his opinion it was a matter in which it was perfectly competent for the committee to act and carry out themselves, without reference to the club, there being no rule barring such a course, yet he considered it the preferable course to give notice of motion for the adoption of the change. The club had now reached a standing which should not require the publication of any papers, except those specified in the proposition of the committee.

Notice of motion was accordingly given for next meeting.

The President announced that a Croydon centre of the London Society for University teaching had been started in

Croydon, and that two courses of lectures would be delivered at the Public Hall this winter. Also read letter from Mr. Stanley, hoping that some of the members would assist the South Norwood Literary and Scientific Society at their soirée on October 17th, by taking their microscopes.

Mr CORDEN then read his report of the Sub-committee on Meteorology, which was illustrated by most carefully executed charts, for the years 1879-80.

After which the PRESIDENT read a letter from Mr. Mawley, in which, after regretting his inability to be present, the writer expressed a hope that Mr. Corden's paper would be published in the Transactions of the Club. It was most desirable that they should have as many, and as full records as possible of the weather phenomena, and their influence upon animal and vegetable life. As an instance of the all-pervading influence of the weather, the year 1879 was engraved in dark characters upon the memory of every member of society; and they were probably suffering at the present time from its influence upon the soil, and crops, and here and there on the cattle. There was now a great craving in the public mind for any means of obtaining a better knowledge of the coming weather; and one of the best and surest keys to the future would be found in the experiences of the past.

Mr. BALDWIN LATHAM, in moving a vote of thanks to Mr. Corden for his able and extremely valuable paper, said—We ought to feel very much indebted to Mr. Corden, not only for this paper, but for his services and research during the long period over which these records extend, the value of such a record depending in a great measure on the extent of the period which it covers. The year 1879 has no doubt been a very disastrous year in the annals of agriculture; and these results show us pretty well that it is not only the question of rainfall, but also of temperature, both of which are intimately connected with each other, that must be taken into consideration. You can't have a better exemplification of this than that furnished by last month. We have had a very cold and wet August. Those diagrams of Mr. Corden's show what appears to be a general law, namely, that cold in summer and heat in winter are associated with rainy seasons, while warm summers and cold winters are dry periods. In 1879 the summer months were very cold, and were noted for the constancy of the rainfall over that period. The great point in connection with this subject of course is to find out what is to be the weather. A great many suppositions have been put forward, and many of these seem to be based upon fact. One very recent one has come from France: that the future weather may be predicted from the declination of the moon's orbit: that is, the greatest declination brings the largest amount of rain; that these periods recur, but not regularly, every six years, and that the periods between are dry. And something of that kind appears to mark the weather. According to the three-years principle, taking the odd years, those divisible by 3, would be the centres of dry periods, whilst those not divisible by 3 would be the centres of wet periods. For instance, 1881 being divisible by 3, would on this principle represent the centre of a dry period. Although this is but rule of thumb, yet there is certainly some coincidence between the principle and what we have experienced in the past. The year 1880, up to a certain period, was a dry year, and of the present year the same may be said. People have a peculiar notion about these wet and dry years. For instance, I have asked a great many persons as to the state of the springs after this wet month, and all said they must be rising fast. Nothing of the sort, the springs have been falling from the beginning and are still falling. The cause is the amount of evaporation. In 1879 the evaporation from the water surface was only 10 inches; and the difference between the amount of rainfall and that evaporated would tend to saturate the ground. And all through 1879 a large amount percolated to a depth of 3 feet; but not a single drop has passed through this year; the ground is as dry as possible. While we have had a rainfall up to the end of last month of 14 inches, the evaporaticn this year has been nearly 20 inches, that is, in excess by 40 per cent. of the amount of rainfall. So that in this sense it is a dry year, and confirms the above rule. Thus the future character of a wet or dry season might be guessed from the amount of water stored in the ground. That will give a much clearer insight into the character of the year than any other sort of observation; hence the importance of these percolation experiments. During the period of active growth in 1879, nearly all the manure put into the ground was washed out by the rains, except in the latter part; and the remarkable fact is, that the latter part of 1879 was extremely dry. The diminution of the rain towards the end of the year, when the earth becomes sensitive to absorb it, and the period of great dryness that followed, in fact landed us in August last with the low state of the springs; but in August the ground received before the rainfall a certain amount of moisture, which was due to the increased humidity of the atmosphere. Long before this period, a replenishment of the ground had taken place. Now that could not have een due entirely to the immediate rainfall in September, if the ground had been as dry as it is now, because we know that in September 1879 the wells began to rise long before the rain began to fall. So that there is no doubt that when the earth begins to cool down, as it does every night, and we have very heavy dews, a large amount of moisture is absorbed, and the earth becomes sensitive to pass rain through. When reading a paper here some time ago on the subject of rainfall I mentioned that there had been an enormous increase of rain in this district, especially during the last 40 years. It was something like 23 inches during the first decade, 1840-50, 24 inches in the decade ending in 1860, 25 inches in that ending in 1870, and 28 inches in the decade ending lasting year. Now, what can be the cause of this enormous increase? I think it is due to the increased growth of timber in the country and the large planting of trees which has taken place of late years. We have authentic information showing that when trees were cut down in certain islands, the springs disappeared, but that when these places were replanted the springs commenced to flow again. I have had a number of holes bored into some trees in my garden, and I found a remarkable difference between the temperature of these trees and that of the external air. In summer the trees are always colder, and therefore they act as condensers of moisture, just in the same manner as elevation causes an increase of rainfall. In the winter, on the other hand, they give warmth; and as we see an increase of temperature in winter leads to an increase of rainfall, so the multiplication and increased growth of trees increases the rainfall both in summer and in winter.

Dr. Carpenter remarked, in reference to the absence of sunshine upon the land generally, and the consequences that have befallen us from that cause, he would wish to see added to Mr. Corden's tabular statistics, if possible, some information as to the amount of carbonic acid that might be present in the atmosphere. He believed that in consequence of the enormous extension of manufactures in this country, and the enormous amount of carbon now daily oxidised all around us, there would be found, if a record had been kept, a sensible increase in the amount of carbonic acid in the atmosphere at present. If the amount was found to have increased from two, 40 years ago, to four parts in 100 now, and five or six sometimes, that influence would make itself felt undoubtedly on the general welfare, or otherwise, of the inhabitants. The difference which that condition of the atmosphere would make in the long run must have some effect, because the air containing a larger amount of that acid than usual, effects would be produced injurious to human life, and also to some extent to vegetable life. When 15,000 tons of sulphur, for instance, were sent into the air at Manchester, it would be carried over a large district of country according to the direction of the wind. Then serious damage might be caused also by the imperfect way coal was consumed.

The following objects were exhibited :—Mr. W. L. Serjeant, live Weevil Beetle, under the microscope ; Mr. H. M. Klaassen, Liassic Fossils from Lyme Regis, with diagrams illustrative of the great landslips there; Mr. H. E. Baldock, Liassic Fossils from the East Coast of Yorkshire ; Mr. Berney, larvæ of Smerinthus ocellatus, and other lepidoptera; Mr. Edward Lovett, young of the garden Spider, preserved in fluid, under the microscope; Portunus pusillus, from deep water in the English Channel, off the coast of Sussex; Ebalia Pennantii, from 10 to 20 fathom water round the Channel Islands.

Ordinary Meeting, 19*th October*, 1881.

Philip Crowley, Esq., F.*Z*.S., President, in the chair.

The minutes of last meeting were read and confirmed.

William Gibson, 20, Outram Road, was ballotted for and duly elected a member of the club.

The following donations were announced :—Journal of the Royal Microscopical Society, part 5 ; article on Crustacea, from "Zoologist," by E. Lovett; Report of the British Association at York, Sir J. Lubbock's address at York, notes on the fall of an Aerolite at Middlesboro, March 14th 1881, by Mr. T. Cushing.

It was announced that 12 members of the club had attended the soiree of the South Norwood Literary and Scientific Institution.

The President stated that the committee had been considering a scheme for increased accommodation for the club, and for the formation of a local museum, which he hoped would soon assume a definite form.

The discussion by the club of the regulations as to the printing of papers was postponed.

Mr. Nation read his paper on "Gums and Resins," of which the following is a summary :—In his opening outline he pointed out that gums and resins are vegetable products. The functions of leaves are to act as the inhaling and exhaling organs of plants, as lungs do in animals, and to contain the various secretions of the tree or plant to which they belong. They inhale from the atmosphere oxygen and other gases requisite for the growth and nourishment of vegetable life, and they exhale the superfluous fluid of the crude sap. They absorb fluid matters, and exhale as well as absorb gases, and in them to a large extent takes place the formation of the various organic secretions and products of plants. He then exhibited a large collection of the various gums and resins, accompanying each exhibit with a description of its nature and qualities, the plants or trees, and the countries whence it is obtained, and its uses in the arts. He divided gums into two great classes, those chiefly valuable for their aromatic properties, such as the gum arabic, and other gums of the myrrh family, nearly all obtained from the trees of the acacia family; and inodorous or malodorous gums, which are chiefly employed in the domestic arts, painting, glazing, varnishing, &c. The various forms of lac were well represented, (seed, shell, and stick lac,) and their several uses enumerated. An interesting illustration of these was furnished by the perfection with which a coating of lac varnish enables German gilding to counterfeit gold leaf, though possessing not a single particle of gold.

Dr. Carpenter proposed a vote of thanks to Mr. Nation, and remarked upon the sanitary uses of various fragrant gums, both in present and ancient times. The vote was very cordially agreed to, and Mr. Nation, in returning thanks, remarked that when a museum room was attached to the club the whole or a great portion of the collection of gums which were then on view would be given to it.

Mr. E. Lovett gave a short account of fossil resin, and enumerated the various specimens of insect and vegetable life that are so often found preserved in it.

The President then brought to the notice of the Club three white Partridges, which were on the table, belonging to himself, Dr. Carpenter, and Mr. Rowland. These birds were shot on Mr. Lewis Loyd's property, Spring Park, Shirley. There were no less than eleven of these white birds this season—five in one covey, three, two, and one in others; the one died young. The keeper noticed them in the different coveys when quite small. The President said he examined carefully the one Mr. Loyd gave him the day after it was shot. The legs were of a dirty straw colour, the eyes a pale blue, with no distinct pupil, although darker in the centre, so no doubt in life it was pink, and the bird a true albino.

The following objects were exhibited:—Dr. Carpenter, cannon balls dug up at Croydon; Mr. W. J. Nation, collection of Gums and Resins to illustrate paper; Mr. E. Lovett, another series, with ambers and fossil Resins; Mr. Turner and Mr. Gill, specimens of Gums; Mr. Long, series of medicinal Gums; Mr. Berney, smoky quartz, Larva of B. rubi and S.

Convolvuli; Dr. T. Parsons, collection of Mosses from Montgomery and our own district; Mr. W. L. Sergeant, Lophopus crystallina, under the microscope; Dr. Hobson, Nerve Corpuscles, from spinal cord of man and horse; Mr. A. D. Taylor, section of Camphor wood, under the microscope; Mr. Collyer, specimens of Lepidoptera from the Croydon district.

Ordinary Meeting, 16th November, 1881.

PHILIP CROWLEY, Esq., F.Z.S., President, in the chair.

The minutes of the last meeting were read and confirmed.

The receipt was announced of "Science Gossip" for November, and of "Notes and observations of British stalk-eyed Crustacea," from Mr. Edward Lovett.

The PRESIDENT read a letter from Mr. Horniman, inviting members to visit his museum at Forest Hill, and requested intending visitors to forward their names to the secretary.

JOHN FLOWER, Esq., M.A., F.Z.S., read a paper "On the Nesting of the Red-breasted Flycatcher (Muscicapa parva) in Kent, in the summer of 1881," being the first known occasion in England. Mr. Flower mentioned another interesting fact which was observed in a garden adjoining the one in which the Flycatchers nested. "Growing in this garden was a small yew tree, and last winter it was killed by the frost. It was cut down and was going to be thrown away, but a stake was wanted to support a young pear tree, and the yew happened to be about the right size for the stake. The boughs and top of the yew tree were cut off, and there remained a fork of the yew tree which was put against the stem of the pear tree, and the other end driven into the ground. I went to see the tree, and found that the whole of the pear tree above the point where the yew stake touched it was dead, and not only that but every bough that had touched the yew stake was dead above the point where it was touched. It looked as if the yew stake had acted like a hot iron to the pear tree, and had killed everything it came in contact with."

Mr. FLOWER exhibited a fine stuffed specimen of the Duck-billed Platypus (Ornithorynchus paradoxus), one of the many peculiar forms which are found only in Australia; and explained that the Mammals found on that continent, and on the islands immediately to the north of it, belong only to two orders, the Marsupials, which comprise the Kangaroos and allied animals, and the Monotremes, to which order the Platypus belongs. He further described the general characteristics of the Marsupials, and explained that the animals of that order, and of the order Monotremata, are now found nowhere except in Australia, and they have this further remarkable characteristic, which distinguishes them from all other Mammals, viz., that they have no Placenta.

The Monotremes, of which there are but two species known to science, form the lowest order of Mammals, and are distinguished by many singular structural peculiarities which are found in no other animals except birds. The one great peculiarity, from which the name of their order is derived, is essentiallly bird-like, the word Monotrema being made up of two Greek words, signifying a single hole or orifice, both the species of Monotremes having only one external orifice for the evacuation of their urine, and the discharge of the excreta from the intestine. This arrangement is found in all birds, but it is not found in any Mammals except Monotremes. In fact, the chacteristics of Birds and Mammals are so singularly blended in the Monotremes that they can best be described as connecting links between the animals of those two great classes.

Mr Flower next proceeded to explain what a connecting link is, as understood since the general acceptance of the doctrine of evolution; and, after sketching briefly the general principles of the theory of evolution as now generally received, he pointed out that the effect of it was to show that the relation of all vertebrate animals, and probably of all animals to one another, can best be expressed in the form of a genealogical tree: all existing forms of vertebrates having been derived by the ordinary process of generation, and by an infinite series of successive minute variations, accumulated through countless generations, from a common ancestor. The new and superior forms would naturally supersede the older ones, so that existing animals would, for the most part, be represented only by the extreme ends of the boughs of the tree; all the intermediate forms having, with rare exceptions, died out, and having ceased to exist, except in some cases, as extinct animals known only to the geologist. It is these intermediate forms that are commonly known as connecting links. They seem to be left for us as guide posts, as it were, to indicate to us the way in which the animal creation has been travelling ever since the world was made.

Referring to the many connecting links which are known to science, Mr. Flower described in detail the Mud Fish (Lepidosiren) now found in the Nile and other African rivers, and which forms a conecting link between the Fish and the Reptiles, and the Archeopteryx, long since extinct, which is a connecting link between the birds and reptiles, and then proceeded to describe in detail the Ornithorhynchus, as a connecting link between the Birds and Mammals. After calling attention to the peculiar shape of the head and the very duck-like beak, (the bones of the head, in adult specimens, being united together and smooth as in birds, not connected by sutures as is usually the case with Mammals,) and the total absence of teeth, all of which are bird-like characteristics, he proceeded to call attention to the mouth, which, unlike that of Mammals, has no lips. As, however, this arrangement would be prejudicial to the young animal when first born, the young Ornithorhynchus, during suckling time only, is provided with lips, which enables it to receive from its parent its natural nourishment.

The brain, smooth as in birds, not convoluted, was next described, and the organs of generation, which, though possessed of many singular bird-like characteristics, do not render the animal oviparous. Many remarkable bird-like characteristics were also pointed out in the bones of the skeleton, and attention was next called to the mammary glands of the female. These are not provided with any nipple, and this fact has led many naturalists to believe that the process of feeding the young is facilitated by the female discharging into its mouth the milk which the glands secrete.

The peculiar structure of the feet of the Platypus was pointed out, and described in detail, particular attention being called to the spur, which is much like that of the ordinary barn-door fowl, and also to the nails which, like the spur, are perforated in a remarkable manner. Having further described the peculiar structure of the hair, specimens of which were exhibited under the microscope, together with specimens of the hair of the common Mole (Talpa vulgaris), the reason for the peculiarities in each, namely, to allow the animal to back out of earth or mud, without soiling its skin, being explained and illustrated. Mr. Flower concluded his paper by explaining why it is that the Mammals of Australia are all either Monotremes or Marsupials, and why those two orders are confined to Australia. Shortly after these two orders of Mammals appeared upon the earth, and when there were as yet no higher animals which had reached Australia, that continent was broken away from the continent of Asia, and has never since been connected with it. Its ancient fauna therefore has thus been left to flourish and develope without interference and without competition with higher forms.

The paper was followed by a full and interesting discussion on the several subjects referred to in it, in which the Rev. Mr. Allen, Mr. F. Warren, Mr. H. Turner, the Rev. E. M. Geldart, Mr. A. Thompson, and Mr. E. Lovett took part. The discussion being extended to some of the more remarkable features of the New Zealand Fauna and Flora. The Apteryx, a specimen of which was in the same case as the Platypus, received special attention, and its many remarkable peculiarities were fully discussed and explained.

At the conclusion of the discussion, a hearty vote of thanks was accorded to Mr. Flower.

The following is a list of the exhibits :—The President, a fine series of photograms of Sea Birds, taken from life on the Farne Islands, Northumberland ; Mr. Flower, Nest of red-breasted Flycatcher; Mr. James Epps, jun., Microscope upwards of 100 years old, constructed by E. Culpepper ; Mr. Low Sargeant, larva of Dragon Fly polarized ; Mr. E. Lovett, Ixodes of Rabbit mounted in fluid, also tray of micaceous mud from Scilly, illustrating decomposition of Rock ; R. J. Backwell, larva of Day Fly ; A. Warner, section through jaws of Rat, showing teeth in situ, also Human Hand (fœtal 4 months).

Twelfth Annual Soiree.

Held on Wednesday, November 23rd, 1881.

The Soirée was held as usual in the Large and Small Halls. The attendance was 772, viz.:—145 Members, 70 Exhibitors, and 557 visitors.

One-hundred-and-forty microscopes were exhibited by 112 exhibitors, including representatives of eleven kindred societies and clubs, besides opticians and private exhibitors.

A great attraction of the evening was the beautiful display of flowers again contributed by the President from his conservatories at Waddon.

The musical arrangements were under the direction of Mr. F. Laughlin.

Near the orchestra a selection of eggs from the collection of the President were exhibited, including a series of 27 nests of British birds, each containing the egg of a cuckoo in addition to its rightful occupants ; and a fine series of nests and eggs of the Dartford warbler.

In the small hall, the Sphygmographs exhibited and worked by Drs. Rosser and Duncan were a great source of attraction throughout the evening.

The Sphygmograph is an invention of Dr. Dudgeon for taking the beatings of the pulse, and detecting the state of the heart. Unlike the cumbersome instrument invented by M. Mari some 20 years ago, the Sphygmograph is remarkable for its compactness and simplicity of construction. It is attached to the wrist by the operator, and by means of the pressure of a spring on the pulse, a record is obtained on paper, which has been previously smoked by burning a piece of camphor. This paper having been prepared, is passed through the instrument, and by means of a pin a perfect tracing is recorded. The paper on which the tracing is taken is then varnished with gum benzoin. The instrument was incessantly engaged during the evening in taking the pulse of any who wished to be experimented upon. Dr. Rosser also showed a spirometer and water hammer.

At another part of the hall Dr. Burdon Sanderson's instrument for measuring the velocity of thought and power of discrimination (shown by Mr. W. F. Stanley), also came in for a large share of attention.

The following is a list of exhibitors of microscopes:—

Croydon.—Mr. Philip Crowley (President), Messrs. H. R. Owen, Maitland-Gardner, W. Ingrams, Compton, E. B. Sturge, E. Lovett, Baldock, Rich, W. Stanley, G. Manners, S. Overton, Jno. Berney, H. Long, M. Mawson, S. W. Low, Jno. Corry, R. G. Hovenden, J. W. Justican, T. M. Loftus, W. J. Fuller, J. F. Rymer, F. R. Cheeswright, J. C. Oswald, J. Epps, jun., T. G. Brewer, K. McKean, A. D. Taylor, E. Williams, H. Turner, J. Toms, R. T. Backwell, R. Hall, Dr. J. M. Hobson.

Royal.—Messrs. F. M. Boosey, J. J. Verzay, J. R. Williams, J. J. Hunter, J. W. Fairey, H. Cronch, A. C. Cole, G. Cole, Moginie.

Quekett.—Messrs. T. D. Russell, W. T. Brown, G. A. Messenger, H. R. Gregory, J. Nelson, F. Enoch, F. H. P. Hind, Clifford, F. Reeves, J. H. Hadland, J. P. Watson, A. L. Corbett, F. W. Andrews, G. Hind, C. Baker, G. Pearce, F. Rudkin, J. W. Bailey, J. E. Simmonds, Alpheus Smith, A. S. E. Arch, G. D. Plomer, M. D. Notting, H. Epps.

South London.—Messrs. W. West, J. W. Worster, J. D. Errssell, E. Dodswell, W. Short, T. W. Henbrey, H. B. Robinson, R. S. West, J. B. Saffroy, W. B. Smith, R. A. Smith, J. A. Smith, T. Parks, T. W. Stidstore, W. T. Suffolk, J. Terry.

Greenwich.—Messrs. C. E. Bloomfield, M. Jakeman, T. W. Dannatt, W. Trickett, G. Dannatt, H. S. Richardson, W. S. Scarr, W. Crush.

New Cross.—Messrs. H. T. J. Hall, F. T. Nottage, G. J. Weightman, G. T. Collingwood, M. Burgess, T. Harrison, G. P. Berry, J. Harrison, F. J. Gregory.

Walthamstow.—Messrs. G. Ward, O. C. Goldthwart, J. Puddy, J. Alstone, J. Thomson, R. Sedgwick, W. S. Vernon.

Sydenham and Forest Hill.—Messrs. R. C. Crossland, E. George, A. C. Perrins, P. P. Pendergast.

Entomological Society, London.—Mr. T. Wood.

Erith and Belvedere.—Messrs. G. Wilcock, H. A. Auld.

Hackney.—Messrs. A. Feldwick, C. Willmott.

Eastbourne.—Mr. F. H. Pepler.

There were also the following private exhibitors:—

Messrs. W. S. Lee, E. C. P. Hardy, J. Carpenter, G. Stratton, J. S. Streeter, Crosfield, T. R. Duggan, E. C. Northcote, W. Fox Hawes, J. How, Dring, Fage.

IN ART.—Mr. J. Chumley exhibited pen and ink drawings: Messrs. Rich and Ray, water-color drawings and Chinese paintings on rice paper; and Rev. E. W. Field, autographs.

GEOLOGY was represented by the collections of fluviatile and estuarine fossils, chiefly mollusca, from the new railway cuttings between Addiscombe Road and Coombe Lane, accompanied by diagrams showing the sections and strata exposed in the works; by the trilobites of Mr. H. Turner, and fossils shown by Mr. Baldock.

ENTOMOLOGY by the exhibits of Mr. H. Bedford Pim, Mr. W. Ingrams (leaf cutter bees), and the series illustrative of the natural history of silk, shown by Mr. Lovett.

ORNITHOLOGY (in addition to the President's contributions already referred to) by Mr. Footit's Bird of Paradise; Mr. Compton's and Mr. Easter's cases of Birds; specimens of a white variety of the Partridge, shown by Dr. Carpenter, Mr. Rowland, and the President, which are described in the Proceedings; the nest of a Red-breasted Flycatcher, shown by Mr. Flower, also the subject of a notice in the Transactions.

BOTANY had its attractions in the Fungi of Mr. E. B. Sturge; the Seaweeds of Mr. J. Carpenter; Mr. Owst's and Mr. Owen's pressed Ferns; and Mr. Straker's stand of dried British Plants.

In other branches of Natural History may be mentioned Mr. Russell's beautiful models of Foraminifera; Mr. Hinton's and Mr. Crouch's Mollusca; Mr. Johnson's Crayfish, &c.

ANTIQUITIES AND CURIOSITIES were contributed as under:— Mr. Maitland-Gardner, Relics of Ancient London, &c.; Mr. Curling, Prehistoric Peruvian Pottery; Mr. Gibson, a Work on the Microscope, dated 1780.

Scientific Instruments, in addition to those already named, were shown by Mr. E. Mawley (Meteorological); Paterson and Baldock (Harmonigraph); and Mr. Stanley (Meteorological).

Ordinary Meeting, 21*st December*, 1881.

PHILIP CROWLEY, Esq., F.Z.S., President, in the chair.

The minutes of the last meeting were read and confirmed.

Mr. Isaac Stow was ballotted for and duly elected a member of the club.

The following donations were announced:—" Science

Gossip" for December, Procés verbal, Belgian Microscopical Society; Journal of the Royal Microscopical Society; Annual Reports of the Eastbourne Natural History Society, the Holmesdale Natural History Club, and the Postal Microscopical Club, from the Societies; Evans on the Archæopteryx, and W. F. Stanley on Fluids, presented by the authors; twelve microscopical slides, presented by Mr. H. Low Sargeant.

Mr. W. Reeve Cooper and Mr. H. S. Cowdell were appointed to audit the accounts of the club.

The PRESIDENT briefly explained a scheme which had already been carefully considered by the committee, as to the form of natural history collections by the club, and Mr. JOHN FLOWER moved the following resolutions, viz.:—(1) That it is desirable that collections of objects of natural history be formed by the club to illustrate and to facilitate the study of the natural history and geology of the district, and that the committee be requested to take such steps as they may consider desirable to form such collections. (2.) That the committee be also authorised to undertake on behalf of the club the custody of such local antiquities as may be entrusted to them. (3.) That the committee be also authorised to offer on behalf of the club, to the Directors of the Croydon Literary and Scientific Institution, for the Museum which they are about to form, the use of the collections of the club upon such terms as the committee may approve. (4.) That the committee be also authorised to accept, on behalf of the club, the invitation of the committee of the Institution, and the committee of the School of Art, to join with them in promoting the Bazaar to be held in or about June next; the proceeds of which are to be equally divided between the institution, the school of art, and the club. (5.) That the participation of the club in the Bazaar be contingent upon the Directors of the Institution providing a room suitable for a museum, and that the share of the club in the amount realized by the Bazaar be applied to providing cases and other necessary appliances for the collections to be formed by the club.

These resolutions were seconded by the Rev. E. M. GELDART, put to the meeting, and carried unanimously.

The PRESIDENT announced that Mr. W. F. Stanley would read a paper at the next meeting "On some new observations of Vortex Motions, and on the evidence of the possibility of such motions being active in vital systems."

With reference to the election of officers for 1882, which would take place at the next meeting, the PRESIDENT asked members to adopt a plan which had been proposed by the committee, viz., that the officers of the club be nominated in writing, and that such nominations be sent to the secretary not later than the 11th January; that a printed list of the nominations for all the officers of the club be circulated at the annual meeting, and that the members present vote by ballot by striking out such names as they do not desire to vote for, and putting the lists in an urn to be placed on the table. Scrutineers to be appointed at the meeting, and the votes to be counted and declared during the course of the meeting.

The following papers were then read :—" Notes on the nest of the Carder Bee," by Dr. Alfred Carpenter; " On one of the means by which Forest Trees may be destroyed, as instanced by the case of a Birch Tree," by the same; " Note on the occurrence of Achatina acicula on Park Hill," by Mr. K. McKean.

Dr. CARPENTER exhibited a tumour which had been removed from an elm tree in Shirley Churchyard, and expressed a belief that the time was not far distant when medical men, by studying the diseases of plants, would find out some matters connected with perverted nutrition which would enable them to deal more successfully with diseases that occurred in human beings, and which they were unable to remove at present except by cutting out.

The following exhibits were made, viz.:—Jas. Epps, jun., Hydra viridis; Ed. Lovett, Sertularia argentea; John Flower, wing bones of Black Swan and Greater black-backed Gull; K. McKean, mature and immature specimens of Achatina acicula; W. Low Sargeant, Wasp's nest (vespa vulgaris), one showing commencement of the nest, and the other the complete nest with hybernating female wasps; E. B. Sturge, Birch Bark, and Lichen from Elm; Nat. Waterall, sections of Beetle Stones.

Twelfth Annual Meeting, January 18th, 1882.

PHILIP CROWLEY, ESQ., F.Z.S., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were ballotted for and duly elected members: — Mr. F. F. Garrad, Rev. George Bailey, Mr. Edward W. Foss, Mr. Charles J. Foss, Rev. George Henry Huddleston, Rev. R. Milbarn Blackiston, Mr. Thomas Robert Tufnell, Mr. James Stocks Miller, Mr. Samuel Jones, Mr. Thomas Dawson, Mr. Henry Lee Berney, Mr. S. Mordaunt, Mr. P. G. Guimaraens, Mr. Henry C. Collyer.

The report and balance-sheet of the committee for 1881, as follows, was read by the Hon. Secretary :—

REPORT.

Your Committee have the pleasure of submitting their twelfth annual report.

During the past year (1881) the Club has been augmented by 25 new members and one associate, while 18 members have withdrawn, and Prof. Rolleston, an hon. member, and Mr. Bindley have died.

On the 31st December the Club consisted of 248 members, four honorary members, and one associate.

The following papers have been read during the year:—

February 16th.—Mr. A. D. Taylor, "On variations of colour in Moths and Butterflies."

March 23rd.—Mr. B. Latham, C.E., F.M.S., "Observations on Rainfall." Mr. H. S. Eaton, F.M.S., "On the climate of Croydon" and "On the best methods of applying Meteorology to Field Observations in Natural History."

April 20th.—Mr. W. Topley (Geol. Survey of England), "On the Geology and Physical Geography of the Weald of Surrey."

May 18th.—Mr. J. S. Johnson, M.R.C.S., "On the Anatomy of the Crayfish."

September 21st.—Mr. George Corden, F.M.S., "On the Meteorology of Croydon." Mr. J. S. Johnson, "Note on the Contents of the Stomach of a Water Vole."

October 19th.—Mr. W. Nation, "On Gums and Resins." Mr. Edward Lovett, "Observations on Fossil Resins and their enclosed traces of Animal Life."

November 16th.—Mr. John Flower, M.A., F.Z.S., "On the Nesting of the Red-breasted Flycatcher (muscicapa parva) in Kent, in the Summer of 1881;" also "Note on the structural peculiarities of the Apteryx and the Ornithorynchus Paradoxus."

December 21st.—Dr. Carpenter, "Note on the Nest of the Carder Bee," and "Note on peculiarity in the Bark and Wood of the Birch Tree." Mr. K. McKean, "Note on the occurrence of Achatina Acicula on Park Hill, Croydon."

Of the excursions made during the year two were very successful.

The first was on Easter Monday, when Mr. Topley conducted a party of 26 members and their friends over an interesting portion of the Surrey Weald, and explained its principal features. The line taken was from Caterham over White Hill to Bletchingley, and thence to Redhill. The weather proved very fine, and a most enjoyable day was passed.

On the 7th May, in response to an invitation from the Geologists' Association, a large number of members joined in an excursion to Addiscombe, Shirley, and Addington Park. The weather again favoured the excursionists, who numbered upwards of 120. The places visited were of great interest, and were ably explained by Mr. John Flower and Mr. Logan Lobly, the directors of the excursion.

In May the Club took possession of its new library and reading room, which, however, does not appear to have been made so much use of as your committee anticipated.

The Club's transactions which, through want of a publishing committee, had been allowed to accumulate for more than three years, were in August published in a newly arranged form. As time pressed, and as it would have been beyond the means at their disposal to print in full all the papers read before the Club during that period, your committee decided to print only those which relate to local subjects or which embody original observations, and to take the opinion of the Club with regard to the publishing of future papers. The thanks of the Club are due to Mr. Flower for editing the transactions referred to.

The twelfth annual soiree was held at the Public Hall, on Wednesday, 23rd November, when the usual kind assistance was given by the Royal Microscopical Society, Quekett Microscopical Club, South London Club, New Cross Club, Sydenham and Forest Hill Club, Greenwich Club, Hackney Club, Erith and Belvedere Society, Eastbourne Society, Tower Hill Club, and the Walthamstow Club, and by several private exhibitors and opticians. One hundred and forty microscopes were exhibited. The attendance was—members, 145; exhibitors non-members, 70; visitors, 557. Total, 772.

The following is a list of the donations received:—The journals of the Royal Microscopical Society and of the Quekett Microscopical Club; the proceedings of the Belgian Microscopical Society; "Science Gossip," from the publisher; report on the crab and lobster fisheries, and the history and description of the Devon and Exeter Museum, from Mr. E. B. Sturge; Rosarians' year book, and the weather of 1880, by E. Mawley, F.M.S., from the author; "Eaton on the average height of the barometer," from the author; notes on the British stalk-eyed crustacea, from Mr. E. Lovett; micrographic dictionary, from Dr. Carpenter; report of the British Association at York, Sir John Lubbock's address at York, note on the fall of an aerolite at Middlesborough, by Mr. Cushing; six books from Mr. E. B. Sturge, viz.: "Student's Natural History," "Text Book of Zoology," "Natural History of Birds," "The Microscope," "Manual of Geology," "Dictionary of Scientific Terms;" "Evans on the Archeopteryx," from the author; "Stanley on Fluids," from the author. Annual reports and transactions of the following Societies:—Holmesdale Natural History Club, West Kent Natural History Society, New Cross Society, Eastbourne Natural History Society, Lewisham Scientific Association, East Kent Natural History Club, Postal Microscopical Club.

There have also been presented to the Club cabinet 12 slides by Mr. W. Low Sargeant.

The thanks of the Club are again due to the Local Press for their reports of the Club's meetings.

BALANCE SHEET FOR THE YEAR ENDING 31st DECEMBER, 1881.

RECEIPTS.

	£	s.	d.
To Balance in hand, 1st January	89	16	4
,, Subscriptions	119	10	0
,, Sale of Lectures	1	15	10
,, Sale of Soirée Tickets	26	15	0
	£237	17	2
To Balance brought down	56	19	1

EXPENDITURE.

	£	s.	d.	£	s.	d.
By Hire of Rooms				10	2	6
,, Furniture for Club Room				15	7	6
,, Postages				3	12	8
,, Books and Binding				0	15	0
,, Printing				6	2	6
,, Printing Transactions, 1878, 1879, 1880 ...				65	6	3
,, Advertisements				11	7	6
,, Fire Assurance				0	7	6
,, Collecting Subscriptions				6	7	11
,, Attendance, Lamps, Oil, &c.				1	11	1
,, Gratuities				1	8	6
,, Sundries				1	0	0
SOIREE ACCOUNT.						
,, Hire of Rooms	7	17	6			
,, Music	6	0	0			
,, Tables	11	10	0			
,, Police and Attendants	0	15	6			
,, Printing	6	3	0			
,, Advertisements	2	17	10			
,, Hire of Lamps	2	5	0			
,, Refreshments	16	5	4			
,, Postages	3	10	0			
,, Sundries	0	5	0			
				57	9	2
Balance forward				56	19	1
				£237	17	2

JOHN FLOWER, TREASURER.

We, the undersigned, having examined the above accounts, and vouchers relating thereto, hereby certify that they are correct, according to the vouchers and bankers' pass-book.

January 6th, 1882.

WM. REEVE COOPER,
HENRY S. COWDELL, } AUDITORS.

The President, in moving that the report as read be adopted and that it be printed in the transactions of the Club, said I have great pleasure in moving the adoption of the report and feel that our Club may be congratulated that its contents are of such a satisfactory nature. Our Club has grown since the first meeting, now 12 years ago, at the house of our valued friend Mr. Lee, from the then eight or ten to upwards of 250, without counting the long list elected this evening, and this has not been a rapid unstable growth, but a steady one, and one we may hope to see maintained. Of course, in such a Club as ours, we must expect fluctuations, and lose, as time runs on, many useful members. During the past year it has pleased the All Wise Being whose creation we are and whose works we meet to study, to remove from us two members by death, one of them being a man of great gifts and knowledge. I allude to the late Prof. Rolleston, one of our Hon. Members; we have also lost 18 members by removal or resignation, but we have gained 26 new members so that our numbers are now over 250. Our papers have this year been of more than usual interest, nearly all of them referring to local matters, and *all* of them by members of our own Club. The report of the Meteorological Sub-Committee by Mr. Corden, and the papers on the same subject by Messrs. Latham and Eaton, added much to our knowledge of local meteorology, bringing before us as they did, not only the most noteworthy events in our own neighbourhood, but also much general information. The facts that all the papers have been by our own members is a very encouraging one, showing the great interest our members take in our Club, and we must hope to see others come forward in the same manner during the ensuing year. The members of our Geological Sub-Committee have several times visited the workings of the new railway now being made through Addiscombe, and I hope we may have a report from them at a future meeting. Since our last Annual Meeting we have secured the small room in which the Committee Meetings are held, for our exclusive use, but at present our members make but little use of it; however, now that the winter has come, we hope to see it more used as our members can meet there to compare notes and assist each other. I would remind our members that on any occasion when they wish to use the room they can have a fire by giving a few hours' notice to Mr. Pusey. There is now before your Committee the subject of the formation of a museum, but as the arrangements with the Directors of the Public Hall and others are not yet completed it would be premature to enter into particulars at the present time. Our balance-sheet, which is to-night before you, shows a very promising result, although the actual balance in hand is only £59 19s. 1d. as against £89 16s. 4d. at the commencement of the year, or about £33 less. We have this year spent, or rather *invested* I may say, £15 in the furniture of our Club room, and the former amount is, you may perhaps remember, to some extent fictitious, as we have for two years printed no proceedings so that the present year has born the expense of three years' proceedings. Our annual soiree has again been a success, and I think as interesting as any of its predecessors. Of course there is not now the same novelty that there was in the first one or two held, when many of those who attended had perhaps never seen an object under a microscope, but in nature there is always something new, and in such a gathering as we had there was something new and of interest for all, not only in the microscopical world, but in other objects of interest. Many of our friends from other clubs remark that ours is one of the pleasantest soirees they attend. As well as being helped at our own soiree by exhibitors from several other Clubs, members of our own Club have assisted some of our neighbouring Clubs.

Mr. Maitland Gardner seconded the motion of the President, and it was carried unanimously.

It was moved by Mr. Flower, seconded by Mr. Henry Turner, and carried by acclamation, "That Mr. Philip Crowley be the President for the ensuing year."

It was moved by Mr. George Manners, seconded by Dr. Carpenter, and carried unanimously, "That Mr. Flower be Treasurer for the ensuing year."

The President, having announced the resignation by Mr. K. McKean of the office of Honorary Secretary of the Club, moved "That Mr. Charles Price Turner be the Honorary Secretary for the ensuing year," this was seconded by Mr. James Chisholm, put to the meeting, and carried unanimously.

It was announced by the President that two additional nominations had been received for the new Committee, viz.: Mr. William Topley, F.G.S., and Mr. K. McKean. Messrs. H. S. Cowdell, W. Low Sargeant, and E. B. Sturge having been appointed scrutineers, the meeting proceeded to vote by ballot for the nine members to compose the new Committee. Dr. Thomson suggested that in future the names of the existing Committee be printed, on the ballot papers, in different type to the new nominations. The scrutineers having completed the counting, Mr. H. S. Cowdell announced that the following gentlemen had been duly elected to serve on the Committee:—Dr. Carpenter, Mr. James Chisholm, Mr. Thomas Cushing, Mr. J. S. Johnson, Mr. Edward Lovett, Mr. K. McKean, Mr. H. T. Mennell, Mr. William Topley, and Mr. Henry Turner.

Mr. H. T. Mennell moved "That in future the officers of "the Club be nominated in writing, and that such nominations "be sent to the Secretary not later than the second Wednes-"day in January, or seven clear days before the Annual "Meeting. That a printed list of all the nominations of the "officers of the Club be circulated at the Annual Meetings, "and that the members present vote by ballot, by striking out "such names as they do not desire to vote for, and placing "the lists in an urn on the table. Scrutineers to be appointed "at the meeting, and the votes to be counted and declared "during the course of the meeting."

The motion having been seconded by Mr. E. Lovett was put to the meeting and carried unanimously.

Dr. Carpenter moved "That the Club approves of the "plan proposed by the Committee that in future the transac-"tions of the Club contain only papers on local subjects or "such as are the result of original observation and research."

Seconded by Mr. Flower, put to the meeting, and carried.

Mr. H. T. Mennell moved a vote of thanks to Mr. K. McKean for his services as Secretary during the past year.

Mr. Sturge seconded the motion which was cordially approved by the meeting.

The business of the Annual Meeting being concluded,

Mr. W. F. Stanley read a paper "On some new Observations of Vortex Motions and of Evidence of the possibility of such Motions being active in Vital Systems." Assisted by Mr. W. Low Sargeant, the lecturer gave some beautiful experiments illustrating whirl motions in vapours and fluids. At the conclusion of the discussion which followed, a hearty vote of thanks was passed to Mr. Stanley.

The following objects were exhibited:—Jas. Epps, Junr. satin leaves from Cape of Good Hope, scale of pike, and scale of sole; W. F. Stanley, injected blood vessels, cerebrum of cat; A. Warner, human ovary showing graffian vesicles; H. Turner, inoceramus (sp ?) from basement bed of Woolwich series, leaf of exogen (sp ?) from yellow clay bed, railway cutting, Park Hill; E. B. Sturge, polycystinæ, splintered sections of oak; the President, group of pezizas from Alton; H. M. Klaassen, section, human lung showing large deposit of carbon, the result of living in a smoky town.

No.	Name of Parish.	Girth. ft.	in.	Height at which the Girth is taken.	Bearing.	Estimated age about.
20B	Limpsfield	11	3 ...	5-ft. ...	W.S.W. ...	470 years
21	Tatsfield	16	3 ...	,, ...	E.N.E. ...	700 ,,
22	Ashtead, about	24	0 ...	,, ...	W.S.W. ...	1400 ,,
23A	Walton-on-the-Hill............	7	0 ...	2-in. ...	W.S.W. ...	500 ,,
23B	,, ...	9	6 ...	5-ft. ...	W.S.W. ...	500 ,,
24A	Burstow	13	6 ...	,, ...	S.E. ...	500 ,,
24B	,, ...	9	9 ...	,, ...	E.S.E. ...	400 ,,
25A	Horley	19	9 ...	,, ...	W.N.W. ...	900 ,,
25B	,, ...	23	0 ...	,, ...	W.S.W. ...	1000 ,,
26	Charlwood	21	5 ...	,, ...	S.E. ...	1300 ,,
27	Capel	14	6 ...	,, ...	E.S.E. ...	600 ,,

The bearings to the points of the compass.

4	Trees bear ...	W.	1	Tree bears ...	E.
9	,, ...	W.S.W.	1	,, ...	E.N.E.
2	,, ...	S.W.	1	,, ...	N.E.
5	,, ...	S.S.W.	1	,, ...	N.N.E.
4	,, ...	S.	0	,, ...	N.
3	,, ...	S.S.E.	2	,, ...	N.N.W.
5	,, ...	S.E.	0	,, ...	N.W.
3	,, ...	E.S.E.	2	,, ...	W.N.W.

The predominating and average bearing is S.S.W.

There are—

35	Trees having...	... SOUTH	bearings
8	,, ...	... NORTH	,,
28	,, ...	... WEST	,,
15	,, ...	... EAST	,,

19.—On the Peculiar Shape of the Claw of the Middle Toe of Birds.

By the President.

[*Read December 15th*, 1880.]

The peculiarly serrated shape of the claw of the middle toe of the Nightjar (C. Europœus) is well known, and many are the ingenious theories which have been framed to account for its peculiar form. The claw of the middle toe is also serrated in the Herons and Cormorants, and in other birds peculiarities in this claw have been noticed. It is not, however, my intention now to go through these in detail, or to endeavour to explain the reason for their peculiarities. I propose on the present occasion merely to point out a matter of some interest, which seems to throw some light upon the peculiarities to which I have referred.

The number of birds in which peculiarities in the claw of the middle toe have been noticed and described is comparatively small, and it is somewhat singular that all naturalists who have dealt with this subject have describdd these cases as something altogether exceptional, as if, in fact, they were the only birds in which this claw is different from the others. I believe, however, that a close and exhaustive examination of the feet of birds would show that there are very few, if any, birds in which the claw of the middle toe is not more or less modified in form. The outside edge of this claw, as a rule, is not peculiar, but the inside edge is so far modified that it is easy to tell whether any particular foot is a right foot or a left foot by this peculiarity alone.

The series of birds' feet which I have here, aud which comprise numerous examples from each of the five orders into which British birds are divided, will make this very clear. In all of them the inside edge of the middle claw is much developed and altered in shape.

It would be dangerous to attempt to frame a theory to account for this peculiarity until the matter has been more fully considered and investigated, but I hope our members will not lose sight of this subject, and if any remarkable modification of this claw should come under their observation they should not fail to bring it forward at one of our meetings.

20.—MOTHS AND BUTTERFLIES, THEIR COLOURS AND VARIATIONS.

By MR. A. D. TAYLOR.

[*Read 16th February*, 1881.]

MR. TAYLOR, in the course of his lecture on the colorization of animals, last November, referred to a moth exhibited by Mr. Lovett. It was a female which had the coloring and markings of the male moth—a very remarkable instance, which rarely happens, and the remark he made, as I understood, was that possibly the alteration of color, &c., might be occasioned by some change in the life of the moth, such as sometimes affected other animals. As such a change could not possibly happen to this order of the insect world, I thought that a few remarks might be made upon the life and history of Butterflies and Moths, with special reference to the cause of their color and markings.

Insect life differs entirely from all other orders in natural history, having four distinct stages of life—the ova or egg, larva or caterpillar, pupa or chrysalis, imago or perfect insect.

Firstly, the butterfly or moth deposits her eggs either singly or in groups; these eggs are very beautiful as microscopic objects, varying greatly in shape, size, and colour, some being round, others oblong, oval, or hexagonal, having numerous facets, with a series of depressions and marks of various designs and characters.

From the egg proceed the larvæ, at first microscopically small, but with all their natural colors displayed on their bodies as when full grown, the caterpillars passing through a series of periodical changes of skin, which seriously affect their health, for many die during the process; when the time arrives for the change of skin, they leave off feeding and remain upon the leaves or branches of their food-plant for some hours motionless. After a time the old skin commences splitting from the head, downwards, and finally the caterpillar in its new clothes crawls away, leaving the remains of the old skin upon the leaf. This may frequently be found in tolerably perfect condition, with the colour as in life, but slightly faded. The number of times they go through this process of change of skin varies from three to seven, or even eight, varying according to species, but this I have never kept an account of.

Swammerdam, the great naturalist, discovered by accurate dissection not only the skins of the larvæ and of the pupa encased in each other, but within these the very butterfly itself, with its organs in an almost fluid state, but still perfect in all its parts. The larva having arrived at its last stage of growth, and being more or less full fed, seeks a convenient place suitable to its species, if a butterfly above ground, on palings, outhouses, trees, and the underside of leaves, firmly attaching itself, in some species head downwards, in others upright, with a silken cord around its body and firmly glued to its resting place.

In the other family, Moths, a few of the larvæ conceal themselves, enveloped in silk-spun cocoons in or under the bark of trees, but most of them bury themselves a few inches under ground to undergo the change into the pupa or chrysalis state.

The larva, having fixed itself in position, in a short time the skin may be seen splitting and shrivelling off the body, leaving it for a short time apparently naked, and in a soft jelly-like condition, and now without the slightest sign of any colour. Gradually the outer surface hardens, and forms a shell-like case more or less transparent, in butterflies, but opaque in moths. The pupa cases of some of the butterflies are more or less colored, some of them with curious angles and projections tipped with metallic gold-like marks; in some the wings antennæ, and eyes are very prominently marked on the exterior; the pupæ of moths are, with few exceptions, dull brown or black. From the pupa comes the butterfly, or moth, as the case may be, and now no further alteration can be made; in whatever size or condition the moth emerges from its pupa case, it remains in until its death, its only apparent object now being to disport itself in the world and propagate its species; if in its former state of caterpillar it has been kept short of food, the result will be a smaller perfect insect, and this I have found to occur frequently when rearing a large number at a time.

I now propose to endeavour to account for the color and variations which are common to a certain extent to both butterflies and moths, in the last named in almost endless variety. In a few instances some of the colors on the caterpillars are more or less reproduced on the perfect insect, but generally an entire change is effected. I select a few examples of both. The larva of the small tortoise-shell butterfly is yellowish grey, with black and brown and yellow stripes on its body, its butterfly reddish-orange, with more or less black spots and blotches, and a small white spot on each of the front wings; but another butterfly in the same genus, the Peacock (Vanessa Io.), which has red and brown and black marks on the fore wings, and on the hind wings the beautiful eye-like spot formed of rings of yellow, black, red, bluish-lilac, rosy and white, has a very spiny, black larva, with numerous white dots, thus presenting a strong contrast in color between the two stages of life.

Several species of butterflies have metallic colored marks upon the underside of their wings, which do not appear at all in their larva state, but appear on the angular projections of their pupa cases.

One of our common moths, the Garden Tiger (Arctia caja), the larva of which is thickly clothed with long black hair, with some whitish ones on the back, and reddish-brown hairs on the sides, in the imago has dark brown fore wings, with white blotches, and the hind wings reddish-orange with six or seven blue-black spots.

In another species the Cinnabar (Callimorpha Jacobæa), the larva is slightly hairy, black, with orange-yellow or reddish rings around its body, and the moth has its fore wings smoky-grey, with a red stripe, and hind wings red, with black margin.

Another moth common in our gardens, the large Magpie (Abraxas grossulariata), has its larva white, dotted with black, and reddish-yellow lines on the sides, the moth being white, with rows of black spots and slender lines, and blotches of orange. In this species both larva and moth are very similar in color, and the pupa is again somewhat like being reddish-black with orange rings around its body. Another moth, Stilpnotia Salicis, the White Satin, which is pure satiny white, without any spots, has its larva many colored, white, with black lines, the sides bluish-white, spotted with black and red velvety tubercles.

Many of the larva of both butterflies and moths have extraordinary forms, some having humps like the camel, others resemble the lobster, some are more or less covered with sharp spines, others thickly or thinly clothed with hairs, or with groups of hairs on their backs in various positions and quantities, but all these curious forms and characters disappear in the final change into the pupa state, and in not one instance do they affect the shape of the moth.

I could quote many other instances of strange variation of colour, but think these sufficient for my purpose of illustration. The question is—What is the cause or origin of color and variation in the markings of both butterflies and moths? Has the food-plant anything to do with it? Experiments have been tried, but with very little success. The larva of the Tiger Moth, which feed upon almost all low growing plants, if fed entirely upon lettuce leaves, will produce pale colored moths, the white predominating over the dark ones, and if others are fed entirely upon the purple cabbage these will produce very dark colored moths, and I have read of some that were nearly or quite black all over.

As a rule larvæ are not easily experimented upon with a variety of food, for with a few exceptions they will only feed upon their natural food-plants, and if these cannot be procured will starve sooner than eat anything foreign to their nature.

I believe myself, and everything I have read as to cause of colour does not change my opinion, that, firstly, the natural colors of both larva and moth exist in the cells of their bodies and are produced when wanted, for we see that when the larva first leaves the egg it has all its natural colors upon its skin. With every after-change of skin the same colors are reproduced underneath the old skin, and appear as the old skin is gradually rejected. Again, when the larva is passing through its last final transition into the pupa, and has thrown off its now somewhat faded skin (for nearly all larvæ seem to lose their bright colours before their last change), it leaves the naked body of the still living insect colorless, yet the full colors of the future butterfly may be seen through the pupa case some hours before the insect emerges, the pupa case of most butterflies becoming semi-transparent during this last process of transition.

Some authors have thought that some of the colors are produced by the scales being placed one over another, two or three combining to form a certain color, but this can only happen on certain parts. As a rule the scales are placed singly in rows, one partly lying over another like slates. A portion of the Buff Tipped Moth (Pygara Bucephalæ) well represents this arrangement. An article in the "Micrographic Dictionary" confirms my ideas upon the cause and arrangement of color. It states that the colors of the scales of insects arise partly from iridescence, partly from the presence of pigments; in general, the brilliant colors depending upon the former, and the more sombre upon the latter; the darkness of the longitudinal striæ is caused by refraction: for scales containing no pigment appear perfectly white by reflected light, although the striæ may be very dark.

The variation in shades of colors and in the breadth and intensity of markings, is easily accounted for; great variations of this kind occur mostly among the moths, and in those species whose larvæ feed upon a variety of food plants. This is one cause, but we may also find another and a very simple one. The eggs of moths are laid in considerable numbers, and those which are first impregnated appear similar to their parents; afterwards, in succession, the remainder of the brood will vary in breadth and intensity of both markings and colors. The same thing happens with plants, seeds procured from any plant, even of one that has not been affected by cross fertilization by insects, will not produce plants all of the same colors and character as the parent, but varieties both of color and excellence. The insect shown by Mr. Lovett I think was only a freak of nature. In conclusion, I should like to call the attention of all to the great and wondrous beauty displayed in the Micro-Lepidoptera, a section unfortunately too much neglected by entomologists in general. If those who have not collected any of these small but exceedingly beautiful species of moths would turn their attention to them—if only between the seasons for collecting the Macro-Lepidoptera, they would not only be amply rewarded, but perhaps, like myself, devote their whole time to this fascinating section, for there is scarcely a day in the whole year but what some may be found either in the larva or imago state, and from March to October and some times later, they may be collected by dozens; on the otherhand, those who search after the larger species of butterflies and moths find them few and far between. For myself, I go out for the Micro, and take the larger if they come in my way.

The larvæ of both the families of the Tortricinæ and Tineinæ, are found in more or less abundance upon all our forest trees, as well as upon nearly all plants and grasses; those of the Tortricinæ, in rolled up leaves, between united leaves, that is between one leaf more or less fastened by its edge to another, (the larvæ living and feeding between the two), also in young shoots more or less spun together. Those of the Tineinæ are still more abundant, and present several peculiarly distinct forms of concealment, such as forming a mine in the leaves, that is, making a narrow gallery between the two cuticles of the leaf, feeding as they go; others form curious cases, out of portions of the leaves on which they feed, living in, and carrying their cases about with them. They also change into their pupæ inside these cases; and as a hint to the collector that the moth has emerged, the empty pupa may be seen half out of the abandoned case. Some of these curious cases I have on the table here.

The perfect insects of the Tortricinæ are all moderately small in size, but vary immensely in color, and some are very beautifully and wonderfully marked. In nearly all the species there is considerable variation—so much so that you may have no less than 50 specimens and no two alike, and some so distinctly different that until Mr. Wilkinson's book on the Tortrices appeared, they had been considered as distinct species. I had the pleasure of helping in describing and collecting specimens for this work, and we bred from one and the same batch of eggs many of these so-called distinct species. But for extraordinarily brilliant colors and markings we must turn to the Tineinæ. As the humming birds are admired by all for beauty of colors and minuteness of form, so ought these small moths to be.

The larvæ of each genus of this family have, as far as is known, their own peculiar habits and modes of life, except as regards one large genus which contains species representing, in the habits of their larvæ, nearly all the other genera of the family.

Some (Tina) feed on waste substances, some (Lampronia, &c.) are case makers, some live in large families in webs (Yponomeuta), some mine in grasses, some form blotches under leaves in which they dwell, some make a white slime like lime on trees (Cemicostema), others (Depressaria) live in the heads o young plants.

21.—On Meteorological Observations.

By Henry Storks Eaton, M.A., late President of the Meteorological Society.

Read 23rd March, 1881.

The area occupied by the Croydon Microscopical and Natural History Club is well defined. It is about 30 miles from East to West, and 20 miles from North to South. It is bounded by the river Darent on the East, by the Mole on the West, the Thames on the North, and includes the Gault formation to the South; but for the purpose of the present paper the Southern boundary may be described as the escarpment of the North Downs, which here extends from ENE. to WSW., as a tract of table-land from 650 to 850 feet above the sea, broken by gaps at Caterham and Merstham. The highest point is Botley Hill, about 7¼ miles south-east of Croydon, near Titsey. The general inclination of the ground immediately north of the Downs is a gentle slope towards the Thames, interrupted by numerous deep dry coombes and valleys in the chalk leading to the comparatively low-lying Tertiaries nearer London. The town of Croydon is situated at the junction of the chalk and the more recent formations, the elevation of the ground within its precincts varying from 120 to nearly 300 feet above the sea, and sea-level is attained at the river Thames in London. This configuration of the ground, and the vast extent of London included in the district and lying to the north of it, are the main features which determine the local peculiarities of our climate. Within this area are situated the two chief meteorological observatories of the kingdom, viz., the Royal Observatory, Greenwich, and the Kew Observatory. At both of these there is a continuous photographic registration of the movements of the barometer and thermometer besides the registration by self-recording instruments of the direction and force of the wind, the fall of rain, and the amount of sunshine. The scheme of observation is, in fact, too comprehensive for private individuals, and demands a staff of observers trained specially for the work. Independently of these, our domain is on the whole well represented by meteorological observers—persons who devote both time and trouble to the work for the pure love of knowledge. There are at least forty stations where the fall of rain is registered. Then there are the more comprehensive observations of Mr. Corden, Mr. Latham, and Mr. Mawley in Croydon itself. The two latter gentlemen include in their programme far more than is usually attempted by private observers. Mr. Latham registers the temperature of the ground down to 50 feet below the surface, and carries on experiments on the percolation of rain through different soils and on evaporation; and he has also established and maintains a comprehensive series of stations for observing the fall of rain in outlying districts on the North Downs, of which he has communicated to us the results this evening. Mr. Mawley both notes the temperature of the soil and keeps a sunshine recorder, and an anemometer —I should like to see one of the latter instruments at the top of the water-tower. There are also observers at Lower Norwood, South Norwood, Beddington, Beckenham, Eltham, and Caterham.

Situated midway between London on the one side and the North Downs on the other, Croydon is alternately subjected to an atmosphere polluted with smoke, and to air comparatively pure according to the quarter from which the wind blows. No sooner does the wind set in from the North than the sun grows dim and the landscape blurred by a gloomy canopy of smoke, which, when mixed with fog in winter, is sometimes so dense as to oblige us to have recourse to artificial light at mid-day. The evil is increasing year by year; there is not a nook or corner in the county of Surrey to which the smoke of London does not at times penetrate and coat stagnant pools of water with a film of carbon. The rapid growth of Croydon has aggravated the nuisance, which is decidedly worse now than it was ten years ago; and the paucity of fructifying lichens on our houses and on trees is a sure witness of its baleful effects; for six months in the year you cannot pluck a twig in your garden without soiling your fingers; and you may walk for miles and not see a sheep with an unsullied fleece. London is known to have a higher temperature than that due to geographical position, owing to artificial causes, but the disturbance thereby produced in the climate of this vicinity has not yet been investigated. With the wind from any other direction than that of London, the climate of Croydon is, on the whole, a pleasant one. Statistics relating to it were submitted to you by Mr. Corden three years ago, to which I may refer you for much interesting information.

I have already stated that the topographical configuration of the ground is one of the causes that give an individuality to our local climate. This is chiefly noticeable at night and in the winter, when the influence of the sun is feeble, and the surface of the ground is cooled by radiation below the superincumbent air. At such times the particles of air resting on the ground become cold by contact with it, and increasing in density descend the slopes of the downs, and collect at the bottom of the coombes, displacing the warmer air. Creeping from these as shallow streams of cold air of limited extent, they gather in the wider valleys, and are the fruitful source of the so-called radiation fogs to which we are rather liable. Now the position of Croydon is such as to receive the united streams of cold air from the Caterham Valley, Smitham Bottom, and the coombes leading into them, and we may accordingly expect to find, and do find, great difference of temperature within short distances on certain occasions in Croydon. The descent of cold air in this way through the valleys is of course counter-balanced by the ascent of the comparatively warm air which it displaces, so that the hills enjoy a somewhat higher temperature than they otherwise would.

Take your stand some calm and cloudless summer evening after a hot day on the mound by the water-tower, and look over the country to the south and west. As the sun sinks you will notice that the smoke of South Croydon is less diffused through the air than it was an hour before, and by-and-bye, as the twilight deepens, it will settle down in a well-defined stratum, extending up the valley to Caterham Junction, reaching perhaps half-way up Russell Hill, and leaving the air transparent above. The outline of the hills is sharply defined against the evening sky, and their shoulders loom darkly above the haze in the valley. The roar and rush of a train descending the cutting from Merstham tunnel perhaps falls on the ear in measured cadences. All else is still save the hum and murmur of the town below. The air is soft and balmy with the scent of flowers, and you enjoy the freshness. Now descend Park Hill and cross the meadow by the footpath to Coombe Lane. Just before you reach the wicket-gate through the hedge, at the bottom of the dip you will suddenly find it chilly and cold, and very likely a faint breeze from the east coming down the hollow from Coombe Farm will fan your brow. A few paces farther on, at the top of the rise, you will again come upon the warm and genial summer air. Suppose you carry a thermometer you will find its indications respond to your feelings, and that it is several degrees colder in the hollow than elsewhere. You will encounter similar phenomena, but less marked, by descending from the water-tower to the Brighton-road and climbing the hill opposite; you will cross a cold current of air setting slowly down the valley to Croydon, and leave it behind on emerging from the haze.

Under similar circumstances of clearness of the sky and stillness of the atmosphere this phenomenon is very marked when the ground is wrapped in a mantle of freshly fallen snow, for then the heat of the ground is effectually cut off by one of the best non-conductors in nature—a layer of snow with air entangled in its interstices, and the cooling effect of radiation is unchecked. A remarkable instance of this came under my notice on the 23rd of November, 1879. The ground was covered several inches deep with snow, which had fallen plentifully on the 20th and 21st of that month, and more sparingly on the following day. The morning of the 23rd was foggy in the lower part of the town of Croydon, but later on the fog dispersed, and the snow glowed with a rosy tint in the bright sunshine. It was a magnificent day, with a gentle breeze from S.W. A few minutes after 2 p.m., at the highest point of Park-hill-road, the thermometer marked 32°, and at the commencement of the hedge which skirts the foot-path through the field from Park-hill-road to Coombe-lane, 30°. Looking down from here into the dell below, a thin mist partly veiled but did not hide the lower half of the elm trees still clad in their autumnal livery of leaves; their tops were quite clear, as was all the landscape beyond; the atmosphere was unusually transparent. On descending into the hollow the sensation was similar to going into a well on a hot day. A thermometer, swung in the air, speedily indicated 16°. The snow creaked and crackled under foot as it only does in severe frost, the little wicket gate jarred harshly against the hard-frozen post, overhead the elm trees perfectly motionless drooped under their heavy burden of snow-clad leaves, and the mist drifting slowly down from Coombe Farm deposited rime on every twig in the hedge and on the iron wires of the fence. A few yards farther on the thermometer marked 25°, and the oak trees were fast shedding their leaves on the unsullied carpet of snow at their feet. In Coombe-lane the temperature was 32°, and avalanches of melting snow intermingled with showers of leaves made the roadway slushy. At the top of the Addington Hills, shortly before 3 o'clock, the temperature was 34°·5, and the air was nearly calm. Returning the same way I found the same results, and that the breadth of the cold current estimated by stepping the distance along the pathway did not exceed 200 yards. But a change was at hand; while I lingered, the temperature, which had been 16°, suddenly rose to 18°, and the mist instantly disappeared. At 4 o'clock the thermometer at the top of Park-hill-road was at 30°. Clouds now spread over the sky from the North, followed later on by a general rise of the temperature.

Again this last winter, on the Sunday afternoon preceding the great snowstorm of January 18th, the air being brilliantly clear and the ground snow-clad, I recorded the following readings of the thermometer in the course of three-quarters of an hour:—On the shoulder of Croham-hurst (about 330 feet above sea level), 27°, below Croham farm 17°; in the hollow where I had detected the cold current of air in the previous winter, 12°·5; and at the top of Park-hill, 25°. On this occasion, too, there was a faint breeze from the S.W., and at sunset there was a fine display of cirrus cloud moving from some northerly point.

In both these instances the sun was not sufficiently elevated above the horizon during the day, or for a long enough time, to counteract the cold produced by radiation ; hence the manifestation of the great differences of temperature within narrow limits which I have described. The question remains, how are we to apply meteorology to field observations in natural history? Meteorology, or more properly climatology, is itself a branch of natural history. I would not, however, advocate a farther extension of the comprehensive system of meteorological observations undertaken by several of our members. It would occupy more time than can be spared by the majority of persons, and would probably lead to discouragement and want of punctuality in observation; and as in everything else, so especially in meteorology, to obtain useful results whatever is undertaken should be carried out carefully and conscientiously. But it would not, I think, be trespassing too much on your time to ask for a register of the readings of a few instruments once a day, at 9 o'clock in the morning. This record should include readings of the dry and wet bulb thermometers, and of the highest and lowest temperature, and the depth of rainfall in the previous 24 hours, with notes of any special occurrences. I feel sure that I may say on behalf of the members of the meteorological committee of the Club, that we would give our aid in seeing to the proper establishment of any station for this purpose; and for my own part, I would gladly undertake to reduce the observations when made. These observations at fixed stations should be supplemented by others that could be easily made on walking expeditions, with a pocket thermometer, and a record entered on the spot in a note-book kept for the purpose ; and if extensively carried out, we should then in a few years get acquainted with the climate of every hill and valley in the district. The great practical utility of information such as this is obvious. Our medical men would know what situation to recommend their patients to live in, and what to avoid. A change of residence from one house to another within half a mile, might obviate the necessity of a delicate patient being obliged to move to the sea coast, or to go abroad for the winter. When the fact of cold local currents of air of limited dimensions, pursuing a definite course in our valleys under certain conditions, came to be recognised, provision could be made against the freezing up of water pipes in houses situated in their path. Gardeners could regulate the planting of their crops in accordance with this knowledge. In Croydon dahlias and scarlet-runners always last longer on the higher ground, and I have known the latter especially to be black and withered by frost on the lower ground weeks before they were touched on Park-hill—the highest ground in Croydon. Again, landscape gardeners would know where half-hardy shrubs and valuable ornamental trees might be planted with the greatest chance of safety; many such plants, I am persuaded, would stand with impunity the climate of Warlingham which would perish in some parts of the Caterham-valley.

But for help in this direction we must appeal to the botanists of our Club. They would do good service by selecting from the common plants indigenous to our district a list, to be observed for their first appearance, their coming into flower, and for the ripening of their fruit; and the limits of the growth of such plants might be defined with advantage. I do not think that the common gorse will be found growing freely in our valleys, though abundant on the downs; if this be confirmed it would be interesting to learn whether it is not owing to the greater cold which, as I have pointed out, sometimes prevails in the former situation. I would, however, carefully exclude any rare plant from the list, as that would ensure its destruction by the hands of some ruthless collector. Finally, the movements of migratory animals should form part of the programme of our observations.

I have yet one other suggestion to make, and that is that the Croydon Microscopical and Natural History Club establish a journal of its proceedings, to be published annually, and which shall contain a summary of the observations in natural history made by its members.

I may remark in conclusion that there is an element of uncertainity in meteorology which adds zest to its pursuit, affording scope for the may-be of the poetic temperament as well as the must-be of the scientific one, and that I never knew any person once having taken to it who ever gave it up.

22.—Observations on Rainfall.

By Baldwin Latham, C.E., F.G.S., F.M.S.

[*Read 23rd March*, 1881.]

As all supplies of water are dependent upon rainfall, an accurate determination of the amount of rain falling in any district is a matter of paramount importance.

The most casual observer must have noticed that there are great variations in the amount of rain falling in different years, and also in different parts of the country. The greatest rainfalls, as a rule, occur on our western shores, but rainfall also increases with the elevation of the ground above sea level. To some extent however, the physical outline of a district modifies the distribution of rainfall.

Five years ago, when the author commenced to make observations upon the underground waters in this neighbourhood, he soon found that there were some marked peculiarities with regard to the rise of the water in the ground which needed close investigation in order to account for the phenomena observed. For example, it was clearly demonstrated that in the deep wells in the North Downs, the water line of which was removed over 160 feet from the surface, the water commenced to rise, after a low period, before it did in the comparatively shallow wells in some of the low grounds. In seeking an explanation of this phenomena, it was essential to establish a number of rainfall stations in the district, in order to determine with accuracy the quantity of rain falling in our immediate neighbourhood. It is a well established fact that rain increases with elevation to a certain altitude, after which it again diminishes. Dr. Miller, of Whitehaven, found from observations made in that neighbourhood, that the maximum quantity of rain occurred at an elevation of about 2,000 feet above the sea level. After this altitude was attained, the rain diminished, as has been demonstrated in certain mountainous districts. The increase of rainfall with the altitude of the ground is due to the degree of coldness and the diminution of the capacity of the air to retain moisture. Dr. Miller has shown that with elevations of from 1,000 to 3,000 feet, the atmosphere has but small absorptive capacity. Warm air from a lower region, which is either driven upwards by the sloping nature of the ground, or is ascending as in a cyclonal depression, or is moving from a warm to a cold quarter with the gyrations of the wind, when it reaches a certain degree of altitude, or has been cooled down by any of the movements of the air referred to, will part with a portion of its moisture, which will be precipitated as rainfall.

As temperature diminishes about 1 degree for every degree of latitude as we proceed northward, and 1 degree for about every 300 feet of elevation, in all probability the region in which the greatest amount of rain would fall in this neighbourhood, if we had any lofty hills to receive it, would be at an elevation of something less than 3,000 feet, the temperature in this district, at this elevation, corresponding pretty nearly with that of 2,000 feet elevation in the neighbourhood of Whitehaven.

A rule for the calculation of rainfall, known as "Hawksley's rule," is that rain increases with the elevation of the ground $2\frac{1}{2}$ per cent. for every 100 feet of elevation. This rule appears, from observation, to be applicable to almost every part of the country. There are, however, seasons in which the rainfall increases at a much greater rate than that stated. Taking Mr. Corden's gauge at Wandle-road as the basis of observation, on an average of the past three years, which have been remarkably wet years, the rain gauge established at Botley Hill, which has an elevation of 870·43 feet above sea level, gives an increase in the quantity of rain at the rate of 4·08 per cent. for every 100 feet of elevation. At "Henley," Chelsham, a rain gauge, 607 feet above ordnance datum, showed an increased quantity of rain at the rate of 4·79 per cent. for each 100 feet of elevation above Wandle-road. In the year 1878, the rate of increase of the Botley Hill gauge above the Wandle-road gauge was 2·37 per cent. for every 100 feet of elevation. In the year 1879, the rate of increase was 6·91 per cent. for every 100 feet of elevation, and in 1880 the rate of increase was 2·63 per cent. for every 100 feet of elevation. It will be observed that the rate of increase at "Henley," Chelsham, for the three years was at a greater rate than at Botley Hill. This is in a great measure due to the physical outline of the district, the Botley Hill gauge being near the escarpment of the North Downs and the Chelsham gauge somewhat inland; the prevailing winds driving against the abrupt slopes of the North Downs, forces the air upwards into the colder regions, and the greatest rainfall occurs a short distance inland, and not on the verge of the slope of the Down itself.

Observations made in 1879 tend to show that the ratio increased with the elevation of the stations, for we find that while the rainfall at Botley Hill increased 6·91 per cent. above Wandle-road, it increased 8 per cent. above Nantwich House, which is a higher gauge, while the gauge at Chipstead, at an elevation of 506 feet, increased 7·28 per cent. for every 100 feet above Wandle-road; it increased 10·23 per cent. above Nantwich House; and the gauge at "Henley," Chelsham, increased 5·37 per cent. above Wandle-road, and 6·95 per cent.

above Nantwich House. Wandle-road increased 6·57 per cent. for every 100 feet of elevation above a gauge fixed at Mitcham, having an elevation of 50 feet above sea level.

In the summer months, not unfrequently more rain falls on the low grounds than at a higher elevation. This is due to thunder storms, which, as a rule, follow the valley lines. For example, 3·82 inches of rain fell last July in Mitcham, as against 2·8 inches at Wandle-road. It is only by a long series of observations that local discrepancies disappear and true averages are arrived at.

The average rainfall in Croydon during the past twenty years has been 27·25 inches, and as a rule it will be found that if we deduct one-third from the average fall it will represent the year of minimum fall, and if we add one-third to the average it will represent the year of maximum fall. It should, however, be observed that during the past 20 years we have had no very dry years, or such as occurred in the decade immediately preceding this period, so that the average of the last twenty years exceeds the true average. In the decade from 1861 to 1870 the average rainfall in Croydon was 25·83 inches, while in the decade from 1871 to 1880 the average rainfall was 28·66 inches, showing that the last decade has been considerably wetter than the one preceding it.

It is to the increased quantity of rain falling upon the high lands of the North Downs that we are and shall continue to be dependent for our supply of water. Although rain increases with the elevation of the ground, yet it is a singular fact that observations made upon the collection of rainfall above the surface of the ground at any particular point show that the rainfall diminishes with altitude above the ground. So long since as 1766, Dr. Heberden placed a rain gauge on the roof of Westminster Abbey, which showed that less rain was collected at that elevation than on the ground. A series of observations on the diminution of rainfall above the ground were made at York, and the results recorded in "The Transactions of the British Association." These observations have been very fully reported upon by the Rainfall Committee of the Association, of which committee Mr. G. J. Symons, F.R.S., was the indefatigable secretary. The three years' observations at York, in the years 1832-5, gave the following results :—

Height of gauge above the ground. Feet. Inches.	Quantity Collected in 1832-5. Inches.	Ratio of decrease.
0 ,, 2	65·44	100
43 ,, 8	52·17	79·7
212 ,, 10	38·97	59·6

Observations made by Professor John Phillips, F.R.S., in 1843-4, showed the following results :—

Height above ground.	Rainfall. Inches.
1½ feet	26·559
3 ,, ...	26·298
6 ,, ...	26·189
12 ,, ...	26·039
24 ,, ...	24·158

Observations were also made by Mr. R. Crimes, at the Rotherham Water Works, the Rev. T. E. Crallan, the Rev. F. W. Stow and others, the results of which are recorded in Mr. Symons' "British Rainfall," and all show that there is certainly less rain collected by the rain gauge as we ascend from the ground.

A number of theories have been advanced as to the cause of this apparent diminution of rain with elevation. The most popular was that of Benjamin Franklin, that it was due to the condensation of the falling rain drops as they descend through the air, the rain drop descending from a considerable altitude condensed the vapour in the lower regions up it. Calculations, however, were made by Mr. James Glaisher, F.R.S., some years ago, which show that if all the vapour in the air were to condense, it would add but an infinitessimal increase to the rain drop in the last few hundred feet of descent, and nothing like the amount of the increase observed as we descend from the higher to the lower regions of the atmosphere.

Another cause has been ascribed to the difference in the electrical tension of the rain drop above the ground, the electrical attraction increasing as the rain approaches the ground, thus causing it to increase in bulk.

M. Arago showed that rain drops do increase in size, and become irregular in shape as they approach the surface of the ground, as signified by the disappearance of the supernumerary rainbow, but in all probability this phenomena is due to the drops becoming irregular in size from cohesion.

The cause of this apparent diminution of rainfall with altitude is more fictitious than real, and is due to the mode in which rainfall is collected. The cause was shown by Professor Phillips, F.R.S., some years ago to be due to the varying angle at which rain falls. From experiments made by Professor Phillips with a globular gauge, he was able to collect more rainfall with an increase of altitude above the ground line, as will be seen from the following figures :—

Ground line.	3-ft. above.	6-ft. above.	12-ft. above.
2·905	2·957	2·934	3·115

In this case as the angle at which rain falls becomes less with the horizontal line as we ascend, a greater surface in the globular gauge is presented to the rain which is driven up the inclined slopes into the gauge, and so an apparent increase with elevation was the result.

In Mr. Symons' "British Rainfall," for 1867, the Rev. T. E. Crallan pointed out that in the path described by the falling raindrops the drops approached each other as they neared the earth. An article upon the same subject in "British Rainfall," for 1870, by the Rev. F. W. Stow, also shows that the diminution above the ground bears a close relation to the velocity of the wind.

The mouth of a rain gauge being placed horizontally, it is clear that in the case of high elevations the rainfall is driven at a small angle to the mouth of the gauge, that it does not present an equivalent area of surface to the reception of the rain as a rain gauge placed at a lower level, in which the rain enters at a large angle to the surface. The observations which have been made clearly show that in times of high wind the diminution is greater with elevation, but with heavy rains in periods of calm weather there is little or no difference in the rain collected at various elevations. The observations that have been published by the British Association Committee in the case of York, show that the diminution with altitude was in proportion to three times the square root of the height; this property of the square root of the height representing the velocities at which the rain-drops would fall according to the laws of gravitation. It is also well to bear in mind that the movements of air over the surface of the earth follow the same natural law as movements of water or other fluids; the velocity is smallest owing to friction on the surface of the earth and increases as we ascend. A drop of rain of sufficient weight so as not to be materially interfered with by the air would fall like other bodies, and would fall a distance in the first second represented by the figure 1, in the second second by the figure 3, in the third second by the figure 5, and so on, the odd numbers representing the proportionate amount of space travelled in every second of time. The horizontal force of the wind diminishing as we near the earth, it is quite clear that a falling drop of rain, when there is any wind, becomes more perpendicular as it strikes the earth than at any point above its surface. The explanation, therefore, of the apparent diminution of the amount of rain collected is due to the diminished area the gauge presents to rain when driven at a varying angle.

During the past three years at the author's residence a rain-gauge 4 feet above the surface of the ground has collected 60·30 inches of rain, while one placed 1 foot above the surface of the ground has collected 61·32 inches.

A pit gauge at Calne, as recorded in volume 41 of the "Transactions of the British Association," is shown to have collected 5 per cent. more rain than one at 1 foot above the ground. In the collection of rainfall, therefore, it is important that the height of the gauge above the ground should be stated, as elevation above the ground may greatly influence the amount collected. As a rule rain-gauges are now fixed 1 foot above the ground level, which secures them from an increase arising from splashing from the surface of the ground, and also protects them from other inconveniences which may affect the quantity of rain collected.

The author, in carrying out the underground water investigations at Croydon, found the level of the water under the town fluctuates with rainfall after a dry period, and that it also fluctuates in consequence of the effects of pumping at the Croydon Water Works. It was a matter of importance, therefore, to determine what fluctuations were due to rain as distinguished from those due to pumping. In order to arrive at this it was necessary to record the periods at which rain fell, and in the recording rain-gauge which the author has used for this purpose some other interesting matters have been brought to light.

Hitherto very few experiments have been made in this country as to the rate at which rain falls, which is a point of some importance. The author's registering rain-gauge not only shows the time of day when rain falls, but also the rate at which it falls. Since the 27th March, 1879, the period when the gauge was fixed, there have been :—

166	times when rain fell	at a rate exceeding	1·44	inches	in 24 hours.
161	"	"	1·60	"	"
159	"	"	1·90	"	"
153	"	"	2·0	"	"
107	"	"	3·0	"	"
77	"	"	4·0	"	"
62	"	"	5·0	"	"
41	"	"	6·0	"	"
32	"	"	7·0	"	"
22	"	"	8·0	"	"
18	"	"	9·0	"	"
15	"	"	10·0	"	"
12	"	"	11·0	"	"
12	"	"	12·0	"	"
10	"	"	13·0	"	"
10	"	"	14·0	"	"
5	"	"	15·0	"	"
4	"	"	17·0	"	"
3	"	"	19·0	"	"
1	when it fell	at the rate of	33·12	"	"
1	"	"	37·44	"	"

The greatest rate at which rain fell in the period was on the 10th July, 1880, when ·13 inch fell in 5 minutes, or at the rate of 37·44 inches in 24 hours. An almost equally heavy rainfall occurred on the 29th December, 1880, when ·23 inch of rain fell in 10 minutes, or at the rate of 33·12 inches in 24 hours. The following figures show the number of times when rain has fallen in certain quantities in 24 hours, from March, 1879, to March, 1881:—

Inches.			
1·44	and 2	... ...	13 times.
2	,, 3	... ...	46 ,,
3	,, 4	... ...	30 ,,
4	,, 5	... ...	15 ,,
5	,, 6	... ...	21 ,,
6	,, 7	... ...	9 ,,
7	,, 8	... ...	10 ,,
8	,, 9	... ...	4 ,,
9	,, 10	... ...	3 ,,
10	,, 11	... ...	3 ,,
12	,, 13	... ...	2 ,,
14	,, 15	... ...	5 ,,
15	,, 16	... ...	1 ,,
17	,, 18	... ...	1 ,,
19	,, 20	... ...	1 ,,
33·12	,,	... ...	1 ,,
37·44	,,	... ...	1 ,,
			166

During these periods of heavy rainfall the actual fall of rain was nearest the maximum rate of fall on the 23rd September, 1879, when 1·35 inch fell in the day; the rate of fall to observed fall was, at one period of the day, as 1·77 to 1. When the maximum rate of fall was at the rate of 37·44 in 24 hours, this rate exceeded the observed fall on that day in the proportion of 108·52 to 1. Of the 166 observations of heavy falls of rain before alluded to, it may be of interest to note that 86 occurred between midnight and noon, and 80 occurred between noon and midnight.

IV.—METEOROLOGICAL REPORTS, 1877, 1878, 1879, 1880,

BY GEO. CORDEN., F.M.S.

On the Rainfall in Croydon during the years 1877 and 1878.

[*Read September 21st, 1881.*]

1877. MONTH.	RAINFALL At 16, Wandle Road, Croydon.						RAINFALL From January 1st.			
	Total Amount.	Diff. from average 10 years. 1867—1876.	No. of Rainy Days.	Diff. from average 10 years.	Greatest Fall in 24 hours.	Date of Fall.	Total Amount.	Diff. from average 10 years. 1867—76.	Total No. of Days.	Diff. from average 10 years. 1867—76.
	Ins.	Ins.			Ins.		Ins.	Ins.		
Jan.	5·53	a2·54	27	a11	1·23	10th	5·53	a2·54	27	a11
Feb.	1·70	a0·15	18	a 6	0·44	13th	7·23	a2·69	45	a17
March	2·15	a0·56	18	a 5	0·32	4th	9·38	a3·25	63	a22
April	4·10	a2·54	17	a 6	0·98	8th	13·48	a5·79	80	a28
May	2·38	a0·95	13	a 4	0·46	14th	15·86	a6·74	93	a32
June	0·87	b0·89	5	b 5	0·44	11th	16·73	a5·66	98	a27
July	2·58	a0·19	11	a 1	0·62	14th	19·31	a6·05	109	a28
August	2·70	a0·72	13	a 3	0·74	25th	22·01	a6·77	122	a31
Sept.	1·65	b1·09	12	0	0·95	3rd	23·66	a5·68	134	a31
October	1·97	b1·02	14	0	0·38	23rd	25·63	a4·66	148	a31
Nov.	4·94	a2·82	22	a 9	1·33	11th	30·57	a7·48	170	a40
Dec.	1·61	b1·33	17	a 2	0·39	28th	32·18	a6·12	187	a42
Year	32·18	a6·12	187	a42	1·33	Nov. 11th				

a signifies above, and *b* below the average.

Remarks.

The total rainfall for the year was 32·18 ins., or 6·12 ins. in excess of the 10 years' average 1867-76. The heaviest monthly falls occurred in January (5·53 ins.), in April (4·10 ins.), and in November (4·94 ins.) The months of June, September, October, and December were dry, but taking the year as a whole it was a wet one, the number of rainy days having been 187, or 42 above the average. Heavy falls amounting to an inch or more occurred twice, viz., on Jan. 10th, 1·23 ins., and on Nov. 11th, 1·33 ins. The latter was the heaviest of the year, torrents of rain falling at midnight, during a terrific SSW gale.

1878.	RAINFALL At 16, Wandle Road, Croydon.						RAINFALL From January 1st.			
Month.	Total Amount.	Diff. from average 10 years. 1867—76.	No. of Rainy Days.	Diff. from average 10 years.	Greatest Fall in 24 hours.	Date of Fall.	Total Amount.	Diff. from average 10 years. 1867—76.	Total No. of Days.	Diff. from average 10 years. 1867—76.
	Ins.	Ins.			Ins.		Ins.	Ins.		
Jan.	1·02	*b*1·97	13	*b* 3	0·25	28th	1·02	*b* ·97	13	*b* 3
Feb.	1·35	*b*0·20	12	0	0·45	13th	2.37	*b*2·17	25	*b* 3
March	1·36	*b*0·23	9	*b* 4	0·83	28th	3·73	*b*2·40	34	*b* 7
April	3·57	*a*2·01	17	*a* 6	1·95	10th to 11th	7·30	*b*0·39	51	*b* 1
May	3·44	*a*2·01	23	*a*14	0·42	24th	10·74	*a*1·62	74	*a*13
June	3·69	*a*1·94	16	*a* 6	1·84	23rd	14·43	*a*3·56	90	*a*19
July	0·69	*b*1·70	11	*a* 1	0·25	26th	15·12	*a*1·86	101	*a*20
August	5·39	*a*3·41	18	*a* 8	0·79	24th	20·51	*a*5·27	119	*a*28
Sept.	0·94	*b*1·80	10	*b* 2	0·21	19th	21·45	*a*3·47	129	*a*26
October	2·29	*b*0·70	16	*a* 2	0·46	9th	23·74	*a*2·77	145	*a*28
Nov.	3·63	*a*1·51	18	*a* 5	0·90	27th	27·37	*a*4·28	163	*a*33
Dec.	1·34	*b*1·60	18	*a* 3	0·16	22nd & 31st	28·71	*a*2·65	181	*a*36
Year	28·71	*a*2·65	181	*a*35	1·95	April 10th — 11th				

a signifies above, and *b* below the average.

Remarks.

The total rainfall for the year was 28·71 ins., or 2·65 ins. in excess of the 10 years average 1867-76. The heaviest monthly fall was 5·39 ins. in August, and the lightest, 0·69 ins., in July, Taken as a whole the year was again a wet one, the number of rainy days having been 181, or 36 above the average.

The most noteworthy features of the year were, the fall of 1·95 ins. (or nearly two inches) in 19 hours on the 10th and 11th of April, and the remarkably heavy thunderstorm of the 23rd of June, when, in 2¼ hours there fell at this station the enormous quantity of 1·84 ins. (hail and rain). Some idea of the nature of the downpour of rain on this occasion may be gathered from the fact that between 2.20 and 2.35 p.m., or in 15 minutes, 0·41 ins. was deposited—equal to 1·60 ins. per hour, or 38·40 ins. in 24 hours.

Taking the falls of rain of less than an inch in their regular sequence as to date, we have, on March 28th, a heavy snow storm, yielding 0·83 ins. On June 8th, during a thunder storm, rain fell for an hour at the rate of 8·64 ins. in 24 hours. On July 26th, during another thunder storm, for eight minutes at the rate of 1·35 ins. per hour, or 32·40 ins. in 24 hours; on August 12th, for five minutes, at the rate of 1·68 ins. per hour, or 40·32 ins. in 24 hours; on August 24th, for 10 minutes, at the rate of 1·98 ins. per hour, or 47·52 ins. in 24 hours, which is the heaviest fall of rain in so short a time that I have ever recorded; and lastly, on September 15th, rain fell for 10 minutes at the rate of 1·02 ins. per hour, or 24·48 ins. in 24 hours.

METEOROLOGICAL REPORT FOR 1879.

In drawing up this report and the tables which accompany it, I have made use of the observations taken at Addiscombe, and kindly placed at my disposal by Mr. Edward Mawley, F.M.S., his meteorological station being, for the purpose I have in view, the best equipped in this neighbourhood.

Position of the Instruments, &c.

The cistern of the barometer is 210 feet above sea-level. The shade temperature thermometers are suspended in a Stevenson's screen, 4 feet above grass, in a freely exposed position. The solar-radiation thermometer is mounted on the top of a post 4 feet above grass, with its bulb directed towards the S.E. The terrestrial-radiation thermometer is exposed on the most open part of the lawn, with its bulb just touching the blades of grass. The temperature of the soil is taken with a Symon's earth-thermometer, the bulb of which is one foot below the surface of the lawn. The funnel of the rain-gauge is 9 inches above a level piece of grass, in a clear site, and 202 feet above sea-level. The cups of the self-recording anemometer are 50 feet above the ground, and 15 feet above the roof of the house. The sunshine recorder is secured to the summit of one of the chimneys, at the south end of the house.

As Mr. Mawley's instruments have not been in position long enough to give what would be considered tolerably fair averages, such as those derived from at least 10 years' observations, he has had a series of tables specially prepared from those taken at Greenwich during the past 38 years, which have enabled me to give the variations of the different means from their respective averages at that observatory. In the case of Rainfall, however, reference to the records of a nearer station appeared desirable, so I have decided to employ for this purpose the observations made by Mr. James Weston at South Croydon, which extend now over a period of twenty years.

General Summary.

Using Mr. Mawley's own words, *"The year 1879 was colder than any of the previous 38 years, and, with one exception, the most gloomy. Both January and December were extremely cold, while July was as extraordinarily dull. It is not, however, the remarkable dulness or coldness of certain months or seasons that calls for special notice here, so much as the fact that the whole twelvemonth continued from first to last persistently sunless and cold. Moreover, it should not be lost sight of, that the two months preceding this year, as well as the month immediately following it, were all singularly cold ones."

"Nevertheless, if we leave out of consideration the important elements of temperature and sunshine, the same uniformity will not be found to have been in other respects maintained. In fact, 1879 appears to have shown in several ways a strange partiality for extremes. For instance, the fall of rain during the summer was excessive; but for the three months at the close of the year so slight as to be remarkable. Again, in July there was not a single calm day, whereas in December there was not, for weeks together, a single windy one. Then again, in January the air was exceptionally dry, while in July it was more humid than in the corresponding month of any year since 1843, or for 36 years. The most seasonable and pleasant months were those of September and October, whereas the weather of July proved to be the most abnormal of all."

I will now, as briefly as possible, draw your attention to a few of the most striking features of the weather of this very exceptional year, and more than this, I do not think it is necessary to attempt, as the accompanying tables, which have been prepared with great care and after much consideration,

* "The weather of 1879, as observed in the neighbourhood of London."

will, I trust, furnish most of the data that may be required for purposes of future reference.

Barometer.

With regard to the mean pressure of the atmosphere, it may be observed that if it had not been for the very high readings of the barometer in the fourth quarter of the year, and especially in December, when, for twenty consecutive days, the mercury continued so high that no observed reading was recorded lower than 30·35 ins., and on two of these days (13th and 22nd) rose to the unusual height of 30·780 ins. and 30·813 ins. respectively, the annual mean would have been very much lower, for I find that the mean height of the barometer during the first nine months was 29·864 ins., or ·10 in. below the average, while the mean for the last three months of the year was 30·238 ins., or ·30 in. above it. The exceptionally high pressures in December were accompanied by dense fogs, further mention of which will be made under the head of "Humidity."

The lowest observed reading of the year was 28·864 ins., on the 10th of February, and the extreme range during the twelve months about 1·95 ins., or nearly 2 inches.

Temperature.

The highest shade temperature (77·4°) occurred on the 30th of July, so that the temperature of 80° was at no time attained, and even that of 70° was exceeded on only 14 days during the year. The lowest shade temperature was 13·6° on the 7th December, and, with one exception, Christmas Day, 1878, lower than any previously recorded at Addiscombe. The long frost, of which this low temperature was the commencement, broke up very suddenly within a few days of the end of the year. The number of nights on which the minimum temperature of the air fell below 32° was 95, but on as many as 155 nights the thermometer exposed on the surface of the lawn fell below the freezing point, and on one of these (December 2nd), the exceptionally low reading of 1·9° (indicating 30° of frost) was registered by it.

The temperature of the soil at a depth of one foot at no time rose higher than 69·7°, and on one occasion (December 17th) fell to within 2° of the freezing point.

Humidity.

A few particulars respecting the most remarkable of the fogs of the year will doubtless be of interest. The first was a wet fog, unaccompanied by smoke, which lasted nearly the whole day (January 17th), and by 3 p.m. had become so dense that only the chimneys and the upper part of the roof of a house 75 yards distant could be distinguished. Again, on the 17th of the month following, a singularly dense smoke fog passed over Croydon about 11 o'clock in the morning, obscuring the atmosphere so much that the print of the "Times" could not be read even when the paper was held close to a window. The air in October was at one time so humid that during the course of four days water was deposited in the funnel of the rain-gauge, by heavy dews and fogs alone, to the depth of ·03 in. In the proverbially foggy month of November, however, there occurred only one fog worthy of special notice (that of the 24th), and even this lasted for only a few hours. But of all the fogs of the year, those of December were the most remarkable, both from their frequent occurrence and their unusual density. In fact, during this month, light fogs were recorded on six days, fogs on six days, and dense fogs also on six days, and very dense fogs on two days, so that only eleven days were entirely free from fog. The former of the two very thick smoke fogs was that of the 22nd, when the atmosphere became so obscured between four and five o'clock in the afternoon that the houses on one side of a road were almost invisible from the other side of it. The most foggy day, however, was Christmas Day, when from early morning until late at night the air was so darkened that during the greater part of the day a garden wall, even the upper edge of it, at a distance of 50 yards, was quite hidden from view. Light fogs were recorded on 32 days during the year, fogs on 19 days, and dense fogs on 16 days.

Wind.

During the spring, and also in January, there was an unusual prevalence of north-easterly winds, but, on the other hand, during the three summer months, the wind blew almost exclusively from some southerly or westerly point of the compass.

The most windy day of the whole year was the 23rd of March, when the total velocity amounted to 497 miles. On the 4th, and again on the 30th of December, however, the wind attained its maximum hourly velocity, namely, 28 miles.

Rainfall.

At Addiscombe rain fell on 197 days, or more frequently than every other day, and on 39 more days than the 15 years' average at my residence, 16, Wandle Road. Snow fell on as many as 55 days, its greatest depth on the ground being $5\frac{1}{2}$ inches, on the 22nd of November.

Falls of rain, amounting to an inch or more in the 24 hours, were three in number. The first of these (1·12 ins.) occurred on New Year's Day. The second (1·55 ins.) on May the 28th, and the last (1·33 ins.) on September the 23rd. The total amount of water yielded by the heavy snow-storms of the 20th, 21st, and 22nd of November was nearly equivalent to a fall of rain an inch in depth.

Sunshine.

Taking the year throughout, on as many as 106 days, or for altogether about 3½ months, no sunshine at all was recorded at Greenwich, and in January there occurred 16 consecutive days during which there were altogether only two half hours of bright sunshine. July was a most exceptionally dull summer month, the average daily amount of clear sunshine falling short of that recorded in the two previous Julys by as much as 2½ hours and 2 hours 6 mins. respectively. The brightest day was the 10th of June, when the sun was shining for 13½ hours.

METEOROLOGICAL OBSERVATIONS taken at ADDISCOMBE, CROYDON, during the year 1879.

1879.	BAROMETER.				SHADE TEMPERATURES.						RELATIVE HUMIDITY.	EXTREME RADIATION TEMPERATURES.	
MONTH.	Mean at 32° and sea level 9 a.m.	Diff. from average of previous 38 years.	Highest observed reading.	Lowest observed reading.	EXTREMES. Max.	EXTREMES. Min.	Mean Max.	Mean Min.	Mean Temperature	Diff. from average of previous 38 years.	Mean at 3 p.m.	Max. in sun.	Min. on grass.
	Ins.	Ins.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	%	Deg.	Deg.
Jan.	30·024	*a* ·10	30·437	29·337	50·9	18·3	35·6	28·0	31·8	*b* 6·8	82	80·0	8·5
Feb.	29·551	*b* ·40	30·128	28·864	52·7	20·9	42·8	34·4	38·6	*b* 1·2	82	101·0	6·8
Mar.	30·001	*a* ·07	30·614	29·564	65·2	28·6	48·8	35·0	41·9	*b* 0·4	70	113·0	19·1
1st Qtr.	29·859	*b* ·08	30·614	28·864	65·2	18·3	42·4	32·5	37·4	*b* 2·8	78	113·0	6·8
April	29·697	*b* ·24	39·328	28·962	58·2	25·7	51·0	36·4	43·7	*b* 4·0	69	117·5	16·3
May	30·021	*a* ·05	30·532	29·573	66·6	29·2	56·3	40·3	48·3	*b* 4·3	67	130·0	18·4
June	29·819	*b* ·17	30·166	29·468	68·7	42·1	64·1	49·8	57·0	*b* 2·1	68	129·7	35·4
2nd Qtr.	29·846	*b* ·12	30·532	28·962	68·7	25·7	57·1	42·2	49·7	*b* 3·5	68	130·0	16·3
July	29·814	*b* ·18	30·181	29·314	77·4	47·2	65·3	51·7	58·5	*b* 4·1	71	134·7	38·5
Aug.	29·847	*b* ·12	30·296	29·515	75·9	45·7	67·2	53·4	60·3	*b* 1·8	71	131·5	40·2
Sept.	29·996	..	30·503	29·498	70·3	38·9	63·6	49·2	56·4	*b* 0·8	70	129·9	33·5
3rd Qtr.	29·886	*b* ·10	30·503	29·314	77·4	38·9	65·4	51·4	58·4	*b* 2·2	70	134·7	33·5
Oct.	30·142	*a* ·25	30·568	29·389	66·0	30·0	55·3	42·9	49·1	*b* 1·1	77	110·4	22·6
Nov.	30·231	*a* ·30	30·640	29·806	53·4	20·8	43·3	33·1	38·2	*b* 4·6	79	84·2	10·9
Dec.	30·341	*a* ·36	30·813	29·501	53·0	13·6	37·6	26·1	31·8	*b* 7·6	87	80·0	1·9
4th Qtr.	30·238	*a* ·30	30·813	29·389	66·0	13·6	45·4	34·0	39·7	*b* 4·4	81	110·4	1·9
Year	29·957	*b* ·005	30·813	28·864	77·4	13·6	52·6	40·0	46·3	*b* 3·3	74	134·7	1·9

a signifies above, and *b* below the average.

METEOROLOGICAL OBSERVATIONS taken at ADDISCOMBE, CROYDON, during the year 1879.

1879.	Rainfall.					Wind.			Mean daily duration of bright sunshine at Greenwich.
Month.	Total fall.	Diff. from average of previous 19 years.	No. of rainy days.	Diff. from average of previous 15 years.	Greatest fall in 24 hours.	Most prevalent direction.	Greatest velocity in any one hour.	Mean hourly velocity.	
	Ins.	Ins.			Ins.		Miles.	Miles.	hrs. mins.
Jan.	2·613	b ·20	12	b 3	1·122	N.E.	25	10	30
Feb.	3·451	a 1·48	23	a 10	·533	S.W.	25	10	1 6
Mar.	·559	b 1·30	12	b 2	·115	S.W.	26	10	2 54
1st Qtr.	6·623	b ·02	47	a 5	1·122		26	10	1 30
April	2·569	a ·76	19	a 8	·620	N.E.	25	8	2 30
May	3·685	a 1·60	18	a 8	1·554	S.W.	21	9	4 24
June	3·710	a 1·48	20	a 9	·766	S.W.	22	9	4 42
2nd Qtr.	9·964	a 3·84	57	a 25	1·554		25	9	3 52
July	3·792	a 1·35	18	a 6	·568	S.W.	27	10	3 12
Aug.	4·613	a 1·87	20	a 6	·808	S.W.	24	9	4 30
Sept.	3·169	a ·66	12	a 3	1·328	S.W.	19	7	3 53
3rd Qtr.	11·574	a 3·88	50	a 15	1·328		27	9	3 52
Oct.	·71	b 2·25	13	b 2	·342	N.E.	22	7	2 9
Nov.	1·194	b 1·133	13	b 2	·384	W.	24	7	1 26
Dec.	·995	b 1·44	17	b 2	·346	S.W.	28	7	55
4th Qtr.	2·900	b 5·02	43	b 6	·384		28	7	1 30
Year	31·061	a 2·68	197	a 39	1·554		28	9	2 42

a signifies above, and *b* below the average.

METEOROLOGICAL REPORT FOR 1880.

General Summary.

Quoting Mr. Mawley's remarks*, which are admirably adapted for conveying a general idea of the chief characteristics of the year under review:—

"Unlike the previous year, the whole twelve months of which were unseasonably cold, that of 1880 contained but four (January, June, July, and October) which could be so described. Of the remaining eight, five were warm months, and three of average temperature."

"Although as a whole the year was wet, and the rainfall of the last four months excessive, yet, on the other hand, the spring was most exceptionally dry, and there occurred four months (January, March, May and August) the totals of which taken together would amount to less than that of a single average month."

"January, March, and February were all particularly bright, and the two former especially so, while the cloudy character of the three summer months was not less remarkable."

"As regards the relative humidity of the air, it will be noticed how great was the dampness which prevailed, the mean amount for five consecutive months, including the entire summer, having been very much in excess of the average."

"Throughout the year there were but two calm months, (January and September) the former having a remarkably still atmosphere; whereas the rest were nearly all windy, and four of them particularly so."

Barometer.

In January, on the 7th of which month occurred the highest pressure (30·684 ins.) of the year, there were ten consecutive days (3rd — 12th) during which the mercury continued remarkably high—no observed reading being lower than 30·450 ins., and on as many as seven different days in the same month the very high pressure of 30·6 ins. was exceeded. Indeed we have to go back 100 years (to 1779) in order to find in the Greenwich records a January having as high a mean pressure. On the 7th of December the mercury rose very nearly as high as the maximum recorded in January, namely, to 30·667 ins., and for a whole week continued high and very steady. On the other hand the lowest readings were recorded on the following dates, viz., 28·862 ins. on the 17th of February, 28·798 ins. on the 28th of October, 28·771 ins. on the 16th of November, and lastly on the 18th of the same

* "The weather of 1880 as observed in the neighbourhood of London."

month, 28·764 ins., which is the lowest reading of the year. The difference between the highest and lowest observed readings of the barometer amounted to 1·92 ins. making the extreme range ·03 in. less than in 1879.

Temperature.

On three days during the year the maximum temperature in shade exceeded 80°. First on the 26th of May (81·2°), and then again on the 3rd and 4th of September (80·5° and 85·1°), but strange to say at no time during the three summer months. And on as many as 54 different occasions the shade temperature rose to or exceeded 70°, whereas in 1879 this moderately warm summer maximum was attained on only 14 days—showing what an extremely cold year this was. On the 18th of January, which was an exceptionally cold month, a remarkably severe frost set in very suddenly, and at the termination of twelve days broke up as suddenly during the night of the 29th, the temperature during this period ranging only from 17° below to 5° above the freezing point. In May the extreme range of temperature was very great, the lowest reading of the month being 30° (2nd), and the highest 81·2° (26th). The latter temperature which was registered on Derby Day was a remarkably high one for the time of year. In fact at Greenwich Observatory, the maximum reading on this day was higher than any that had been recorded there in any May, for at all events 39 years. June deserves some notice here on account of the unusually low minima temperatures recorded on the morning of the 5th, 35° being registered in the thermometer screen, and 27·6° (or 4½° of frost) on the surface of the lawn. The first few days in September on the other hand were exceptionally hot for the season, the temperature of the air rising on three successive days (2nd, 3rd, and 4th), to 78·7°, 80·5°, and 85·1°, respectively. On 58 nights the mimimum temperature in the screen fell below 32°, and on 136 nights (or 19 less than in 1879) frosts were indicated by the thermometer exposed on the grass. The temperature of the soil at a depth of one foot at no time rose higher than 68·2°, and on one occasion (January 29th) fell to within two-tenths of a degree of the freezing point.

Humidity.

In January there were unusually dense fogs on three successive days. The first of these occurred on the 27th, and obscured the atmosphere so much that at one time in the early morning objects became invisible at a distance of fifty yards. The next noteworthy fog was that of the 13th of March, which also prevailed throughout the early morning hours. On this occasion, however, objects became completely hidden from view at forty yards. The densest fog, however, of the year took place in November, for at midday on the 21st of that month it was noticed that no part of the front of a house could be distinguished at a distance of 30 yards. December, for a winter month, had a remarkably clear atmosphere, as many as 23 days being altogether free from fog. Light fogs were recorded on 47 days during the year, fogs on 25 days and dense fogs on 10 days.

Wind.

The most windy day of the whole year was the 2nd of March, when the total velocity amounted to 681 miles. During the afternoon of the same day 33 miles were recorded in a single hour, which was the only occasion during the twelve months, when a velocity of 30 miles was in any hour exceeded. As in 1879 there was an unusual prevalence of north-easterly winds during the spring months.

Rainfall.

At Addiscombe rain fell on 166 days (or on 31 less than in the previous year) to the total depth of 30·438 ins.

Snow fell on only 12 days, and its greatest depth on a gravel path at no time exceeded an inch. On a lawn however on the 20th of October, it measured three inches.

The spring quarter was most exceptionally dry, but on the other hand, during the autumn, rain fell at frequent intervals, and at times very heavily indeed. The first fall of rain exceeding an inch in depth took place on the 11th of September, and amounted to 1·33 in., and the second on the 14th of the same month with a total of 1·17 ins. The third and last (all three be it observed in the autumn quarter) which occurred on the 9th of October (2·18 ins.) is worthy of special notice as being with one exception, the heaviest fall of rain of which we have in Croydon any record. I wish to draw more particular attention to this one exception, because Mr. Mawley, in "The Weather of 1880," states that the fall of rain on this day was by far the greatest that had been known in Croydon for at least 20 years. It was certainly by far the heaviest in any "rainfall day" (between 9 a.m. one day and 9 a.m. the next), but at 9 p.m. on the 26th of July, 1867 (the occasion referred to) I measured 2·58 ins. as the amount deposited during the previous 24 hours, which exceeds the heaviest fall of the year under review by ·40 in.

Two most remarkable and almost unprecedented periods of heavy rain occurred during the year, the first in September when in the course of nine consecutive days (11th — 19th) the total amounted to 3·981 ins. including two falls of over an inch in 24 hours. The other in October, when the amount deposited between the 4th and 9th reached the large sum of 4·023 ins. Of the most remarkable dry periods, the first lasted 23 days (8th and 30th March), the second 21 days (May 6th and 26th) and the third 30 days (August 8th to September 5th). On the 20th of October there occurred one of the heaviest snowstorms ever experienced so early in the season which, owing to their being still in leaf, did much damage to the trees in this neighbourhood.

Sunshine.

Taking the year throughout on 81 days no sunshine at all was recorded. The brightest day of all was the 25th of July, when the sun was shining for 13 hrs. 36 mins.

The winter (1879 — 1880) proved very dull, the spring (1880) seasonably bright, the summer very dull, and the autumn somewhat brighter than is usual.

METEOROLOGICAL OBSERVATIONS taken at ADDISCOMBE, CROYDON, during the year 1880.

1880.	Barometer.				Shade Temperatures.						Relative Humidity.	Extreme Radiation Temperatures.	
Month.	Mean at 32° and sea level 9 a.m.	Diff. from average of previous 39 years.	Highest observed reading.	Lowest observed reading.	Extremes. Max.	Extremes. Min.	Mean Max.	Mean Min.	Mean Temperature	Diff. from average of previous 39 years.	Mean at 3 p.m.	Max. in sun.	Min. on grass.
	Ins.	Ins.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	%	Deg.	Deg.
Jan.	30·401	*a* ·45	30·684	29·813	55·3	14·9	38·3	27·9	33·1	*b* 5·3	82	87·3	5·5
Feb.	29·828	*b* ·17	30·475	28·862	53·9	24·3	48·4	36·9	42·7	*a* 2·4	77	96·5	16·3
Mar.	30·132	*a* ·19	30·497	29·294	63·7	25·8	52·9	36·5	44·7	*a* 2·7	67	110·0	16·3
1st Qtr.	30·120	*a* ·156	30·684	28·862	63·7	14·9	46·5	33·8	40·2	*b* 0·07	75	110·0	5·5
April	29·884	*b* ·05	30·429	29·312	64·8	34·2	54·6	40·4	47·5	..	64	123·4	25·8
May	30·104	*a* ·13	30·480	29·682	81·2	30·0	61·5	41·8	51·6	*b* 0·1	57	138·2	20·6
June	29·926	*b* ·08	30·248	29·630	75·1	35·1	65·3	49·2	57·2	*b* 1·5	65	135·0	27·6
2nd Qtr.	29·971	...	30·480	29·312	81·2	30·0	60·5	43·8	52·1	*b* 0·53	62	138.2	20·6
July	29·915	*b* ·07	30·189	29·480	76·2	47·9	69·6	53·9	61·8	*b* 0·4	65	133·3	41·3
Aug.	30·004	*a* ·03	30·301	29·225	78·1	46·5	70·5	55·3	62·9	*a* 1·2	67	132·9	41·3
Sept.	29·994	..	30·506	29·288	85·1	44·1	68·1	51·7	59·9	*a* 2·6	69	129·2	34·6
3rd Qtr.	29·971	*b* ·013	30·506	29·225	85·1	44·1	69·4	53·6	61·5	*a* 1·13	67	133·3	34·6
Oct.	29·899	..	30·422	28·798	66·1	29·3	53·1	39·6	46·3	*b* 4·0	78	113·5	21·4
Nov.	29·984	*a* ·05	30·466	28·764	57·9	23·6	48·3	36·4	42·4	*b* 0·3	78	88·9	17·2
Dec.	29·934	*b* ·05	30·667	29·124	55·6	27·6	48·6	38·4	43·5	*a* 3·4	84	83·2	18·3
4th Qtr.	29·939	..	30·667	28·764	66·1	23·6	50·0	38·1	44·1	*b* 0·30	80	113·5	17·2
Year	30·000	*a* ·035	30·684	28·764	85·1	14·9	56·6	42·3	49·5	*a* 0·1	71	138·2	5·5

a signifies above, and *b* below the average.

METEOROLOGICAL OBSERVATIONS taken at ADDISCOMBE, CROYDON, during the year 1880.

1880.	Rainfall.					Wind.			Mean daily duration of bright sunshine.
Month.	Total fall.	Diff. from average of previous 20 years.	No. of rainy days.	Diff. from average of previous 16 years.	Greatest fall in 24 hours.	Most prevalent direction.	Greatest velocity in any one hour.	Mean hourly velocity.	
	Ins.	Ins.			Ins.		Miles.	Miles.	hrs. mins.
Jan.	·423	b ·29	9	b 10	·242	S.S.W.	22	5	1 31
Feb.	2·800	a 1·00	20	a 5	·569	E.	30	12	2 10
Mar.	·638	b 1·15	5	b 9	·389	E.	33	11	4 24
1st Qtr.	3·861	b 2·44	34	b 14	·569		33	9	2 42
April	1·870	a ·07	14	a 2	·650	S.W. & N.E.	24	11	5 7
May	·353	b 1·76	5	b 7	·189	N.E.	21	9	6 20
June	3·444	a 1·12	19	a 8	·633	S.W.	24	8	4 47
2nd Qtr.	5·667	b ·57	38	a 3	·650		24	9	5 25
July	2·847	a ·63	21	a 8	·791	S.W.	19	8	6 14
Aug.	·396	b 2·03	7	b 8	·282	N.E.	23	8	4 18
Sept.	4·451	a 1·86	15	a 1	1·329	W.S.W.	19	6	4 8
3rd Qtr.	7·694	a ·46	43	a 1	1·329		23	7	4 53
Oct.	7·648	a 4·88	21	a 5	2·182	N.E.	28	8	1 40
Nov.	2·393	b ·09	13	b 2	·600	S.W.	29	10	1 59
Dec.	3·175	a ·96	17		·763	W.	24	10	48
4th Qtr.	13·216	a 5·75	51	a 3	2·182		29	9	1 29
Year	30·438	a 3·20	166	b 7	2·182		33	9	3 37

a signifies above, and *b* below the average.

24.—On Seven Hybrids between the Common Pheasant *(Ph. colchicus)* and the Common Fowl.

By John Flower, M.A., F.Z.S.

[*Read 18th May,* 1881.]

These birds were hatched in the summer of 1879, in an aviary at Woodcote Hall, near Carshalton, the residence of Edward Wormald, Esq., who has kindly sent them here this evening for examination by the members of the club.

Mr. Wormald being desirous of obtaining hybrids, placed in the aviary a Cock Pheasant, and with it a Golden Spangled Hamburg hen, and a small black hen. I saw the cock pheasant more than once, and he seemed to be a bird of the ordinary size, weighing, probably, about 3-lbs. The two fowls were killed in February, 1881, and, being then in good condition, the Hamburg was found to weigh 4-lbs. 4-oz., and the small black hen 2-lbs. 2-oz. Both fowls had broods, and seven hybrids were reared. One of each brood was killed and preserved in the spring of 1880, and these Mr. Wormald exhibited at the meeting of the club on April 21st, 1880. Unfortunately the weights of these two birds, which however were killed before they were quite mature, were not taken, nor was their sex noted, but the weights of the five birds, which I have here this evening, and which are the remaining ones of the seven, were carefully taken, before they were skinned, by Mr. Swaysland, of Brighton, who preserved them. The weights of the three very dark birds were 6-lbs., 5-lbs. 4-oz., and 4-lbs. 7-oz., making a total for the three of 15-lbs. 11-oz., and an average for the three of 5-lbs. 3⅔-oz. The other two birds, which bear a strong resemblance to the Hamburg hen, weighed 5-lbs., and 3-lbs. 11-oz., making a total for the two of 8-lbs. 11-oz., and an average for the two of 4-lbs. 5½-oz.

It is, I believe, well ascertained that it is one of the characteristics of hybrids that they usually exceed the parents in size. This is well illustrated by the weights which I have given you, but there are one or two facts connected with these weights which are, I think, very remarkable, and worthy of special attention. The two broods were not kept separate, and were brought up together after they were able to shift for themselves. But the plumage of the birds seems to show pretty clearly their parentage. The four very dark birds, almost black in some lights, would seem to be the produce of the black hen, whilst the three birds which so strongly resemble the Hamburg are probably her progeny. If this be so, and there seems every reason to suppose that it is, and disregarding the two birds whose weights were not taken, the smallest of the black hen's hybrids is more than double her weight, and the largest of them is nearly three times her weight. Again, one of these birds is 14-oz., and a second 2-oz. more than the combined weight of both parents, whilst the third is only 11-oz. less than the combined weight. The weight of the three dark birds again contrasts strangely with those of the two birds which are the produce of the Hamburg hen. The weight of this bird was double that of the little black hen which produced the big hybrids, and yet of the two hybrids which she produced, one is 9-oz. less, and the other only 12-oz. more than her weight taken alone.

There is another remarkable feature about these five birds. Mr. Swaysland tells me that he examined them carefully to ascertain their sex, and he found them all males.

The facts connected with these hybrids are exceedingly interesting, and well worthy of record, but we must not, I think, attach the same importance to the singular discrepancies as to size and so on, to which I have referred, as we should be entitled to do had the cross been between wild birds, or with birds less liable to variation than the Common Fowl. Neither of the fowls were, I think, very purely bred, and it is impossible to ascertain anything as to their ancestors. The most probable explanation seems to be that the little black hen has "thrown back," as it is termed, and has produced birds resembling in size one of its ancestors more or less remote.

25.—On the nesting of the Red-Breasted Fly Catcher *(Muscicapa parva)* in Kent, in the Summer of 1881.

By John Flower, M.A., F.Z.S.

[*Read November 16th*, 1881.]

It has, I think, been quite satisfactorily established that a pair of these birds built a nest, and reared a brood of young ones, in May and June of the present year, in a small garden in Kent. I know the garden well, but I have thought it better, for the present, not to mention the town in which it is situated, as it is not at all improbable that the birds may return next year, and if they do, their chance of rearing another brood will be but small, if it is once known where they are to be found. This Flycatcher is exceedingly rare in the British Isles. Two birds of this species were seen near Falmouth in January, 1863 and one of them, a female, was shot. Two more specimens have since been obtained in the Scilly Islands, one in October 1863, and the other in November 1865. As these are the only known instances of its occurrence in Great Britian, the nesting of this species in Kent in the present year is a fact that ought certainly to be recorded. I have taken care, therefore, to ascertain all the facts connected with these birds, and these are now for the first time made public.

The garden in which the birds built is a small one, not more than about 70 feet square. The house to which it is attached is on the west side of it, and on the north side is a wall. In the garden, and only a few yards from the wall is a Deodara tree, *(cedrus deodara)* and in this the nest was placed. It was about eight or ten feet from the ground, and it was not placed in a hole in a decayed bough, or near the trunk of the tree, as is said usually to be the case, but it was placed some distance out, and towards the end of one of the branches. The young birds left the nest on June 27th, and after that nothing further was seen or heard either of the young birds or the old ones. The nest was afterwards sent to me, and I have brought it this evening for your inspection. It is rather larger than one would expect the nest of this species to be, but that is no doubt due to the fact that a brood of young ones has been reared in it. I did not hear anything about these birds till June 26th, and before I could go down to see them they had taken their departure. The gentleman in whose garden they were, is not a practised ornithologist, but he is a keen naturalist, and a good observer; and as he saw the birds repeatedly, generally on the top of the wall, and examined them carefully through an opera glass, I do not think there can be any doubt at all as to their identity. On one occasion he examined the male through the glass, and compared him with the plate and description in "Morris's British Birds," and on July 2nd I sent him skins of the male and female of this species, which Mr. H. E. Dresser very kindly lent me for this purpose, and which are the identical skins from which the plate of this species in his well-known work on the "Birds of Europe" were coloured and described. Having examined these my friend expressed himself perfectly satisfied as to the identity of the birds. There is no species of bird which has occurred, or which is at all likely to occur in Great Britain, which could be mistaken for this Flycatcher, unless possibly it be the common Redbreast. But the Redbreast is a much larger bird, and its note and movements are very different to those of the Flycatcher. Further than this, the Flycatcher has two conspicuous white streaks on either side of the tail, which the Redbreast has not, and the plumage of the male differs very considerably from that of the female, which is not the case with the Redbreast; and all these peculiarities were observed and noted. With regard to the general habits of these birds, but little was learnt. The birds were so successful in avoiding observation that the nest was not discovered until a short time before the young ones flew, and after the nest was discovered the old birds were seldom seen in the garden except when going to or coming from the nest.

26.—On the Nest of the Carder Bee *(Bombus Muscorum.)*

By Alfred Carpenter, Esq., M.D., &c.

[*Read 17th December*, 1881.]

Walking in my field on July 12th, just after it had been mown, it being a dry and hot day, I noticed a small felted ball made of numerous particles of dried grass and moss. It was about the size of an ordinary orange and seemed to be half imbedded in the turf. I touched it with my fingers, and immediately a loud buzzing noise proceeded from it, which made me withdraw very quickly my hand from contact with the mass. A large humble bee made her appearance and buzzed round me in a threatening style. I then more carefully but leisurely examined the lump and slightly raised the upper portion of the dome, and then found a considerable number of humble bees occupying the interior. I rapidly replaced the top of the nest and then watched their proceedings. Three bees in addition to my threatening neighbour immediately set to work to repair the damage I had done, and fine threads of moss were entwined in the base so as to rivet the whole together again. They evidently assisted each other in the work, and half an hour afterwards all trace of the mischief was removed, and the soft smooth outline of the dome was restored as perfectly as before. The buzzing ceased about ten minutes after I had given over touching the nest. The pieces of which it was composed were from a quarter to three-quarters of an inch in length, mainly of moss and fine grass, and it was so arranged that watching it as I did afterwards in the rain, I perceived that the water did not penetrate, but ran off into the soil round the nest. It was formed in a depression of the field; not on a bank, but on a piece of level ground, and yet arranged so that even in heavy rains, I did not find that it allowed any serious amount of water to pass through it. I watched the nest for some time, day by day doing some occasional damage to the dome, and always finding it immediately repaired. One day I took off a portion of the top and a part of the comb, and in two hours it was entirely repaired as far as the exterior was concerned. I calculated that the colony contained about 40 humble bees. At the end of July, I was obliged to give up the watching process during the meeting of the International Medical Congress, and whilst away attending to my duties at the British Medical Association, at Ryde. During my absence the grass had grown so much that, on my return I had difficulty in finding the nest. It was quite covered up by long grass, and the shape was somewhat destroyed. As the season was very wet for some time after my return I was unable to pay attention to my friends, but in the first week of September I removed what remained of the dome and found about a dozen bees very heavy and listless. They buzzed slightly but were unable to fly, and some dead bees were in the nest. The mossy dome, unlike the dome of a month before, was no longer waterproof. It was sodden through, and the nest itself in a process of rapid decay. The underneath part was more soaked than the neighbouring ground, and what interested me most was the number of enemies who had attacked the nest on all sides; slugs, and beetles, and weevils. I tried carefully to excavate it, but an immense number of earth worms had assaulted it from below. They surrounded the comb at the part underneath. Not less than one hundred were there. They put me very much in mind of the snakes upon the head of Medusa. They were of all sizes, from one inch to six inches in length, and a large part of the comb was already destroyed. I rescued the portion which I show you. There were no eggs in the cells, and one is occupied by a dead bee. Whether my examination of the dome before the wet season had set in, had destroyed its power to keep out the rain, or not, I don't know. I think possibly that might have been the case, and that the rain finding entrance, had damaged the colony so that the worms were able to effect a breach below, and destroyed the work before its time. I think also that the queen (if there be a queen) had been attacked and the larva of royal blood had been destroyed at an early stage of the proceedings, for I could not find it there. At any rate something in this case had arisen to lead to the attack of the worms upon the nest. It is reasonable to suppose that such a result does not usually follow, otherwise the Bombus Muscorum or Carder Bee would soon be extinct. There must be a means of defence against worms in a general way, yet this colony was on the point of utter destruction when I completed that process by removing it altogether. I was unable at any time to find honey in the nest, though we may assume that some of the cells had been so occupied. There are a few remaining as complete cells, but they do not contain honey now. The material of which the cells are made are very inflammable, allied to wax, if not true wax, and it is probable that the inner side of the mossy dome was lined with a similar kind of material by means of which the rain was kept out of the mass, but I did not find any evidence of such a dome in the felted mass which I removed.

27.—One of the means whereby Forest Trees are destroyed.

By Alfred Carpenter, Esq., M.D., &c.

[*Read 17th December*, 1881.]

Dr. Carpenter, being called upon by the President, read a short paper on a peculiarity in the birch tree. It was as follows:—The specimen submitted is a portion of the Betula Alba, the ordinary birch tree, a tree which is very common in light and sandy soils, and in all hilly countries. In this specimen, which has been recently cut down, it will be observed that included within the true wood is a layer of what appears to be the liber of the bark, and which is in the form of a paper lining. The specimen was brought to me by Mr. Flaxman, the dairy inspector, as shewing how curiously a sheet of paper had become impacted in and become a part of the tree. It may not be an uncommon thing, but I have not seen it before, neither do I find any account of a similar production in any of the botanical works to which I have access. It will be observed in the specimen that the abnormal condition is limited to the duramen, and the very centre of the wood appears to be undergoing a process of decay. The rings are very indistinct, as is usual with the birch, but the paper like envelope seems to take in two or three of the rings. My first impression was that some abnormal state of nutrition enabled the alburnum of the wood to enclose the liber or inner layer of the bark and cut it off from communion with the cellular or corky layers. I expected to find evidences of this by examination of the tissue with the microscope. My first difficulty, however, arose in finding that the tissue was formed in a matted or felted plan, and not in parallel layers or lines, as is the case in bark. It was not acted upon by acetic acid. Boiled with nitric acid it was simply rendered more granular. Boiled with acetic acid the same result followed, and not the change which usually comes over lignine when so treated. A portion of the tissue teazed out with the needle, and examined with a one-fifth power showed a felted mass of fine fibres with distinct contour, but without nuclei and none of those markings which belong to the ordinary liber; neither were there any of the joints and rings which belong to the woody tissue. At first I concluded that it must be made up entirely of lacticiferous tissue. But its position could not be reconciled with this idea, although it corresponds somewhat in character with that tissue. There is an absence of junctions and of regularity of arrangement. I conclude from its microscopical appearance that it is the mycelium of *merulius lacrymans*, or the fungus which produces dry rot, which has permeated the tissue in the lines which separate each year's growth, and that it has originated the decay which is commencing in the interior of the tree, and that that which is so similar to paper is entirely devoid of the properties which belong to that material. It is curious to find that it has penetrated so completely into the heart of the wood and explains somewhat how decay extends in our timber trees, and by what means they become touchwood. This specimen had extended some fourteen feet from the ground, and next year the tree would probably have died. It appears to me that the unaccountable death of forest trees may in some instances be explained by the effect of the fungus upon the living tissues of the plant as is shewn in the specimen which I now produce.

28.—NOTE ON THE OCCURRENCE OF ACHATINA ACICULA ON PARK HILL, CROYDON.

By KENNETH MCKEAN, Esq.

[*Read 17th December*, 1881.]

On the 4th December, 1881, I visited the new railway works, and there met Mr. Flower, who, in taking measurements of the strata in the cutting on the south side of the hill, remarked the great depth of the worm borings as shown on the face of the cutting. While I was engaged in flaking away the sand to trace one of the worm borings down as far as possible, I came upon two Achatinæ close together inside the tube. One was living, the other dead. We measured the place, and found it was twenty-six inches below the surface. I subsequently found five others (dead) that day, all within worm borings, and all about two feet from the surface. The specimen taken alive was hybernating, and had secreted an epiphragm exceedingly thin and glistening. Being desirous of noting more particularly the position this mollusc takes underground, I paid another visit to Park Hill on December 11th, and as the works had progressed slightly during the week a fresh surface in the cutting was exposed. I found a worm tube close under the grass roots, and following it downwards with the aid of my knife, I came upon what one might term a small "heading" opening from, and at right angles to, the tube. It was scarcely three-quarters of an inch broad, and half an inch high, and so smooth it looked as if it had been formed by the displacement of a pebble. In this cavity, twenty-three inches below the surface, were five Achatinæ hybernating. They were all the same size, not quite full grown. As they lay they formed the radii of a circle, the tips of the spires touching, mouth outwards and turned down. The worm tube so close to which they were wintering was an old one, as it was wet and much discoloured with the surface drainage, yet the cavity itself was quite dry. I dug a good way into the face of the cutting, and in one spot, where for a space the size of one's fist the sand was very soft, though two feet below the surface and surrounded with hard sand, I found embedded among the grains more than twenty Achatinæ, but all had been dead some time, as the shells were exceedingly brittle. In another worm tube, twenty inches under ground, I took by itself a young Achatina, of two whorls. In all probability this specimen had escaped but a very short time from the egg,

Achatina acicula cccurs abundantly where it occurs, but its minute size and subterranean habits render it rather difficult to find. Instances are recorded of its capture alive on the surface of the ground, but they are very few, and of all our land shells this is the only one of whose life-history nothing is known.

29.—On some new observations of Vortex Motions, and on the evidence of the possibility of such motions being active in Vital Systems.

By Mr. W. F. Stanley.

[*Read Wednesday, January 18th*, 1882].

The object of the present paper is to bring before you certain thoughts which sprang up in my mind during my experiments with fluids, of which I have published an account, a copy of which is in our library.

Before offering (as I intend to do) some evidences of the possibility of vortex motions being active in *vital systems* I may briefly discuss two points:—First, the evidence of mechanical action being general in vital systems; and, secondly, the nature of vortex motions in a general sense.

If we study the anatomical and functional construction of any animal it becomes at once evident to us that independently of the vital principle, which is beyond our reach, the functions of motive parts are carried on upon the highest *mechanical* principles—principles generally that we believe to be more exact than it is possible to reproduce by art. Thus we witness in the eye, with its back and front lens and its adjustable stop, the perfection of the camera obscura ; further in this organ the researches of Bol have shewn that the retina absolutely receives and retains a picture of the objects placed before it in a manner that is somewhat like our photographic processes. So that here we have altogether a perfect mechanical contrivance as well as a vital one. In like manner we have part of the ear placed in sensitive equilibrium so as to be motive to the small impulses of the air which we recognize as sound. In like manner also the heart resembles, and really is, a *force pump* to the artereal system, and in like manner also we find the functions of *all* vital parts, so far as we can trace them, following independently as it were of vitality, strictly mechanical law. From this we may therefore argue that if a *vortex motion* is a form of motion adapted to the vital system such a form will in all probability be active within it.

I will first endeavour to discuss vortex motion simply. Following my original experiments I find that only one form of the motion of a fluid within a fluid, or a resisting medium, assumes the condition of a free projectile ; and this form is that which has been previously distinguished as a *vortex motion*. Upon further investigation I have drawn the conclusion that this is the *only* form of motion in which one fluid could move upon another or really upon any other body. In carrying out my researches by a long series of experiments I endeavoured to ascertain what were the conditions of motion in natural fluid systems. These observations extend to the greatest spaces and the smallest; taking our great oceans, whose currents we have mapped out on our naval charts, for the large spaces ; and the terminal capillary vessels of the animal body, as we may observe them under the microscope, for the smallest. It is unnecessary to say that in these observations it was in the smallest that there was the greatest difficulty in tracing principles.

[Mr. Stanley then proceeded to exhibit a series of experiments illustrative of vortex motion in liquid and aerial fluids and to describe them, and he referred his hearers for further information to his work on "Fluids," now in our library, and especially with regard to the phenomenon of the vortex rings, and then proceeded with the more special subject of his paper, viz. :—The possibility of vortex motions being active in *vital systems*].

From the experiment of Prof. Tait, just given, we find that a smoke ring is projected from the smoke chest for a considerable distance in the air by a sudden impulse upon the stretched canvass which forms the back of the chest; whereas the continuity of the impulse for a longer time, so that it becomes a pressure, projects the smoke for a short distance only. From this we may conclude that impulsive impressions are the most highly projectile; therefore, assuming that this principle applies also to the circulatory system of an animal, we see the reason why the heart of all animals should act by pulsation and not by simple alternate pressures, which would not diffuse the blood in the same manner.

If we minutely examine the action of the heart, which we may readily do in many of the lower animals, as in daphnia, or the common snail, or better still by dissection of a live mussel or oyster, we shall see that the opening of the valves is relatively slow, whereas the closing is impulsive. The same form of action is also clearly felt in the motion of the human pulse; therefore it is only in the smaller blood-vessels that this impulsive action of the heart is lost, or is left only slightly evident, as may be seen in the circulation of blood in the frog's foot or fish's tail, where the pulsatory motion is nearly exhausted. In the same manner it may be observed in the breath issuing from the mouth and nose, that the vitiated fluid we exhale, which it is necessary should be projected to such a distance as not to be again inhaled, is ejected by a more sudden and powerful action of the lungs than the reverse action of inhalation; this we may particularly notice under great exertion when breath is thrown out with the greatest vigour, and panting, as it is termed, occurs.

In the next place we may notice that the impulsive action producing the vortex form of motion throws the current lines of a moving fluid outwards, and therefore the lateral openings in a central artery, which take certain directions, do not necessarily in taking this direction produce a very frictional form of motion in the fluid which enters them. This is a very important point in animal economy. Thus, assuming that a current running down an artery has to enter a lateral orifice, the vortex direction will already be that which will assist the entry.*

Considering again our original form of vortex motion, as shewn in a former experiment, we find as a principle that a unit projection has a natural tendency to separation from a centre, and if the area of motion be reduced to a *plane* in any way by side resistance, a simple current will have on projection a constant tendency to move outwards from the axis of

*Mr. Stanley was able to illustrate this very clearly by experiment.

projection, that is to bifurcate ; and this we find is the general form of arteries and veins in the animal system. The principle of this form of motion I have endeavoured to follow carefully by experiment, the result of which I shall be able to show you.

Taking a narrow glass trough filled with water and projecting from the upper surface a small current of Indian ink, we shall see that the ramifications which the stream of ink undergoes, under the resistance of the water through which it passes, outwardly resembles the separation of veins and arteries in the animal system.

This action I am able to show for the first time by means of the magic lantern.*

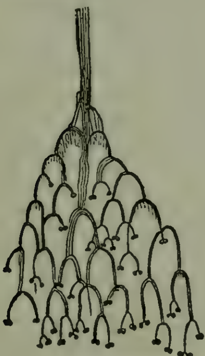

Fig 1.—The Ink Stream, natural size.

Fig 2.—The Terminal Projections enlarged.

The termination of the bifurcated projections of the ink stream are worthy of special attention. These terminations begin to bifurcate within themselves and at first form terminal knobs. This knob termination I conceive to be analogous to the termination of many vascular vessels in the animal body ; as, for example, those termed pacinian bodies, which form the nerve-endings of the lymphatics ; the termination of sweat glands ; and the malphigean bodies in the kidneys. These I propose only as similarities, but if the mechanical principles proposed are in degree active, they must in all cases be considered under much differentiation by other active principles existing (known and unknown) in the animal system.

If we assume such mechanical principles to be active in vital systems as those proposed (differentiated doubtless in these by

* The illustrations are taken from Mr. Stanley's work on "Fluids."

other active vital forces known or unknown), it becomes apparent that *growth* may be the resultant of continuity of the same system of forces, which may at first induce a vascular or supply system in the smaller earlier parts of a vital system, vegetable or animal. This consideration is important to us in other ways, as it opens to us the mechanical principles of abnormal growths; as, for instance, the class of tumours of the *sarcomatous* class, which are popularly termed *wens*, which often attain large dimensions and contain a circulatory system entirely abnormal to the animal upon which they grow.

I have some hope also that these ideas may be influential in further opening up the science of *vital mechanics*—a science which under the name of biology has already made such rapid advances by the labours of such men as Darwin, Huxley, Spencer, and Dyer in our own country, and of Cohn, Hæckel, Woolf, Kühne, in Germany, and of others elsewhere.

We may, with our present knowledge, define a vital being as a unit cell or one made up of cellular aggregates or tissues in which there is often mineral matter interposed. This knowledge apparently reduces the mechanics of life to a certain amount of simplicity. But when we come to examine more closely we find that cells although apparently alike are so various that by assumed internal differences (of the causes of which we have no conception) every fabric of animal and vegetable life is raised to a special form or condition, in which the *cellular* construction becomes much more differentiated or even disappears. This is effected principally, or at least in higher organisms, by means of an induced intercellular vascular system of some kind, and it is the mechanics of this vascular system (*and not the vital principles* which I do not pretend to comprehend) of which I have offered suggestions to you this evening. I have also some thoughts that the cell itself, which acts as a kind of raw material of life, and is so small in its germ form as to be invisible under any microscope yet invented, although it contains in this primitive form many millions of atoms, is itself a complex system; in which similar vascular systems to those of which I have spoken may be active in influencing the production by development of visible forms.

Croydon Microscopical and Natural History Club.

OFFICERS FOR 1882.

President:

PHILIP CROWLEY, F.Z.S

Treasurer:

JOHN FLOWER, M.A., F.Z.S.

Committee:

A. CARPENTER, M.D., J.P. F.R.M.S.

JAMES CHISHOLM.

THOS. CUSHING, F.R.A.S.

J. S. JOHNSON, M.R.C.S.

EDWARD LOVETT.

KENNETH McKEAN.

HENRY T. MENNELL, F.L.S.

WILLIAM TOPLEY, F.G.S.

HENRY TURNER.

Hon. Secretary:

CHARLES PRICE TURNER.

PROCEEDINGS

AND

TRANSACTIONS

OF THE

Croydon Microscopical and Natural History Club,

FROM

FEBRUARY 15th, 1882,

TO

JANUARY 10th, 1883.

CROYDON:

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Mr. H. T. MENNELL moved "That in future the officers of "the Club be nominated in writing, and that such nominations "be sent to the Secretary not later than the second Wednes- "day in January, or seven clear days before the Annnal "Meeting. That a printed list of all the nominations of the "officers of the Club be circulated at the Annual Meetings, "and that the members present vote by ballot, by striking out "such names as they do not desire to vote for, and placing "the lists in an urn on the table. Scrutineers to be appointed "at the meeting, and the votes to be counted and declared "during the course of the meeting."

The motion having been seconded by Mr. E. LOVETT was put to the meeting and carried unanimously.

Dr. CARPENTER moved "That the Club approves of the "plan proposed by the Committee that in future the transac- "tions of the Club contains only papers on local subjects or "such as are the result of original observation and research."

Seconded by Mr. FLOWER, put to the meeting, and carried.

Mr. H. T. MENNELL moved a vote of thanks to Mr. K. McKean for his services as secretary during the past year.

Mr. STURGE seconded the motion, which was cordially approved by the meeting.

The business of the Annual Meeting being concluded,

Mr. W. F. STANLEY read a paper "On some new Observations of Vortex Motions and of Evidence of the possibility of such Motions being active in Vital Systems." Assisted by Mr. W. Low-Sargeant, the lecturer gave some beautiful experiments illustrating whirl motions in vapours and fluids. At the conclusion of the discussion which followed, a hearty vote of thanks was passed to Mr. Stanley.

The following objects were exhibited:—Jas. Epps, junr., satin leaves from Cape ot Good Hope, scale of pike, and scale of sole; W. F. Stanley, injected blood vessels, cerebrum of a cat; A. Warner. human ovary showing graffian vesicles; H. Turner, inoceramus (sp ?) from basement bed of Woolwich series, leaf of exogen (sp ?) from yellow clay bed, railway cutting, Park Hill; E. B. Sturge, polycystinæ splintered sections of oak; the President, group of pezizas from Alton; H. M. Klaassen, section, human lung showing large deposit ot carbon, the result of living in a smoky town.

Ordinary Meeting 15th February, 1882.

PHILIP CROWLEY, ESQ., F.Z.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The following gentlemen were balloted for and duly elected members:—Mr. H. J. Houghton, Mr. Arthur J. Norris, Mr. Wm. J. Robinson, and Mr. E. J. Winter Wood.

The following donations were announced:—Procès verbal, Belgian Microscopical Society; Science Gossip for February; Notes on the British Stalk-eyed Crustacea by Mr. Edward Lovett; Transactions of the Norwich and Norfolk Naturalists' Society; Journal of the Royal Microscopical Society.

The PRESIDENT also announced that Mr. Horniman had been kind enough to send an invitation for the Members of the Club to pay a second visit to his Museum at Forest Hill upon the afternoon of Saturday, the 4th March, and that lady friends would be welcome.

The President gave notice that at the next meeting of the Club he would move as follows:—"That the day for the "Ordinary Meetings of the Club be, and it is hereby changed "from the third Wednesday to the second Wednesday in the "month."

Mr. FLOWER then delivered an address* upon the geology of Croydon as illustrated in the railway cuttings at Park Hill. In the course of his remarks, he said that matters of considerable interest had come to light during the progress of the railway works. Those who were specially interested in geology had an opportunity not often met with, while those who were not specially interested could learn something as to the past history of the land on which the town stood, and on which they walked. To begin with the chalk, which formed really the basis or bottom of all the Croydon district, the first thing to do was to ascertain what was the position of the chalk bed, and what was its nature. The chalk was a hard white rock, and it had been deposited in the open sea, no doubt, and afterwards raised to the surface. It was from 550 to 1,000 feet thick, and formed a compact floor on which the tertiary beds, which made up our soil, rested. The bottom bed of Park-hill was chalk, then came a bed of Thanet sand. The green sand bed lay immediately over it, above that came a thick bed of clay, over that a thick bed of sand, which had at its bottom the shell rock. At the top was a pebble bed in some places, but in other places the pebble bed was resting, not on the sand, but on the clay. Proceeding to give particulars of the various beds,

* Owing to the lamented death of Mr. Flower, this address which would, in his hands, have formed a valuable addition to our Transactions, can now only be very imperfectly summarised.—EDITOR.

Mr. Flower commenced with the Thanet sand. The Thanet sand was very well seen in the road going down to Beddington. It was also to be seen at Duppas-hill, but the best places to see it were at the cutting of the London, Brighton, and South Coast Railway in Coombe-lane, and at the Coombe-lane end of the new railway. No doubt the Thanet sand was essentially a marine bed, the sand having evidently been deposited in a comparatively deep sea. The result of this fact was that there were very few fossils indeed found in it. He had, however, found a few. The bed of green sand above the Thanet sand was evidently an esturial deposit, not deposited in a deep sea, but deposited in a deeper sea than the beds which lay immediately over it. The bed was about 15 feet thick. The most interesting part of the bed was the three feet which lay close over the Thanet side. Oysters, sharks' teeth, &c., were found in this three feet of green sand. The greater part of the oysters were free, not attached to each other, as was generally the case. They seemed from their appearance to have laid perfectly still at the bottom of the sea, and probably, therefore, there was not a great amount of current. A singular fact was the quantity of sharks' teeth that had been found there. It was on the 18th December, after a heavy rain, when the side of the cutting had been very much washed, that he first saw a shark's tooth lying on the surface, and found about eight or nine there. A very large number of these sharks' teeth had been found, and he had in his boxes some 700 of them which had all come out of the cutting. The finding of sharks' teeth in this green sand bed was something entirely new as far as he could find out. The green sand graduated into a lavender-coloured sand, which was separated from the over-lying clay by a sharp black band. The clay which lay over the green sand was of a very peculiar description. At the Coombe-lane end the bed was quite yellow, but at the other end it became a deep blue. Several feet of the lower part of the clay was of a beautiful mottled colour. He heard some time ago that a number of bones had been found in this clay, and was rather sceptical about them. He could only get one of these bones, and very much doubted whether it came from this clay at all. There was only one other bone he had heard about, and this he had seen. He did not think there could be any doubt that that came from the bed in question. It was apparently the bone of a large species of deer, of the character of the extinct Irish deer. There seemed no reason why there should not be plenty more bones in this clay. They were probably deposited by the action of rivers in a bay, and there was no reason why dead animals and large pieces of wood should not be brought down, the water not being very deep; and being covered up, they would naturally remain where they had been deposited. Fossil wood in considerable quantity was in fact found in this bed. All these beds belonged to the series known as the Woolwich Beds. Immediately over the clay came the Oldhaven bed, which was in two divisions, first a thick bed of whitish sand, which might be seen in the Addiscombe-road where the line crossed, and at the base of that the shell rock. This shell rock was some seven feet thick, made up entirely of oysters and other shells. The shell rock was an exceedingly interesting bed. It was so hard that the contractor was now blasting it with powder. These beds appear to have undergone great denudation from the action of water, and chiefly on the tops of our hills we find large deposits of water-worn pebbles also belonging to the Oldhaven series. Over the Oldhaven beds came the London clay, but a local clay lay over the pebbles in some part. A peculiar thing about the local clay was the large blocks of stone that occurred in it, solid masses of sand stone. This clay was as full as it could be of oysters. In concluding his remarks, Mr. Flower announced that he hoped to put all the objects he had collected at Park Hill at the disposal of the club if they formed their collection. These objects ought not, he considered, to be kept in private collections if there existed any public collection to which they could be contributed.

After some remarks from Dr. Carpenter,

Mr. Henry Turner remarked that, with regard to the Thanet sand, he had not been able hitherto to find anything at all more than the sand itself. In the bed immediately overlying it, the base of the bed was really of a brown colour, but it graduated in the course of two or three feet into the green character which Mr. Flower had remarked upon. A remarkable thing about this brown bed was that it contained plant remains in a condition that one might expect plants would be in that were deposited in sand like that. He (Mr. Turner) obtained some leaves, but immediately they were handled they fell to pieces, and were lost. He also found a seed in the brown bed, very much the size of a pea, and very much like it in shape. He had also found in another section the leaves now exhibited. One of the teeth he had found he had taken to Kensington, and found it to be the tooth of a fish considerably differing from a shark.

Mr. Klaassen and Mr. Chisholm also took part in the discussion, and the latter gentleman exhibited some diagrams to elucidate the subject.

At the conclusion of the discussion a vote of thanks was passed to Mr. Flower.

The lecture was illustrated by the exhibition of numerous fossils and rock specimens from the Woolwich beds and Thanet sands, exposed in the Park Hill section, viz., by John Flower, series of teeth of lamna (shark) (species various), series of ostrea flabellula, wood with iron pyrites, inoceramus (all from the Woolwich beds), casts of cardium (from the Thanet sands), flint nodules and rock specimens; by Henry Turner, series of ostrea flabellula, inoceramus, teeth of lamna elegans, &c., and Edaphodon Bucklandi, also leaf and seed remains from the clay bed; by H. T. Mennell, series of ostrea, calyptræa, melania (Sp.), and cyrena (Sp.); by H. M. Klaassen, sectional drawing and rock specimens, illustrating the Park Hill section, also fossils of allied forms from the lower greensand, coprolite beds, and from the lias.

There were also exhibited the following objects:—Edward Lovett, ostrea and pebbles (in situ), illustrating the possible manner in which the former had been destroyed by the shifting of a shoal, also, under his microscope, membranipora pilosa, mounted in fluid, with tentacles extended as in life (1½-in. object; Kenneth McKean, under his microscope (3-in. obj.), helix pulchella var., costata (in balsam), obtained from chalk pits, Coombe Lane; Mr. Low-Sergeant, under his microscope (2-in. obj.), the crustacean, amneothea pycnogonoides alive; E. B. Sturge, under his microscope (1½-in. obj.), sand from the Park Hill section, showing microcosms, also causes of colour of the stratum; Nathaniel Waterall, Early English bridle, bit, and stirrup, which were dug from the banks of the river Wandle, near Waddon Lodge.

Ordinary Meeting, March 15th, 1882.

PHILIP CROWLEY, Esq., F.Z.S., President, in the Chair.

The minutes of the meeting held on the 15th February were read and signed.

The following gentlemen were balloted for and duly elected members of the Club:—Henry E. Dresser, Joseph Stanley.

The following donations were announced:—Procès Verbeaux, Belgian Microscopical Society, Vol. xi.; "Science Gossip" for March; Report of the Migration of Birds in the Spring and Autumn of 1880, presented by Mr. Sturge; the Weather of 1881, as observed in the neighbourhood of London, presented by Mr. Mawley; The Rosarian's Year Book, 1882, presented by the Author.

The PRESIDENT announced that on Saturday afternoon of the 4th March a party, consisting of members of the Club and friends, numbering altogether about 30, paid a visit (the second this year) to Mr. Horniman's Museum at Forest Hill.

The PRESIDENT also announced that the Geologists' Association would have an excursion to Hastings and Battle Abbey on Easter Monday and Tuesday, and that the Council of the Association would be glad to be accompanied by any members of the Croydon Club upon the occasion.

The PRESIDENT stated also that a letter had been received from the Hon. Sec. of the Holmesdale (Reigate) Natural History Club inviting the members of the Croydon Microscopical Club to join them in an excursion to the railway cutting at Park Hill (under the guidance of Mr. John Flower) on the afternoon of Saturday the 22nd April.

The PRESIDENT said that steps were being taken by the committee of the Club to give increased facilities to the members for making use of the books contained in the library, and that with this end in view a library sub-committee had been formed consisting of the following gentlemen :—Messrs. Brewer, Justican, Low-Sergeant, Lovett, Epps, Straker, Sturge, and McKean ; and further that Mr. McKean had been appointed Librarian.

The SECRETARY then read from the minutes of the committee meeting held on the 15th February certain resolutions which had been passed laying down rules and regulations for the circulation of books.

In conformity with a notice of motion which was read at the last meeting, the PRESIDENT moved the following resolution, viz. :—" That the day for the ordinary meetings of the Club be, and it is hereby, changed from the third Wednesday in the month to the second Wednesday in the month."

This resolution, having been seconded by Mr. LOVETT, was put to the meeting and carried unanimously.

Mr. LOVETT then read a paper entitled " The Embryology of the Podophthalma or Stalk-eyed Crustacea " (see Transactions, article 30). The paper was illustrated by the following exhibits, viz. :—Three cases of crustacea, illustrating the subdivisions of the podophthalma (British) ; thirty-six microscopic preparations of the embryological forms of various crustacea ; diagrams illustrating various points in connection with the zoœa and ova forms of these animals ; (under his microscope, $1\frac{1}{2}$-in. obj. and spot lens), the swimming appendages of the bunter prawn *(palducorne varians)* ; (through the kindness of Mr. McKean) the ova of contracted crab *(hyas coarctatus)* ; (through the kindness of Mr. Sturge) the ova of spiny lobster *(palinurus quadricornis)*.

A hearty vote of thanks was passed to Mr. Lovett for his paper.

The following exhibits were made :—Mr. Low-Sergeant, plants preserved by a new process. Mr. Low-Sergeant has since communicated the following description of the method pursued in the preservation of the plants:—"A mixture is made of equal parts of lime and plaster of Paris which has been exposed to the action of the air until it has lost its setting properties. A flower pot or other vessel of convenient size to contain the flower or fern to be preserved is taken, the bottom of which is covered with the mixture, and the flower is placed on it in the position in which it is required to dry it, the mixture is then carefully sifted over the plant so as to thoroughly cover and bury it. The vessel and contents are then to be heated up to about 90° or 100° Fah., and kept at that heat for several hours (8 to 24) according to the nature of the plant. The plant when dry is removed from the plaster, carefully dusted, and then varnished with a varnish composed of gum dammar dissolved in benzole and turpentine." Mr. Collyer, specimens of blue fluor and iron pyrites.

Ordinary Meeting, April 12th, 1882.

PHILIP CROWLEY, Esq., F.Z.S., President, in the Chair.

The minutes of the meeting held on the 15th March were read and signed.

The following gentleman was balloted for and duly elected a member:—Charles W. Willoughby.

The following donations were announced:—"Science Gossip," from the publishers; and "Notes and Observations of the British Stalk-eyed Crustacea," from Messrs. Carrington and Lovett.

The PRESIDENT reminded the members that the excursion of the Holmesdale Club, which was announced at the last meeting, would be held on Saturday the 22nd April, and that the members attending it would assemble at the Water Tower at three o'clock in order to proceed, under the direction of Mr. Flower, to inspect the strata which are exposed at the adjacent railway cutting.

Mr. HENRY DRESSER, F.L.S., F.Z.S., &c., now delivered a most interesting lecture upon "Species and Varieties in Birds" (see Transactions, article 31).

After some remarks from Mr. FOOTTIT upon the subject the meeting passed a hearty vote of thanks to Mr. Dresser.

The lecture was illustrated by a large series of skins of birds.

The following objects were exhibited:—By Mr. Henry Turner, series of fossil plant remains from the beds exposed in the Park Hill section; by Mr. McKean, under his microscope, *planorbis albus* 10 days old, showing first appearance of spiral form; by Mr. Low-Sergeant, under his microscope, *alcyonia digitalis* alive; by Mr. Edward Lovett, under his microscope, swimming foot of crustacean, *squilla desmarestii*, showing fringed plates and pigment cells; by Mr. A. Warner, under his microscope, section of ovary of daffodil; by Mr. Collyer, specimens of Cinnabar moths and tiger beetles.

Ordinary Meeting, May 10th, 1882.

PHILIP CROWLEY, Esq., F.Z.S., President, in the Chair.

The minutes of the meeting held on the 12th April were read and signed.

The following gentlemen were balloted for and duly elected members of the Club:—St. John Boultbee and Edward Bidwell.

The following donations were announced:—"Science Gossip," from the publishers; Journal of the Royal Microscopical Society; Third Annual Report of the Lewisham and Blackheath Scientific Association; Fourth Annual Report of the Erith and Belvedere Natural History and Scientific Society; Procès Verbal of the Belgian Microscopical Society, 25th March, 1882; Notes and Observations of the British Stalk-eyed Crustacea, from Mr. Lovett.

The CHAIRMAN announced that a circular letter had been received from the Essex Field Club forwarding the proof of a proposed memorial "to the Conservators and others in favour of the retention of the highly interesting and valuable natural features of Epping Forest, and the desirability of protecting in every way the wild animals and plants inhabiting the same."

The meeting decided to adopt the memorial, and the President and Secretary were requested to sign it in behalf of the Club.

The PRESIDENT read a letter which he had received from Mr. Nathaniel Waterall asking whether the Club could arrange for visits to be made to the Natural History Museum at South Kensington.

The meeting was of opinion that the suggestion was a good one, and it was left to the President to endeavour to give effect to it and to make the necessary arrangements.

The PRESIDENT announced that the Annual Soirée would be held on Wednesday, the 22nd November next.

With the permission of the President Mr. W. F. STANLEY drew attention to a new publication entitled "Studies in Microscopical Science," a weekly periodical for the use of students, professors, teachers, the medical profession, and others interested in the progress of natural science or engaged in higher education.

Mr. W. T. Suffolk then delivered a most instructive and interesting lecture upon "Abbe's diffraction experiments and their bearing on Microscopic Vision." The lecture was beautifully illustrated by numerous diagrams.

An interesting discussion followed, in which Mr. Lovett, Mr. Stanley, and the lecturer took part.

A cordial vote of thanks was passed to Mr. Suffolk.

Mr. Henry Turner then communicated some notes upon "Some Vegetable Remains which he had found in the railway cutting at Park Hill," as follows :—Among other indications of the nearness of land to the estuary or sea in which the beds of the Park Hill series were deposited, nothing, to my mind, is clearer than the large quantity of vegetable remains found in the series from the chalk upwards. It is true that, either from the nature of the material of which the beds are composed, or from the unquiet state in which they were deposited, these plant remains are not now in a good state of preservation; still they are in some places sufficiently well preserved to enable one to form some notion of the kind of plants that grew in the locality, and consequently of the nature of the climatal and other conditions in which they grew. I have been so fortunate as to be able to collect a very interesting collection of leaves from the blue clay brought up from No. 1 shaft, nearest the Addiscombe Road. When the clay was first brought to the surface so tenacious was it that delamination or splitting was impossible, but on becoming dry it became hard, and although it did not readily split of itself, as clay quietly deposited will do, into thin laminæ, it split in a rough sort of way into layers, though often across, exposing the plants deposited. Unfortunately the materials excavated are so jumbled together that only now and then, and here and there, could a lump of splitable clay be met with, and now the material is being fast taken away, otherwise I hoped that we might be able to obtain a rich collection of fossil plants from these Park Hill beds. Not being a fossil botanist, I am unable to determine with any degree of certainty the character of these leaves, but I think there is no doubt that among them are specimens of oak, the sinuous outline being well preserved, as well as willow and poplar. There is also one beautiful leaf in the collection whose spiny margin is almost as sharp as when the leaf fell from the plant. In the same clay is also a beautiful little tooth of a species of shark. I hope some of our members will be better able than I am to determine the genera of these leaves.

Mr. Nathaniel Waterall called attention to the fact that after the recent storm sea salt was found deposited upon his windows, although Croydon was about 60 miles from the sea at the point from which the wind came.

The President said that he noticed his own back windows, which were cleaned on the day previously, looked, on the Saturday of the storm, as if they had had soap and water thrown upon them. Mr. Jaques, of Hillside, Duppas Hill, kept some of the crystals and had them analysed, and a large quantity of salt had been detected in them. The wind that day travelled over 500 miles in 24 hours, and as it was about sixty miles from Croydon to the nearest south-western point at which the sea occurred, the wind would have brought the salt to Croydon in about two hours.

Mr. Klaassen said it had been considered that the blackness of the leaves of trees was due to the spray of salt. But he put this result down to a simple mechanical action. The leaves were very young, and friction going on by the action of the wind produced the blackness in question. He had examined his own garden and elsewhere and everywhere found traces of friction having gone on.

The President had no doubt that the blackness of the leaves was caused by friction, which view was also confirmed by Mr. Cushing.

After some remarks by Mr. Gill and Mr. Berney the proceedings terminated.

The following objects were exhibited:—By Mr. McKean, curious malformation of mollusc, *limnæus pereger*, consisting of a double lip, from Mr. Beeby's aquarium; by Mr. McKean (for Mr. P. G. Guimaraens), specimens of "earth" (being a variegated sandstone) from one of the richest vineyards of the Upper Douro; by Mr. Low-Sergeant, under his microscope, tadpole of smooth newt, about 10 days old, showing the pulsation of the heart and the blood in circulation through the external branchia; by Mr. W. F. Stanley, under the microscope, section of a meteorite showing the motion of carbonic acid bubble in a fluid cavity; by Mr. Edward Lovett, under his microscope, final stage of one of the marine crustacea, *porcellana platycheles*.

Ordinary Meeting, 13*th September*, 1882.

Philip Crowley, Esq., F.Z.S., President, in the Chair.

Before calling upon the Secretary to read the minutes of the last meeting the President very feelingly alluded to the death of Mr. John Flower, the late Treasurer of the Club and a former President, and he asked the Club to authorize him to write to Mrs. Flower a letter of condolence and sympathy.

The proposal, which was supported in brief speeches by Messrs. W. H. Rowland, Henry Turner, and Curling, was carried unanimously.

The minutes of the meeting held upon the 10th of May were then read and signed.

The following gentleman was balloted for and duly elected a member of the Club:—John E. Syms, Trinity Lodge, Lower Addiscombe.

The President announced that the following publications had been received:—"Journal of Science (June, 1882), from the publishers; "Science Gossip," from the publishers; and the Journal of the Royal Microscopical Society.

With reference to the bazaar which was held in July last at the Public Hall, the President stated that the sum realised was £750, and that after deducting expenses about 200 guineas would be paid to each of the three bodies who had combined to hold the bazaar, viz., the Literary and Scientific Institution, the School of Art, and the Microscopical Club.

The President reported that during the recess the Geologists' Association had paid a visit to the railway cutting at Park Hill, where they were met by several members of the Croydon Microscopical Club.

With regard to the proposed visit of members of the Club to the Natural History Museum at South Kensington, he reported that he had been in correspondence with Professor Owen and that he hoped before long to be able to announce the date upon which the Professor could conduct the members over the Museum.

The President further announced that the undermentioned gentlemen had been appointed as additional members of sub-committees:—Mr. Low-Sergeant, the Rev. George Bailey, and the Rev. E. M. Geldart, to the Zoological Sub-Committee; Dr. Franklin Parsons, to the Botanical Sub-Committee; and Mr. Thomas Walker, to the Geological Sub-Committee.

The President stated that if there were any other gentlemen who could render any assistance to the sub-committees the committee would be very glad if they would send in their names.

Mr. Kenneth McKean then read a very interesting paper upon "the Mollusca of the Club District" (see Transactions, article 32).

At its close, Mr. Lovett remarked that, though he had done little or nothing compared to Mr. McKean in the same field, there were one or two points of interest which he had noticed during his rambles. A few weeks since he had walked down the valley from Caterham Junction to Caterham, and had observed that along the roadside, near the Junction, *Helix virgata* was the most abundant shell, with its variety *alba*; further along the road this species gave way to *Helix cantiana*, which was the predominant species; still further, both these shells gave way to *Cyclostoma elegans* and *Helix pomatia*, so that it would seem as if, even in a small district, there were, so to speak, small areas affected by different species of mollusca. He also exhibited and drew attention to some remarkable forms of *Limnea palustris* which he had obtained from the small pond at the foot of Croham Hurst on the Croydon side. He observed that in almost every instance the epidermis of these snails had been tunnelled through, in some cases being entirely eroded. This, Mr. Lovett considered, might possibly be due to a want of inorganic matter of a calcareous nature in the water, and his experiments with some of the living animals seemed to bear out this idea. The channels in the shell were not at all like anything caused by vegetable growth. He drew attention, in conclusion, to the splendid series of local shells collected and exhibited by Mr. McKean.

Mr. TURNER said he wished to ask Mr. McKean whether he was to understand from his paper that *Helix pomatia* was confined to the chalk district, for he had found it in great numbers on the Cotswold Hills just about Cheltenham, and on rocks of a calcareous nature elsewhere, although not to so great an extent.

Mr. McKEAN replied that he had taken the snail two miles from the chalk escarpment, but not further.

Mr. TURNER said he was at Northampton in the spring, and visited the secretary of the Microscopical Society there. He showed him his aquarium, and told him that some time before he had observed a young mussel, with which the aquarium was well stocked, attached to the hind leg of a water beetle. He wrote to Mr. Darwin, who thanked him for sending the observation to him, as it explained to him a circumstance he had himself been puzzled about, namely, how bivalves could make their way from one pond to another a considerable distance away. This accounted for it. The water beetle was an animal that did not remain in the water in which it lived, but in the course of time got out and flew away, and in doing so carried away with it anything that might happen to be attached to its limbs. In this way Darwin considered the bivalves were carried about from one place to another. This encouraged the observer to make further observations, and see if he could find any other circumstances of a like nature. He did so, and a short time afterwards found small mussels attached to the legs of frogs, which left the water and jumped about, and got from one pond to another, and carried these bivalves with them.

Mr. McKean said Mr. Darwin mentioned in his book that he put a duck's foot in a tank in which there were a great number of young mussels, and some of them immediately attached themselves to the foot. These mussels, upon the foot being taken out of the water, were found to live a sufficient time in the air for a duck to go many hundred miles.

Mr. H. T. Mennell said the subject of Mr. McKean's paper was one very interesting to him. He had given the subject of conchology considerable attention, though more in other localities than in this immediate neighbourhood. He thought they must all of them be very much struck with the very beautiful specimens which Mr. McKean had exhibited, not only for the number and variety, but the extreme beauty of the specimens and their cleaning and preparation. As a collector of many years' standing he (Mr. Mennell) was perhaps qualified to judge of the amount of labour and pains requisite to obtain shells in the perfect condition Mr. McKean's were in. The study of conchology was one he could strongly recommend the members to pursue. One of its advantages was its comparatively limited area, from the limited number of British species of land and fresh water mollusca. One interesting feature about the distribution of these shells was the extremely local character of their distribution, take for example *balia perversa*, by what perverse instinct it inhabited the trunks of only two trees in the neighbourhood of Croydon it would be difficult to explain. These two trees were in the centre of a very large field. With regard to the erosion of water snails that was a subject worth more attention, particularly with the microscope. Nearly all his (the speaker's) specimens of *Limneus glaber* were affected in the same way. If they looked at the shells of the pearl-bearing mussel it would be found they were also often eroded. He was inclined to attribute the erosion of these fresh-water shells to some small vegetable growth eating into the surface of the shell. He should think that ought to be made out by microscopical examination. One very beautiful species of *helix* Mr. McKean did not appear to have observed (*helix carthusiana*), probably one of the most beautiful species we had. It had certainly been found more than once on Banstead Downs, and it would be worth while for anyone interested in the subject to look carefully for it in that locality. Mr. McKean had spoken of the peculiarity of the slug *Testacella*. This was a slug that instead of carrying its shell as a plate protecting its vital organs internally, carried it externally. Although a beautiful and conspicuous animal, it lived underground and was nocturnal in its habits, so that its capture was very much a matter of chance. It was a carnivorous animal, eating worms. It was not at all infrequently met with in London gardens. He (Mr. Mennell) had seen or heard of specimens being taken at Peckham, Leytonstone, and numbers of places round, and it seemed to have a partiality for old gardens. He had no doubt whatever it would be found in this neighbourhood. As to introducing alien species into this locality, he wished to protest against it as likely to give great trouble to future conchologists. In Botany it was considered a distinctly immoral practice. He hoped Mr. McKean would not attempt it.

Further remarks were made by Messrs. F. Thompson, C. C. Morland, the Rev. H. F. Blackett, and the President. At the conclusion a hearty vote of thanks was accorded to Mr. McKean for his valuable paper.

The following is a list of the objects exhibited;—By Mr. McKean, a large collection of land and freshwater shells entirely from the Surrey district including many rare and beautiful forms; by Mr. Low-Sergeant, a collection of British land and freshwater shells to illustrate Mr. McKean's paper; by Mr. Edward Lovett, under a microscope, leaf of *drosera rotundifolia* (sundew, mounted naturally), series of *helix pomatia*, from Caterham, and a rare boring crustacean, *callianassa subterranea;* by the Rev. H. F. Blackett, land shells and plants from Mentone; by Mr. E. B. Sturge, large echinoderm from off Scarborough; by the Rev. George Bailey, fine fossil vertebra of whale, Red Crag, Oxenford; by Mr. Klaassen, interesting series of rocks from the Cornwall district, including specimens of kaolin or china-clay; by Mr. Collyer, case of natural history specimens from Australia.

Ordinary Meeting, 11*th October*, 1882.

Philip Crowley, Esq., F.Z.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The following gentleman was balloted for and duly elected a member of the Club:—George Henry Leresche.

The President read a letter which he had received from Mrs. Flower, thanking the Club for its expression of sympathy with her in her late bereavement.

The President announced also that "Studies in Microscopical Science," Nos. 1 to 22, were now in the library.

The following donations were announced:—Address of the President of the British Association, 1882, presented by Mr.

Cushing; "Science Gossip" for October, from the publishers; Proceedings of the Berwickshire Naturalists' Club, 1881; Notes and Observations on British Stalk-eyed Crustacea, presented by Mr. Lovett.

The PRESIDENT alluded to the loss which the Club had sustained in the death, during the recess, of Mr. W. Reeves Cooper, an old and valued member of the Club.

The PRESIDENT then introduced to the meeting Mr. Seebohm, who delivered a most interesting lecture entitled "Ornithological Research in the Valley of the River Yen-e-say" (see Transactions, article 33).

Upon the conclusion of the lecture, which did not raise any discussion, the meeting unanimously passed a most cordial vote of thanks to Mr. Seebohm.

The following objects were exhibited: By Mr. Low-Sergeant, under his microscope, *Plumatella repens* (alive), also nodules of iron pyrites from Oxted tunnel; by Mr. Edward Lovett, under his microscope, mature ova of one of the sea slugs (*doris tuberculata*), also specimens of large *patella*, striped varieties of *mytillus edulis*, and finely marked varieties of *helix nemoralis*, from the Northumberland coast and the Farne Islands; by Mr. Warner, under his microscope, human anatomical injections.

Ordinary Meeting, 8th November, 1882.

PHILIP CROWLEY, Esq., F.Z.S., President, in the Chair.

The minutes of the meeting held on the 11th October were read and signed.

The following donations were announced:— "Science Gossip" for November, and List of Foreign Correspondents of the Smithsonian Institution, to January, 1882.

The PRESIDENT drew attention to the small number of microscopes and objects which were exhibited at the ordinary meetings of the Club, and pointed to the desirability and importance of increasing the number. He also reminded members to send in to the Secretary the forms of entry for the Soirée.

Mr. EDWARD BIDWELL then contributed some "Notes on the Ornithology of the Farne Islands" (see Transactions, article 34).

He was followed by Mr. EDWARD LOVETT, who gave an account of the geology and marine fauna of the Islands.

Mr. LOVETT said that his visit to the Farne Islands having only occupied a few days it would be presumptuous in him to attempt to read a paper on them, but he would endeavour to show what might be done, even in a short holiday by any of our members, in adding to his collections and knowledge, and especially so, if he left the beaten track and used a little discretion in the selection of the locality—favourable and unfavouable being found in close proximity.

He was agreeably surprised to find that his idea that the cold unfriendly north was sure to be disappointing in its Marine Fauna, was entirely erroneous, for he found that at the Farne Islands, Crustacea, Echinoderms, Molluscs, and other Marine forms, not only attained to sizes quite equal to those from the Channel Islands, with which he was most familiar, but in colour and markings also they were by no means inferior. In fact, of some Molluscs the largest known specimens have been obtained from the Northumberland coast.

Mr. LOVETT then described the character of the Islands, their names and number, stating that they consisted of a group of seventeen rocky islets composed of Basalt, situate from 2 to 5 miles east by south of Bamborough.

Proceeding to describe the Marine Fauna, he said, we landed upon nine of the outer rocks and in the small space of time at my command I collected a few examples of the local Fauna. *Patella vulgata* and *Patella athletica*, though common Molluscs, were of considerable interest owing to their abnormal size, and it was worthy of notice that those which were exposed to the full fury of the sea were of an elevated form, whilst those fixed on the sides of gullies, up which the water rushed with great force, were very much depressed. *Purpura lapillus* was also of fine dimensions, and *Halcion pellucida* was abundant on the fronds of the *Laminaria*. We also obtained several specimens of a nudibranch mollusc as well as *Pecten varius*, *Anomia ephippium*, *Saxicava rugosa*, *Modiola barbata*, *Chiton discrepans*, *Acmæa testudinalis*, *&c.* Of the Echinodermata, we found *Ophiocoma rosula*, and some remarkably fine specimens of *Echinus sphæra* (specimens of the latter are on the table). At one point we sailed over a bit of sheltered water about 30 feet deep, where we could see the bottom clearly, and there, among gigantic Laminaria, their broad fronds waving in the current, were numbers of this fine *Echinoderm*, the delicate pink of their densely set spines and pedicellaria contrasting with the bronze-like tints of the stems of the Laminaria. Upon the latter were dotted the fragile *Halcion pellucida* and numbers of *Doris* were crawling over the fronds.

Among the Crustacea we saw the edible crab *Cancer pagurus*, the shore crab *Carcinus mænas*, the long-horned crab *Porcellana longicornis*, and the hermit *Pagurus bernhardus*.

Carcinus mænas and *Porcellana longicornis* were beautifully marked specimens, and no doubt the locality was an extremely favourable one, and many other species might have been observed had time and tide permitted. I noted that *Pagurus bernhardus* here was inhabiting the dead shells of *Fusus islandicus* and *Buccinum undatum.*

I may mention that one of the largest British star fishes is taken by the trawlers off this part of Northumberland; it is *Goniaster equestris* and so far as I am aware it does not occur much farther south than this. Here is a striking instance of the favourable surroundings of a Northern locality being more conducive to the existence of a fine form, than a Southern, and, as we might think, a more congenial and life-supporting one.

I will now make a few remarks on the other specimens exhibited and which are from parts of the main coast adjacent to the Farne Islands.

North Sunderland, a small fishing hamlet, from which the islands are visited, is built on rocks of the Carboniferous series with large dykes of Basalt in the district, on one of which Bamborough Castle stands. To the North the coast line is composed of dunes, or hills of blown sand. From these sand hills I obtained some very decided varieties of *Helix nemoralis*, the most beautiful being one of a bright warm brown tint, devoid of bands; owing to the abrading nature of sand in motion, many of the shells in this locality were injured in the epidermis. Some beautiful forms of *Helix virgata* were also found here, having the bands transparent, or nearly so.

A curious fact which I noticed, and one that I have observed before, was, that owing to the scarcity of stones on these sand hills the birds had made use of the few there were as regular "slaughter-houses," for around every suitable stone were heaps of the smashed shells of the snails already mentioned, as well as of *H. aspersa.*

On the coast south of North Sunderland the sand hills give way to more level expanses which flank a small estuary where many illustrations of physical geology could be observed in the miniature deltas, shoals, bars, and underminings of the surface formed by the little stream.

On this sandy "link" *Helix nemoralis* was very common, but the varieties were decidedly different from those which I obtained on the sand hills to the northward.

I now pass on to the district at the mouth of the river Tyne, from which the striated blocks of morainic fragments of rocks exhibited on the table were procured.

The Boulder or Glacial Clay is very generally distributed in Northumberland and Durham, covering the palæozoic rocks of these counties to a considerable thickness.

This deposit consists as usual of a brownish tenacious unstratified clay containing immense numbers of fragments of rocks amongst which are limestones grooved, scratched, and polished by the ice, and a most noticeable fact is that a large number of remarkably small bits exhibit this rounding, scratching, and grooving in a most marked form, proving how very close this enormous ice cap must have pressed upon the rocks over which it passed.

Another interesting feature in connection with this particular section of Boulder Clay is that its upper portion appears to belong either to a reconstructed condition of the lower portion, or, as is considered by many local geologists, to be a continuation of the Scandinavian drift. It contains flints scattered sparingly through it, as well as pebbles of white quartz and fragments of porphyry and sandstone.

The flints are said to exactly resemble some obtained from a similar deposit at Hamburg.

I have also exhibited upon the table a small series of interesting forms of the Magnesian limestone, part of which I obtained at Marsden, but others have since been sent me which came from quarries at Fulwell Hill; the series of specimens show the mammillated, radiate, spherular, columnar, coral-like, brecciated structure of this series of rocks. At Marsden the breccia is seen to advantage, immense chasms in the rock having become entirely filled up with it. These dykes are supposed to have been caused by volcanic disturbance at some geological period, and the broken and splintered fragments of the surface, falling or being washed in, were cemented together in the solid breccia as we see them now.

In conclusion, I can only say that the coasts of Northumberland and Durham are sure to well repay the visit of anyone who is interested in either geology, botany, ornithology, conchology, marine zoology, entomology, or that which embraces all, microscopy.

Mr. Henry T. Mennell followed with some additional remarks on the Islands.

He said that Mr. Lovett's testimony to the advantages of the Northern shores and climate was very gratifying to him as a North-countryman. Those who like himself hailed from the North were well aware of the fact, but they were also well aware how long a time it took a South countryman to learn it. He would only add to what Mr. Lovett had said, a few further remarks on the geology of the district.

Its most interesting geological feature was the great basaltic dyke which ran across the whole of the counties of Northumberland and Durham, and to which these Farne Islands owed their existence. Near the coast at Kyloe Crags it formed very fine cliffs 100 feet high. All these islands were outlyers of this great mass of basalt. To the South-West, in the heart of Northumberland, the scenery along the dyke was most beautiful and picturesque, high precipitous crags with little lakes nestling at their base, and crowned along part of their course by the old Roman wall, in many places very perfect.

At Bamborough the mass of basalt was about 40 or 50 feet thick. At its opposite extremity where it crosses the head of the Tees, between Durham and Yorkshire, it attained a thickness of about 200 feet. The basaltic dyke was in the whole of its course thrust up through the mountain limestone. Its date appeared to be between the end of the carboniferous period and the beginning of the new red sandstone period, as the latter rocks are never disturbed by it. In addition to this great dyke were others much smaller and more local, and running more or less nearly at right angles to the great dyke; these mostly occurred in the coal measures of Northumberland and Durham, and produced the disturbances and faults so well known in the working of collieries.

Wherever the basalt is thrust up through other strata it produces remarkable effects upon them, entirely altering their character. Hence its effect upon the flora of a district is considerable.

In Northumberland, at Kyloe Crags and elsewhere, several rare and interesting plants are only found, *Asplenium septentrionale*, *Allium schœnoprasum*, *Convallaria verticillatum*, amongst others. But it is in Teesdale that its action is most marked, the many very rare and interesting plants found there, growing almost exclusively on the "Sugar" limestone—which is Mountain Limestone metamorphosed by heat, and converted into a friable white granular stone, whence its name.

On this formation, three plants, found nowhere else in Britain, grow, viz.: *Viola arenaria*, *Alsine uliginosa*, *Polygala uliginosa*, besides some others of extreme rarity, *e.g.* *Helianthemum vineale* and *Kobresia caricina*.

It is worthy of note also, that the localities for these plants are excessively limited in area; they are confined each to one spot, and in several cases these spots are inhabited by only one of the plants.

Reverting to the Farne Islands and the neighbouring mainland, Mr. Mennell referred to their interesting historical associations. Bamborough Castle, built by Ida, king of Northumberland, around which many memories cling, from that early date down to near our own times. Dunstanborough Castle, remarkable for its wild and picturesque situation, which forms one of the finest drawings in Turner's "Liber Studiorum."

But it is with legends and stories about Saint Cuthbert that the whole region abounds. The Eider Duck is known as S. Cuthbert's duck. The joints of the fossil *encrinites* which abound along the coast are S. Cuthbert's beads; and it was to the little cell on the Farnes that he so often escaped from the cares and splendours of his priory of Lindisfarne and of his Bishopric, and where at last he died.

The papers were illustrated by some interesting specimens from the locality, together with charts and photographs.

After a few remarks from Mr. W. F. Stanley and the Rev. E. A. Eaton (a visitor), the meeting terminated with a hearty vote of thanks to the three gentlemen who read the papers.

The following objects were exhibited:—By the President, a series of seabirds' eggs from the Farne Islands, also photographs of the Isles; by Mr. Bidwell, stuffed specimens of cormorants, guillemots, gulls, &c., stuffed specimens of eider duck, &c., also the young of puffins and other birds from the Farne Islands; by Mr. Mennell, specimens of mountain limestone, normal and metamorphosed by proximity to basaltic upthrusts, stems of encrinites (locally known as St. Cuthbert's beads), &c., from Northumberland; by Mr. Lovett, series of striated blocks from boulder clay from the mouth of the Tyne, magnesian limestone from Marsden and Fulwell Hill, and basalt from the Farne Islands, series of *patella*, *saxicava*, *pecten*, *purpura*, and other shells, and *helices*, *mytilus*, &c., from other localities, *echinus sphæra* and *goniaster equestris* from the neighbourhood of the Farne Islands, photographs and charts of the Islands and neighbourhood; by Mr. A. Warner, under his microscope, section of hoof of sheep, showing junction of horn and muscle; by Mr. McKean, under his microscope, *Lumbricus terrestris*, young, from small cavity at right angles to a worn boring 26 inches below the surface; by the Rev. George Bailey, shells from the coast of Northumberland and Durham, including *pecten danicus*; by Mr. H. M. Klaassen, crystals of gypsum from salt pans, America, stalk barnacles (*lepas*) in spirit; by Mr. Low-Sergeant, *ophiocoma neglecta* (alive), microscopic photographs of various objects; by the Rev. E. A. Eaton, drawings by Mr. A. T. Hollick, of *platyarthrus Hoffmanseggii*, the ant's nest wood louse.

Thirteenth Annual Soiree.

The 13th Annual Soirée was held on the 22nd November. The attendance was slightly larger than that of last year, viz., 139 members, 93 exhibitors (non-members), and 559 visitors; total, 791.

The excess is chiefly in the exhibitors from a distance, and is gratifying as shewing the cordial co-operation and kindly feeling of kindred clubs in the London district. No less than thirteen of these clubs lent their assistance on the occasion.

Six opticians also sent instruments, as well as fourteen gentlemen not attached to any club.

The number of microscopes was 130, ten less than last year, but as many as the visitors to the Soirée can do justice to, and leaving more space, as well for the instruments and their owners, as for the exhibitors of other collections and objects which have of late years become an increasingly important and attractive feature at these gatherings.

The conservatories of the President were again liberally drawn upon for the decoration of the platform—chrysanthemums and foliage plants being the special features of the display.

Amongst the many valuable and interesting exhibits, the first place must be given to the large and unique collection of Russian crosses, eikons, and triptychs, formed by Mr. Seebohm during the travels in Russia which form the subject of his delightful books "Siberia in Europe" and "Siberia in Asia," travels which have been further familiarised to our members by Mr. Seebohm's admirable lecture before the Club which forms part of this volume of our transactions.

Mr. Edward Bidwell exhibited a splendid series of the eggs of the Lapwing (vanellus cristatus), 252 in number.

Many of the specimens were of very great interest, not only from the marvellous variations of colour, size, and markings, which they displayed, but from the close imitations of the eggs of other species which were to be found among them.

The President (Mr. Crowley) exhibited 45 drawers of British, and 11 drawers of foreign Moths, admirably arranged.

Mr. Lovett's collection of British Stalk Eyed Crustacea (podophthalmata), the fruit of three years' work on our shores, was also of special interest, but little attention having been paid to this interesting order by previous observers. Mr. Lovett's researches in the development and life-history of these creatures form the subject of a paper contributed to our transactions.

Other exhibits were as follows:—

Entomological.—Rev. E. M. Geldart, wood bored by larvæ of Goat Moth; E. Lovett, series of insects, illustrative of their protective resemblance to other substances.

Geological.—Fossil wood from Lulworth, Rev. E. M. Geldart; head of Ichthyosaurus, Mr. Klaassen; Plant remains from the Bagshot beds, from the railway works at Park Hill, and from the oolite beds of Whitby, Mr. H. Turner.

Scientific Instruments and Appliances.—Revolving table and stand for microscope and lamp, Mr. E. H. Baldock; Rain gauge for use at sea, air meter with arrangement for keeping it turned towards the wind, Mr. E. Mawley; geological and physiological transparencies for the lantern, Messrs. How & Co.

Works of Art, &c.—Collection of antique watches and jewellery, Mr. Rymer; Japanese and other oriental carvings, &c., Mr. Foss; quaint Chinese figures carved out of the root of the tea plant, Mr. B. H. Ridge; oil paintings, by Mr. J. W. Drage, Mr. Fulcroft Fletcher, and Mr. H. D. Turner; water colour drawings, by Mr. A. W. Rich and Mr. J. Chumley.

The music was under the direction of Mr. Laughlin; the refreshments of Mr. Pusey.

The following are the Clubs, &c., contributing microscopes, viz.:—Croydon, 40; Royal, 6; Queckett, 21; South London, 13; Greenwich, 9; New Cross, 6; Tower Hill, 6; Sydenham and Forest Hill, 5; Hackney, 2: Walthamstow, 1; Entomological Society, 1; Eastbourne, 1; Holmesdale, 1; Lewisham (other exhibits); Blackheath (other exhibits); Opticians, 10; Unattached, 8. Total, 130.

Ordinary Meeting, 13th December, 1882.

PHILIP CROWLEY, Esq., F.Z.S., in the Chair.

The minutes of the meeting held on the 8th November, and of the Soirée held on the 22nd November, were read and signed.

The following gentlemen were unanimously elected members of the Club:—A. A. Campbell, Harry Fuller, Fred. Foss.

The PRESIDENT announced that the Soirée of the Lambeth Field Club and Scientific Society would be held in the St. Philip's Schools, Kennington Road, on Monday, the 1st January, 1883, and that that Society would be glad to receive the assistance of members of the Croydon Club as exhibitors.

The PRESIDENT stated that it was necessary at this meeting to appoint two members of the Club to audit the accounts for the past year, and Mr. McKean proposed Mr. A. W. Rich and Mr. Edwin Williams. This proposal having been seconded by Mr. John Berney was carried unanimously.

The PRESIDENT reminded the members that the 13th Annual Meeting of the Club would be held on Wednesday, the 10th January, and that it was necessary that the names of gentlemen nominated to serve as officers of the Club for the ensuing year should be sent in to the Secretary seven clear days before the 10th of January.

The PRESIDENT gave notice that the following proposed resolution would be submitted to the Club at the Annual Meeting, viz.:—

"That Vice-Presidents be elected, not to exceed four in number, to be chosen from past Presidents, and that they shall be *ex-officio* members of the Committee.

The following donations were announced:—"Science Gossip," from the publishers; "Société Belge de Microscopie Procès-verbal de la Séance du 26, Août, 1882"; "Annales de la Société Belge de Microscopie, 1880"; Cabinet for Slides illustrating "Microscopical Studies," presented by Mr. W. F. Stanley; Abstracts of the Transactions of the Royal Society from the beginning, presented by Mr. Topley.

The PRESIDENT then called upon the Rev. E. M. Geldart, M.A., who read a learned and interesting paper entitled "The birth of Zoological Science in the 4th century B.C.," of which the following abstract has kindly been prepared by the author:—

Zoology, as a science, dates from Aristotle, born at Stagira, in Thrace, 385 B.C. Aristotle's work was essentially that of a pioneer. As such he must be judged, and allowance made for the unavoidable deficiencies of his system. His classification in its main outlines is as follows: He begins by dividing all animals into those with blood and those without blood. The animals with blood answer to our *vertebrata*, and the bloodless to our *invertebrata*.

Animals having blood Aristotle further divides into the following groups:—

I.	Viviparous	Mammals.
II.	Ornithes	Birds.
III.	Four-footed and footless *ovipara*	Reptilia and Amphibia
IV.	Ichthyes	Fishes.

Bloodless animals are grouped by him as follows:—

V.	Malakia (Molluscs)	Cephalopoda.
VI.	Malakostraka	Crustacea (more particularly Stomopoda).
VII.	Entoma (insects)	Terrestrial Annulosa.
VIII.	Ostrakodermata	Gasteropods, Bivalves, Ascidia, Holothuria and Actinia.

Viviparous animals are further sub-divided by Aristotle as follows:—

I.	Man.	
II.	Four-hand animals	Monkeys and Apes
III.	Many-toed, fully-toothed and tailed	Carnivora, Rodents, and Insectivora.
IV.	Double-hoofed, without incision in upper jaw, and furnished with horns ...	Ruminants, except the Camel.

V.	Tusked Animals	Suidæ.
VI.	Clump-footed animals ...	Equidæ.
VII.	Ketódè	Cetacea (Dolphin, Whale, Porpoise, Seal, &c.)
VIII.	Dermoptera (skin-winged) ...	Bats.

This involves a cross-division, as the Bats are insectivorous, but the separation of the Dolphin and other cetacea from the fishes is creditable to Aristotle, considering the age in which he lived and his opportunities of observation.

Birds.

I.	Curve-clawed, or flesh-eaters sub-divided into	Birds of Prey.
	a Diurnal predaceous ...	Eagle, Hawk, Falcon, Vulture, &c.
	b Nocturnal ditto	Owls.
II.	Worm-feeders...	Tits, Wagtails, Warblers, Sparrows, Greenfinch, &c.
III.	Thistle-feeders	Finches generally.
IV.	Woodworm-feeders	Woodpeckers
V.	Pigeons and Doves	
VI.	Cloven-footed water birds ...	Marsh Birds, and a miscellaneous number as the Heron, Gull, Stork, &c.
VII.	Web-footed birds	Anseres (especially Anatidæ)
VIII.	Heavy, not-flying	Gallinaceæ, &c., *e.g.* Barndoor Fowl, Partridge, Pheasant, and Quail.

A considerable number of birds remain unclassified, *e.g.* Nightingale, Crow, Thrush, Blackbird, Swallow, and Ostrich. Others cursorily mentioned cannot be identified.

Amphibia.

I.	Four-footed ovipara with scaly plates	Saurians, Turtles, and Tortoises.
II.	Toothless ovipara with scaly plates	Snakes.
III.	Four-footed vivipara without scales	Batrachia.

This classification is rough by Aristotle's own confession, as he himself describes a viviparous snake. Sometimes the same species of snake is viviparous or oviparous according to circumstances.

Fishes.

These are roughly divided into two main groups, viz. :—

I. Selachè or Gristle-bone Fishes	Cuvier's "Chondopterygii."

These are further described as ovo-viviparous.

II. Oviparous	Acanthopterygii and Malacopterygii of Cuvier.

The Selachè or Gristle-bones are further sub-divided as follows :—

a Long-shaped or Polecat-like ...	Sharks.
b Broad-tailed	Skates and allies.

The second division is not further classified.

Cephalopods.

These are classified as follows :—

I. With large bodies, short legs, and two prehensile arms ...	Cuttle-fish, Squids, &c.
II. With small bodies, long limbs, and no prehensile arms ...	Octopus, Nautilus, &c.

Crustacea.

I. Astaki, with ten legs and long bodies	Lobsters and Crawfish.
II. Karabi...	Sea Cray-fishes (?)
III. Karides	Shrimps and Prawns, perhaps as Mr. Lovett suggests, the Sessile-eyed Crustacea.
IV. Tailless and ten-footed ...	Crabs.
V. Little Crabs "half-way between Crustacea and shell fish."	Hermit Crab.

Insects.

Here Aristotle distinguishes:

I. Coleoptera or sheathed wings	Beetles.
II. Four-winged insects with stings	Hymenoptera.
III. Diptera with stings in front ...	Blood-sucking Diptera.
IV. Psychai	Butterflies and some Moths.
V. Jumpers or Leapers	Homoptera and Orthoptera.

VI. Epizoa... ... ... Fleas, Bugs, Ticks, Lice, &c.

VII. A miscellaneous group ranging from Cynipidæ to Tineina.

VIII. Julus and Scolopendra ... Centipedes, Millipedes, Wood-lice, &c.

IX. Spiders and Scorpions.

X. Helminthes ... ... Tape Worms and Thread Worms.

MOLLUSCA.

These are grouped as follows:—

I. Without Shells, fixed ... Sponge, Sea Anemones, Sea Nettles, and Sea Acorns.

II. Without Shells, not fixed ... Sea Cucumbers, &c.

III. Tethyon, a solitary representative of the Ascidia.

IV. Star fishes.

V. Echini or Sea urchins.

VI. Shell-fish, viz.:— *a*, Univalves; *b*, Bivalves; *c*, Spirals.

Under these heads Aristotle describes or mentions some 400 species of Animals.

In addition to the classification and description of particular forms, Aristotle may also claim the credit of being the first known writer acquainted with some of the main principles of comparative physiology, *e.g.* he distinguishes the various tissues, and recognises homological relations. In regard to human anatomy, however, his knowledge is very defective. He is aware of the existence of an optic nerve, but denies any connexion between the brain and the ear; though he is acquainted with the Eustachian tube. His notions of the circulation of the blood and of the processes of digestion are of the vaguest kind, nor does he clearly distinguish between excretion and secretion. He knows the windpipe and its bifurcation, is aware that it communicates with the lungs; but has an entirely erroneous conception of the process of respiration, imagining the heart to be filled with air. He mentions the most important organs, but has no clear notion of their functions. Among Aristotle's more important errors in comparative and descriptive anatomy, are his confusion of the knee and the heel in the horse, and his statement that the lion's neck consists of a single bone and has no marrow. He describes at considerable length and with much detail the development of the chick in the egg, which he had evidently attentively watched, and particularises the germ of the embryo, the yolk, the albumen, the allantois, and the amnion, in language which is substantially correct though there are errors in detail.

Dr. Carpenter said he rose for the purpose of moving a vote of thanks to Mr. Geldart for his explicit *resumè* of Aristotle's observations and deductions. He (the speaker) was not competent to criticise these further than to remark upon the fact that Aristotle had no microscope, and none of those means of observation which belong to the present day, and therefore we should not be surprised at the many mistakes he made in his observation of the changes that took place in the development of the chick in the egg. The changes that took place in the egg were of a much more intricate character than laid down by Aristotle. They were very peculiar and very definite. It was quite true as mentioned that the first germ from which the chick appeared always did, in a short period, find its position at the surface of the egg, no matter where they placed it. But it was not correct that a portion of it was contained within the centre of the white. It was not in the centre of the white at all. That which he spoke of also as the eye was not actually the eye. The nervous system, which was of a very minute character at first, was in a somewhat different position from that in which it was placed by Aristotle. He (the speaker) could not explain in a few short words the actual process of development. It was one that was very well worthy of observation, and by the aid of the microscope they were able to trace every step of it, The way in which Mr. Geldart has brought this matter before the notice of the society might perhaps lead some of the younger members to take the subject of chick development in hand. He (Dr. Carpenter) thanked Mr. Geldart for his very capital statement with regard to Aristotle. At the same time there were classifications older than Aristotle's. In reading the Book of Job he had often wondered at the knowledge that was evidently possessed by the writer with regard to natural history. There were some beautiful references there which indicated a knowledge of things, and an acquaintance with subjects which had really only recently become popularised.

Mr. Topley said he would second the vote of thanks. It was simply amazing, he considered, to note the great amount of knowledge which Aristotle had of the facts at that early period. It was almost impossible to conceive that he was simply a pioneer. He must have drawn a great deal of knowledge from sources not now known. The great point was the facts he gave, and not so much the deductions from those facts. There was one thing of very great importance, and that was the way in which Aristotle collected facts. For example, he seems to have stated as a fact that animals died as the tide was going out. He did not know whether Mr. Geldart had met with that statement. Pliny examined it and said it was true of men, but he did not think it was true of animals. That belief had survived to the present time. In the early part of the last century, a committee was appointed to inquire into it in France, and the committee thought there was not much truth in it. It was still believed, however, by fishermen and others on the English coast. Dickens told them a little about it in "David Copperfield." At Hartlepool the belief was very strong. There were two tombstones at Hartlepool on which it was said that the persons died as the tide was going out. A lady had told him that she used to visit a good deal amongst the poorer classes of Hartlepool, and she had heard from them of people dying at the fall of the tide. Remembering that the Mediterranean was not a tidal sea, Aristotle could hardly have got this idea from observation, but had probably heard it from travellers who had been on the coasts of Western Europe and Asia, where the tides were stronger. There was also a belief on the English coast that people could not properly be born until the tide rose.

Dr. CARPENTER said he might observe, with regard to that point concerning the tide, that, when attached many years ago to St. Thomas's Hospital, he kept a record of the moments when patients died, and the moments when some 860 children were born, and found the births and deaths ran pretty equally throughout all hours of the day and night.

The Rev. E. M. GELDART said with reference to what Mr. Topley said about the tide, it must be borne in mind that a great number of writings were attributed to Aristotle that he never wrote. Even in the book before him there was no doubt that part of the 7th and the whole of the 10th books were spurious. He could not find in the note books any reference to the tide; and indeed the Greeks originally had no word for tide, because there was no tide in the Mediterranean; but they invented a word for it when it became known to them.

The following is a list of the objects which were exhibited:— By the Rev. E. M. Geldart (to illustrate his paper), specimens of Athenian Lepidoptera; by Mr. E. Lovett (to illustrate the paper), specimens of Crustacea and Mollusca; by Mr. J. E. Syms (under his microscope), membrane from human eye; by Mr. W. J. Nation, Natural Cloves on the stalk, Vegetable Ivory, and fossil gum containing insects; by Mr. J. S. Johnson, fine specimens of Chalcedony, embryo of abnormal pig, and (under his microscope) section of equisetum: by Mr. W. Field, specimens of woody Fungus from Jerusalem; by Mr. Low-Sargeant (under the microscope, 1½ object), molecular movement of colour particles in water; by Mr. W. F. Stanley, Hardy's Compressorium; by Mr. A. Warner (under his microscope), Head of Tipula, showing eyes, &c.; by Mr. N. Waterall, old portrait and lock of hair of Jeremy Bentham, also some examples of ancient literature.

Thirteenth Annual Meeting, 10th January, 1883.

PHILIP CROWLEY, Esq., F.Z.S., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were ballotted for and duly elected members :—Messrs. Charles W. Hancock, Charles E. Howse, Gustav Küster, Hugh David Sandeman, and Thomas Josiah Witt.

The following resolution was moved by Mr. MCKEAN, seconded by Mr. WATERALL, and carried :—"That vice-presidents be elected, not exceeding four in number, and chosen from past presidents of the Society, and that they be *ex-officio* members of the Committee."

The Report and Balance Sheet of the Committee for 1882 were then read by the Hon. Secretary :—

REPORT.

"Your Committee have the pleasure of submitting to you their thirteenth Annual Report.

During the past year the Club has been augmented by 28 new members, whilst 16 have withdrawn, and your Committee regret to have to announce that Mr. Joseph Page, Mr. Frith, Mr. John Moore, Mr. William Reeves Cooper, and Mr. John Flower have died.

Mr. Reeves Cooper was one of the original members of the Club, and for several years held office as a member of the Committee.

In the death of Mr. John Flower the Club lost one of its most valued members. He was for two years President of the Club, and at the time of his death he held the post of Treasurer. For a considerable time before he died he had been very actively engaged in working out the geology of the new railway cutting at Park Hill.

The Club at present consists of 263 ordinary members, four honorary members, and one associate.

The following papers have been read during the year,—

February 15th.—Mr. JOHN FLOWER, "Observations upon the Geology of Croydon as illustrated by the Railway Cutting at Park Hill."

March 15th.—Mr. EDWARD LOVETT, "The Embryology of the Podophthalma, or Stalk-eyed Crustacea."

April 12th.—Mr. HENRY E. DRESSER, "Species and varieties in Birds."

May 10th.—Mr. W. T. SUFFOLK, "Abbe's diffraction experiments, and their bearing on Microscopical Vision." Mr. HENRY TURNER, "Notes upon some Vegetable Remains found in the Railway Cutting at Park Hill."

September 13th.—Mr. KENNETH MCKEAN, "The Mollusca of the Club District."

October 11th.—Mr. HENRY SEEBOHM, "Ornithological Research in the Valley of the Yen-e-sei.

November 8th.—Mr. EDWARD BIDWELL, "Notes on the Ornithology of the Farne Islands." Mr. H. T. MENNELL and Mr. EDWARD LOVETT, "Notes on the Geology, Fauna, and Flora of the Farne Islands."

December 13th.—The Rev. E. Martin Geldart, M.A., "The Birth of Zoological Science in the Fourth Century B.C."

On Saturday afternoon, the 4th of March, a party, consisting of members of the Club and friends, numbering in all about 30, paid a second visit to Mr. Horniman's Museum at Forest Hill.

In response to an invitation from the Holmesdale Natural History Club (Reigate), some of the members of this Club joined in an excursion to the Railway Cutting at Park Hill. Under the guidance of the late Mr. Flower, the members examined the strata there exposed.

By the courteous permission of Mr. J. Firbank, this Club on the 22nd July, conducted by Professor John Morris and Mr. H. M. Klaassen, in conjunction with the Geologists' Association of London, inspected the strata exposed at the Park Hill Railway Cutting.

In consequence of the meetings of some other Scientific Societies being held upon the third Wednesday in the month, it was thought advisable that the meetings of this Club should be held upon the second Wednesday in the month, and not upon the third Wednesday. The Club accordingly on the 15th March last passed a resolution changing the day of meeting from the third to the second Wednesday.

By resolutions passed on the 21st December, 1881, the Club undertook, in conjunction with the Literary and Scientific Institution and the School of Art, to hold a Bazaar, the proceeds of which were to be equally divided between the Institution, the School of Art, and this Club.

Your Committee have now to report that the Bazaar was held at the Public Hall, on the 8th, 10th, and 11th July last. They are glad to be able to state that it was in every way a success, and that it resulted in a profit of £779 17s. 8d. £212 7s. 2d. will form the share belonging to this Club, and it will be applied in providing cases and other necessary appliances for the collections of objects of Natural History to be formed by the Club, to illustrate and facilitate the study of the Natural History and Geology of the District.

The thirteenth Annual Soirée was held at the Public Hall on Wednesday, the 22nd November, when members of the undermentioned Clubs and Societies rendered valuable assistance as exhibitors :—

The Royal Microscopical Society; Quekett Microscopical Club; South London Microscopical Club; Greenwich Microscopical and Natural History Club; New Cross Microscopical and Natural History Society; Tower Hill Microscopical Club; Sydenham and Forest Hill Microscopical and Natural History Club; Hackney Microscopical and Natural History Society; Walthamstow Microscopical and Natural History Society; the Entomological Society of London; Eastbourne Natural History Society; Holmesdale Natural History Club; Lewisham and Blackheath Scientific Association. Private exhibitors and opticians also did much towards making the Soirée a success.

One hundred and thirty microscopes were exhibited. The attendance was rather larger than usual, viz. :—139 members; 93 exhibitors, not members; 559 visitors; total 791. A fuller account of the Soirée will appear in the proceedings of the Club.

The following is a list of the donations received during the year:— The Journals of the Royal Microscopical Society, from the Society;

the Journals of the Quekett Microscopical Club, from that Club; the Proceedings of the Belgian Microscopical Society, from that Society; Science Gossip, from the Publishers; Notes on the British Stalk-eyed Crustacea, from Mr. Lovett; the Transactions of the Norwich and Norfolk Naturalists' Society, from that Society; Report of the Migration of Birds in the Spring and Autumn of 1880, from Mr. Sturge; the Weather of 1881 as observed in the neighbourhood of London, from E. Mawley; the Rosarian's Year Book, from the Author; Third Annual Report of the Lewisham and Blackheath Scientific Association; Fourth Annual Report of the Erith and Belvedere Natural History and Scientific Society; the Journal of Science, from the Publishers; Address of the President of the British Association, 1882, from Mr. Cushing; Proceedings of the Berwickshire Naturalists' Club; List of Foreign Correspondents of the Smithsonian Institution to January, 1882; Abstracts of the Transactions of the Royal Society, from the beginning (bound), from Mr. Topley; Cabinet for Slides illustrating "Microscopical Studies," from Mr. W. F. Stanley.

The Library has received a most welcome addition through the kindness of Dr. Carpenter, who, in May last placed 96 valuable books of reference with the Committee on loan. Mr. Mennell has also lent to the Club, for purposes of reference, 28 volumes. A list of these books will be given in the proceedings. In addition to the loan collections the library has been augmented by 17 volumes of the Abstracts of the Proceedings of the Royal Society from the beginning, presented by Mr. Topley.

There has been no increased demand among members for books on loan.

The thanks of the Club are due to Mr. Mennell for editing the Proceedings and Transactions of the Club for 1881, and to Mr. McKean for editing the Report for 1872. By the publication of this latter report the gap which existed in the Reports of the Club has been filled up.

The attendance at the meetings of the Club has been good.

Your Committee have the pleasure to submit the following short reports of the work of the different Sub-Committees during the past year.

Zoological Committee.

The Entomological section of the Zoological sub-committee have to report that their list of local *Lepidoptera* is now being compared with the newly-issued Doubleday catalogue, and is nearly completed, and that it will be laid before the Club at an early date.

The committee are greatly desirous of enlisting workers in the departments of *Coleoptera*, *Diptera*, and *Hymenoptera*, which have, up to the present received very little attention. The winter of 1881-82 was excessively mild, and the summer which followed was the most barren known for many years to insect collectors. It may be worth mentioning, as being perhaps not generally known, that cold dry winters are invariably followed by seasons of abundant insect life, and, conversely, warm winters are succeeded by a paucity of insect life. The reasons are probably not far to seek, for in mild winters the ground remains soft, and the grubs and pupæ are readily obtained by birds, while the mildness itself is fatal to most species in an immature condition.

The mollusca of the club district have received a fair share of attention, and a list has already been laid before the members. One species of snail *(Zonites glaber)* new to Surrey has been recorded within the last twelve months.

Report of the Meteorological Committee for 1882.

The Meteorological Committee has not undertaken any work in a collective capacity during the past year, but is happy to report that satisfactory progress continues to be made both in and around Croydon in recording for future use a large number of valuable observations.

In addition to the meteorological stations previously existing, our president, Mr. Crowley, has recently established a station, which he has equipped with a set of standard thermometers and a new rain-guage, in an excellent situation in the grounds of Waddon House. The observations here, as well as of Mr. Rostrow at Beddington Lane and Mr. Stanley at South Norwood, will afford a means of determining the pecularities of the climate of the lower grounds near Croydon ; and by the aid of Mr. Mawley's at Addiscombe, Mr. Latham's on Park Hill, and Mr. Corden's in Katharine Street, there will be no difficulty in ascertaining those of the town of Croydon itself. There is, however, a great lack of observers south of the town, and the committee express a hope that some members of the club residing at Caterham, or anywhere on the high ground east or west of it, will supply this deficiency by establishing suitable meteorological stations where they are at the present time so much needed. As an instance of the contrast that might at times be expected the committee may mention that on Sunday, the 10th of December last, when Croydon was all day enveloped in a thick fog and rime, the weather was beautifully fine, and the sun shone brilliantly on the hills to the south of the town.

Without anticipating subsequent communications it may be remarked that the most noteworthy features in the last twelve months were first the extraordinarily high reading attained by the barometer on the morning of the 18th of January, namely, 30·98 inches at sea-level ; this being a higher pressure than any recorded in this part of England since trustworthy instruments were made—considerably over one hundred years ; and secondly, a severe south-westerly gale on the 29th of April. This gale excited considerable interest at the time not only on account of the great destruction to the foliage of trees and the blossoms of fruit trees, but also of the presence of sea spray in sufficient quantities to produce at one time during the afternoon quite a thick haze.

Report of the Geological Sub-Committee for the year 1882.

The Geological sub-committee of the Croydon Microscopical and Natural History Club in handing its first report has the pleasure to state that the Committee, which originally consisted of the following members: Alfred Carpenter, M.D., J.P., James Chisholm, H. M. Klaassen, F.G.S., Wm. Topley, F.G.S., H. Turner, and the officers of the Club, has been strengthened by the addition of a new member, Thos. Walker, C.E. As the committee intends to present the Club at some future time with a geological map of Croydon and its neighbourhood, it is evident the Club could not have added a more efficient member to our committee to accomplish this work, for no one can be more intimately acquainted with the geological details of Croydon and its neighbourhood than the engineer and surveyor of the district.

The sub-committee has sustained a great loss in the death of Mr. John Flower, M.A., F.R.S., treasurer of the Club, who took much interest in the geology of the district, and especially in the progress of the new railway cutting, hereafter mentioned.

At the meeting of the various sub-committees, held in the Club-rooms on 18th October, 1882, Mr. H. T. Mennell presiding, it was considered desirable that the various sub-committees should appoint an hon. sec. to their respective sections. This was agreed to, and Mr. H. M. Klaassen, F.G.S., was asked to be the first secretary to the Geological committee, which position he has accepted.

The Club is aware that this sub-committee has important work on hand, and work which will engage their attention for some time to come, namely, collecting the geological strata of the beds in the cuttings and tunnels of the new railway between Coombe Road and the Upper Addiscombe Road. Though railway cuttings abound in the neighbourhood of Croydon, a glance at a geological map will show that none of them, in geological interest, equal those which are now being made in the Croydon Section of the Woodside, Oxted, and East Grinstead Railway. A greater length of the Woolwich and Reading Beds will be cut through here than can be seen in any part of the Kingdom. We watch the progress of the railway carefully, and keep pace with the work on the line. Our work is daily labour, healthy and pleasant it is, and we ill deserve the pity which friends so readily bestow upon us after emerging from clay tunnels. The lavender-coloured band of the Woolwich and Reading Beds in the south cuttings dips into the tunnel; its direction has to be traced, and we mean to follow it.

The Hon. Sec. has devoted much attention to the excavations, visiting them at frequent intervals. The information thus obtained is valuable from its bearing upon certain questions of much interest regarding the classification of the Lower Tertiaries. Full details will be laid before the Club at a future time.

Signed, Alfred Carpenter.
James Chisholm.
William Topley.
H. Turner.
Thos. Walker.
H. M. Klaassen, *Hon. Sec.*

The President then moved the adoption of the reports. He remarked that they were so full that but little was left for him to speak about. He congratulated the members on the favourable nature of the reports, and on the increase of the membership. Including the five just elected there had been 17 new members received during the year. Of the five members, to whose death allusion was made in the report, Mr. W. Reeves Cooper was one of the earliest members of the club, and for some years was an active member of the committee, taking great interest in the club's welfare. Of Mr. Flower, one of the earliest members, and also one of their ablest supporters, he found it very difficult to speak. In him he (the president) felt that he had not only individually lost a genial and true friend, but that the club had lost one of its mainstays, and a man whose equal for energy, knowledge, and perseverance, they did not often find. Although much engaged in business, he devoted the whole of his leisure time to the study of some branch of natural history, and was until a very short period prior to his death, actively engaged in working up the various particulars of interest connected with the new railway cutting at Park Hill. To his research the club, and also the scientific world at large, were indebted for the discovery of the interesting structure of the wing of the gannet, which, as he so clearly explained, was attached to the body by a sliding joint, to break the force of the blow it would otherwise receive when diving for its prey from such a tremendous height. To him also the club were indebted for the interesting facts brought before them concerning the interbreeding of the common pheasant with the common fowl at Mr. Edward Wormald's, and they also had the honour, through him, of being the first to record the nesting of the red-breasted flycatcher in England. But it was unnecessary to recapitulate all that Mr. Flower had done; all the members knew and appreciated him. Nine of the papers read had been by members, viz.:—Messrs. John Flower, H. E. Dresser, E. Lovett, Henry Turner, Kenneth McKean, E. Bidwell, Henry Tuke Mennell, and the Rev. E. M. Geldart. They had also to thank Messrs. W. T. Suffolk and Henry Seebohm for their very interesting papers. The excursions had been as well attended as usual. On two occasions the members had to thank Mr. Horniman for a visit to his museum at Forest Hill, when they much enjoyed looking over his fine collection of foreign lepidoptera, ancient books, china, and other interesting articles. As announced by the committee, there was a sum of about £200 in hand, the proceeds of the bazaar held in July, and this it was proposed to devote to furnishing cases for the museum, which it was hoped would soon be established, so that they could have a place where local objects of interest might be deposited. The reports of the sub-committees were of special interest, as showing the work done by each. The occasional meetings had not been quite so well attended, but arrangements were being made by which one or two members would attend to assist any members anxious to learn how to use the microscope, or to explain any difficulties which might arise. The library had been considerably enlarged by loans and gifts of works of reference, and now contained many really valuable works. The annual soirée was, he thought, even a greater success than its predecessors, as there was no less than 791 visitors. A hundred and thirty microscopes were used, showing many objects of great interest. Of special interest was the large and unique collection of sacred pictures, brasses, and crosses exhibited by Mr. Henry Seebohm, and obtained by him in Siberia. In fact the soirée was now second to none, and special value might be said to attach to it from the fact that several of the neighbouring clubs had found it necessary to discontinue their annual gatherings in consequence of the expense. Members of other clubs had again rendered them much assistance, and the members of the Croydon club had reciprocated by assisting other societies. The balance sheet showed a balance of £30 4s. as against £56 19s. the last year, or a little over £26 to the bad. This at first sight looked anything but satisfactory, but when looked into, he thought they would be satisfied that things were not so bad as they appeared at first sight. In the first place there was some £12 due from members who had forgotten up to the present to pay their subscriptions for 1882. He would remind these and all the members that the subscriptions for 1883 were now due, and that the treasurer would be very happy to receive them. Something like £19 had been laid out in furniture for the library, so that taking all things into consideration, they stood in a better position now than a year ago.

Mr. Morland seconded the motion, which was carried.

The following officers having been nominated in accordance with the rule were, on the motion of Mr. Linney, seconded by Dr. Thompson, unanimously elected. Mr. John Berney, F.M.S., president; Messrs. A. Carpenter, M.D., P. Crowley, F.Z.S., and Henry Lee, F.L.S., F.G.S., vice-presidents; Mr. Henry T. Mennell, treasurer; Mr. C. Price Turner, secretary; and Messrs. T. Cushing, F.R.A.S., J. G. Johnson, M.R.C.P., E. Lovett, Kenneth McKean, Low-Sarjeant, H. J. Strong, M.D., Henry Turner, William Topley, F.G.S., and E. Straker, as members of the committee.

Mr. Crowley, in vacating the presidential chair, expressed a hope that the club had not suffered in any way from his holding office. When he accepted office, he did so with a feeling that he was hardly competent, but that he would do his best. He hoped they would forgive him for any neglect he had shown, and he most cordially thanked the members for the way in which they had supported him.

Dr. Thompson moved a vote of thanks to Mr. Crowley for the efficient way in which he had conducted the business of the club during the last two years. The office was no sinecure, there being a great deal of work in the way of looking up members to read papers. Their president who was just going out of office had brought before them many matters of great interest, and the hearty thanks of the club were really due to him.

The vote of thanks was carried with applause.

Mr. Crowley responded, and moved a vote of thanks to the secretary for the admirable way in which he had discharged his very heavy duties.

This was carried with enthusiasm, and Mr. Turner having replied, the meeting terminated.

BALANCE SHEET FOR THE YEAR ENDING 31st DECEMBER, 1882.

RECEIPTS.	£	s.	d.
To Balance in hand, 1st January	56	19	1
,, Subscriptions	119	0	0
,, Sale of Lectures	0	4	0
,, Sale of Soirée Tickets	30	5	0
	£206	8	1
To Balance brought down	30	4	0

EXPENDITURE.	£	s.	d.	£	s.	d.
By hire of Rooms				15	12	6
,, Book-case for Library and Box for Books				19	2	0
,, Postages				6	7	6
,, Books and Binding				1	11	10
,, Printing Transactions, 1872 & 1881 (also delivery)				41	19	3
,, Printing				7	15	6
,, Stationery				1	5	6
,, Advertisements				9	16	8
,, Fire Assurance				0	7	6
,, Collecting Subscriptions				5	19	0
,, Attendance, Lamps, Oil, &c.				1	7	2
,, Gratuities				1	8	6
,, Sundries				1	9	3
SOIREE ACCOUNT.	£	s.	d.			
,, Hire of Rooms	7	14	6			
,, Decorating Platform (1881 and 1882)	3	0	0			
,, Tables	11	10	0			
,, Music	6	0	0			
,, Police and Attendants	0	16	0			
,, Refreshments	16	19	8			
,, Printing and Stationery	4	10	0			
,, Advertising	3	19	10			
,, Hire of Lamps	2	14	0			
,, Postages	3	12	6			
,, Sundries	1	5	5—	62	1	11
Balance forward				30	4	0
				£206	8	1

PHILIP CROWLEY, TREASURER, *pro tem.*

We, the undersigned having examined the above Accounts, and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and the Bankers' Pass-book.

EDWIN WILLIAMS,
ALFRED W. RICH, } AUDITORS,

5th January, 1883.

CATALOGUE OF BOOKS FOR REFERENCE LENT BY DR. CARPENTER.

Publications of the Ray Society.

VOL.					
1844	Memorials of Ray				
1845	Alternations of Generations.—*Steenstrup*				
1845	Reports and Papers on Botany				
N.D.	Reports and Progress Zoology and Botany				
1846	Botanical Geography.—*Meyen*				
1847	Reports on Zoology				
1847	Elements of Physiophilosophy.—*Oken*				
1848	Correspondence of John Ray				
1849	Reports and Papers on Botany				
1849	Nat. Hist. Brit. Entomostraca.—*Baird*				
1851	Angiocarpous Lichens.—*Leighton*				
1851	Monograph of the Cirrepedia.—*Darwin*				
1848	Bibliographia	Zoologiæ.—	*Agassiz*	A to B	
1850	,,	,,	,,	C to F	
1852	,,	,,	,,	G to M	
1854	,,	,,	,,	N to Z	
1853	Botanical and Physiological Memoirs				
1853	Monograph of the Cirrepedia and Balanidæ				
1863	Higher Cryptogamia.—*Hofmeister*				
1865	British Hemiptera Heteroptera.—*Douglas & Scott*				
1864	Monograph	British	Spongiadæ.—	*Bowerbank*	
1866	,,	,,	,,	,,	
1866	Miscellaneous	Botanical	Works of	Robert Brown	
1867	,,	,,	,,	,,	
1869	Vegetable Teratology.—*Masters*				
1873	Monograph of Collembola and Thysanura.—*Lubbock*				
1874	Monograph British Spongiadæ, Vol. III.—*Bowerbank*				
1878	Monograph	British	Copepoda.—	*Brady*	
1880	,,	,,	,,	,,	
1880	,,	,,	,,	,,	

FOLIOS.

Organisation of Trilobites.—*Burmeister*
Nudebranchiate Mollusca.—*Alder & Hancock*, 7 vols.
Recent Memoirs of the Cetacea
Introduction to the Study of Foraminifera.—*Carpenter*
British naked-eyed Medusæ.—*Ed. Forbes*
Oceanic Hydrozoa.—*Huxley*
Recent Foraminifera.—*Williamson*
Monograph of the British Annelids, 2 vols.—*McIntosh*
Spiders of Great Britain and Ireland, 2 vols.—*Blackwall*
Reptiles of British India.—*Günther*
Freshwater Polyzoa.—*Allman*
Monograph of the Gymnoblastic Hydroids.—*Allman*
Structure and development of shoulder-girdle and sternum in the Vertebrata
Botanical Works of Robert Brown; Atlas of Plates
Pterylography.—*Nitzsch*

Selecta Fungiorum Carpologia, 3 vols.—*Tulasne*
Illustrations of the Genus Carex, 4 vols.—*Boot*
Publications of the Palæontographical Society; a complete set
Withering's Botany, 4 vols.
Royal Society—Abstracts of Proceedings, 1801 to 1872, 20 vols.

Lent by Mr. Mennell.

Transactions Tyneside Naturalists' Field Club, vols. 1 to 6
Nat. Hist. Trans. Northumberland and Durham, vols. 1 to 7
Daniel's Meteorology, 2 vols.
The Letters of Rusticus, 1849
Handbook of the Yorkshire Vertebrata
Natural History Review, 3 vols.
British Poisonous Plants.—*Sowerby & Johnson*
The Common Frog.—*St. George Mivart*
Origin and Metamorphoses of Insects
British Ferns.—*Newman*
Flora of Essex.—*Gibson*

THE CROYDON

Microscopical and Natural History Club,

(Established March, 1870, as "The Croydon Microscopical Club.")

The Club has for its objects the mutual help of its Members in the study of Microscopy and Natural History, the investigation of the Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon and the County of Surrey, and the dissemination amongst its Members of information on the subjects of Microscopy and Natural History.

The Ordinary Meetings of the Club are held on the second Wednesdays in the months of February, March, April, May, September, October, November, and December. The Annual Meeting of the Club is held on the second Wednesday in January.

The Rooms are open for the reception of Microscopes and objects of interest at 7 p.m. The chair is taken at 8 p.m.

A Soirée is held in the month of November, to which Ladies are admitted.

Field Excursions are occasionally arranged during the summer months.

In order to organise and develope the work of the Club in Meteorology, Geology, Botany, and Zoology, a Sub-Committee is appointed for each of these branches of science; and the Members of these Sub-Committees, whose names and addresses are given below, will, at all times, be glad to receive notice of, and to investigate, any facts of interest connected with the Natural History of the district, and to give to Members of the Club any advice and assistance in their power.

METEOROLOGICAL SUB-COMMITTEE.

George Corden, F.M.S.	18, Katharine Street.
H. S. Eaton, M.A., F.M.S.	Chepstow Road.
E. Mawley, F.M.S.	Outram Road.

GEOLOGICAL SUB-COMMITTEE.

Dr. Alfred Carpenter, J.P., F.R.M.S.	Duppas House.
James Chisholm	Nicholson Road.
H. M. Klaassen, F.G.S.	2, Chepstow Road.
W. Topley, F.G.S.	Elgin Road.
H. Turner	"The Chestnuts,' North End.
Thos. Walker	Warrington Road.

BOTANICAL SUB-COMMITTEE.

A. Bennett	107, High Street.
W. F. Miller	Havelock Road.
H. T. Mennell	Park Hill Rise.
Franklin Parsons, M.D.	South Norwood.
Edward Straker	Kenley.

ZOOLOGICAL SUB-COMMITTEE.

John Berney, F.R.M.S.	North End.
Philip Crowley, F.Z.S.	Waddon.
E. Lovett	Clyde Road.
K. McKean	Warham Road.
Rev. George Bailey, M.A.	1, South Vale, Upper Norwood.
Rev. E. M. Geldart, M.A.	Lower Addiscombe Road.
W. Low-Sarjeant	Andaman Villas, Portland Road, South Norwood.

The President, Vice-Presidents, and Hon. Secretary of the Club for the time being are ex-officio Members of each of the Sub-Committees.

RULES.

TITLE AND OBJECTS OF THE CLUB.

The Club shall be called "The Croydon Microscopical and Natural History Club," and shall have for its objects the mutual help of its Members in the study of Microscopy and Natural History, the investigation of the Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon, in the County of Surrey, and the dissemination amongst its Members of information on the subjects of Microscopy and Natural History.

MANAGEMENT OF THE CLUB.

The business of the Club shall be conducted by a President, Vice-Presidents (not exceeding four in number), Treasurer, and Hon. Secretary (*ex officio*), and a Committee of nine Members, who shall be elected by ballot at the Annual General Meeting, three to form a quorum. The office of President shall not be occupied by the same Member for more than two years in succession.

MEMBERSHIP.

1.—Every candidate for Membership shall be proposed by two or more Members, one of whom, at least, shall have a personal knowledge of him, and who shall sign a certificate in recommendation of him, according to the form appended. The certificate shall be read from the chair, and the candidate therein recommended balloted for at the following meeting. One black ball in five to exclude.

2.—The Annual Subscription shall be 10s., payable in advance on the 1st of January (or on election, if previous to November), and no person shall be entitled to the privileges of the Club until his Subscription shall have been paid.

3.—Distinguished men may be elected Honorary Members of the Club; such Honorary Members shall not be subject to any of the expenses of the Club, and shall have no vote in its affairs.

4.—In order to encourage the study of Microscopy and Natural History amongst mechanics, &c., residing in the district, individuals of that class may be admitted as Associates, provided they shall first communicate some original information or observation on Microscopy or Natural History, or exhibit such specimens as shall, by their merit, satisfy the Committee. Such Associates shall enjoy the privileges of Honorary Members.

5.—No Member shall be considered to have withdrawn from the Club until he shall have paid his arrears, and given a written notice to the Secretary of his intention to resign.

6.—If it shall be thought desirable to expel any Member from the Club, the same shall be done by a resolution of the Committee, which shall be read at the next ordinary meeting; and at the following meeting a ballot shall take place with respect to the proposition, and if two-thirds of the Members present shall vote for such Member's expulsion, he shall no longer be considered a Member.

7.—Any Member may introduce a visitor at an ordinary meeting, who shall enter his name with that of the Member by whom he is introduced, in a book kept for that purpose.

ORDINARY MEETINGS.

1.—The ordinary meetings of the Club shall be held on the second Wednesday in every month (excepting the months of June, July, and August), at seven o'clock in the evening; the chair to be taken at eight precisely; or at such other time as the Committee may appoint.

2.—The ordinary course of proceedings shall be as follows:—

I.—The minutes of the previous meeting shall be read and submitted for approval as being correct.

II.—The names of candidates for Membership shall be read, and the ballot for the election of Members shall take place.

III.—Scientific communications shall be read and discussed; after which the chair shall be vacated, and the meeting shall resolve itself into a conversazione, to terminate at ten o'clock.

3.—In the absence of the President, the Members present at any ordinary meeting shall elect a Chairman for that Evening.

4.—No paper shall be read which has not received the sanction of the Committee; and, whenever it is possible, early notice of the subject of the papers to be read shall be given, by the Secretary, to the Members. No paper shall exceed twenty minutes in the actual reading, unless by the special permission of the Chairman.

5.—In addition to the above ordinary meetings, others, for conversation and the exhibition of Microscopical objects and Natural History specimens, and for the borrowing and exchanging of books, shall be held on the fourth Wednesday in each month throughout the year, at half-past seven o'clock in the evening.

BUSINESS MEETINGS AND ELECTION OF OFFICERS.

1.—The accounts of the Club shall be audited by two Members appointed at the ordinary meeting in December. No Member of the Committee shall be eligible as an Auditor.

2.—At the same meeting, notice of the Annual Meeting in January shall be given from the chair.

3.—An Annual Meeting of the Club shall be held, in the place of the ordinary meeting, on the second Wednesday evening in January, at eight o'clock, when the election of officers for the year ensuing shall take place, and the report of the Committee on the affairs of the Club, and the balance sheet, duly signed by the Auditors, shall be read.

4.—The Officers of the Club shall be nominated in writing, and such nominations shall be sent to the Secretary, seven clear days before the Annual Meeting. In the event of the number of nominations exceeding the nnmber of Officers to be elected, a printed list of the nominations for all offices of the Club shall be circulated at the Annual Meeting, and the Members present shall vote by ballot by striking out the names of those for whom they do not desire to vote, and placing the lists in an urn upon the table. Scrutineers shall be appointed at the meeting, and the votes shall be counted during the course of the meeting.

5.—No permanent alteration in the Rules shall be made, except at one of the monthly meetings of the Club, and notice of any proposed alteration or addition must be given at or before the preceding ordinary meeting.

LIBRARY.

1.—Application for the loan of books or Microscopical slides to be made to the Hon. Librarian at any "Ordinary" or "Conversational" meeting of the Club, the borrower to sign a receipt, which will be cancelled on the return of the work borrowed.

2.—No Member may have more than one work at a time.

3.—No work may be retained longer than one month, but the same work may be again borrowed provided there be no other applicant for it. Any Member not complying with this rule will incur a fine of 1s. for each month after the first that the work is retained.

4.—The borrower shall make good all damage which any book, &c. may receive while under his charge; such damage to be assessed by the General Committee.

5.—Books marked "R" (reference), and unbound pamphlets are not to be removed from the reading room.

6.—No Member will be entitled to the privileges of the Library who has not paid such fines as he may have incurred.

30.—Some Observations on the Embryology of the Podophthalma, or Stalk-eyed Crustacea.

By Mr. Edward Lovett.

[*Read 15th March*, 1882.]

Having recently had the opportunity of examining a large number of the stalk-eyed forms of Crustacea, collected from a variety of localities and depths, and extending over a period of about eighteen months, I noticed some interesting features with regard to the ova of these animals that seemed worthy of attention.

In the first place, several species were with ova, whilst others from the same locality were not; secondly, some species were with ova at periods totally different from the time recorded by authors on this subject; thirdly, the ova of various species were, as regards their size, out of all proportion with the ova of other species; fourthly, the protective power of the parent differed widely in species living under various conditions; and fifthly, the ova themselves underwent great changes in appearance as they approached maturity.

As regards the first of these facts, it would appear that many species may be double-brooded, and although I have noticed that it is during the early summer months that ova is generally carried in the immature state, yet there are many species that are later and others that are earlier than this. In May I obtained the ova, in an immature state, of *Portunus marmoreus*, *Palæmon serratus*, *P. squilla*, *Portumnus latipes*, *Gebia deltura*, *Scyllarus arctus*, *&c.* I had, however, obtained the ova of several species in January, February, and March. In September I obtained the mature ova of *Xantho florida*, *X. rivulosa*, and *Achæus Cranchii*, and in December the semi-mature ova of *Hyas coarctatus.* It thus appears that the spawning season extends, in different species, over the whole year, and that more or less favoured localities causing a variation in the spawning season of particular species may account for the discrepancy to which I have referred in the second place.

Taking as an example a species of somewhat wide distribution, I have found that specimens from the South-west parts of the English coast, and from the Channel Islands in particular, attain to a more developed condition in many ways; and it is thus that we find species with ova in such favourable localities at a time when the same species from the Thames estuary or the North-east coast would be without; hence possibly arises the difference in time recorded by different authors as to the spawning season of one and the same species.

Not only does this variation obtain under these conditions, but the geological features of a district have a most marked result upon the life inhabiting it; for instance, the protected rocky caves and chasms, or the *Zostera* covered pools of a granitic locality are far more conducive to the development in every way, of a species, than the cold and unfriendly clay shores of the estuaries of the Thames or Medway, or the cretaceous ledges of the South-east coast; hence we find the ova or zoœa stages of Crustacea in a more advanced state in the former localities than in the latter.

We have next to consider the remarkable disparity that exists in the size of the ova of some species as compared with others.

To take a familiar example; the eggs of the common lobster *Homarus marinus* are three times the size of those of the spiny lobster or cray fish *Palinurus quadricornis*, although the latter animal exceeds the former in size. Besides this marked example there are numbers of others; the ova of all of the *Palæmonidæ* or prawns, are far larger in proportion to the size of the animal than the ova of any of the *Brachyura*; and those of the "burrowing shrimp" *Axius stirhynchus*, an animal only three or four inches in length, are even larger than those of the spiny lobster, which is usually over a foot in length.

It would seem, however, that the size of the ova may to some extent be regulated by the same law that regulates the protective power which the parent Crustacean is able to afford to its ova during development. These, I think, depend, if not entirely, at any rate to a great extent, upon the conditions under which the animal exists, so that a deep water species of sluggish habits, or a species that passes most of its life either in sand banks or mud banks will have larger ova with a smaller amount of protection than a species living on the shore, subject to the rough treatment of the surf, or one swimming near the surface, and exposed to the disturbing influence of the waves and wind. As examples of this we find that the protective segments of *Corystes cassivelaunus*, a crustacean inhabiting loose sand in deep water are by no means so developed as those of any of the species existing under a less quiet condition of things, those of the *Portunidæ*, or swimming crabs, being very broad, and thus capable of affording the necessary protection to the spawn carried beneath. Again, we find that when the abdominal segments are broad, the ligatures by which the ova are connected together, and to the base of the swimmeret are more slight than when those segments are narrower, in an animal existing under equally favourable conditions.

The protection referred to consists in the Brachyura of broad pear-shaped somites which, as we have seen, fold beneath the sternum ; when the ova are exuded they are covered by this shield, and are besides defended by the beautiful fan-like swimming feet which also circulate the water through the mass of eggs. In the ANOMOURA, the hermit crabs, *Paguridæ*, living as they do in the dead shells of Mollusca, obtain this somewhat remarkable and artificial protection for their young. The MACRURA having the abdominal somites developed into arched processes, are furnished with a double row of swimmerets between which the ova are securely carried ; the ova in this tribe are usually attached by very strong ligatures, thus obtaining additional protection.

We will now briefly consider the ova or spawn of these animals, noting any particular points of interest that present themselves in certain species.

The usual form is spherula, but there are exceptions to this rule, for the ova of the *Crangonidæ* are oval in shape, whilst those of the *Paguridæ* are slightly so, but closely approaching the circular form, as also are the eggs of *Homarus marinus*.

The colour is generally golden, pale brown, or of an amber tint, and it is worthy of remark that the colour of the ova is certainly regulated to some extent by that of the parent Crustacean. For example, that of *Portumnus variegatus*, an animal of a pale tawny tint and inhabiting sand banks, being of a very light straw colour, that of *Xantho florida*, an animal of a warm reddish-brown tint, being of a rich golden, and that of *Carcinus mænas*, an animal of a very variable tint, but usually of a brownish green, being precisely similar in colour to the parent.

There are, however, one or two remarkably striking exceptions to this rule ; the ova for instance, of *Pandalus annulicornis* (the Thames "red shrimp,") are of a brilliant blue-green tint, and those of *Passive sivada*, an almost ivory white crustacean, are of an aqueous colourless appearance.

The manner in which the eggs are exuded and arranged in symmetrical groups on the swimmerets is difficult to ascertain, and as the females of most species retire either to deep water or to hiding places, at this period, very little is known on this point, but if we remove one of the swimming feet and a group of ova from the abdominal segments and examine them under a low power of the Microscope, by means of dark ground illumination, we shall find that the basal joint or coxopodite of the swimmeret supports, as well, a transparent stalk branching out into smaller and still smaller processes, and at the end of each of these minute stems is fixed an ovum, so that each swimmeret thereby protects one bunch of ova, and supplies the young with oxygen by setting up a current of water through them. An ovum, when newly deposited, is found to consist of a colourless transparent envelope full of transparent fluid of a tint varying as we have seen in different species. This envelope of membrane is continued in a strong viscid ligature which is apparently twisted, and as these ligatures unite they become stronger and thicker, ultimately forming the stout peduncle which attaches them to the basal joint of the swimmeret, and supports the whole group.

The first indication of the development of the egg is the granular appearance that the yelk assumes, and its separation from the envelope; gradually the outline of the enclosed *Zoœa* becomes defined, and the yelk is then enclosed in the large cephalo-thorax.

At this stage the most prominent feature is the eye which gives the ova a most remarkable speckled appearance even when seen without the aid of the Microscope.

In the mature egg, the abdomen of the *Zoœa* is closely folded on the sternum of the cephalo-thorax, and the limbs lie in close contact with the antennæ, antenules and mouth organs. When the *Zoœa* leaves the egg the envelope of the latter is simply a collapsed and crumbled membrane, and in this respect resembles the ova of many of the Lepidoptera.

The larval, or *zoœa* form of the stalk-eyed Crustacea are most remarkable in structure, and until comparatively recently were regarded as a distinct order of animals, or rather as allied to the ENTOMOSTRACA. When first hatched their eyes are sessile, their cephalo-thorax large, more or less round in form, and, in many genera, armed with large curved spines. The abdominal segments are long, simple, and terminate in a remarkable filamentous tail (the *Zoœa* of *Lithodes maia* is particularly curious in this respect, its tail development presenting a broad fan-shaped expanse of branching filaments of most delicate and beautiful structure). The swimming feet are absent, but the ambulatory feet are developed into limbs armed with setæ, thus supplying the necessary natatory organs; as the true swimmerets appear, these others gradually assume the structure of walking appendages.

These larval forms, in successive moults, assume the eyes fixed on peduncles and the other characteristics of the fully developed animal.

It is very remarkable that, unlike the Lepidoptera and Coleoptera, the Crustacea arrive at their final stage before they can be said to have grown at all. If we take any of the insects we find that all the growing takes place during the larval state; whereas, if we take as an example, the common edible crab, *Cancer pagurus*, we find that it reaches its final stage when very minute. I have frequently taken it, developed, a quarter of an inch across the carapace, and yet this species sometimes attains a weight of 12-lbs., so that the amount of growth that takes place during the zoœa form, as compared with the crab form, is very small.

There is no doubt that these curious *Zoœa* constitute the food of numerous fishes as well as other marine animals, and that millions upon millions of them are thus destroyed; were this not so, the sea bottom could not afford standing room to the various Crustacea that would be produced, for the number of eggs deposited by one individual is something astounding.

There seems, however, to be a wide difference in the proportionate numbers produced by different species, and it would appear as if those species whose young were more especially liable to this destruction, were more prolific than those whose young were not so liable owing to their different mode of existence.

For examination by the microscope these objects afford a wide and comparatively new field, and apart from the amount of information which they afford to the student of zoology, particularly that part of his subject which refers to the embryo stages, they are also specially interesting on account of their great beauty when shewn by means of dark ground illumination, as also on account of the remarkable structure of the developing zoœa form of the animals.

In order to obtain the desired means of examination, it is necessary, with such delicate organisms, to preserve them in such a manner as shall retain their living appearance and form and at the same time enable them to be mounted for microscopic examination, not only temporarily, but for future reference. This it is quite possible to do, but there are a few species the ova of which do certainly lose some of their living colour, the most notable being that of *Pandalus annulicornis*, whose eggs are of a remarkable turquoise blue and this colour it is at present impossible, under preservation, to retain.

The method of examination best adapted to this class of object in order to define their structure and make out their general form is by means of the Binocular Microscope with a 1½-in. or 2-in. object glass, No. 1 eye-piece and either parabola or spot-lens; if, however, the ova be small, or it is desired to examine more minutely the structure of any part, a higher power with different illumination may be resorted to. If the objects referred to be thus examined, after proper preparation, they will be found not only to have retained their rotundity and natural appearance, but it will be quite easy to discern the limbs, pigment cells, tail appendages, &c., of the mature *Zoœa* though still enclosed in the egg envelope.

31.—Species and Varieties in Birds.

By Henry E. Dresser, F.L.S., F.Z.S., &c.

Read 12th April, 1882.

There are doubtless many here present who have, at some period, tried to work out one of the groups of birds, insects, or other animals, and whoever has done this will be fully aware of the extreme difficulty in defining the difference between a species and a simple variety. As I have, during the time I have studied Natural History, devoted my time chiefly to birds, and more especially to those which inhabit the Palæarctic and Nearctic regions, I propose, in making a few remarks on species and varieties, to refer chiefly to those found in the former region, which will be better known to my audience than those frequenting the Nearctic region.

Many years ago, even as late as during the last twenty-five years, collectors were satisfied if they possessed a male and female of each species, and the idea of any climatic variation requiring illustration by means of a series of birds of the same species from various localities was not thought of, and if a bird from some distant country, differing but slightly from one of our European species, was obtained, it was generally put down at once as a distinct species.

One of the first ornithologists to recognise the variability of our common species of birds was the celebrated German naturalist, Dr. C. L. Brehm, but he at once put down every variation as constituting a specific distinction, and hence burdened the ornithological literature of the day with a vast amount of useless synonymy, to the great discomfort of working ornithologists. Thus he sub-divided the common Treepipit into 13, and the Meadow Pipit or Titlark into eight species, the differences in many cases being so slight that I could not make them out. That birds belonging to the same species differ not a little according to the nature of the soil they frequent or the altitude where they are found, is now very generally conceded; hence those birds which frequent sandy, dry districts are much paler than others of the same species which live in darker and more fertile soil, but these differences are certainly not specific, but only individual; but by recognising these varieties as species, Brehm multiplied the number of European birds very greatly, and got European ornithology into a state of chaos, from which subsequent writers have by degrees only rescued it. Amongst the earliest to realise the importance of collecting together a large series of specimens, so as to illustrate the geographical variation in species, was the late Marquis of Tweeddale, who was indefatigable in securing large series from various countries, and when we commenced the issue of "The Birds of Europe," I, following in Lord Tweeddale's footsteps, used my best endeavours to secure for examination and comparison as large a number of specimens from different localities as I possibly could, and always had his hearty co-operation. Since then many collectors have done the same, and hence the question of climatic variation is being now more thoroughly worked out than formerly, though very much remains still to be done before much light can be thrown on the subject. We have to deal with individual variations, climatic variations, or such as arise from the nature of the soil inhabited by the birds, and variations that arise from interbreeding; and it may be well, before going further into these various causes, to take a glance over some of our European species of birds, and note a few facts especially as regards climatic variations; for climatic variations, when continued isolation has taken place for a long space of time, frequently merge into good species, and hence it is often difficult to determine with any degree of certainty where the variety ends and the species begins.

Take, for instance, the Redtailed Fieldfare, *Turdus naumanni*) which is a very good and distinct species; still one finds in eastern Russia examples of this bird, which show much similarity to *Turdus dubius*, and makes one doubt whether they may not be hybrids between the two species; and, again, I have seen in the Berlin Museum a large series of specimens, showing an almost uninterrupted passage from two other perfectly distinct Thrushes, *Turdus ruficollis*, which has the throat and upper breast bright fox red, and *Turdus atrigularis*, which has these parts deep black, and in this case I cannot but believe that the two species interbreed in localities where their breeding range interosculates, and that the hybrids are fertile, as is the case in so many instances where allied species interbreed. Dr. Severtzoff, the celebrated Russian ornithologist, believes that these four species of Thrushes are all sprung from one parent stock, and he obtained specimens of a Thrush in Turkestan (which I believe to be a form of *Turdus atrigularis*), but which he named *Turdus mystacinus*, and which he believes to be the parent stock of all these four species.

The Blue Rock Thrush, *Monticola cyanus*, in Europe is subject to scarcely any variation, but as one goes further east one finds another closely allied form, *M. pandoo*, and still further another, *M. solitarius*, both of which differ in having rufous on the under parts, and must be reckoned as climatic forms which have attained the rank of distinct species.

Most birds which are non-migratory, or which, like the Dippers, only travel from stream to stream, or only wander over a limited area, are less subject to variation, or when variation does exist it is so constant as to raise them to distinct species. Hence I have treated the European Dippers as being referable to three species, *Cinclus melanogaster*, *Cinclus aquaticus*, and *Cinclus albicollis*, for though the differences are slight they are constant, and each species has its distinct range. Amongst the *Saxicolinæ* one also finds several instances where forms, though closely allied, should be treated as distinct species, for the differences are constant, and each form has its distinct range; thus *Saxicola rufa*, though closely allied to *Saxicola melanoleuca*, always has the black on the throat covering a smaller area, and it inhabits south-western Europe, whereas *Saxicola melanoleuca* only inhabits the eastern portion of the Palæarctic region and western Asia. The common Stone Chat, *Pratincola rubicola*, is replaced in eastern Europe and Asia by a very closely allied, more brightly coloured form, *Pratincola maura*, which may always be distinguished by the upper tail coverts being uniform white and not marked with colour; and again in the south-eastern portions of the western Palæarctic regions, and in western Asia, a third form, *Pratincola hemprichi*, is found, which has the basal two-thirds portion of the tail pure white. Our common Redstart is replaced in south-eastern Europe and Asia Minor by a very closely allied form, *Ruticilla mesoleuca*, which, besides other slight differences, always has a conspicuous white speculum on the wing, and our common Robin, *Erithacus rubecula*, has, as one goes further east, two very close allies, which must, however, be treated as two distinct species, viz., *Erithacus hyrcanus*, inhabiting Persia, and differing in having the tail feathers broadly margined with bright ferruginous, and the red on the throat and breast much richer in colour, and *Erithacus akahige*, inhabiting Japan, which has the red on the breast, bordered below with a band of blackish, and the flanks greyish black.

Of the Blue-Throated Warblers there are two distinct species, which, by many naturalists, have been united, but, I feel convinced, without good reason, for they have quite distinct breeding ranges, and, furthermore, have never, I believe, been known to interbreed. One of these, *Cyanecula Suecica*, has a patch of red in the middle of the blue throat, and inhabits eastern Europe and western Asia, breeding numerously in Scandinavia and northern Russia, whereas the other, *Cyanecula wolfi*, which has a white patch in the centre of the blue, inhabits western Europe and breeds numerously in Holland. In the winter season the two species meet in Africa, but as a proof that they keep apart during their migrations I may name that in Heligoland, where they occur by thousands when on passage, Mr. Gätke informs me only the Red-Spotted Blue Throat occurs, and during the forty years he has been there he has only seen one or two White-Spotted Blue Throats, which were evidently stragglers driven out of their course. One curious circumstance recorded by Mr. Gätke is the fact that these Blue Throats evidently pass right over Europe in a single night, for they have never been recorded on the spring passage between north Africa and Heligoland, and taking all the data respecting their passage into consideration, I believe that he is correct in his surmise. That they can traverse the distance in one night I fully believe, for birds migrate at great altitudes, frequently from two to three miles above the earth, where the air is rarified, and offers but little resistance, and that, when at great altitudes, they can and do travel at a speed that will enable them to traverse the distance in the time named his researches all tend to prove. This gentleman is now busy at a most exhaustive work on migration, and I am looking forward with great interest to seeing its publication.

Amongst the Warblers there are many instances of eastern and western forms, as, for instance, *Sylvia curruca*, of which an eastern form has been treated as distinct under the name of *Sylvia affinis*, *Sylvia orphea*, of which a large-billed eastern form exists, and *Sylvia melanocephala*, which is replaced in the east by a very closely allied form, *Sylvia momus; Phylloscopus collybita*, also is replaced in the east by *Phylloscopus tristis; Hypolais opaca*, by *Hypolais olivetorum; Hypolais pallida*, by *Hypolais caligata;* and *Ædon galactodes*, by *Ædon familiaris*, all of which are climatic races, which have, in the course of time, become valid species. The genus *Hypolais* is peculiar, inasmuch as the birds themselves resemble their allies belonging to the genus *Acrocephalus* so closely that it is often very difficult to separate them generically, but if one sees the nest and eggs there can be no shadow of doubt, as those of a *Hypolais* differ so widely from those of an *Acrocephalus*.

Amongst the Titmice one finds several climatic varieties which have merged into distinct, though closely allied species. Thus one finds *Acredula caudata* in northern Europe, *Acredula rosea* in Great Britain and in continental Europe down to the Pyrenees and Appenines, below which it is replaced by *Acredula irbii*, and again in south-eastern Europe and Asia Minor there is a very distinct form, *Acredula tephronota*. *Parus ater*, which inhabits continental Europe, is replaced in

Great Britain by *Parus britannicus*, and in north-west Africa by *Parus ledouci*, and *Parus cinctus*, which inhabits northern Scandinavia, is represented in north Asia by a very closely allied species, *Parus grisescens*. The Marsh Tits may fairly be divided into several distinct forms, viz., *Parus palustris*, the common continental and British Marsh Tit, which is replaced in Scandinavia by a paler and slightly different form, *Parus borealis*, which, again, in north Asia has the differences so much intensified that it merges into *Parus camtschatkensis*, but curiously enough in Japan we find a form so closely assimilating with *Parus palustris* that it does not appear to me to be fairly separable, though some authors treat of it as a subspecies under the name of *Parus palustris*, or *japonicus*. Our common Blue Titmouse, *Parus cæruleus*, under the influence of the brighter skies of southern Europe, becomes much more rich and bright in tone of colouration, but these southern birds are not specifically separable. In north Africa and on the Atlantic Islands, however, a permanently different, much deeper coloured form occurs, which is separated under the name of *Parus teneriffæ*.

The Nuthatches vary not a little in different portions of the Palæarctic regions, some of the varieties not being sufficiently pronounced to allow of specific distinction, whereas some are referable to closely allied, though distinct species. The Wren has a near ally, *Trogloytes borealis*, inhabiting the Fœroes and Iceland, but the common Creeper, though subject to some little climatic variation, is found right across into the Nearctic region.

Amongst the Wagtails the variations are extreme. In Europe proper there are but two species of White Wagtails, *Motacilla lugubris* the western form, and *Motacilla alba* the eastern form; but in Asia this latter has split up into several climatic forms which have fully attained the rank of species. The Yellow Wagtails, again, have branched out into several closely allied species, as for instance *M. flava*, *M. viridis*, *M. melanocephala* and *M. raii*, and the same may be said of the *Pipits*.

The Grey Shrikes present a peculiar instance of extreme climatic variation. In Europe we have in northern and central Europe *Lanius excubitor*, in south western Europe *Lanius merididionalis*, in north western Africa *Lanius algeriensis*, all differing sufficiently and constantly so that they may fairly be looked on as distinct species; and in south eastern Europe we have a form of *Lanius excubitor* which is fairly distinct, viz., *Lanius lahtora*, which ranges, subject to some variation, far into Asia; but in northern and central Asia we find a number of forms of *Lanius excubitor* all varying in colouration and in the amount of white on the wings and tail, and forms which as one goes east pass into the American *Lanius borealis*, so that it becomes a question whether one should treat all as one species, or split them up into several. I have here a considerable series of specimens from different parts of Europe, Asia, and North America, which will at a glance show the extreme difficulty there is in defining what is a species and what a variety. I may also name, with regard to these Shrikes that the varieties appear to be solely climatic, and do not at all arise from the interbreeding of allied forms.

Amongst Flycatchers are found two species of Pied Flycatchers in Europe, *Muscicapa atricapilla* and *Muscicapa collaris*, the latter differing only (but constantly) in having a white collar. Our Redbreasted Flycatcher, which throughout Europe is not subject to any variation, is replaced in eastern Asia by *Muscicapa luteola* which has only the throat and not the breast red, and in some parts of India and Ceylon by *Muscicapa hyperythra* which has the red on the breast bordered with rich velvety black. *Muscicapa parva*, though an extremely rare British bird, has been once known to breed with us, and I believe that the first announcement of this fact was made in this room by Mr. J. Flower, one of our members.

Our common Swallow, *Hirundo rustica*, is replaced in north east Africa by a very deeply coloured allied species *Hirundo savignii*, and in eastern Asia one finds a form *(Hirundo tytleri)*, which is half way between our bird and the widely distributed American species *Hirundo horreorum*.

Amongst the *Fringillidæ* one finds several instances of climatic forms, which, by constant isolation, have become distinct species, as for instance *Serinus hortulanus* which is replaced by *Serinus canonicus* in the east, and by *Serinus canarius* on the Atlantic islands. *Ligurinus chloris* in southern climes becomes much brighter coloured, but cannot be divided into two species, but *Fringilla cœlebs* is replaced in north Africa by *Fringilla spodiogena*, and in the Azores by *Fringilla tintillon*.

The Redpolls are a most puzzling group, for, although they may be fairly sub-divided into four species, *Linota rufescens*, *Linota linaria*, *Linota exilipes*, and *Linota hornemanni*, yet one finds so many forms between *Linota linaria* and *Linota exilipes* that one is almost inclined to term the latter a species still in the process of differentiation.

Of our common Bullfinch we have two forms in Europe, *Pyrrhula Europæa* in the west, and *Pyrrhula major* in the east; but on the Atlantic islands one finds a very distinct species, *Pyrrhula murina*; and in eastern Asia two, one *Pyrrhula orientalis* which has only the throat red in the male, and

Pyrrhula cinerascens in which the male has the under parts silvery grey without any red, and this last species is also found in north western America, if, as I believe, *Pyrrhula cassini* is specifically identical with it.

Amongst the Larks there are some interesting instances of climatic variation, thus the Crested Lark and the Short-toed Lark vary extremely in colouration according to the nature of the soil they frequent, but besides these individual varieties one finds in north Africa two species of crested Lark fairly distinct from our bird, *Galerita macrorhyncha* and *Galerita isabellina;* and of the Short-toed Larks we have in Europe besides *Calandrella brachydactyla*, *Calandrella minor*, *Calandrella bœtica*, and *Calandrella pispoletta*, and of this last a distinct form of a pale grey colour, *Calandrella leucophœa*, inhabits the sandy dry steppes of Central Asia.

I could continue these examples of variation in species, and of the way they branch out into allied but specifically distinct forms through the whole of the groups represented in Europe, but the above remarks will, I think, tend to give my hearers some insight into the matter, and if they will themselves collect series of examples they will be able to record many interesting facts tending to throw more and more light on the subject. The two most prominent causes of the variation one observes in species are the interbreeding of closely allied forms, and the difference in climate and locality in the habitat of the birds. The subject of variation arising from the interbreeding of allied species is one which has hitherto had but scant attention, and one which certainly deserves the utmost investigation. It has long been known that interbreeding does occur amongst birds in a wild as well as in a semi-domesticated state, but it has chiefly been recorded amongst the *Columbœ Gallinœ* and *Anseres*. In a domestic or semi-domestic state it is well known that the Pigeons and the Pheasants will cross with allied species belonging to the same group, and the offspring being fertile, will, by interbreeding again, merge off into endless varieties, but in a state of natuie the offspring are, comparatively speaking, seldom fertile. It is known now that all the various forms of the domestic Pigeon are evolved by selection and interbreeding from the common Rock Dove, *Columba livia*, and should any of these forms be let go and become wild they will, in the course of a short time, revert back to the original species from which they have sprung. The common Barndoor Fowl, also, if turned out will revert back to the original wild form, and curiously enough the male will cease to crow, as this note, so characteristic of our domestic cock, is not uttered by the wild bird. The Pheasant, also, which in our coverts interbreeds so much that it is now almost impossible to procure in Great Britain a specimen of true *Phasianus colchicus*, interbreed but seldom in a native state, and so far as I know the offspring is sterile. Amongst the Grouse one finds, not so infrequently, wild hybrids, for instance between the Ptarmigan and Black Grouse, the Red Grouse and Black Grouse, the Hazel Grouse and Black Grouse, the Capercaillie and Black Grouse, the American Ruffed Grouse *(Bonasa umbellus)* and the Canada Grouse *(Tetrao canadensis)*, &c., &c., but so far as I know there is no instance on record of the offspring being fertile. Amongst the Ducks wild hybrids are occasionally found, but they are not of frequent occurrence, and are, I believe, sterile, whereas in a state of semi-domestication they have been found to interbreed to the third and fourth generation.

Interbreeding has been noticed far less amongst the Passerine birds, but it does occur, and it has been long known that some of the *Pici* and *Coccyges* regularly interbreed with closely allied species; thus in eastern North America there is one form of Flicker, *Colaptes auratus*, and in the west and south another perfectly distinct species, *Colaptes mexicanus*, but where the range of the two species meets they interbreed regularly, and every gradation between the two species may be found, whereas only a few miles on the one side pure bred birds of the one species are found, and on the other side of the other species, and the same thing occurs in Asia where *Coracias indicus* and *Coracias affinis* meet.

One of the most curious instances of this interbreeding is that of *Corvus corone* and *Corvus cornix*. In the northern portion of continental Europe the Elbe forms the boundary line between the two species, and whereas a few miles to the east of this river one finds only true *Corvus cornix*, and to the west only *Corvus corone*, all along the Elbe hybrids of every sort between the two species are seen, and comparatively seldom a pure bred bird.

A curious circumstance was related to me by one of my correspondents in Austria. Some years ago in one particular district *Corvus corone* and *Corvus cornix* were nearly evenly balanced in numbers, and interbred freely, but by degrees the former increased until now, although many hybrids are found, they all resemble *Corvus corone* more than *Corvus cornix*, and ere long, without doubt, all trace of the latter species will have disappeared, it having proved the weaker in the struggle for existence. In Siberia where the two species meet they also interbreed as in Europe, and I am enabled, by the kindness of Mr. H. Seebohm, to exhibit here a large series of specimens showing all the gradations between the two species. This gentleman has lately been investigating the subject of the interbreeding of allied species, and has some interesting series of examples, amongst which the most interesting are, in my opinion, the series I now exhibit, showing that the Asiatic and European Goldfinches interbreed where they meet. Our common Goldfinch *(Carduelis elegans)* does not vary throughout Europe except that in the extreme east examples are rather larger and have more white on the nape and fore part of the back, and the rump and upper tail coverts are pure white. In most parts of Asia, however, our bird is replaced by a perfectly distinct species, *Carduelis caniceps*, and until lately no specimens showing a gradation between the two species had been recorded, but a series of specimens from a part of Central Asia where the two species meet has been sent over (and which I exhibit here), which clearly shows that there they interbreed as much as the two crows do, and it is clear that the offspring is fertile as will be seen by the extreme variation shown in the specimens before you. It may, however, be quite as possible that the original stock of the two species was a bird intermediate between the two, inhabiting that part of Asia, and that the two forms have spread out from thence, one to the eastward merging in the course of time into *Carduelis caniceps*, and the other migrating to the westward and becoming *Carduelis elegans*.

As regards the species which have been evolved by a long continued isolation from the original stock the most interesting, and those which may be cited as most clearly proving this to be the case, are island forms. Thus in Great Britain we have two species which are peculiar to the islands, *Lagopus scoticus*, our common Red Grouse—which differs from the continental *Lagopus albus* in never becoming white in the winter, but which at some distant period was doubtless identical with the continental form—and *Parus britannicus*, a form of *Paru ater* differing from that species in having the upper parts olivaceous instead of blue grey, but which is also, doubtless, a form evolved by long-continued isolation. Our Dipper, also, being non-migratory, differs also almost enough from the continental species to be raised to specific rank.

In the Atlantic islands (Madeira, the Canaries, and Azores) there are many more species which have become distinct by continued isolation, as for instance *Cypselus unicolor*, *Regulus maderensis*, *Anthus berthcloti*, *Fringilla tintillon*, *Serinus canarius* and *Pyrrhula murina*, the last being one of the most interesting, for it resembles the female of *Pyrrhula europœa*, but whereas the male of the latter species has the underparts always red, the male of *Pyrrhula murina* differs but a little from the female, and resembles the female of *Pyrrhula europœa* not a little.

In these islands a peculiar melanistic variety of the Blackcap also occurs, which, so far as I know, has not been observed elsewhere, and which has been described as a distinct species under the name of *Sylvia heinkeni*, but which later research has proved to be only an accidental and not a constant variety, one out of a brood of ordinarily coloured birds in the same nest being of this dark tint of colour.

A curious circumstance that has been frequently remarked on is the strange similarity between the avifauna of Japan and Western Europe. Amongst the species common to Japan and Europe I may enumerate the following: *Parus palustris*, *Bonasa betulina*, *Picus major*, *Picus leuconotus*, *Gecinus canus*, *Dryacopus martius*, *Nucifraga caryocatactes*, *Acredula caudata*, *Coccothraustes vulgaris*, and *Alauda arvensis*, besides which several European species are there represented by closely allied forms, as for instance *Cyanopica cooki* by *Cyanopica cyanea*, *Troglodytes parvulus* by *Troglodytes fumigatus*, *Regulus cristatus* by *Regulus japonicus*, and *Erithacus rubecula* by *Erithacus akahige*. A very remarkable circumstance is that there are but two species known of *Cyanopica*, a genus so very distinct in colouration, one found in Japan and Eastern Asia, and the other in Western Europe, these two being so closely allied that many naturalists do not separate them, and in the vast intervening tract this genus is unrepresented. Doubtless at some remote geological period these birds were identical, and in the course of time the one form has been driven out to the east, and the other to the west, and the parent stock has become extinct.

However, I have now considerably exceeded the time allowed me for my remarks on the subjects I have treated of, and must now close, trusting that, though crudely strung together, the facts I have mentioned will tend to throw some little light on the extreme difficulties that are in the way of defining where the limit is, between a mere variety and a species.

32.—On the Mollusca of the Club District.

By Mr. Kenneth McKean.

Read 13th September, 1882.

This branch of zoology has hitherto not received much attention at our meetings. The only paper we have had on the subject was read by Mr. G. F. Linney, ~~17th~~ September, 20th 1871, "On the land and fresh water shells of the Croydon district." The aim of that excellent little paper was, however, rather directed towards encouraging a taste for conchology among the younger members of our newly formed club, and assisting them with advice as to the methods of collecting shells and preparing them for the cabinet, than placing on record a list of the molluscs which live within our boundaries.

Croydon being situated so close to the edge of the county, I have included in my working ground, in addition to the whole of Surrey, that small portion of Kent which is enclosed by the river Darenth. The botanical sub-committee also adopted that line as their eastern boundary.

The district throughout offers considerable diversity of soil. In our immediate neighbourhood the chalk is well known to be particularly favourable to many kinds of snails. Near to Croydon we have but little water of that kind which yields a harvest to the conchologist, but the western part of the county is rich in ponds, ditches, and marshes, streams both rapid and sluggish, and certainly not least in importance an almost disused canal. On the eastern side of the district near to the junction of the Thames and the Darenth are brackish ditches, within tide marks, which yield several species found only in those circumstances. I will not detain you by dealing with the arrangement and classification of the mollusca, but will at once proceed to note very briefly the genera that occur in our district, offering a few remarks upon less common species.

Accepting the system of Gwyn Jeffreys as being the most commonly used at the present time, we commence with the Bivalves.

Of the genus *Sphærium* we have all the species with the exception of *S. ovale*. *S. rivicola*, a local and scarce shell throughout the kingdom, I have only found in the Basingstoke canal near to Weybridge, the River Wey, near Newark Abbey, and the Wey and Arun Canal, near Cranleigh. I put some of these shells in a small aquarium, but they were so exceedingly active, incessantly ploughing up the bottom in all directions that the delicate epidermis was in danger of being greatly destroyed, so to save their beauty they were placed in the cabinet. This restlessness may, I think, have been caused by the change from their native gently flowing water to the stagnation of an aquarium, for when freshly taken this bivalve shows little or no signs of abrasion. *S. lacustre* is widely diffused in Surrey. It occurs in vast numbers on Wandsworth Common as well in the mud as among weeds at the surface.

The next genus *Pisidium* requires to be dealt with very cautiously, as two of the species and many of the varieties are difficult to separate. It is comforting to observe that the tendency of modern writers is to reduce the number of species, of which no less than forty-one have been named by various authors as inhabiting Europe. This dreadful array has now been brought down to *six* species, of which five inhabit Great Britain. In Surrey we have all these, and they may all be found, some in the rapid little streams, and some in the ditches and swamps in the low lying ground between Merstham and Bletchingly. The variety *obtusalis* of *P. pusillum* occurs in ditches at Charlwood. The only safe plan to adopt with this genus is to collect specimens from numerous localities and to compare them, and more important still to compare them with good collections.

Of the larger mussels, the *Unios* and *Anodons*, we have plenty. *Anodon cygneus* of a very large size occurs on Fetcham Common, *A. anatina* in the stream west of Nutfield Marsh, *Unio pictorum* in the river Wey near Guildford, and *Unio tumidus* in the Basingstoke Canal. The stomachs of these bivalves yield many kinds of diatoms. *Unio margaritifer*, the true pearl mussel, seems to be entirely a northern type. I made the attempt though unsuccessfully to introduce it here seven years ago. One hundred and fifty Unios were forwarded from the river Don in Aberdeenshire, and deposited July, 1875, in what appeared suitable localities in the Wandle, between Bridge House, Wallington, and Hackbridge. The weather, unfortunately, became very hot at the time of transit, and the mussels, which were packed in wet moss, were rather languid when put in the river. The sickly ones were immediately attacked by the leeches; fifty-two mussels were taken out dead within a week. None appear to have survived long. It is worthy of note that the waters of the river Don, in its lower part where the pearl mussel lives, contain only 5·8 grains inorganic matter per gallon, whereas the Wandle holds in solution upwards of 19 grains inorganic matter per gallon. The Don which contains so small a quantity of lime, produces a shell which is remarkably thick and strong; the Wandle, containing three times as much lime, produces shells which are thin and fragile. On the other hand the Don has 2·5 grains organic (that is vegetable) matter per gallon, and the Wandle only 1·74 grains. *Dreissena polymorpha* occurs in great plenty in the stony shallows at the junction of the Rivers Wey and Thames, but these specimens are totally devoid of markings.

Gasteropoda, or water breathing snails.—*Neritina fluviatilis*, the most singular in appearance of all our shells may be taken in the Thames at Weybridge, in places where the bed of the river is shingly. The snail will not live in captivity. *Paludina vivipara* is widely spread over the western district in the Wey, the Surrey and Sussex Canals, and the Basingstoke Canal, those from the latter place being of a lighter colour. My friend

Mr. E. Saunders, of the Holmesdale Club, tells me he took *P. contecta* some years ago at Flanchford, near Reigate, but it does not appear to live there now. *Bythinia tentaculata* is common in most ditches that contain water all the year round. The operculum of this species fits the mouth of the shell with such accuracy that if the animal be killed in boiling water and then allowed to dry up within and the shell be held in the warm hand, the expansion of the air causes the operculum to fly off with a considerable report. *B. Leachii*, a very local shell, may be obtained where one would hardly expect to find anything uncommon, viz., the little pond at the top of Coombe Lane where a large portion of the Croydon dogs enjoy their Sunday tub. *Valvata piscinalis* and *V. cristata* both occur in the Wandle at Waddon; the last named is decidedly uncommon. It should be noticed that the shells of the Wandle are very clean and somewhat smaller than those of our other streams.

Hydrobia, of which we have one of the two British species, viz., *H. ventrosa*, occurs between Woolwich and Erith, in ditches which are only filled at the top of the tide but which never run quite dry. *Assiminea Grayana* inhabits the same locality, but selects those ditches which leave it quite dry about four hours each tide; it may then be found in such countless myriads as to completely blacken the surface of the thick tenacious clay. When Hydrobia and Assiminea are placed in a vase of brackish water supplied with Ulva, their habits are seen to be widely different; the former will feed for hours at a time and then roll off and lie motionless at the bottom till again hungry. Assiminea immediately seeks the air and wanders round the edge of its prison, even escaping if not prevented ; it seems to wait for the rising of the tide to remind it of feeding time, and will remain out of water for days till obliged by hunger to descend in quest of food.

Pulmonobranchiata, or air breathing water snails.—The next family the *Limnaeidae*, is a large one, and is fairly represented here. The beautiful *Planorbis nautileus* is found on Mitcham Common, Chipstead and Betchworth. At the last-named place I took a monstrosity having the last whorl separated. *Planorbis nitidus* inhabits the sewage farm. *P. corneus* is very local. Fine large shells of this species abound on Wandsworth Common. The rare *var. albina* occurs at Kingswood. *P. complanatus*, the most frequent of this genus, appears more liable to distortion than any other shell ; instances of this where the last whorl turns downwards and inwards, occur at Pease Marsh, near Shalford. The ubiquitous *L. peregra* flourishes alike in marsh, pond, ditch, and stream wherever we choose to look. In clear rapid streamlets the shell is small and the whorls of gradual increase and much compressed ; in ponds and ditches where vegetation runs riot, he attains aldermanic proportions. Observing that differences of locality and food produce corresponding differences in the shape of the shell, I have numbered and recorded each specimen taken, and I find that the rule, though not absolute, generally holds good. The two extreme types are—one from a very rapid rill flowing into the large pond at Frensham, the other from the ditch at Moat Farm, near Godstone. *L. auricularia* is not very common; it occurs in the Surrey and Sussex Canal at Bramley, the Basingstoke Canal, near Frimley, and on Earlswood Common. *L. palustris* we have in plenty. A well marked variety (*conica*) having a distinct umbilicus, inhabits the fields bordering the river at Putney, where it lives quite out of the water about the roots of sedges. *L. truncatula* is not often met with. Like the last-named variety it sometimes leaves its native element and rambles in the fields. I have taken it at Fetcham Common, under stones several yards from the water. Last autumn while walking out with Mr. Beeby, near Oxted, we found a tiny pool, evidently made during the railway works, containing perhaps forty gallons of water in which some chara was growing; we searched the plants and mud carefully but found no molluscan life of any kind. We visited the same pool on the 7th April this year, and took five *L. truncatula* fully grown. *L. glabra*, a very rare snail in the south-eastern counties, occurs sparingly near Hedgecourt Common.

Of *Ancylus* both species occur. Fine specimens of A. *fluviatilis* inhabit the rapid little stream at Limpsfield, and the shells are quite free from the usual incrustation. A favourite haunt of a *A. lacustris* is between the fronds of rushes growing in the shallows of the Mole about Leatherhead.

Limacidae.—We now come to the slugs, most of which are too common to call for especial remark. *Arion ater* battens on the sewage farms and attains a gigantic size. The beautiful sea-green variety of *Limax arborum* occurs in a garden on Bramley Hill, where a little family of them lives in a hollow in an old oak. Slugs are most difficult to preserve in a satisfactory manner. In the first place the animal must be killed with extreme rapidity in order that the body and tentacles may not get time to retract, and secondly a medium has to be found which will not destroy the colour. Tate recommends corrosive sublimate as a speedy killer, but I find this only acts well with one species L. *maximus*, indifferently well with two more of the same genus, *L. flavus* and *L. arborum*, and very badly with all others. If an adult *L. maximus* be allowed to crawl on a slip of card till fully extended, with the respiratory orifice open, and then plunged into a saturated solution of corrosive sublimate it hardly retracts at all, the head and tentacles becoming rigid within forty seconds, although sensation continues in the tail from eight to ten minutes. Glycerine and water in equal parts are recommended as a preservative medium, but in this, though better than spirit, the beautiful colourings are quickly robbed of their brilliancy. *Testacella*, which forms the connecting link between slugs and snails, is said to live near London, but I have not yet been able to find it. Its appearance is so peculiar that if it does exist here it could hardly fail to be detected.

Helicidæ.—Succinea elegans is found at Putney, Nutfield Marsh, and Waddon, but I have not taken it elsewhere.

Vitrina pellucida, whose exquisite shell is filmy as a soap bubble, is widely spread. During summer it lives deep among decaying leaves, or under stones, in cool hollows, but when the autumn frosts visit us it becomes very active, and may then be taken in plenty in the neighbourhood of elms and beeches, rapidly skimming over the fallen glistening leaves. Of the ten species of *Zonites* we have eight. *Z. radiatulus* is uncommon, though it occurs as near to Croydon as Purley Farm. I took *Z. glaber* last week for the first time between Chaldon Church, and Fryern Farm, and upon taking the shells to the British Museum for identification, I found Mr. Groves had already deposited specimens taken at Tatsfield. This snail was only added to the Fauna of the country ten years ago, when it was discovered in Cheshire. We now come to the genus *Helix*, the shells of which are familiar to all. I will first deal with those species which live mostly or entirely upon the chalk. *H. pomatia* might be called the Surrey snail, so closely is it identified with this district. Its true home might also be described as lying within a triangle which has Caterham Junction for the apex, and Boxhill and Tatsfield for the base. Although it keeps pretty closely to the chalk, wanderers are occasionally met with in the succulent hedgerows on the lower greensand near Bletchingly, two miles south of the chalk escarpment. To obtain this snail with its calcareous epiphragm in situ it is necessary to dig in or about the edge of beech copses between December and April. Its winter quarters are usually some inches below the surface. White Hill is the most favourable locality. *H. lapicida* is frequent but not abundant. It occurs at intervals along the Downs from Tatsfield to Farnham. *H. ericetorum* flourishes on the chalk and attains the largest size in the bleakest situations, Woldingham Downs for instance. *H. virgata* is the most variable shell in its markings we have; as many as 14 distinct variations were taken in one stubble field near Beggar's Bush. On one of the few hot days this summer I took a Virgata on an old tarred fence which was in the full glare of the sun, and so hot I could scarcely bear my hand upon it. *H. caperata* also chooses dry places, and courts the heat like the last species. The beautiful var. *ornata* lives on the almost bare chalk heaps over Merstham tunnel. The three last-named shells (which all select the dryest localities) as well as *H. Cantiana* and *H. rufescens* to a lesser degree, will, when roughly handled, void a considerable quantity of a clear tasteless fluid like water, amounting in a full grown virgata to more than two drops. *H. Arbustorum* is uncommon. I have seen it in the riverside meadows at Putney, the low-lying land south of Godstone, and near Godalming. Mr. Low Sarjeant sent me some fine specimens yesterday, from Waddon, where he says it is tolerably abundant. *H. rufescens* is by far the commonest snail we have. It inhabits all parts of the county, although showing a decided preference for the chalk. *H. pygmæa*, difficult to find on account of its microscopic dimensions, is best obtained by searching during dry or cold weather, under fragments of chalk or stones lying among the grass on the southern slopes of the Downs. The beautiful *H. cartusiana* has been found on several occasions on Banstead Downs, but I have not yet been so fortunate as to obtain it. An interesting feature of the *Helices* is the curious spiculum with which several species are furnished during the breeding season. I do not know whether any snail produces more than one spiculum in the course of a season, but it seems probable. Out of three *aspersa* and three *nemoralis* dissected 17th June last year, two of the *aspersa* and all three *nemoralis* contained spiculæ. The spring of last year was certainly a late one, yet I found a fully formed spiculum in *aspersa* on 14th April.

The *Pupæ* and *Vertigos* do not seem to inhabit this district in great variety. *P. umbilicata* under rotting wood about Gatton and White Hill, *P. marginata* and its *var. edentula* under tiles, old bricks, &c., on Epsom Downs and Walton Heath. *Vertigo pygmæa* is common in woods, *V. antivertigo* inhabits the margin of the Basingstoke Canal, near Brentwood. *Balia perversa* secretes itself among interstices of the bark of elms about Coombe Lane, but is somewhat difficult to find. *Clausilia biplicata*, which is about the rarest British land shell, only occurs, so far as is known, in Wiltshire and on the banks of the Thames at Hammersmith and Putney, at which latter place I have taken it. *Cochlicopa lubrica* flourishes equally well in dry or wet places; it may be found in the arches of the Brighton railway, between this and Stoat's Nest, and I have taken it *in* the Hammer pond, at Merstham. *C. tridens* is a scarce shell throughout England, but where one is found a few minutes' search will generally reveal others, for it lives in little families of five or six, which keep pretty close together. They get under moss growing on stones in cool dark woods. I have noticed the species at Gatton, Winder's Hill, and Tadworth.

Achatina acicula was mentioned last year as occurring on Park Hill.

Carychium minimum only requires looking for; it lives in vast numbers under decaying leaves in most of our beech woods. *Conovulus bidentatus* is found at Erith, under the blocks of chalk which face the dykes, but so high up as to be quite beyond the reach of any ordinary spring tide. *Cyclostoma elegans* is a well-known shell in this part of the county. It keeps pretty closely to calcareous soils. *Acme lineata* is said to have been taken at Gatton but I have not found it myself anywhere in Surrey.

Appended is a detailed list of the Mollusca taken in the club district.

In the list it will be noticed that several species are wanting which there is every reason to believe exist within the district, and I would take this opportunity of reminding members that the Zoological Sub-Committee (instituted by our late deeply-lamented President, Mr. John Flower, for collecting data with regard to the Natural History of the Club's working ground) will always be glad to receive any notes upon this subject, however insignificant they may appear. It is only by pulling together as a Club that we can hope to make these lists perfect.

List of Mollusca taken in the Club district:—

AQUATIC.

Sphærium corneum
,, ,, (var. flavescens)
,, rivicola
,, lacustre
Pisidium amnicum
,, fontinale
,, ,, (var. pulchella)
,, ,, (var. cinerea)
,, pusillum
,, ,, (var. obtusalis)
,, nitidum
,, roseum
Unio tumidus
,, pictorum
,, ,, (var. radiata)
Anodonta cygnea
,, anatina
,, ,, (var. radiata)
Dreissena polymorpha
Neritina fluviatilis
Paludina vivipara
Bythinia tentaculata
,, Leachii
Valvata piscinalis
,, cristata
Assiminea Grayana
Hydrobia ventrosa
Planorbis nitidus
,, nautileus
,, albus
,, spirorbis
,, vortex
,, carinatus
,, complanatus
,, corneus
,, ,, (var albina)
,, contortus
Physa hypnorum
,, fontinalis
Limnæa peregra
,, auricularia
,, stagnalis
,, ,, (var. fragilis)
,, palustris
,, ,, (var. conica)
,, ,, (var. decollata)
,, ,, (var. roseo labiata)
,, truncatula
Ancylus fluviatilis
,, lacustris

TERRESTRIAL.

Arion ater
,, hortensis
,, flavus
Limax maximus
,, flavus
,, agrestis
,, arborum
Succinea putris
,, elegans
Vitrina pellucida
Zonites cellarius
,, ,, (var. compacta)
,, alliarius
,, glaber
,, nitidulus
,, ,, (var. Helmii)
,, radiatulus
,, nitidus
,, crystallinus
,, fulvus
Helix aculeata
,, pomatia
,, aspersa
,, nemoralis
,, ,, (var. hortensis)
,, ,, (var. hybrida)
,, arbustorum
,, cantiana
,, cartusiana
,, rufescens
,, ,, (var. albida)
,, concinna
Helix hispida
Helix virgata
,, ,, (var. alba)
,, caperata
,, ,, (var. ornata)
,, ericetorum
,, ,, (var. alba)
,, rotundata
,, ,, (var. Turtoni)
,, ,, (var. alba)
,, pygmæa
,, pulchella
,, ,, (var. costata)
,, lapicida
Bulimus obscurus
,, montanus
Pupa umbilicata
,, ,, (var. edentula)
,, marginata
Vertigo antivertigo
,, pygmæa
,, edentula
Balia perversa
Clausilia rugosa
,, biplicata
,, laminata
,, ,, (var. albida)
Cochlicopa tridens
,, lubrica
,, ,, (var. hyalina)
Achatina acicula
Carychium minimum
Conovulus bidentatus
Cyclostoma elegans

33.—ORNITHOLOGICAL RESEARCHES ON THE YEN-E-SAY.

By MR. HENRY SEEBOHM, F.Z.S., &c.

Read 11th October, 1882.

Three hundred years ago, when Ivan the Terrible reigned over Russia, and the Tartar races struggled in mortal combat, a peaceful expedition left the shores of Britain for the Arctic regions. Three ships were sent to the Arctic regions on a wild goose chase after Cathay, a country where it was thought the rarest fruits could be had for the plucking and where the rivers ran over sands of gold. This expedition was a failure. Poor Sir Hugh Willoughby, it was supposed, discovered the island of Nova Zembla, but failed to winter there, and landed with his crew upon the peninsula, where they were all starved to death. But another ship was more fortunate. Driven by contrary winds into the White Sea, the port of Archangel was there discovered. It was found that the inhabitants were at that time actually carrying on a trade with this wonderful land of Cathay. They built themselves boats of birch planks, sewn together with willow twigs, and in these little frail barks they performed their journeys, returning during the same season to Archangel. When the port of Archangel was opened out to British commerce, in the struggle for existence which then took place the weakest had to go to the wall. Russian maritime enterprise finally died, and for a couple of hundred years the inhabitants of Archangel received their tea and their silks from the Thames instead of from the Yen-e-say and the Obb. No attempt was made to re-open communication with Siberia by sea, and for 200 years it was believed that the Kara Gates were closed with impenetrable barriers of ice. In 1874 Capt. Wiggins, of Sunderland, took it into his head to explore this district and open up communication with the Siberian rivers by sea. He chartered the *Diana* steam yacht and sailed from Sunderland round the North Cape, went through the Kara Gates and explored the mouths both of the Obb and the Yen-e-say, but had some difficulty with his men, and was obliged to come home, which he managed to do without any material disturbance from the ice. In 1875 Professor Nordenfelt chartered a walrus sloop, and sailed round. He brought it into the mouth of the Yen-e-say, sent his sloop home, while he went up as far as Yen-e-saisk, and returned to Europe by the overland route. In 1876 both these gentlemen attempted to take a cargo by sea to the Yen-e-say. Nordenfelt was the first to arrive. He entered the Yen-e-say, sailed 250 miles up, until he came to the little town of Kor'-e-o-poft'-sky, and then, finding no channel deep enough for his ship, returned home. Capt. Wiggins arrived a week or two afterwards, heard that the other explorer had been there and was unsuccessful in finding a channel up the Yen-e-say, and determined to show the superior quality of the British sailor. He succeeded in getting his ship a thousand miles into the Arctic circle, and left it about half-a-mile up the Koo-ray-i-ka, where it was frozen in a couple of days afterwards, and having made provision for his sailors to winter there returned to Europe and to England by the overland route. He (Mr. Seebohm) had in previous years paid some little attention to the ornithology of Lapland, and visited the valley of the Perchora and returned with booty in the shape of birds' eggs and skins. Hearing that Capt. Wiggins was going back to his ship he asked permission to be his travelling companion, and on the 1st March, 1877, they left London together, and reaching

Russia went through St. Petersburg and Moscow to Nishni Novgorod. He was fortunately able to get into communication with Count Schouvaloff, and he gave them letters to the Minister of the Interior of Russia, who furnished them with letters to all the principal Governors in Siberia. They left Nishni Novgorod, which was 2,400 miles from London, and where they bought a sledge, and travelled over the snow 3,200 miles, throughout the whole country there being government relays of horses. They used on their journey more than 1,000 horses. When they got too far north for the horses they had dogs, and at the end they had employed altogether forty reindeer and eighteen dogs to draw the sledge along. On the first part of the journey, that down the Volga on the ice, they found themselves a little incommoded by the melting snow, but afterwards this inconvenience ceased. Reaching the Ural Mountains they found them a comparatively insignificant range. They did not reach any great height and were very broad, reminding one of travelling over the Peak of Derbyshire. All along the journey hitherto they had passed through fine forest districts, and during the whole time they had tolerably good roads, but when they had crossed the Ural Mountains they came on an entirely different class of scenery. The forests suddenly disappeared, and they came upon the Barabinsky Steppe, where there were no trees. There were perfectly flat plains as far as the eye could reach in every direction ; nothing but one white field of snow at their feet, and the blue sky overhead, the only relief to the monotony of the landscape being a line of telegraph posts stretching from one horizon to the other. The telegraph line they followed. They had four to six feet of snow, and it was only where the road had been trodden hard for five or six months that they were able to pass. In Ekatereenberg they met some interesting people who spoke English and German. One of these was the curator of the museum and observatory there. He gave them information that the rain gauge during 40 years had only averaged, snow included, 11 inches of rain per annum. The amount of absolute rain was very small indeed. When at Tumain they were hospitably received by a Scotch engineer who had settled there some years before. When they arrived at Omsk they took their letters of introduction to the Governor of West Siberia, but unfortunately found he was from home, having gone by another road on his way to St. Petersburg. His good lady, a relative of the emperor, received them very kindly, and the travellers spent a few hours there very pleasantly. She spoke German and French well, and had an English governess for her children. From Omsk they went to Tomsk, and the scenery again changed. They came again on a mountainous district, rich in forests, and in many parts one might imagine he was driving through an English nobleman's park. There were magnificent fir trees, willow, poplar, birch, &c. They passed on to Krasnoyarsk, which was the extreme east point of their journeyings. It lay about 100 miles east of Calcutta, and possibly 3,000 miles north of it. Here they found quite an important town of possibly 40,000 inhabitants. Here they found themselves nearly overtaken by the south wind, and found nearly all the inhabitants were travelling on wheels. In some places there was a foot of water in the streets. In consequence of this they were anxious not to stop any longer than they could help, and applied to the post for horses. They were obliged to organise a little caravan consisting of three waggons. On one of these they placed their sledge, on the other their baggage, and on the third waggon they travelled themselves. For the first two stages they had some difficulty, but as they got further north they threw aside one of their waggons, the next stage they threw aside another, and finally the frost again made the roads hard, and they were able to sledge until they reached Yen-e-saisk. This was a town of at any rate some 20,000 inhabitants. It was formerly more important still, but a few years ago was almost entirely destroyed by fire. Captain Wiggins had passed through Yen-e-saisk before, and consequently they had no loss of invitations, many of the merchants living in elegant houses and amid a great deal of comfort and luxury. Three or four days sufficed to prepare for the further journey. The most important thing he (Mr. Seebohm) had to do was to find somebody who could act as a skinner of birds. There was no one in the town who understood this operation, but at last he succeeded in finding a Jew who was a tolerably good German scholar, and also able to speak Russian, though he mixed Hebrew words with both. This Jew he (Mr. Seebohm) had to teach himself, but that was accomplished in one or two lessons. He had the good fortune to meet an Englishmen in Yen-e-saisk, a native of Heligoland, which was under the English Government. This person had a ship three parts built standing in the stocks, and he (Mr. Seebohm) made a bargain with him for this ship. Immediately the ice broke up, he and the builder were to bring the vessel down to the Koo-ray-i-ka and to go about finding birds and birds' eggs. At the end of the week they started on their journey northwards. They were obliged to leave the one sledge and to take to two lighter sledges, as there were now three of them, and they started sledging down this great river. This great river was said to be the third largest in the world. The Amazon, Missisippi, and Missouri were longer, but not so wide. Its total length was 4,000 miles, and at this point it was a mile wide. He afterwards sledged down it 800 miles, and found it had reached a width of three miles, at the end of another 800 miles it was nearly six miles wide, and for the last 400 miles it averaged 20 miles in width. They sledged down this river, the natives whom they met being always extremely friendly, and, owing to their assistance, the sledge never once overturned in going down the steepest hills. The first natives they met with were the Tungoosk, copper coloured individuals, something like Japanese. They were short, and many of them were dressed in furs. Of course they (the travellers) were all dressed in furs. It would have been impossible to travel unless they had been thoroughly well provided against the cold. They never experienced any very great difficulty, however, on account of the cold. He did not think they ever had more than 10° below zero. On a previous journey they had 23° below zero, or 55° below freezing point, and then found their furs absolutely necessary. At almost all times, however, the frost was most intense when there was no wind. Another race they came across further north were the Ostyaks, who slightly differed from the Tungoosk. They arrived on the Koo-ray-i-ka in the Arctic Circle on the 19th April, and there found the crew of Captain Wiggins' steam yacht in excellent health. They had passed through the winter without any trace of scurvy. A little further to the north another crew had wintered belonging to Sideroff, a merchant of St. Petersburg. The ship had a crew of four or five men. They had not been provided with lime juice, and had been allowed to sleep as long as they liked. Consequently they all had scurvy, and all died except the mate, who had a very tough constitution and recovered. Captain Wiggins' men had had a plentiful supply of lime juice, and were kept well employed at chopping wood. When they reached the yacht there were six feet of snow on the ground, and they looked down from the crew's quarters on to the crow's nest of the yacht. All around was forest. The timber was so extremely cheap that you could buy a ship's mast of larch 60 feet long for a sovereign, and if you wanted 40 you could have them all during the week. From the middle of April to the 1st June they had six feet of snow on the ground. He immediately bought a pair of snow shoes, and spent the bulk of his time in making excursions into the forest, shooting, &c., and visiting the village of Koo-ray-i-ka on the other side of the great river. When they first arrived the number of birds was small, but soon afterwards various kinds began to appear, and as the summer began to come, although there were no signs of its approach except the arrival of these birds, now and then late in May, there appeared a flock of white geese and swans. Most of these birds had migrated too early, and the great bulk of them came back again. By the 1st June the river had slightly risen, and there were on each side great masses of ice on the river, perhaps 12 to 20 feet of thin ice where the river had risen and frozen over again. On the 1st June, as they came out of their cabin, they suddenly saw at the angle of the bank where the two rivers joined a little chain of ice mountains. Going down to the spot, they found that on the great river a large field of ice had broken loose. Half of it had found its way down the little narrow strip of thin ice, and the other had rushed against the precipice and knocked itself into little mountains. He found the river was covered with three feet of transparent ice, as clear as glass and almost as blue as the sky. On the top of that was about four feet of ice as white as milk, apparently the flooded snow which had afterwards frozen. The moment this was discovered the sailors took alarm, and many of them removed their goods and chattels from the vessel, and though Captain Wiggins discouraged alarm, he was anxious enough to put a watch on board, so that they might be advised of anything unusual that occurred. At one o'clock in the morning the watchman called down and said he thought the best thing for them to do was to get up, that the river was rising rapidly, the ice was beginning to break up, and to march up stream. On going on deck they found that there had evidently been a tremendous thaw somewhere on the ice, and that the large blocks had flown into the river so rapidly that it was beginning to flow up all its tributaries. They found, however, that the ice was breaking up into very small pieces. One piece of ice came against the ship with such violence as to cause some alarm. But presently the whole had passed, and they had clear water to the Yen-e-say. They then found the ice in the great river had broken up and was coming up stream. There was only one thing to do, and that was to slip their anchor and run with it, and the ship was driven up the Koo-ray-i-ka about a mile. At the end of something like 36 hours they found that the result of what had taken place was a leakage, and there was a stream of water running into the hold of the ship. They were thus obliged to desert her. They scrambled on to the shore over the ice blocks, but the next day there was a subsidence in the rivers, and the stream had turned the other way. They found their ship safe, and were able to get on to her again and to stop the leak. When the river again rose they were able to guide her into the little creek which the captain had originally intended to take her into. There they ran the ship ashore in order that she might be repaired and a new rudder (the old one having been carried away by the ice) made. All this occupied about a fortnight, and during that time at least 50,000 acres of ice, he calculated, had gone up stream. They afterwards heard that a lot of it had found its way into the forest, which was partially flooded, and there melted during the summer. At the end of 14 days they found themselves in the middle of a hot summer, and the river had risen 70 feet perpendicularly in the fortnight. Twenty-four hours after the snow had melted, flowers came out, the first being our common white anemone. By the end of the fortnight all the banks on the river were like an English garden run wild. Pansies and pinks and anemones, and all kinds of flowers were out, the trees began to burst into leaf, and the whole country swarmed with birds. As a rule he got five or six new birds, the greatest number being ten new species, in one day. All this was extremely interesting, but during the whole of this time Captain Wiggins was lamenting the injuries done to his ship. By and bye the steamers from Yen-e-saisk came down, and one of them brought the little ship he (Mr. Seebohm) had bought, but in consequence of Captain Wiggins' misfortunes they agreed to wait, and arranged that they should go down together as soon as he could get his new rudder made. They started the first week in July, but got upon a sand bank, and at the end of a week, after trying to get her afloat, the river had fallen so rapidly that the ship was left on dry land. They were obliged to leave her there, a monument of British pluck and blunder. The captain and crew did everything they could, and if the reports they gave him (Mr. Seebohm) of their adventures going up the river were true, the ship appeared to have had at least nine lives. The ship was lost at least ten times, and the captain was only fortunate in floating her nine times. One of the peculiarities one always found in an Englishman was the unlimited capacity to blunder, and his unlimited pluck and energy in extricating himself from the consequences of his blundering. However, he gave Captain Wiggins credit for having done everything that he could. The only thing left for him to do was to take his compass and a few extra sails and a few of his own men and go along with him (Mr. Seebohm) in his little vessel as far as he could. There they left the ill-fated *Thames*, and sailed in this little ship nearly a thousand miles. The whole country, when the thermometer was up to 90°, swarmed with mosquitos, which were so thick that when he raised his gun to fire, and was rather longer than usual about it, he had to sweep the mosquitos off before he could take aim and then fire his gun off rapidly. Captain Schwanenberg, of the other party, was without a ship, and was extremely anxious to buy theirs. They were, however, anxious not to sell it him. When the accident to the *Thames* had happened Captain Wiggins had made a bargain with him (Mr. Seebohm) to rig the ship with all his best rigging, and when they got to the mouth of the river to sell it and divide the proceeds. But the men refused to serve in her, and it was no doubt a madcap thing to attempt it. The end of it was that the ship was transferred to the Russian captain, and in her he sailed out of the Yen-e-say, had good luck not to meet with storms or ice in crossing the Kara Sea, and eventually got her down the Baltic to St. Petersburg, where she now lay in the Yacht Club premises as the only ship ever built in Siberia which had succeeded in reaching Europe. The feat was, however, entirely outdone by the journey of Nordenskiöld. He started out 4,000 miles from Halifax to Behring Straits, and at the end of 3,850 miles was frozen in and obliged to stop for nine months until open water again allowed him to come round to the Red Sea and across the Suez Canal, and round by England to Stockport, the most extraordinary Arctic expedition which had ever been achieved. Having disposed of their ship he (Mr. Seebohm) of course set his face homewards. They met some still more interesting and curious natives. For instance the Samoyades, living almost entirely in the winter by the chase, and in the summer roaming the forests, and spending their time in fishing. Another race frequented the river Khatanga, and were called Dolghans, and another were the Yakhuts, a copper-coloured race. He took the numerals from 1 to 20, and found those of the Dolghans to be much the same as those used in Constantinople at the present time. Their religion is like that of the North American Indians. There was also another race, the Yuraks. Reindeer travelling was about the swiftest kind of travelling one could have. For fifteen miles they never once stopped, galloping the whole time. When he reached Yen-e-saisk he had the good fortune to meet a Pole, and they travelled the overland route together. All the travelling had now to be done on wheels. To show of what importance their letters of introduction were, he might tell them that at one stage they were told they could not have any horses, as a general was coming that way and required them, but a Cossack rode 30 miles from the last stage to say that the general might go to Hong Kong, but the Englishman must have the horses. The travelling was extremely cheap. For the hire of their horses they only paid ½d. per mile ; they purchased excellent beef at 3½d. a pound, and grouse at 7d. per brace. On one occasion during the journey home they met a caravan with 15 tons of gold from the mines. The whole of the gold dug there had to be sold to the Government at a fixed price, and that was the reason the Russian Government did not become bankrupt. The total journey he (Mr. Seebohm) performed was 15,000 miles, occupying from seven to eight months. In conclusion Mr. Seebohm said—Siberia is not the desolate country it is sometimes supposed to be, but may prove to be a second Canada. In the course of centuries America may become so thickly populated that people will have to find some place further west to which to emigrate, and in that way possibly Siberia may be peopled by English speaking races from that side.

34.—Notes on the Ornithology of the Farne Islands.

By Edward Bidwell.

[*Read 8th November*, 1882.]

The group of islands known as the Farnes, ever memorable as the scene of one of the most touching examples of female heroism, lie off the northern part of the Northumberland coast.

Formed of basaltic rock and exposed to the full fury of the north sea, with its strong gales, one does not expect to find much vegetation on the islets (over twenty in number), which are dotted about, at distances of two to five miles from the mainland. Some of the smaller are nothing but bare rock, but several of the larger islands are partially covered with earth and these are brightened by the flowers of the sea campion, the sea pink, and the rag wort, and two of them, the Farn and the West Wide-open, afford a scanty pasture to some half dozên sheep and a few rabbits. The seal breeds on the Crumstones, one of the outlying rocks. But the glory of the islands is their bird life, about which I have been asked to speak to you this evening. I have only twice been able to spare the time for a trip to this interesting place, once early in June, when unfortunately a gale which lasted for several days prevented a boat being launched until nearly the end of the limited time at my disposal, and again in the first week in August, 1881, I spent two days here for the purpose of procuring a few specimens of the birds.

In the Ornithology of Francis Willoughby, published in 1678, we find the first reference to the Birds of the Farne Islands. In 1661 Willoughby and Ray, passing through the county of Northumberland on a botanical tour to Scotland, stayed at Sir William Foster's house at Bamborough. Although within sight of the Farnes they did not visit the islands, but whilst there Willoughby evidently obtained the information embodied in the seventh chapter of his first book, which I have copied from the English edition, translated by the "illustrious Ray."

In enumerating the various breeding stations on the British coast he says:—"The Farne Islands, near a village on the coast of Northumberland called Bambergh, famous for an ancient castle built on a rock, now almost ruined. The birds which chiefly frequent and build upon these islands in summer time are—

1st. St. Cuthbert's Duck, called by Wormius as I suppose Eider. This is never seen but in breeding time, and as soon as her young ones are hatched takes them to sea, and never looks at land till breeding time next. It is proper to these islands, and breeds nowhere else about England that we know of.

2nd. Guillemots or Sea Hens, *i.e.*, *Lomwiæ Hoieri.*

3rd. The Scout, *i.e.*, *Alka ejusdem.*

4th. Counter-nebs or Coulter-nebs *hic dictæ*, *i.e.*, *Anates Arcticæ*, *Clusius.*

5th. Scarf, *i.e.*, Cormorants, or perhaps Shags.

6th. Puffinets, which name argues to be Puffins, but the description here given us of them (for we saw not the bird) agrees rather to the Basse Turtle.

7th. Several sorts of Gulls, viz.:—

1. Mirecrows, all white bodied, only having black heads, and somewhat bigger than Pigeons, by which description we conclude them to be Pewits.
2. Annett, small white Gulls having only the tips of their wings black and the bill yellow; perhaps the Black-footed Gull.
3. Pickmires, or Sea Swallows.
5. Terns, the least sort of Gull, having a forked tail.

8th. Sea Piots, *i.e.*, Sea pies, *Hæmatopus Bellonii.*"

These birds, whose names sound rather strange to us are perhaps more familiar as—

1st.	St. Cuthbert's Duck	The Eider.
2nd.	Guillemots	The Guillemot.
3rd.	Skout	The Razor Bill.
4th.	Coulter-neb	The Puffin.
5th.	Scarf	The Cormorant.
6th.	Puffinet	The Black Guillemot.
7th.	Gulls	
	A Mirecrow	The Black-headed Gull.

Still called the Pewit Gull in many parts of England, and called the Pewit in Willoughby.

	B Annets	The Kittiwake.

A provincial name still in use in the North of England.

	c Pickmires	The Tern.
8th.	Sea Piots	The Oystercatcher.

Frequently known as the Seapye.

As Willoughby probably obtained his information from his host, Sir William Foster, who at that early date had a small collection of "stuft" birds, and from the Bamboro' fishermen, it is remarkable that his list is so correct. With two exceptions these birds are found to breed on the islands at the present time. The Black Guillemot, according to Selby, in his day bred in the Isle of May some sixty miles further north, and so may formerly have frequented the Farnes; but the Black-headed Gull, being an inland breeder, could hardly have resorted thither for nidification.

It is not a little curious that the majority of the species frequenting the Farnes in any quantity, for breeding purposes select different islands for their stations. For instance the Cormorants are entirely confined to the Megstone, a rock inaccessible except in quite smooth water. They have tried on several occasions to establish a colony on the South Wamses, but the Lesser Black-backed Gulls, which breed in great quantities on this island, were too much for them, and being unable to hold their own, they soon had to retire to their old quarters. The Sandwich Terns are confined to the Knoxie (the northern end of the West Wide-open) and the Longstone. The Common and Arctic Terns have colonies on the same islands and on the Brownsman. The Puffins breed only on the North Wamses and the Staples. The Guillemots and the Kittiwakes resort to the Pinnacles and the Skeney Scar end of the Staples, whilst the Eider and the Lesser Black-backed Gull are more widely distributed.

The only small bird that breeds on the islands is the Rock Pipit—*Anthus obscurus* (Latham) a bird which was first recognised as a distinct species by British Ornithologists. It is purely a shore bird. In its actions it much reminds one of a wagtail as it runs from rock to rock, searching for its food amongst the seaweed thrown up by the tide, and it is constantly in the nesting time, enlivening the scene with its short but cheerful song, which seems strangely at variance with the screaming of the sea birds and the surging of the water against the rocks. Its nest, composed of dry grass, is placed amongst the crevices of the rocks, or under a tuft of tall grass, and is not at all easy to find except by careful watching. Professor Newton notes that a curious fact in the distribution of this bird, is, that it breeds on the whole of the English coast with the exception of that part between the Thames and the Humber.

The Ringed Plover (*Charadrius hiaticula, Linnæus*) breeds in limited quantities, as there are not many spots suitable for its nest, if such we may call, the slight cup shaped hollow in the sand, neatly paved with small stones, in which this bird deposits its four pyriform eggs with the smaller ends downwards. Sir Thomas Browne, the father of English Oologists, curiously describes their position in the nest, on the authority of the "Eringo diggers" as "That they were set upright like eggs in salt." These nests often remain perfect for a year or two after the young birds have left. On a small stretch of sand on the Wide-opens I found a nest placed just above high water mark on the 1st August, containing a clutch of four eggs.

A few pairs of Oyster Catchers *(Hœmatopus ostralegus, Linnœus)* resort to the Islands every summer, depositing their eggs in the same situation as the Sandwich Tern. This bird may be considered a grand addition to the avifauna of any locality. Its striking plumage of black and white and bright orange bill, being very conspicuous as it stands on some point of rock at the water's edge, or skims with outstretched wings round the rock-bound coast. When in Holland in winter time I have been often struck with the enormous flocks of these birds dotting the dark mud at low water as far as the eye could see.

The Turnstone *(Strepsilas interpres, Linnœus)* may be seen here quite late into the summer. In the first week in June I have seen hundreds evidently on passage to their northern haunts, and again in July and August they may be seen in small numbers. I have shot them on August the 1st.

The Eider Duck (*Somateria mollissima, Linnœus*) is probably the bird of greatest interest to the English ornithologist, who here sees, in its most southerly and only English breeding station—if we except the Coquet Island, some ten miles further south, where one or two pairs occasionally breed. The nest of this bird is placed in various situations, sometimes in the crevices of the shelving rocks, sometimes in the coarse vegetation. I have found several in the large patches of nettles on the Wide-opens, and when thus placed they are probably much more safe from the marauding propensities of the Black-backed Gulls. Although Eider down is an article frequently spoken of, I suppose that comparatively few people have seen it pure and unadulterated, and it must be seen in its pure state for one to form any idea of its wonderful elasticity. In June, 1880, I found a nest placed in a triangular fissure of the rocks, it contained six eggs. I carefully collected every scrap of down that I could see. On my return home I picked out all the grass, lichen, &c., that was mixed in it, and I have brought it to-night for your inspection. Its weight is just over half-an-ounce, it quite fills a box measuring 624 cubic inches, but you see that I have packed it into 12 cubic inches. I may add that although the full complement of eggs had been deposited the duck had hardly commenced incubation, so that probably the amount of down would have been nearly doubled if the bird had been left undisturbed.

During each of the last three summers a male King Eider (*Somateria spectabilis, Linnæus*), one of the rarest of our *Anatidæ*, has been seen frequently, but as the duck of this species can hardly be distinguished from the female of the common Eider except at close quarters, it is impossible to say whether he has been accompanied by his mate, during his sojourn in such a southerly spot for this bird to frequent in the summer. Its eggs properly authenticated are rare in collections, as its breeding haunts are in the far north.

The only other duck that has been known to breed here is the Shelduck (*Tadorna vulpanser, Flem*), and this only once within the last few years. It nests, however, in the rabbit holes that abound amongst the long grass of the links on the mainland, especially north of Bamborough, and during the breeding season, the drake, in his variegated dress of black, white, and chestnut, may frequently be seen in the neighbourhood of the islands.

We now pass on to another group, sometimes called the Diving and sometimes the Rock birds, and chief amongst these is the Guillemot *(Uria troile, Linnæus)*. Mr. Seebohm has written such a vivid description of his visit to their stronghold that I cannot do better than give you his account of it.

"The breeding season is the time when the Guillemot's habits are most interesting and the easiest to observe. During that period, which commences in May and lasts up to August, the birds are confined to certain localities—the rocky headlands and the isolated rocks. Amongst the breeding-places of the Guillemot the cliffs at Flamboro' and Bempton probably stand unrivalled, so far as the British Islands are concerned, but I know of no place where sea-birds can be studied to greater advantage than at the Farnes. I have visited these islands many times and every time I have been more charmed than before. But very few Guillemots are to be seen on the Farne Islands or the neighbouring coast during winter. The lighthouse-keeper told me that they make their first appearance *en masse* in March, visiting the "Pinnacles" about sunrise at first and remaining but a very short time, disappearing out to sea again. Every day they make a longer stay than on the previous one, and about the beginning of May they begin to lay and then remain altogether. The few Guillemots, in the opinion of the light-men, seen during the winter, are not birds bred on the Pinnacles, but come from the far north. On the Farne Islands there is but one breeding station of these birds, the islands being naturally low, and affording them but little accommodation. The first colony of birds that we visited on one of my visits to these islands was that of the Guillemots. Whilst our little craft was scudding along before the wind, the mast bending to the sail, and sometimes too far removed from the perpendicular to be altogether agreeable to our landsmen's nerves, especially when our lee bulwark dived just under water for a second or two and the spray dashed over us, we could see, some two miles ahead, a group of rocks called "The Pinnacles," standing out conspicuously, like great white-washed rocks in front of one of the islands. They stand some 50 feet from the cliffs of the adjoining island, of which they at one time probably formed a part, and are some 40 feet high, the summit of each being a tolerably level platform, about 12 or 15 feet square. The top and more than half-way down the sides is completely white-washed with the excrement of the birds, and on the leeward side the smell of guano is strong, but not very offensively so, as the lime almost overpowers the ammonia and entirely absorbs the sulphuretted hydrogen. The top of these "Pinnacles" at the time of our visit was one dense mass of Guillemots, and as we approached all became excitement. Streams of Guillemots poured off every corner in long strings like Wild Ducks, but for some time the dense mass seemed to get no less. In every direction shoals of Guillemots were hurrying and skurrying away over the sea almost as far as the eye could reach. Some desperate individuals took a header from the top of the rocks and flinging out their legs so as to make a three-fold rudder with their tail, plunged at once into the sea and dived out of danger. By the time we had landed an anchor the rocks were nearly cleared, and for a mile or more away the sea seemed covered with birds. The flight of the Guillemot is heavy and laborious, though rapid, reminding one of that of a Kingfisher or a Hawk Moth. We were able to climb some distance up the "Pinnacles," and a good ladder we brought with us from the next island landed us at the top. On the lime-washed top of each pinnacle were some thirty or forty eggs. looking exactly as if a smart gust of wind would sweep off the lot. Not the remotest vestige of a nest of any kind was there. The rock having recently been cleared of eggs those we found were nearly all fresh laid, very clear and looking most beautiful on the dark rock, especially the dark green eggs. The Guillemot only lays one egg, indeed it could not sit upon two, the egg being enormously large for the size of the bird, which does not sit upon it on its breast, like a duck for instance, but rests upright on its tail. As we were leaving the rocks we saw an anxious maternal Guillemot alight behind her egg, which, with a quiet poke of her bill, she pushed between her legs. The Guillemot's egg is laid bare and exposed on the face or summit of the cliff, without any attempt being made to conceal it, nor is it fastened to the cliff by any glutinous substance, as we are sometimes told is the case by persons who have never visited the bird's lofty nesting-place."

That well-known variety of this bird with a narrow white ring round its eye continued in the form of a narrow line down the neck for about an inch, by many people thought to be a distinct species and commonly called the Ringed Guillemot, occurs, Mr. Seebohm says, in about the proportion of one to ten.

The Razor Bill (*Alca torda*, *Linnæus*) though in many other localities breeding with the Guillemot—which it resembles in its habits as well as in its appearance—occurs here in very small numbers, I should say in a much smaller proportion than at either Bempton or the Bass. Being a much more wary bird it is not so easily identified, and as a proof that the bird is rare here, I may mention that the keeper showed me a single egg amongst hundreds of Guillemot's eggs, by which he set great store as it was the only one he had taken that year (1880).

The next bird on our list is the Puffin (*Fratercula arctica, Linnæus*), which has colonies here on the Wamses and the Staples. Selby, who lived within a short distance of the Farnes, and was a frequent visitor to this interesting group, writes:

"Many resort to the Fern Islands selecting such as are covered with a stratum of vegetable mould, and here they dig their own burrows, from there not being any rabbits to dispossess upon the particular islets they frequent. They commence this operation about the first week in May, and the hole is generally excavated to the depth of three feet, often in a curving direction and occasionally with two entrances. When engaged in digging, which is principally performed by the males, they are sometimes so intent upon their work as to admit of their taken by hand."

At the further end of this hole the single egg is deposited, and from its being laid on the bare ground it soon becomes covered with soil, and so peat-stained that its original colour is quite hidden.

The Megstone is less often visited than most of the other islets, as except in extremely calm weather it is impossible to land, and as a strong wind was blowing each time that I was in this neighbourhood, I was unable to study the Cormorant (*Graculus carbo, Linnæus*) in its breeding haunts.

The Shag or Crested Cormorant (*Graculus cristatus, Faber*) very rarely nests here; the last record of it being in 1873.

We now come to the most beautiful group of birds—the Terns, of which there are four species that I must bring under your notice. It is a sight not easily to be forgotten, as in sailing out to the islands one passes near where a flock of these birds are feeding, and sees their light airy flight—now suspended in mid-air for a second, now skimming the surface of the water and taking a small fish, without seemingly touching the sea—things of buoyancy and life, glorious in the sunlight. One hardly knows which most to admire, the Common and Arctic with their long tail feathers, pure white underparts, silvery grey mantles and black crown set off by the coral red of the bill, or their larger congener, the Sandwich, with its more powerful flight, its black and yellow bill, and the black patch on its head broken by a splash of white feathers on the forehead. Or again, how touching the sight if one of these birds falls to the gun of the collector; to see the sympathy shown by its fellows as they dash down to their wounded companion, screaming piteously the while, is enough to make the most ardent sportsman regret the success of his shot.

> "Have they no feelings, or does man pretend,
> That he alone can make and mourn a friend."

In years gone by the Sandwich Tern *(Sterna cantiaca, Gmelin)* nested at the mouth of the Thames, and it takes its name from having been first recognised as a species by Dr. Boys, of Sandwich, in Kent, but the destruction of its old breeding haunts at Yantlet, have deprived the Londoner of any chance of seeing one of the most beautiful sights in the bird world, without a long run to the north. Though breeding on some of the same Isles as the two common species, the Sandwich Terns always form a colony by themselves. Their two beautiful eggs are deposited generally without any nest on the fine shingle, the similarity of their markings and colouration to the surrounding objects being their greatest protection. These birds are particularly jealous of interference, and if disturbed whilst breeding will frequently change their locality, sometimes deserting a spot for several seasons, on account of having had their eggs taken.

By far the most exquisite of the birds mentioned this evening —if not of all our British Birds—is the Roseate Tern *(Sterna dougallii, Montagu)*, so called on account of the lovely pink tinge with which its breast is suffused. Still, in spite of persecution, it is found again and again endeavouring to maintain its place in its old haunts. In the summer of 1881 three magnificent specimens of this bird were shot here, its extremely long and elegant tail feathers helping to prove its identity when on the wing.

The Common *(Sterna fluviatilis, Naumann)* and the Arctic Tern *(Sterna hirundo, Linnæus)*, are in about the same proportion. Frequently flying together, and with their nest in the same situation, it is hard to procure well authenticated eggs of these two species, although they are in such numbers—the only plan being to find out a small colony, and carefully watch the birds with a field glass from some hiding place.

Of the three species of Gull met with, the Lesser Black backed (*Larus fuscus*) is by far the most numerous. In spite of its eggs being taken by the bushel for domestic purposes, and the quantity of young birds destroyed by the ruthless shooters—I cannot call them sportsmen—who yearly make pleasure parties for the sole aim and purpose of committing the indescriminate slaughter of any birds that may come within range—these Gulls still keep up their numbers. Their nests are placed quite thickly on some of the Islets.

There are commonly reported to be a few pairs of Herring Gulls (*Larus argentatus, Linnæus*) on the Staples, but I must admit I never identified one. I have heard their numbers spoken of as some three pairs of breeding birds, but strange to say in the photograph of the Gulls on the rocks, taken last summer by Mr. Green, the majority are of this species instead of the Lesser Black-backed Gull.

The last of the breeding birds, the Kittiwake (*Larus tridactylus, Linnæus*) places its nest on the ledges, by the side of the Pinnacles and Skeney Scar, in the immediate vicinity of the Guillemots.

Placed as the Islands are one might expect a good many stragglers, especially at the time of the spring and autumn migrations, but the list of winter visitors and other birds that have occasionally been met with, though interesting, would be much too long for me to give you. I may just mention that some birds, which one would hardly expect to meet with, have been procured, for instance, although there is not a single tree or bush, the Tree Creeper has been found, and so has the Pied Flycatcher. The reports from the two light stations, afford a valuable amount of information to that useful but inadequately supported work—"The Report on the Migration of Birds," by Messrs. Harvie-Brown & Cordeaux.

Wallis in his Natural History of Northumberland, published in 1769, on page 340 of Vol. 1, records the capture of the Great Auk, in the following words:—

"The Penguin, a curious and uncommon bird, was taken alive a few years ago in the island of Farn, and presented to the late John William Bacon, Esq., of Etherston, with whom it grew so tame and familiar, that it would follow him with its body erect to be fed."

Croydon Microscopical and Natural History Club.

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PROCEEDINGS

AND

TRANSACTIONS

OF THE

Croydon Microscopical and Natural History Club,

FROM

FEBRUARY 14th, 1883,

TO

JANUARY 9th, 1884.

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Selecta Fungiorum Carpologia, 3 vols.—*Tulasne*
Illustrations of the Genus Carex, 4 vols.—*Boot*
Publications of the Palæontographical Society; a complete set
Withering's Botany, 4 vols.
Royal Society—Abstracts of Proceedings, 1801 to 1872, 20 vols.

Lent by Mr. Mennell.

Transactions Tyneside Naturalists' Field Club, vols. 1 to 6
Nat. Hist. Trans. Northumberland and Durham, vols. 1 to 7
Daniel's Meteorology, 2 vols.
The Letters of Rusticus, 1849
Handbook of the Yorkshire Vertebrata
Natural History Reviews, 3 vols.
British Poisonous Plants.—*Sowerby & Johnson*
The Common Frog.—*St. George Mivart*
Origin and Metamorphoses of Insect
British Ferns.—*Newman*
Flora of Essex.—*Gibson*

Ordinary Meeting, 14*th February*, 1883.

John Berney, Esq., F.R.M.S., President, in the Chair.

Before calling upon the Secretary to read the minutes, Mr. Berney thanked the Club for the honour which they had done him in electing him President.

The minutes of the Annual Meeting, held on the 10th January, were then read and signed.

Mr. Hermann Moore was duly elected a member of the Club.

The following donations were announced: — "Science Gossip" from the publishers; the Weather of 1882, as observed in 1882 in the neighbourhood of London, and the Rosarian's Year Book for 1883, presented by Mr. Edward Mawley; Procès Verbaux Soc. Malacologique de Belgique, 1882; and of the Belgian Microsc. Soc.; List of Foreign Correspondents of the Smithsonian Institution, January, 1882; Annual Report of the Brighton and Sussex Natural History Society, 1882; Notes and Observations on British Stalk-eyed Crustacea, from Mr. Edward Lovett.

The President called the attention of the members to the conversational meetings which are held on the fourth Wednesday in each month.

The President announced that, in response to a very generally expressed wish, the Committee had decided that in future the meetings would begin at eight o'clock instead of at 8.30.

The President gave notice that the soirée of the Walthamstow Microscopical Club would be held on the following Monday, and that anyone who could exhibit would oblige by sending his name at once to the hon. sec., Mr. Goldthwaite.

Mr. Edward Lovett then read the report of the Entomological Section of the Zoological Sub-Committee. *(See Trans. Art.* 35.*)*

After some remarks from the Rev. E. M. Geldart and the President, the Club passed a vote of thanks to Mr. Lovett.

The President stated that he regretted to have to announce the death of Mr. Hudson, F.R.S, of Clapham Common, who was one of the early members of the Club.

The following objects were exhibited, viz. :—By the President, a large series of lepidoptera, embracing many rare and local insects from the neighbourhood of Croydon; Mr. Edward Lovett, cases of insects, illustrating the protective resemblance of insects to the objects upon which they rest, hybrid of *S. ocellatus* and *S. populi*, &c.; Mr. Collyer, specimens of lepidoptera captured in the Croydon district; Mr. Low Sargeant, portable incandescent lamp and battery, also microscopic photographs taken by means of this lamp; Mr. N. Waterall, two pieces of marble from Italy, believed to have been procured from the Coliseum of Rome.

Ordinary Meeting, 14*th March*, 1883.

John Berney, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The President stated that it was with very great regret that he had to announce the death of Dr. Foottit, who was an old and valued member of the Club.

The President gave notice that the annual soirée of the New Cross Microscopical Society would be held on the 4th April, and that the co-operation of members was invited.

Mr. William Castle Turner was duly elected a member of the Club.

The following donations were announced :—The Journal of the Northamptonshire N. H. Soc., February, 1883; Report of the South London Entom. Soc., 1882; and the Journal of the Royal Microscopical Society.

The President reported that at the last conversational meeting Mr. W. Low Sargeant gave a demonstration of staining and mounting vegetable tissues. Mr. Sargeant showed firstly the method of embedding the tissue in paraffin wax and of cutting transverse, diagonal, or horizontal sections, the apparatus being of his own designing; secondly, the bleaching process by means of chlorine gas; thirdly, both methods of double staining, viz., by aniline dyes and by ordinary colours, carmine and logwood, each process requiring different treatment; fourthly, fixing the colours in absolute alcohol; fifthly, clearing the section in oil of cloves and washing off the superfluous oil with benzol; and, lastly, mounting the section in dammar and mastic. The members gained many valuable hints.

The PRESIDENT announced that an Excursion Sub-Committee had been formed with a view to making arrangements for excursions during the summer.

The Rev. GEORGE BAILEY, M.A., then read his "Notes on Parasites in some Mollusca," the results of his own observations and research. *(Trans. Art.* 36.*)* In the discussion which ensued the PRESIDENT, Mr. LOW SARGEANT, Mr. LOVETT, and Mr. W. J. FULLER took part. A vote of thanks was accorded to Mr. Bailey.

Mr. HENRY TURNER read a paper entitled "Lowly Forms and their Labours." After some remarks from Mr. JOHNSON, Mr. BAILEY, and Mr. FULLER, the meeting was brought to a close by a vote of thanks to Mr. Turner.

The following objects were exhibited:—Mr. Low Sargeant (under his microscope), tadpole of frog, showing ciliæ on the surface of the skin; Rev. George Bailey, paleolithic flints from the Hackney gravels; Mr. Edward Lovett (under his microscope), pupa form of ichneumon of Arctia Caja; Mr. W. Gibson (under his microscope), young of broad claw crab, *porcellana platycheles.*

Ordinary Meeting, 11*th April,* 1883.

JOHN BERNEY, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and confirmed.

Mr. Charles Ernest Morland was duly elected a member of the Club.

The CHAIRMAN announced that at the next conversational meeting (April 25th) Mr. Suffolk would attend to illustrate by means of the microscope Abbé's Diffraction Theory.

The following donations were announced:—Transactions of the Ottawa Naturalists' Field Club, vol. I., 1879-80; Check List of Coleoptera of America, north of Mexico; two new Potamogetons, by Arthur Bennett, F.L.S. (reprinted from the Journal of Botany), all presented by Mr. Bennett; "Natural History Notes" for April; fifth Annual Report of the Erith and Belvedere Nat. H. Soc.; "Science Gossip" for April;

Essays on the Microscope, by the late George Adams, 1798, presented by Mr. Bonella.

The PRESIDENT then called upon Mr. GEORGE PAYNE, F.S.A., to deliver his lecture upon "Romano-British Interments, including discoveries in glass, bronze, and pottery." *(Trans. Art.* 37.*)*

Upon the conclusion of the lecture a discussion took place, the speakers being Mr. TYLER, Mr. SKERTCHLEY (Geological Survey), Mr. HENRY TURNER, and Mr. C. C. MORLAND.

Mr. PAYNE having replied to and commented upon the remarks of these gentlemen, the PRESIDENT proposed a vote of thanks to him, which was carried with acclamation.

The following objects were exhibited :—Mr. Payne, a fine series of glass, pottery, and ornaments, including gold and jet armillæ, a finger ring, &c., and also Saxon glass tumblers; Rev. George Bailey, photographs of, and specimens of ware from a barrow, opened in Yorkshire; W. Low Sargeant (under his microscope), stephanoceros (alive); H. Turner, hydra viridis (alive); Edward Lovett, case of 72 microscopic preparations of the smaller forms of marine life, mounted for the International Fisheries Exhibition.

Ordinary Meeting, May 9th, 1883.

JOHN BERNEY, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The PRESIDENT announced that on Whit Monday, May 14th, the Club would make an excursion to Worth and Tilgate Forests, under the guidance of Mr. Topley.

The following donations were announced :—The Journal of the Royal Society; "Science Gossip" for May; Movements of Diatoms, by Jabez Hogg, presented by Mr. Sandeman; "Notes and Observations on the British Stalk-eyed Crustacea," presented by Mr. Lovett.

The PRESIDENT then called upon Mr. H. M. KLAASSEN, who read a paper entitled "The Park Hill Section on the Woodside and South Croydon Railway."

A discussion ensued, in which Messrs. EATON, MENNELL, and LOVETT took part.

Mr. KLAASSEN replied, and a vote of thanks was passed to him, the PRESIDENT remarking that Mr. Klaassen's paper was quite distinct from the report which would be presented by the Geological Sub-Committee.

The following objects were exhibited :—Mr. K. McKean, eggs of perch (showing young about to emerge, under microscope); Mr. Edward Lovett, young of long-horned porcelain crab, *porcellana longicornis* (under microscope), Croydon flints, containing fossils; Mr. W. Low Sargeant, *Lacinularia socialis*, *Vorcitella*, &c. (under microscope); Mr. Klaassen, map of section of Park Hill beds exposed in the new cutting, also drawing of a new fossil shell (perna), discovered by Mr. Henry Turner, and bones of coryphodon, a mammalian allied to the tapir and horse; Mr. J. E. Syms, section of limestone with foraminifera (under microscope).

Ordinary Meeting, September 12th, 1883.

JOHN BERNEY, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The PRESIDENT announced that the paper which would be read in October would be "A Week in the Fens," by A. B. Farn, Esq. He also announced that the committee had made arrangements for the Club to visit the Zoological Gardens on Saturday, the 29th September.

The following donations were announced:—Report of the Hampstead Naturalist's Club; Report of the West Kent Micros. and Nat. Hist. Society; "Science Gossip" for June, July, August, and September; Journal of the Northamptonshire Nat. Hist. Society; Journal of the Royal Micro. Society, June and August.

Mr. G. C. CHISHOLM then read a paper entitled "Endemic Species and their Lessons." Mr. Chisholm commenced his paper by pointing out the important bearing of the facts of geographical distribution on the theories of the origin of new species, and the influence such facts had on the minds of Darwin and Wallace in directing them to the solution of the problem which is associated with their names.

He then proceeded to review the facts of the occurrence of endemic species, that is to say, species peculiar to certain regions, and found nowhere else, such species being specially abundant in islands remote from the mainland, thus each of the Canary Islands, each of the Sandwich Islands, each of the Galapagos, the Island of St. Helena, all possess such peculiar species. It has also been found by Engler that in those islands which lie at no great distance from the mainland but have been severed from it for a long period, the endemic genera of plants are represented by one or few species; in those at a greater distance from the mainland the endemic genera are less numerous, but consist of more numerous species. In islands separated in recent geological time the flora consists mainly of introduced species.

Isolated regions of the mainland also possess these endemic types, and especially the drier regions of the globe. Darwin has further pointed out that the endemic species of islands are related to those of the nearest continent or larger island, and Wallace and Engler have confirmed this fact. These writers have therefore pointed out that the smaller islands must have originally derived their fauna and flora from the regions to which they still show a relationship, but the species have become modified in process of time in their new homes, and have become specifically distinct. The flora and fauna of the Sandwich Islands, Mr. Chisholm pointed out, is especially interesting, and strongly confirms this view. Mr. Chisholm then proceeded to discuss the alternative theories which have been put forward. First, that the species which are now peculiar to their present restricted region may have died out altogether in other neighbouring countries, and thus the hypothesis of modification may be eliminated. Second, the old theory of the independent creation of each species in its present habitation—a theory which, to use the words of Asa Gray, "can only be regarded with sterile wonder."

To the first of these theories, doubtless, some species now endemic in limited areas owe their present isolation, but only in comparatively few cases will this account for the fact, and to local modification we must attribute the larger number of endemic forms.

Mr. Chisholm then proceeded to work out in ampler detail the facts, and the conclusions to be deduced from them, arguing especially from the present fauna and flora of the Sandwich Islands and the Fiji Islands, and the geological history and antiquity of both groups. He also pointed out how favourable the very dry regions are to the formation of varieties from the absence of the competition of the abundant vegetation, which distinguishes moister regions, thus favouring the development of the few forms suitable to them.

In conclusion, Mr. Chisholm summed up the important bearing upon, and confirmation of the derivative origin of species which the facts adduced in his paper possessed.

A discussion followed, in which Mr. W. F. Stanley, Mr. Topley, and Mr. Fuller took part.

Mr. Chisholm replied to the remarks which had been made, and the President proposed a vote of thanks to him for his valuable paper.

The following objects were exhibited :—Mr. Sturge, eggs of stone mite on granite (under microscope), fossil lobster, Oldhaven sands, Park Hill, bees impaled on thorns by butcher birds, shells of genus Rissoa; Mr. Crowley, a very fine series of silk producing moths, including *attacus atlas* and others, also living larvæ of several species; Mr. Lovett, *Argulus foliaceus* preserved in fluid (under his microscope), a starfish (*Uraster glacialis*), over 18 inches in diameter, caught on a deep sea line off Jersey, also scavenger beetles at work from Tilgate Forest; Mr. Low Sargeant, *Argulus foliaceus* (alive, under microscope, polarised), some excellent photographs of views and of members of the party taken during the excursion to Guildford in August.

Ordinary Meeting, October 10th, 1883.

JOHN BERNEY, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The following gentlemen were elected members of the Club:—E. Garnet Man, Esq., and Wm. Aldridge, Esq.

A "List of Ephemeridæ found in the neighbourhood of Croydon," by the Rev. A. E. Eaton, was taken as read. (*Trans. Art.* 38.)

The PRESIDENT announced that on the 29th September a number of members of the Club, accompanied by some ladies, paid a visit to the Zoological Gardens, and that, although the weather was wet, a very pleasant afternoon was spent there. The President also announced that on the 14th November a paper would be read by Howard Saunders, Esq., F.Z.S., upon the "Fauna of Spain." He then read a letter which he had received from Mr. N. Waterall, describing how a starling, having become entangled in the branches of a tree by means of a piece of string which was fastened to its leg, was fed by a thrush.

The following donations were announced:—Journal of the Northamptonshire Nat. Hist. and Field Club (No. 14); 6th Annual Report of the Hackney Micro. and Nat. Hist. Soc.; "Science Gossip" for October; Report of the South London Micro. Soc.

Mr. A. B. FARN then read a very interesting paper entitled "A Week in the Fens or Broads of Norfolk." (*Trans. Art.* 39.)

After a short discussion, in which the Rev. E. M. GELDART, Dr. CARPENTER, Mr. STRAKER, Mr. MCKEAN, Mr. FULLER, and Mr. HENRY TURNER took part, the meeting passed a hearty vote of thanks to Mr. Farn.

With the permission of the President, Dr. CARPENTER then called the attention of the members of the Club to the scheme for the enlargement of the Public Hall, and stated that collectors were about to go round for subscriptions to defray the cost of such enlargement.

The following objects were exhibited:—Mr. Crowley, collection of nests of birds, in illustration of Mr. Farn's paper; Mr. McKean, *Perca fluviatilis*, just hatched, ten embryo shells taken from one specimen of *Sphærium rivicola;* Mr. Low Sargeant, *Volvox globator*, gathered early in June and placed in an aquarium, where they have increased until the water is green with them; James F. Rymer, human retina; H. F. Parsons, M.D. (1) wood stained green by mycelium of a fungus *(Heliotium æruginosum)*, (2) piece of charred wood, found under 8 feet of peat on Goole Moor, Yorks, relic of an extensive ancient forest, mostly pine, destroyed apparently by human agency, (3) portfolio of rare British plants collected in 1882-1883; J. G. B. Brewer, a tray of fungi and lichens from Addington; J. E. Syms, *Chelifer caucoides;* A. Warner, human fœtus, section through neck, stained, also a simple tray for storing objects, and a list of sections prepared foi mounting for students in animal histology.

Ordinary Meeting, November 14th, 1883.

John Berney, Esq., F.R.M.S., President, in the Chair.

The minutes of the last meeting were read and signed.

The following gentlemen were balloted for and duly elected members of the Club:—John Lloyd, J. W. Fairley, Peter Paget, jun.

The following donations were announced:—Journal of the Royal Micro. Society; "Science Gossip" for November; the Address of the President of the Sutton Scientific Society; the Address of the President of the Ealing Micro. and Nat. Hist. Society.

The President announced that at the December meeting Mr. Low Sargeant would read a paper upon the Photography of Microscopal Objects.

Mr. Howard Saunders, F.Z.S., then read a paper upon "The Fauna of Spain." *(Trans. Art. 40.)*

After a few observations by Mr. Topley, the meeting passed a cordial vote of thanks to Mr. Saunders.

The following objects were exhibited:—James Epps, jun. (under microscope), *Dasya coccinea* and parasite of swallow; Mr. Low Sargeant, snake *(Coluber natrix)*, from Tunbridge Wells; K. McKean, a rare *Ephemera* (under microscope), also shells of helix aspersa; Edward Lovett (under microscope), *Leptodora hyalina* (new to Britain), also a natural model representing moths at sugar; J. E. Syms, a beetle (*Tingis crassicornis*), under microscope.

Fourteenth Annual Soiree.

The fourteenth annual soirée was held on Wednesday, the 22nd November, 1883. The attendance of members and their friends again shows an increase, having been 815, viz., members, 151; exhibitors (non-members), 69; visitors, 595.

The number of microscopes placed at the service of the company was again less than formerly, being only 102, the smallest number for many years. Whilst on some occasions the number of instruments might have been thought to be more than could be properly enjoyed, care must now be taken that this most important feature of the soirées maintains its old predominance and interest. The microscopes were contributed as under; Croydon, 42; Royal, 3; Quekett, 13; South London, 12; New Cross, 7; Greenwich, 3; Sydenham and Forest Hill, 3; Tower Hill, 2; Lambeth, 1; unattached, 8. Members of the South London Entom. and the Entom. Soc. of London also contributed other exhibits, as did 29 other members of the foregoing clubs not credited with microscopes.

The floral decorations were again the object of general admiration, and were again contributed by our vice-president, Mr. Crowley.

Mr. Laughlin's band, as usual, enlivened the proceedings of the evening, and the refreshments were dispensed by Mrs. Pusey.

Among the exhibits calling for special remark the first place this year must be given to the grand series of exotic lepidoptera, exhibited by Mr. Crowley; amongst those specially attracting attention were the various silk producing insects, the leaf insects, and the splendid Peruvian diurnal lepidoptera.

A special feature of this year's exhibition were the numerous and excellent collections of British mollusca contributed by Mr. by McKean (chiefly local); by Mr. Mennell, land and fresh water; by Mr. Lovett, marine, especially such as are used for food; and by Mr. Jenkins, land and fresh water. Together, these collections formed an admirable and most instructive series.

Mr. W. H. Beeby's very fine series of British Cyperaceæ (sedges) and of other rare Surrey plants were well displayed on the wall of the Small Hall.

On these walls also were Mr. Topley's models and raised map of the South-Eastern portion of England and the opposite coast of France.

Mr. Edward Bidwell, whose peewit's eggs were such an interesting contribution last year, now showed 100 nests of various birds all containing a cuckoo's egg, admirably illustrating the vexed question of the powers of the bird to imitate in its own egg the colour of those amongst which it is laid.

Other exhibits were as follows :—

Scientific Instruments.—Mr. T. Cushing exhibited and explained the heliograph, used for signalling during the Afghan War. Dr. Rosser exhibited a steam carbolised spray diffuser, used for protecting surgical operations and amputations, in accordance with the antiseptic treatment of the eminent surgeon, Sir Joseph Lister, now almost universally adopted.

Natural History.—Mr. Sargeant had a number of very interesting aquaria tanks, illustrating an improved method of water circulation ; Mr. Thorp, a number of preserved animals, birds, &c.; Mr. Mawley, fresh flowers from Addington ; Mr. Drage, nests of weaver birds, &c.; Mr. Sturge, bees impaled by a shrike or butcher bird.

Geological.—Mr. Sturge, Mr. Cushing, and Mr. F. Jenkins were exhibitors in this section.

Antiquities, &c.—Mr. Berry, jun., a fine series of coins and medals, ; the President, Chinese curiosities.

Works of Art.—A large number of paintings by artists resident in Croydon and neighbourhood adorned the walls of the Hall. Among these were " Autumn on the Wandle," by Mr. J. T. Fletcher ; " Little Nell and the Old Woman," Mr. Walter Wallis, headmaster of the School of Art ; " An Exploring Party," " On the Brent," " On the Thames," by Mr. J. H. Drage ; " Winter in the Woods," Mr. H. M. Page ; " West Wickham Church," Mr. H. D. Turner, &c., &c.

The interest of the soirée was well sustained, and the general opinion of the numerous company present, and of the Press was that it had not been excelled by any of its predecessors.

The sale of tickets realised £31 5s.

Ordinary Meeting, December 12*th*, 1883.

JOHN BERNEY, ESQ., F.R.M.S., President, in the Chair.

The following gentlemen were unanimously elected members of the Club :—His Grace the Archbishop of Canterbury ; Edward Fredk. Benson, Esq.; J. Spencer Balfour, Esq., M.P. ; Bertram Alexr. Williams, Esq., L.D.S. ; W. Hancock, Esq., John Harwood, Esq., George Gurney, Esq.

The PRESIDENT announced that the Lambeth Field Club and Scientific Society would hold their annual Soirée at the St. Philip's Schools, Kennington-road, on Monday, the

7th January, and that assistance from Members of the Croydon Club upon that occasion would be welcome.

A letter from the Secy. of the Young Men's Christian Assoc., 49, North End, was read asking for the assistance of the Members of the Club upon the occasion of their Soirée, on Tuesday, the 18th December.

The following donations were announced: "Science Gossip" for December; Transactions of the Eastbourne Nat. Hist. Soc., January 1883 and May 1883; Smithsonian Report for 1881. On "*Najas marina* (L) as a British Plant," by Arthur Bennett; from the Author; "Chronicles of Croydon," by J. Corbet Anderson; presented by Mr. Waterall.

The Meeting passed a vote of thanks to Mr. Waterall for his present.

Mr. Low Sarjeant then read a paper, entitled "The Photography of Microscopic Objects, and Lantern Transparencies." Mr. Low Sarjeant practically illustrated his paper by taking Photographs of Microscopic Objects which were afterwards shown by means of a magic lantern upon a screen.

A short discussion followed the reading of the paper, in which Dr. Strong, Mr. W. F. Stanley, Mr. Brewer, Dr. Thompson, and Mr. McKean took part. The Meeting passed a vote of thanks to Mr. Sarjeant for his interesting paper.

The following objects were exhibited:—

Mr. J. E. Syms (under microscope) Transverse Section of *Rubus fruticosus*, stained in two colours; Mr. McKean (under microscope) Shell of *Helix aspersa*, showing crystals; specimens of *Anodonta Cygnea*, from various localities; a species of *Sphærium*, from the Wey and Arun Canal, Cranley; Mr. Ed. Lovett, large series of *Anodonta Cygnea*, from the River Wandle, at Mitcham; (under microscope) a Sandhopper—*Leucothoe articulosa*; Mr. Low-Sargeant, Apparatus for Micro-Photography, in illustration of his paper; Rev. G. B. Bailey (under microscope), section of Silicified coniferous wood, found with flint, from the chalk, at Lewisham; also *Atax Ypsilophora*, *parasite* on *Anodonta*; Mr. Sturge (under microscope), peat Moss litter, showing the structure of the Moss fronds in a dried condition.

14*th Annual Meeting*, 9*th January*, 1884.

John Berney, F.R.M.S., President, in the Chair.

Before commencing the business, the President explained that in consequence of an oversight at the last meeting of the

Club the appointment of Auditors in conformity with the rules had been omitted, but that the committee had requested Mr. A. A. Campbell and Mr. John Drage to audit the accounts. He now asked the Club to confirm the action of the Committee in this matter. The meeting thereupon confirmed the action of the Committee accordingly.

The minutes of the last meeting were then read and signed.

The following gentlemen were balloted for, and duly elected members of the Club:—The Rev. J. M. Braithwaite, M.A., Thomas N. Trew, M.D., John Henry Drage, Alfred L. Sly, John Noble, Wm. Webb, junr., H. H. French, Ferdinand Falk, James Henry Morgan, F.S.S., and Louis de Clercq.

The following donations were announced:—Journal of the Royal Micro. Socy. for December; Proceedings of the Berwickshire Naturalists' Club; "Science Gossip" for January; Paper read by Mr. Lovett before the Royal Microscopical Society, 10th October, 1883, on an improved method of preparing Embryological and other delicate Organisms for Microscopical Examination; a Paper on the Flora of South Lincolnshire, by W. H. Beeby, reprinted from the "Journal of Botany," for January, 1884.

The Report for the year, and the annual balance sheet were read by the Hon. Secretary.

The Report of the Geological Sub-Committee was read by Mr. Henry Turner, and the report of the Botanical Sub-Committee by Mr. H. T. Mennell. The Report of the Entomological Section of the Zoological Sub-Committee was submitted by Mr. Lovett.

REPORT.

Your Committee have the pleasure of submitting to you their Fourteenth Annual Report.

During the past year twenty new members have been elected; thirty-two members have withdrawn. Your Committee regret to have to add that the following members have died since the date of the last Annual Meeting, viz.:—Mr. C. W. Bonus, Dr. Foottit, Mr. Robert Hudson, F.R.S., Mr. Michael Pope, Mr. H. T. Smith, and Mr. Edwin Williams. The resignations during the past year have been more numerous than usual. This is due chiefly to removals from the neighbourhood. The number of new members, on the other hand, has been below the average, but your Committee trust that in the ensuing year the loss will be more than made up.

The total number of members on the 31st December last was 238 ordinary members, 4 honorary members, and 1 associate.

The following Papers have been read during the year:—

14th February.—Mr. Edward Lovett, "Report of the Entomological Section of the Zoological Sub-Committee."

14th March.—Rev. George Bailey, M.A., "Notes on Parasites on some Mollusca"; Mr. HENRY TURNER, "Lowly Forms and their Labours."

11th April.—Mr. GEORGE PAYNE, F.S.A., "Romano-British Interments, including Discoveries in Glass, Bronze, and Pottery."

9th May.—Mr. H. M. KLAASSEN, "The Park Hill Section on the Woodside and South Croydon Railway."

12th September.—Mr. G. C. CHISHOLM, "Endemic Species and their Lessons."

10th October.—Mr. A. B. FARN, "A Week in the Fens."

14th November.—Mr. HOWARD SAUNDERS, F.Z.S., "The Fauna of Spain."

12th December.—Mr. W. LOW SARJEANT, "The Photography of Microscopic Objects and Preparation of Lantern Transparencies."

The Club have made four excursions during the past year. The first of these was made on Whit-Monday, May 14th, when about 40 members and friends (including one or two ladies) started from East Croydon Station for Three Bridges. The party then, under the guidance of Mr. W. Topley, visited the Saxon Church at the village of Worth, where they were very kindly received by the Rector. Leaving the church the excursionists proceeded through Worth Forest, past the sites of the old iron furnaces at Cinder Banks, to the summit of Balcombe Tunnel, returning through Tilgate Forest to Three Bridges, having walked a distance of about 10 miles. The weather was fine, and a very enjoyable day was spent by everyone.

The second excursion was on Saturday, July the 7th, when between 40 and 50 members and friends visited the Fisheries Exhibition, under the guidance of Mr. Henry Lee, one of the Vice-Presidents of this Club, who was a member of the Exhibition Committee. Although, in consequence of its being a Saturday, the Exhibition was rather crowded, Mr. Lee was able to show and to explain to the visitors all the principal objects of interest.

The third excursion was held on the August Bank Holiday, when 17 members of the Club met at the East Croydon Station at 10 a.m. and proceeded to Gomshall by train, walking thence to the village of Shere, where the first halt was made to inspect the church, which contained some interesting brasses. Leave having been kindly given by the Duke of Northumberland, the party next visited Albury Park, and spent a considerable time in viewing the beautifully laid-out pleasure grounds, glass houses, the cave, and the celebrated yew hedge. The small church, romantically situated in the Park, attracted much attention, being the oldest church in Surrey. It is partly in ruins, but one portion, restored to serve the purpose of a mortuary chapel, is ablaze with heraldic designs and stained glass. Much regret was felt that time did not permit of a longer stay at Albury. After a short halt at the "Silent Pool" the excursionists wended their way through the cornfields, busy with reapers, to St. Martha's Chapel, which was carefully inspected inside and outside. The chapel stands 500 feet above the level of the sea, and the day being tolerably clear views were obtained extending to the South Downs. Mr. Low Sarjeant, who had succeeded in getting good photographs of Shere Church and village, took a picture of St. Martha's, and the view from the south door.

He also took two excellent groups of the excursionists. A move was then made towards Guildford, which was reached by six o'clock.

The fourth and last excursion was made on Saturday afternoon, the 29th September, when, by the instrumentality of Mr. Philip Crowley, about 25 members, accompanied by some ladies, visited the Zoological Gardens. One of Mr. Bartlett's assistants kindly acted as guide. In spite of the persistent down-pour of rain during the whole of the afternoon, the excursionists thoroughly enjoyed their visit.

Your Committee hope this year to make the excursions a still more important feature of the Club's proceedings, and they venture to trust that the members will show their appreciation of their efforts in this direction by attending in larger numbers. The Committee will be glad to receive any suggestions with regard to excursions for this year.

Conversational Meetings.—The attendance at the Conversational Meetings, which are held in the Club Room on the fourth Wednesday in the month, has been small of late, but your Committee trust that as the advantages of these little gatherings become better known, they will be more appreciated. Through the kindness of Mr. Low Sarjeant and Mr. Lovett the members of the Club have had some very instructive evenings, particularly with reference to the preparation and mounting of microscopical objects.

The Fourteenth Annual Soirée was held at the Public Hall on Wednesday, the 21st November, when members of ten Clubs and Societies, as well as many private exhibitors and opticians, rendered valuable assistance.

Your Committee consider it worthy of remark that, whilst other large Clubs and Societies in and around London have for various reasons (but chiefly upon the ground of expense) discontinued the practice of holding an annual soiree, the soiree of this Club grows larger and more popular every year.

The following is a list of the donations during the year (details given in the Reports of Proceedings of each Meeting).

The thanks of the Club are again due to Mr. Mennell for editing the proceedings and transactions of the Club.

The attendance at the meetings of the Club has been good.

Your Committee have the pleasure to submit the following short reports of the work of the Sub-Committees during the past year :—

Report of the Botanical Committee.

Mr. H. T. Mennell, having made some remarks on the proposed New Flora of Surrey undertaken by Mr. Beeby, and asked the co-operation and assistance of all the members of the Club interested in botany, read the following list of Surrey Desiderata, drawn up by Mr. Beeby, with a view of giving a more definite aim to the observations and efforts of our local botanists :—

Surrey Desiderata, by Mr. W. H. Beeby.

The following list contains most of the plants which are likely to occur in Surrey, but which are not yet known to inhabit the county. A few have already been reported, while some that are included are known to have occurred, but have now become extinct in the recorded stations. Indications of the localities in which the different species should be sought have been given where it has seemed necessary. The extensive heaths and bogs which abound in the south-western portions of the county are best deserving of attention, and should produce several Hampshire species which are not yet included in the Surrey list. The interesting discovery of *Rhyncospora fusca*, found last summer by Mr. E. S. Marshall in a bog on Thursley Common, is an indication of what may be expected in these comparatively unworked fields. The Wey and Arun Canal is also worth attention, while the River Thames and adjacent wet lands have scarcely been searched as they deserve.

In compiling this list I have largely made use of a somewhat similar, but much more copious one, published some years ago by Mr. Arthur Bennett when collecting those materials for a New Flora of the county, which are now in my hands. As there are several points even yet undecided respecting the new divisions of the county, I have thought it best to defer making any remarks on them at present.

Critical forms, and those species which are likely to occur as casuals only, are for the most part omitted.

Anemone Pulsatilla. Chalk downs.

Ranunculus Lingua, *R. ophioglossifolius*. Should be looked for in wet places.

Drosera anglica. Bogs in the south-west.

Polygala austriaca. Chalk downs.

Dianthus prolifer.

Vicia Orobus, *V. sylvatica*. Copses, &c.

Lathyrus palustris. Marshy places in the Thames valley.

Sanguisorba officinalis.

Geum rivale, *G. intermedium*. Damp places.

Pyrus pinnatifida.

Isnardia palustris. May quite possibly be found in the south or south-west.

Callitriche truncata. About the Wey and Arun Canal.

Parnassia palustris. Bogs.

Cicuta virosa. Marshy places in the Thames valley.

Œnanthe pimpinelloides. Wet meadows.

Carduus eriophorus. Reported; may possibly occur.

Senecio campestris. Chalk downs.

Gnaphalium dioicum. Reported; may occur about Hind Head, &c.

Erica ciliaris. Heaths about Farnham, Frensham, &c., in the south-west.

Pyrola rotundifolia. Mossy woods, especially under fir trees.

Cicendia filiformis. Moors in the south and south-west.

Gentiana campestris. Should be found.

Bartsia viscosa. Wet places in the south.

Orobanche Picridis. It is worth while to look for this wherever *Picris* is abundant.

Mentha pubescens. Wet places. Formerly in Surrey.

Pulmonaria angustifolia. Borders of Hants.

Pinguicula vulgaris, *P. lusitanica*, and *Utricularia intermedia* are quite likely to occur in bogs in the south-west.

Sparganium minimum.

Potamogeton plantagineus, *P. zosterifolius*.
P. prælongus. Will probably be found in the Thames.
Zannichellia pedicillata.
Orchis purpurea, *O. Simia*. Borders of beech-woods on the chalk.
Leucojum aestivum. By the Thames, &c.
Gagea lutea. Said to have been found at Godalming.
Scirpus pauciflorus. Heaths and moors.
Eriophorum gracile. Extinct in Surrey. Should be re-discovered in some of the bogs in the south-west.
Carex dioica.
C. teretiuscula. Should be looked for generally in osier beds and wet places.
C. stricta. Not unlikely to occur by the Wey and Arun Canal.
C. montana.
C. Hornschuchiana (fulva).—Should be found.
C. strigosa.—Thickets below the chalk range.
Hymenophyllum Tunbridgense. May possibly occur in the south-east.
Lycopodium complanatum. The Hants station for this plant is but a few yards from the Surrey border. It should be searched for in the neighbourhood of Hind Head and Haslemere.
Chara contraria, *C. connivens*. Occur in Hants.
Tolypella glomerata. Occurs at Staines. Should be found on the Surrey side of the river.*

Mr. MENNELL then read the following notes communicated by Mr. A. Bennett :—

To the Surrey Flora there have been several additions last year (not that I can claim any of them), but as Mr. Beeby is to give a paper on "The Surrey Flora" in March, I cannot anticipate him by showing specimens. There can, I think, be no harm in detailing them.

Viola lactea, *Sm.*, Smith's dog violet.
Stellaria umbrosa, *Opitz*, wood chickweed.
Arctium nemorosus, *Lej.* Lejeune's burdock.
Potamogeton Zizii, *Mat. et Koch.* Ziz's pondweed.
Alisma lanceolatum With. Lanceolate-leaved water plantain.
Rhynchospora fusca, *R. et S.*, Brown Beak-sedge.

Mr. Beeby has what he thinks will prove *Hypericum dubium*, *Leers.* To the Flora of Great Britain, the following additions have been made :—

Najas marina, *Lin. (pp)*, a submersed aquatic plant, generally distributed in Western Europe, was found by myself in Hickling Broad, East Norfolk, the largest of the East Anglian meres, covering as it does between 400 and 500 acres.

Najas alagensis. *Poll*, a tropical and subtropical aquatic, was found in a mill pond in Lancashire, the water of which was raised in temperature by steam being condensed. Probably introduced with Egyptian cotton.

Carex ligerica, *Gay*, a littoral Sedge, sparsely distributed on the shores of Western Europe, has been found in St. Mary's, one of the

* Since the above was written, Mr. Beeby has found in Surrey *Carex dioica*, *C. Hornschuchiana*, *Scirpus pauciflorus*.

Scilly Isles, Cornwall, where it was gathered by Mr. Cunnach as the common *C. arenaria*, *L.*

Chara Braunii, *Gmel.* (Braun's Stonewort), a generally distributed European species, was gathered in the canal at Reddish, Lancashire, by Mr. C. Bailey, of Manchester, and sent to me for determination.

Report of the Geological Sub-Committee.

The attention of the Geological Sub-Committee during this year has been directed mainly to collecting the geological data of the beds at Park Hill, from the footpath bridge, near Coombe Road, to the Upper Addiscombe Road. The beds there exposed are, in ascending order, the *Thanet Beds*, the *Woolwich and Reading Beds*, and the *Oldhaven Beds*, collectively called the *Lower London Tertiaries.* Of these, the Woolwich and Reading Beds had the greatest geological interest, on account of the great length of the beds there cut through, which offered an opportunity for thoroughly studying their sub-divisions and for collecting the fossil remains of their fauna and flora. The reputation of instability, with which these beds have been credited, has been fully maintained in the long cuttings; their behaviour has caused a greater exposure of the beds than would otherwise have taken place, but has greatly impeded the progress of the contractor's work. The cuttings, however, are approaching completion, and our notes, which extend over a period of two years, may be arranged and prepared for publication.

In May, when the sections were fresh, when the neatly trimmed banks of the south cutting displayed the variously coloured strata with such admirable definition that the divisions in the section were seen distinctly from the banks above, the Honorary Secretary exhibited and explained to the Club his large working diagram, "in which the contour line of Park Hill and the position and thickness of the beds were rendered with scrupulous accuracy." We have the pleasure of reproducing this section on a horizontal scale of 528 feet to the inch and vertical scale of 80 feet to the inch.

As the details of the Lower London Tertiaries at Park Hill have been gathered in, the Geological Sub-Committee intends to enter upon fresh work full of scientific interest and practical usefulness, namely, that of preparing, on a scale of six inches to the mile, a geological map of Croydon and its neighbourhood. In connection therewith we have collected some vertical sections of the neighbourhood, of which we publish the following, showing in descending order the sequence and thickness of the beds passed through:—

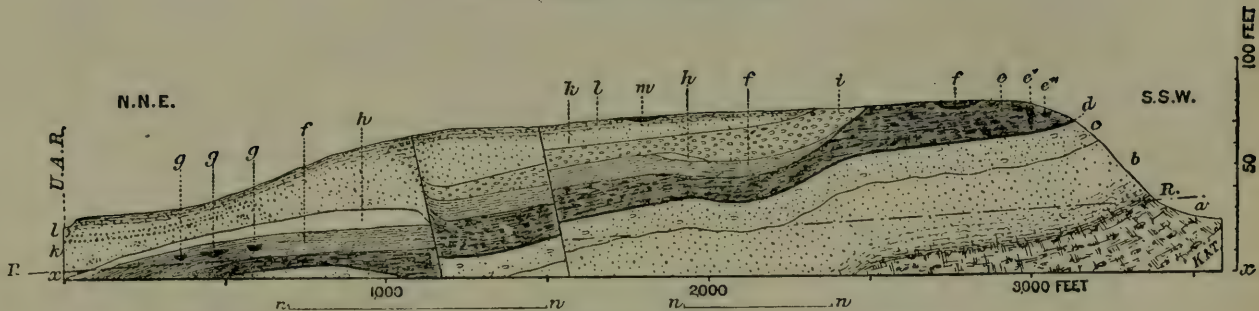
Croydon Water Works' Well, sunk in 1876, in Surrey Street:—Surface of the ground 150-ft. above Ordnance Datum; gravel, valley drift, 10-ft.; chalk with flints, 204½-ft.

Croydon Gas Works' Well, 1868, at Waddon. Communicated by Mr. Baldwin Latham, C.E.:—Surface of the ground 126-ft. above Ordnance Datum; black clay, 16-ft.; yellow clay, 6-ft.; black sand, 20-ft.; mottled clay, 33-ft.; oyster bed, 10-ft.; mauve coloured sand and pebbles, 12-ft.; green coloured sand, 6-ft.; green flints, 9-in.; chalk, 138-ft.

Croydon Workhouse Well, Queen's Road. Communicated by Mr. John Berney:— Surface of the ground 162-ft. above Ordnance

PARK HILL SECTION ON THE WOODSIDE AND SOUTH CROYDON RAILWAY.

SCALE: Horizontal 528 feet = 1 inch.
Vertical 80 feet = 1 inch.



x 300 feet above sea-level.
a Chalk.
b Thanet beds.
c Woolwich and Reading Bottom beds.
d Lavender-coloured sandy Pebble bed.
e Mottled, Clay (fluviatile).
e' e'' Pockets.
f Blue Clay (estuarine).
g Lignite beds.
h Hard white shell-bed.
i Pebble beds.
k Grey Sand.
l Brown and grey laminated clayey Sand.
m Drift.
n n Tunnels.

R. Railway Level.
U. A. R. Upper Addiscombe Road.

Datum; mould, 2-ft.; gravel, 9-ft.; mouse coloured clay, 3-ft.; London clay, 6-ft.; septaria, 1-ft.; London clay, 22-ft.; sandy clay, 1-ft.; London clay, 4-ft.; sandy clay, 3-ft.; London clay, 6-ft.; sandy clay, 3-ft.; London clay, 2-ft.; sandy clay and septaria, 1-ft.: sand, * 2-ft.; sand and pebbles, 1-ft. 6-in.; blue clay, 25-ft. *; mottled clay, 16-ft.; dark sand, 1-ft.; green sand and pebbles, 14-ft.; light sand, 43-ft.; loamy sand, 10-ft.; flints, 1-ft.; chalk with flints at 281-ft. 6-in. In 1866 a well was sunk 100-ft. west from the site of the present well. The vertical section in this was from * to * inclusive: 2-ft. dark sandstone, 5-ft. light sand, 1-ft. stone, 1-ft. pale sand, 4-ft. black sand, 5-ft. sand stone, 3-ft. sandy clay, 4-ft. shelly beds, 6-ft. black sand, clay and pebbles.

Park Hill Railway Section.—Sequence and greatest thickness of the Lower London tertiaries in descending order: Brown and grey laminated clayey sand, 10-ft.; grey sand, 24-ft.; hard white shell-bed, 10-ft.; blue clay with lignite, 10-ft.; mottled clay, 21-ft.; lavender coloured sandy pebble bed, 1-ft. 6-in.; green sand, 3-ft.; greenish-brown sand, 6-ft. 8-in.; grey sand, 2-ft.; brown clayey sand, 2-ft.; Thanet beds, 38-ft.

Croydon Rural Sewage Works' Well, at Merton. Communicated by Mr. Baldwin Latham, C.E.:—Surface ground 36·69 feet above Ordnance Datum; mould and peat, 10-ft.; ballast [gravel] 1-ft. 6-in.; blue clay with septaria, 51-ft.; shells, 1-ft.; brown sand, 5-ft.; blue clay, 7-ft.; shell rock, 1-ft. 6-in.; dark coloured clay, 8-ft.; dark blue clay, 3-ft.; black blue clay, 3-ft.; yellow clay, 3-ft.; purple clay, 3-ft.; red clay, 4-ft.; brown and green sand, 1-ft. 6-in.; brown sand, 9-ft. 6-in.; brown clay, 5-ft.; pebbles, 1-ft. 6-in.; green sand, 6-ft. 6-in.; grey sand, 31-ft.; chalk with flints, 77-ft.

Crystal Palace, Upper Norwood, Well in the lower part of the ground: Surface of the ground about 190-ft. above Ordnance Datum; ferruginous sandy loam, 9-ft.; London clay with septaria, 249-ft.; pebbles, 1-ft.; Woolwich and Reading beds, 47-ft. 1-in.; Thanet beds, 54-ft. 6-in.; chalk with flints, 149-ft.

These geological details look uninviting, but it is often necessary to be acquainted with them. During a heavy rainfall, gardens, resting possibly upon a thin stratum of impervious clay, may become flooded; the position of the garden may make it impossible to lead the water into the main drain, and good feeling does not allow us to remove a brick from the garden wall, by which the water could be drained into a neighbouring field or into a neighbour's garden. It is useful then to know the succession and thickness of the London tertiary beds, which are partly pervious to water, namely, sandy, shelly and pebbly beds, partly clayey beds, impervious to water. By boring or sinking to the pervious bed, surface water may thus sometimes be easily disposed of.

Signed

ALFRED CARPENTER.
JAMES CHISHOLM.
WILLIAM TOPLEY.
H. TURNER.
THOS. WALKER.
H. M. KLAASSEN, *Hon. Sec.*

ZOOLOGICAL SUB-COMMITTEE.—ENTOMOLOGICAL SECTION.

The year 1884 has not been a very favourable one for insect life This is no doubt owing partially to the mild weather last winter, and also to the scarcity of insects last summer, ova being in consequence but sparsely deposited. Although the eye of the entomologist has not been gladdened with the usual abundance of butterflies and moths, the farmer and gardener on the other hand have suffered less from the ravages of farm and garden pests. We have been free from the swarms of large and small white butterfly larva, which are wont to assail cabbage of various descriptions. The troublesome larva of the turnip and cabbage moth are certainly less common than formerly, and this last summer gardens suffered less from the onslaughts of the caterpillars of the currant moth and currant sawfly than usual. On the whole the season of 1884 was more favourable to the agriculturist than the entomologist. Your Committee, thinking that their work is of little value unless practical, wish to draw attention to the importance of the periodicals relating to insect farm and garden pests written by Miss Ormerod, and to suggest that they should be duly brought before the notice of farmers, gardeners, and others.

The breeding of varieties of moths and butterflies, as to their markings and colour, is occupying considerable attention among entomologists. An unique and valuable variety of the common tortoiseshell butterfly *(Vanessa urticæ)* is in the possession of one of our members—Mr. F. Berney—and, we understand, is being figured in the *Entomologist.*

The PRESIDENT, in moving the adoption of the foregoing reports, said:—Before moving that the report of the committee be received and adopted, I think we may be congratulated upon the fruitfulness of our past year. Many subjects full of interest, and some having reference to our own locality, have been well discussed at our meetings. The paper by Mr. Klaassen on the section of the Park Hill cutting was of great interest, especially as it related to our own neighbourhood; and Mr. Low Sargeant's illustrated paper on Micro-Photography was a great assistance to all those contemplating taking up this subject. I understand Mr. Sargeant is willing to repeat his work at one of the monthly bye meetings, and I hope many members will take advantage of it.

We have, I am happy to say, sub-committees in connection with meteorology, geology, zoology, and botany, and they have done much in gathering information for us, especially of local matters. These sub-committees are formed of men who do not desire to retain within themselves those things they find or see, but who are anxious to bring everything prominently before the Club at its meetings, and so benefit the members by the discussions, and it is by these discussions that the truths or fallacies of a subject or matter are brought out. The more that members are willing to bring to our meetings the several plants, insects, fossils, and other things found or seen (especially if collected or seen in our own neighbourhood) and to hear discussions upon them, the more our Club will rise and improve its standing amongst the kindred societies. Young members frequently suppose that things noticed by them are too trivial and not of sufficient importance to bring to the notice of the Club, but let them remember that it frequently happens that those things which are thought of little value turn out of great worth, and it is seldom we find out their worth till they have been thoroughly examined, and it is for the purpose of examining and arriving at their truth and value that such Clubs as ours are established. I make these remarks well knowing that we have members who are silent workers, and who could, no doubt, add much to our knowledge, but who through bashfulness and timidity are afraid to bring things before the Club. I hope in future these timid members will consider that we are a happy family, and we look on each other as hard and fast friends, not ready to take a mean advantage of each other, but to the best of our ability to help, direct, and advise each other; let neither pride nor the fear of exposing your want of knowledge make you shrink from seeking information, for this only leads to permanent ignorance, and such a state of things ought not to be, and I therefore say to our young members, if you do not know, enquire. I am sure there is not a member of this Club who will not heartily give you the information to the very best of his ability, and in such a way that you need not fear to repeat the question; further, be not satisfied till you thoroughly understand the point.

Now with regard to the papers read by gentlemen not members of the Club which, although they did not refer to our own neighbourhood, were still most interesting and instructive. Mr. Geo. Payne's paper on "Romano British Interments," Mr. Farn's paper, "A Week in the Fens," and the paper of Mr. Howard Saunders on "The Fauna of Spain," were all papers of great interest, and I am very thankful that we possess friends who have such kind hearts, and are ready to put themselves to so much trouble for the purpose of describing to us the new things they have met with in their travels or collecting grounds.

The excursions, as the committee's report states, have been four in number, and owing to three out of four being under proper guidance, were especially interesting, the most prominent and interesting points being ably described to the members present. The visit to Worth Church, a good example of an old Saxon building, was well worthy a visit, the long and short work, as it is termed, being well shown in several portions of the older work. The sites of the old iron furnaces at Cinder Banks in Worth Forest were also well worthy of a visit, vast quantities of slag and cinders still remaining visible. All this was pointed out to us by our member, Mr. Topley, who conducted the excursion, and to whom our thanks are due, for had it not been for his guidance in all probability many of our members would not have seen these interesting remains. The iron railings around S. Paul's Cathedral were cast from iron manufactured in one of these Sussex Forests.

The excursion to the Fisheries Exhibition was well attended, and under the able guidance of our kind old friend, Mr. Lee, we were enabled to see a great deal in a short time.

The excursion on the 6th August last, although there was no one specially told off as a conductor, was most enjoyable. Mr. John Charles Oswald, one of our members, took the trouble on the day before the excursion to travel down on his bicycle to Albury, the seat of the Duke of Northumberland, and to obtain permission for the members of our Club to visit the gardens and premises. The particulars of this excursion are so well given in the committee's report, that I need not further comment on it. I most heartily thank all those gentlemen who took the conduct of these excursions for the trouble and pains they took to make them successful, and Mr. Oswald for his kindness in obtaining for us an entrance to the Duke of Northumberland's grounds. I think it well to remind our members that we wish to make out our list of excursions for this season, and to ask them kindly to furnish our committee with a list of places of interest within a reasonable distance of Croydon, to enable them to prepare their this year's list.

With regard to the work of the Zoological Sub-Committee, I may mention that one of our members, Mr. Lovett, a hard and steady worker, has received the Diploma of the International Fisheries Exhibition for excellence of Embryological Microscopic work. Nothing much has been done in Entomology, insects having been exceedingly scarce, but my son, Frederic Lee Berney, is in possession of a very extraordinary variety of the Vanessa urticæ, or small Tortoiseshell Butterfly, bred this year from a larva, obtained in the neighbourhood of Coombe Lane. This insect is at present in London, being figured for publication in the Entomologists' Magazine.

Mr. McKean has taken a specimen of the variety *Ferussaci* of Limax maximus, at Bramley Hill. This British slug has not been before recorded as taken in Surrey. I may state that an important new work on slugs is now in course of compilation by the Conchological Society, and this society is particularly anxious for records. I shall be glad if members will bear this in mind, and give notice not only of those specimens found in our own neighbourhood, but also of those found in other parts of England.

Mr. Beeby, F.R.M.S., &c., a member of our Club, has been very successful in finding botanical specimens. It appears that six new plants have been added to the Surrey list; this ought to encourage our botanical members, and we may hope that by our next annual meeting the list may be further enlarged.

The conversational meetings, which have occasionally been well attended, have not been so at other times. I wish to impress on members the great usefulness of these meetings, where notes can be compared, and if doubts exist, books can be referred to, and where mounting of objects can be practised, and section cutting, illumination of objects under the microscope, in fact, all those things which cannot be so well studied at a large meeting, can be well carried on at these bye meetings. I therefore impress upon our members the importance of attending, and hope that those who are well up in any particular subject will cheerfully lend a helping hand and make a point of attending and assisting those who require it. Remember that it is by mutual confidence and mutual aid that great things are done and great discoveries made.

With regard to our Library we must look at it as our stock-in-trade; it is our own property, and we are always ready to see that property increased; the more our bookcases are filled with good books of reference, and our cabinets with microscopes, slides, and other objects and instruments, the more we shall be able to work up any particular subject. I therefore advise our members to give liberally, and to those who may not be willing to part with their books or instruments during their lives, I say there is no bar to their leaving all, or any of them, to the Club after they have passed away, and though it will be no loss to them, it will be a great gain to the Club.

Our soirée this year has, as usual, been most successful, and I thank all for the general interest and trouble they took to make it so. I also more cordially thank those kindred societies who with so much good will rendered us assistance, and hope when it falls to our lot to assist other societies at their soirées, we shall do it with as hearty a good will, and give them every support in our power.

Before concluding my address, I am sorry to have to refer to our losses in deaths. We have thus lost Mr. C. W. Bonus, one of our oldest members; Dr. Foottit, well known to us all as a gentleman much interested in Natural History, and who was always ready to help us at our soirees, by exhibiting his unsurpassed collection of Humming Birds. Mr. Robert Hudson, a fellow of the Royal Society well known in the scientific world, and also one of our oldest members; Mr. Michael Pope, another of our oldest members; Mr. H. T. Smith, and Mr. E. Williams.

Our losses by resignation have been 31, and the number of our new members 20. Most of the resignations have been by persons leaving the neighbourhood, and this number has been exceptionally large this year, and is not likely to occur again to the same extent. I feel certain that we shall very soon fill up all our losses, and I look forward with your assistance to a prosperous new year. I beg to remind our members that we are always ready to receive new nominations, and that if every member of the Club will only make up his mind to bring a fresh nomination, there will not be any difficulty in doubling the number of our members. Members means an increase of income, and increase of income will enable us to increase our library, our objects for the cabinet, our instruments, and many other necessaries. Now there is nothing better for a society than a first-class reference library; this attracts many, and is likely to draw to us scientific men who know that our library is good, and worth referring to, and from whom we should be likely to get some good papers.

I now have the pleasure to propose that the Report of the Committee as read, be received and adopted.

Mr. Sandeman having seconded the resolution, it was put to the meeting, and unanimously adopted.

It was announced by the President that the following gentlemen had been nominated to serve as officers of the Club during the ensuing year:—*President*, Mr. John Berney, F.R.M.S. *Vice-Presidents*, Alfred Carpenter, M.D., J.P., &c.; Philip Crowley, F.Z.S.; Henry Lee, F.L.S., F.G.S., &c.; *Treasurer*, Henry T. Mennell, F.L.S. *Honorary Secretary*, Charles Price Turner.

It was proposed by Mr. Sandeman, seconded by the Rev. G. Bailey, "That Mr. John Berney be elected President for the ensuing year." It was at the same time proposed to thank Mr. Berney for his services as President during the past year. Both motions were carried with acclamation. Mr. Berney having in brief terms thanked the Committee for having re-elected him, it was resolved that Mr. H. T. Mennell be re-appointed Treasurer, and Mr. Charles Price Turner be re-appointed Hony. Secretary.

The number of gentlemen nominated to serve upon the committee being in excess of the number constituting the committee (9), Messrs. C. Grundy and C. C. Morland were appointed scrutineers, and the meeting proceeded to vote by ballot. The counting having been completed, the scrutineers announced that the following gentlemen had been elected, viz.: Messrs. Brewer, Cushing, Lovett, McKean, Low-Sargeant, Straker, Strong, Topley, and Turner.

Mr. Rowland then proposed, and Dr. Thompson seconded, a vote of thanks to the officers for their services during the past year. The motion was carried unanimously.

The President gave notice that at the next meeting of the Club, he would move the following resolution, viz.:—

That the Rule* relating to the management of the Club be rescinded, and that the following be adopted in its place:—

"The business of the Club shall be conducted by a committee "(four to form a quorum), consisting of a President, four Vice-"Presidents (to be elected from past Presidents), a Treasurer, "an Honorary Secretary, and nine other members.

"The officers of the Club shall be elected at the General "Annual Meeting. The President shall not hold office for more "than two years in succession. Of the nine members of the "committee, two shall retire each year, and shall not be eligible "for re-election that year. The retiring members shall be (*a*) "the one who has attended the smallest number of committee "meetings during the past year; (*b*) the one who has served "upon the committee the longest. The remaining seven shall "retain office without re-election. If two or more members "have attended an equal number of committee meetings, that "member shall retire who has served the longest. If two or "more members have served an equal length of time, that "member shall retire who has attended the committee least "often during the past year."

Dr. Strong gave notice that he would move an amendment to the clause referring to Vice-Presidents.

The following objects were exhibited:—J. L. Berney (under microscope) section of bone, illustrating growth; J. Berney (under microscope) Eggs of parasite of Reeve's Pheasant; W. Low-Sarjeant (under microscope), *Melicerta ringens* (living); K. McKean (under microscope), Odontophore of paludina

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* The Rule at present runs as follows:—

"The business of the Club shall be conducted by a President, Vice-Presidents (not exceeding four in number), Treasurer, and Hon. Secretary *(ex-officio)*, and a Committee of nine Members, who shall be elected by ballot at the Annual General Meeting, three to form a quorum. The office of President shall not be occupied by the same Member for more than two years in succession."

vivipara; Edward Lovett, series of small fan shells *(pecten)* from Jersey (under microscope) Volcanic Dust from the Java eruptions, which fell upon a ship 1,000 miles from the outbreak; Rev. G. Bailey (under microscope), *Foraminifera* from the red chalk of East Yorkshire (very rare); E. B. Sturge (under microscope), The Club's Slides of Cole's series of microscopic preparations; W. R. Harwood, Fossil Wood, from the Lower Tertiaries, with borings of *Teredo navalis*.

Balance Sheet for the Year ended 31st December, 1883.

RECEIPTS.	£	s.	d.
To Balance in hand ...	30	4	0
,, Subscriptions ...	107	10	0
,, Sale of Lectures ...	2	3	5
,, Sale of Soirée Tickets ...	31	5	0
,, Petty Cash re-paid into Bank ...	0	7	0
	£171	9	5
To Balance brought down ...	13	19	0

EXPENDITURE.	£	s.	d.	£	s.	d.
By Hire of Rooms ...				15	12	6
,, Postage ...				2	4	3
,, Ditto (Postcards for Notices of Meetings, and Printing of the same) ...				16	14	8
,, Printing Transactions ...				33	19	9
,, Printing ...				2	11	0
,, Fire Assurance ...				0	7	6
,, Collecting Subscriptions ...				5	1	6
,, Attendance, Lamps, Oil, &c. ...				1	3	9
,, Reporting Discussions ...				6	6	0
,, Stationery and Binding ...				1	8	6
,, Gratuities ...				1	8	6
,, "Studies in Microscopical Science" ...				4	4	0
,, Sundries ...				0	2	10
,, Petty Cash re-paid into Bank ...				0	7	0
SOIREE ACCOUNT.	£	s.	d.			
By Hire of Rooms ...	7	14	6			
,, Decorating Platform ...	1	10	0			
,, Tables ...	11	10	0			
,, Music ...	6	0	0			
,, Police and Attendant ...	0	13	0			
,, Refreshments ...	17	4	2			
,, Printing and Stationery (including £2 18s. 6d., 1882) ...	9	15	0			
,, Advertising ...	3	18	4			
,, Hire of Lamps ...	2	14	0			
,, Postage ...	3	11	4			
,, Sundries ...	1	8	4			
				65	18	8
Balance forward ...				13	19	0
				£171	9	5

HENRY T. MENNELL, TREASURER.

We, the undersigned, having examined the above Accouuts, and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers, and to the Bankers' Pass Book.

A. A. CAMPBELL, } AUDITORS.
JOHN DRAGE, }

5th January, 1884.

THE CROYDON
Microscopical and Natural History Club.

(Established March, 1870, as "The Croydon Microscopical Club.")

The Club has for its objects the mutual help of its Members in the study of Microscopy and Natural History, and the investigation of the Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon and the County of Surrey, and the dissemination amongst its Members of information on the subjects of Microscopy and Natural History.

The Ordinary Meetings of the Club are held on the second Wednesdays in the months of February, March, April, May, September, October, November, and December. The Annual Meeting of the Club is held on the second Wednesday in January.

The Rooms are open for the reception of Microscopes and objects of interest at 7 p.m. The chair is taken at 8 p.m.

A Soirée is held in the month of November, to which Ladies are admitted.

Field Excursions are occasionally arranged during the summer months.

In order to organise and develope the work of the Club in Meteorology, Geology, Botany, and Zoology, a Sub-Committee is appointed for each of these branches of science; and the Members of these Sub-Committees, whose names and addresses are given below, will, at all times, be glad to receive notice of, and to investigate, any facts of interest connected with the Natural History of the district, and to give to members of the Club any advice and assistance in their power.

METEOROLOGICAL SUB-COMMITTEE.

George Corden, F.R. Met. Soc.	18, Katharine Street.
H. S. Eaton, M.A., F.R. Met. Soc. ..	Chepstow Road.
E. Mawley, F.R. Met. Soc.	Outram Road.
Thos. Cushing, F.R. Met. Soc.	Alexandra Road.

GEOLOGICAL COMMITTEE.

Dr. Alfred Carpenter, J.P., F.R.M.S. ..	Duppas House.
James Chisholm	Nicholson Road.
H. M. Klaassen, F.G.S.	2, Chepstow Road.
W. Topley, F.G.S.	Elgin Road.
H. Turner	Parson's Mead.
Thos. Walker	Warrington Road.

BOTANICAL SUB-COMMITTEE.

A. Bennett	107, High Street.
H. T Mennell, F.L.S.	Park Hill Rise.
W. F. Miller	Havelock Road.
Franklin Parsons, M.D.	South Norwood.
Edward Straker	Kenley.

ZOOLOGICAL SUB-COMMITTEE.

Rev. George Bailey, M.A.	1, South Vale, Upper Norwood.
John Berney, F.R.M.S.	North End.
Philip Crowley, F.Z.S.	Waddon.
Rev. E. M. Geldart, M.A.	Lansdowne Road.
E. Lovett	Clyde Road.
K. McKean	Warham Road
W. Low-Sarjeant	Andaman Villas, Portland Road, South Norwood.

The President, Vice-Presidents, and Hon. Secretary of the Club for the time being are ex-officio Members of each of the Sub-Committees.

RULES.

TITLE AND OBJECTS OF THE CLUB.

The Club shall be called "The Croydon Microscopical and Natural History Club," and shall have for its objects the mutual help of its Members in the study of Microscopy and Natural History, the investigation of the Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon, in the County of Surrey, and the dissemination amongst its Members of information on the subjects of Microscopy and Natural History.

MANAGEMENT OF THE CLUB.

1.—The business of the Club shall be conducted by a Committee (four to form a quorum) consisting of a President, four Vice-Presidents (to be elected from past Presidents), a Treasurer, an Honorary Secretary, and nine other members.

2.—The Officers of the Club shall be elected at the General Annual Meeting. The President shall not hold office more than two years in succession. Of the nine members of the Committee two shall retire each year, and shall not be eligible for re-election that year. The retiring members shall be (*a*), the one who has attended the smallest number of Committee Meetings during the past year ; (*b*,) the one who has served upon the Committee the longest. The remaining seven shall retain office without re-election. If two or more members have attended an equal number of Committee Meetings that member shall retire who has served the longest. If two or more members have served an equal length of time that member shall retire who has attended the Committee least often during the past year.

MEMBERSHIP.

1.—Every candidate for Membership shall be proposed by two or more Members, one of whom, at least, shall have a personal knowledge of him, and who shall sign a certificate in recommendation of him, according to the form appended. The certificate shall be read from the chair, and the candidate therein recommended balloted for at the following meeting. One black ball in five to exclude.

2.—The Annual Subscription shall be 10s., payable in advance on the 1st of January (or on election, if previous to November), and no person shall be entitled to the privileges of the Club until his Subscription shall have been paid.

3.—Distinguished men may be elected Honorary Members of the Club; such Honorary Members shall not be subject to any of the expenses of the Club, and shall have no vote in its affairs.

4.—In order to encourage the study of Microscopy and Natural History amongst mechanics, &c., residing in the district, individuals of that class may be admitted as Associates, provided they shall first communicate some original information or observation on Microscopy or Natural History, or exhibit such specimens as shall, by their merit, satisfy the Committee. Such Associates shall enjoy the privileges of Honorary Members.

5.—No Member shall be considered to have withdrawn from the Club until he shall have paid his arrears, and given a written notice to the Secretary of his intention to resign.

6.—If it shall be thought desirable to expel any Member from the Club, the same shall be done by a resolution of the Committee, which shall be read at the next ordinary meeting, and at the following meeting a ballot shall take place with respect to the proposition, and if two-thirds of the Members present shall vote for such Member's expulsion, he shall no longer be considered a Member.

7.—Any Member may introduce a visitor at an ordinary meeting who shall enter his name with that of the Member by whom he is introduced, in a book kept for that purpose.

ORDINARY MEETINGS.

1.—The ordinary meetings of the Club shall be held on the second Wednesday in every month (excepting the months of June, July, and August), at seven o'clock in the evening; the chair to be taken at eight precisely; or at such other time as the Committee may appoint.

2.—The ordinary course of proceedings shall be as follows:—

I.—The minutes of the previous meeting shall be read and submitted for approval as being correct.

II.—The names of candidates for Membership shall be read, and the ballot for the election of Members shall take place.

III.—Scientific communications shall be read and discussed; after which the chair shall be vacated, and the meeting shall resolve itself into a conversazione, to terminate at ten o'clock.

3.—In the absence of the President, the Members present at any ordinary meeting shall elect a Chairman for that evening.

4.—No paper shall be read which has not received the sanction of the Committee; and, whenever it is possible, early notice of the subject of the papers to be read shall be given, by the Secretary, to the Members. No paper shall exceed twenty minutes in the actual reading, unless by the special permission of the chairman.

5.—In addition to the above ordinary meetings, others, for conversation and the exhibition of Microscopical objects and Natural History specimens, and for the borrowing and exchanging of books, shall be held on the fourth Wednesday in each month throughout the year, at half-past seven o'clock in the evening.

BUSINESS MEETINGS AND ELECTION OF OFFICERS.

1.—The accounts of the Club shall be audited by two Members appointed at the ordinary meeting in December. No Member of the Committee shall be eligible as an Auditor.

2.—At the same meeting, notice of the Annual Meeting in January shall be given from the chair.

3.—An Annual Meeting of the Club shall be held, in the place of the ordinary meeting, on the second Wednesday evening in January, at eight o'clock, when the election of officers for the year ensuing shall take place, and the report of the Committee on the affairs of the Club, and the balance sheet, duly signed by the Auditors, shall be read.

4.—The Officers of the Club shall be nominated in writing, and such nominations shall be sent to the Secretary, seven clear days before the Annual Meeting. In the event of the number of nominations exceeding the number of Officers to be elected, a printed list of the nominations shall be circulated at the Annual Meeting, and the Members present shall vote by ballot by striking out the names of those for whom they do not desire to vote, and placing the lists in an urn upon the table. Scrutineers shall be appointed at the meeting, and the votes shall be counted during the course of the meeting.

5.—No permanent alteration in the Rules shall be made, except at one of the monthly meetings of the Club, and notice of any proposed alteration or addition must be given at or before the preceding ordinary meeting.

LIBRARY.

1.—Application for the loan of books or Microscopical slides to be made to the Hon. Librarian at any "Ordinary" or "Conversational" meeting of the Club, the borrower to sign a receipt, which will be cancelled on the return of the work borrowed.

2.—No Member may have more than one work at a time.

3.—No work may be retained longer than one month, but the same work may be again borrowed provided there be no other applicant for it. Any Member not complying with this rule will incur a fine of 1s. for each month after the first that the work is retained.

4.—The borrower shall make good all damage which any book, &c. may receive while under his charge; such damage to be assessed by the General Committee.

5.—Books marked "R" (reference), and unbound pamphlets are not to be removed from the reading room.

6.—No Member will be entitled to the privileges of the Library who has not paid such fines as he may have incurred.

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ASSOCIATES.

Collyer Edward B., Selsdon Road, Croydon
Rodbourn J., The Gardens, Coombe, Coombe Lane

There are commonly reported to be a few pairs of Herring Gulls *(Larus argentatus, Linnæus)* on the Staples, but I must admit I never identified one. I have heard their numbers spoken of as some three pairs of breeding, birds, but strange to say in the photograph of the Gulls on the rocks, taken last summer by Mr. Green, the majority are of this species instead of the Lesser Black-backed Gull.

The last of the breeding birds, the Kittiwake *(Larus tridactylus, Linnæus)* places its nest on the ledges, by the side of the Pinnacles and Skeney Scar, in the immediate vicinity of the Guillemots.

Placed as the islands are one might expect a good many stragglers, especially at the time of the spring and autumn migrations, but the list of winter visitors and other birds that have occasionally been met with, though interesting, would be much too long for me to give you. I may just mention that some birds, which one would hardly expect to meet with, have been procured, for instance, although there is not a single tree or bush, the Tree Creeper has been found, and so has the Pied Flycatcher. The reports from two light stations, afford a valuable amount of information to that useful but inadequately supported work—"The Report on the Migration of Birds," by Messrs. Harvie-Brown & Cordeaux.

Wallis in his Natural History of Northumberland, published in 1769, on page 340 of Vol. 1, records the capture of the Great Auk, in the following words :—

"The Penguin, a curious and uncommon bird, was taken alive a few years ago in the island of Farn, and presented to the late John William Bacon, Esq., of Etherston, with whom it grew so tame and familiar, that it would follow him with its body erect to be fed."

35.—Report of the Zoological Sub-Committee, Entomological Section.—Lepidoptera.

[*Read* 14*th February*, 1883.]

The sub-committee of the above section have thought it desirable to make a report upon the work hitherto done by them, so that the Club generally may have an opportunity of judging as to the insect fauna of the district, and that members who are desirous of taking up the subject for practical work may have some sort of basis upon which to start, and be assisted in ascertaining favourite localities, food plants, peculiarities of mode of life, and other points connected with the objects of their study.

In order to obtain a systematic record by the different members of the sub-committee, of the insects found in our district, a series of lists were drawn up of all the species hitherto recorded as British. Sufficient space was left after each species for the different members to record their experiences and observations, and it is intended, from time to time, to add such fresh observations as may be made.

We are just entering upon another season, and already many insects are out. In its present form our lists are very incomplete, as regards our local lepidoptera, but we trust that with the assistance of the members generally we shall be able to make considerable progress this summer and autumn.

There is also another matter that should be referred to. The study of entomology, although widely taken up, is, comparatively speaking, confined to the lepidoptera; and the collecting and study of lepidoptera again is pretty generally confined to the larger forms, often leaving out, for various reasons, the micro-lepidoptera.

Of late years the latter have come in for much more attention than formerly, but their study and manipulation is much sterner work than that of the larger forms.

Hence this report must be regarded as simply part of the first of a series, the remaining portion of which will embrace the micro-lepidoptera. The rest of the series should comprise the Coleoptera, or beetles, the Hymenoptera, or bees, wasps, &c., the Diptera, or two-winged flies, to say nothing of the dragon flies, the plant lice, the aphides, the gall insects, and others. The committee would be glad to know of any members who may be working at any of the above sections, or who would be willing to take one or the other up systematically, with a view to recording the species found in our own district.

Having thus defined the limits of this report, we have now only to consider those species of the British lepidoptera, included under the divisions Diurni, Nocturni, Geometræ, Drepanulæ, Pseudo-Bombyces, and Noctuæ, which have been recorded from this locality.

The Croydon district is a very favoured one, and for many years has been much frequented by collectors, who, it is to be regretted, sometimes make enormous hauls of a good insect, thereby greatly assisting in making it a rarity. The Archbishop's fence, Croham Hurst, Shirley Hills, and the pine wood, are household words to entomologists, and are perhaps better known to north-country entomologists than even to some of the inhabitants of Croydon itself, to whom a butterfly is a butterfly, and nothing more.

Situated as Croydon is on the edge of the London clay, its surface is varied, hence also its flora, and therefore we get a good number of species of lepidoptera. One of our members recently pointed out that in Northumberland and Durham, where intrusive dykes of Basalt had converted the limestone into a crystalline form, known as the "sugar limestone," the flora was of a distinctly marked type. As, therefore, the larvæ of our butterflies and moths have all their special or favourite haunt where the food-plant occurs, we must expect to find the distribution of insects also affected by the geological characteristics of the country, and the vegetation prevailing in it. As an instance of this we generally find *L. corydon* in profusion on such chalk hills as Riddlesdown, *S. semele* the same, *V. urticæ* in waste fields where plenty of nettles grow, *C. edusa* in clover or lucerne fields, *Trachæa piniperda* and *Fidonia piniaria* in pine woods, *Anarta myrtilli* and *S. carpini* on heaths, &c., so that as we have about Croydon oak-woods, pine-woods, heather-covered hills, chalk downs, and cultivated fields, we have the lepidoptera usually found in such localities, for the reason that their larvæ feed on the plants that distinguish them.

Besides this it has been noticed of late years, not only in Croydon, but in other places near London, that a kind of false insect fauna is obtaining, and the reason is this: building is spreading rapidly and surely, and with it gardens are made and trees are introduced, and fresh food is furnished for species which were once uncommon, so that now Park Hill alone produces more *Smerinthus occellatus*, *tiliæ*, *populi*, *S. ligustri*, and *C. vinula*, than the whole district did when it was clothed with its natural vegetation, such species being able to multiply extensively, owing to the wide (and highly gratifying) planting of poplars, limes, willows, lilacs, &c.

Whilst, therefore, we are losing a large number of species in our immediate neighbourhood, owing to the advance of railways, roads, and buildings, destroying their food-plants, we are at the same time obtaining a larger number of such species as feed upon the various trees and shrubs introduced to modify the effects of such inroads.

Such observations as these are not only of great interest in themselves, but are of considerable value from more than one point of view, and this brings us to notice another, or rather two other matters of importance. One is the effect of weather and seasons upon insect life, and the second is the effect of insect life upon our farms, orchards, and gardens.

As regards the former, it is generally thought, and even stated in black and white, that a severe winter has a destructive effect upon insect life, and in fact upon what is termed by gardeners, "vermin" in general. This, however, is not so, for as we all know, winter is the time when most insects are in the pupal state, and therefore either beneath the ground, or in some equally secure position, which position is rendered doubly safe by the hardening of the surface or exterior by frost. It may not be generally known that a damp warm atmosphere is far more destructive to insect life generally than a dry and frosty one. Again, in a soft winter birds are far better able to obtain insects for food than they are in a hard one.

A severe winter, however, that is followed by a very rapid break up of the frost, accompanied by damp warm winds, is very fatal to insects, as many are brought out by the sudden change only to fall an easy prey to half starved birds. Last year (1882) was an exceedingly poor one for the entomologist, and there is every reason to believe that this one (1883) will be worse.

It has been noticed of late how much less common the large garden white butterfly, *P. brassicæ*, has become. This is certainly not due to any scarcity of the food-plant, but very probably to the series of wet seasons that we have of late years experienced.

Our Meteorological Sub-Committee would find it a subject of great interest to compare their observations upon the weather with the appearance or non-appearance of various insects.

With regard to what are called "noxious insects," our club can, we think, render valuable assistance in giving information as to the causes and remedies of many of the ills that farms and gardens are heir to. Leaving out of the question the aphides, various coleoptera, &c., which cause such havoc amongst our crops, there are many larger enemies amongst the lepidoptera. The larva of *Z. æsculi*, the wood leopard; of *C. ligniperda*, the goat-moth, and some others feed upon the solid wood of some of our trees; and the death of the tree is generally attributed to some other cause, because the real foe is hidden from view. How often we see orchards of fruit destroyed by what is known as a *grub*: currant and gooseberry bushes bare of leaves to their ultimate death; the former caused by *carpocapsa*, *nepticula*, *pomonana*, and *pomella*, and the latter by a saw fly larva, and the currant moth *Abraxas grossulariata*. Lime and birch trees served in the same way by the larvæ of *Pygæra bucephala*, to say nothing of the ravages committed by the night-feeding larvæ of *Mamestra brassicæ* upon cabbage plants, and *Agrotis segetum* upon turnips.

Before leaving so interesting a subject as the life, habits, and economic bearing of insects, we would draw attention to one particularly important point which is the survival or disappearance of certain species in the struggle for existence owing to the favourable or adverse circumstances by which they are surrounded. It is pretty generally known that many birds feed largely upon insects, but it is not so well known that whilst some insects are a favourite food, others are entirely passed over owing to their obnoxious flavour. Now this latter class may generally be recognised by their bright colours, and attractive markings, for being rid of so powerful an enemy as birds, they would obtain no advantage by being of a sombre colour. Amongst this class, we recognise *Arctia caja*, *dominula*, *jacoba*, *filipendulæ*, *Calimorpha hera*, and others.

Turning, however, to the other class, the palatable ones, we have an enormous number of striking illustrations of the protection which such insects derive from their strong colour resemblance to the objects on which they rest, and which is usually the stem or trunk of the plant or tree upon the leaves of which the larvæ feed.

For instance, such moths as *Œscularia progemmaria* and others which are out in the months of January to March, closely resemble in appearance the dead leaves so abundant at that season. To enumerate all the examples which support this interesting fact would occupy a paper in itself, but the subject is one well worthy of study.

Before proceeding to enumerate the species of our larger lepidoptera which have been recorded from our district, we would first propose one or two rules which those who are thinking of taking up the study of entomology should follow.

1st.—Keep a record of the time, locality, manner of capture, and, if possible, state of the weather, of all butterflies or moths taken.

2nd.—Much the same as regards larvæ, with the addition of either a specimen, sketch, or correct name of the food-plant, especially if the food-plant happen to be an unusual one for that particular insect. Also record whether the larvæ is feeding on the leaves, stem, blossom, seed, capsule, or root of the plant. Also whether the larvæ be gregarious or solitary.

3rd.—To draw comparisons between the records of any given locality, one year with another, with probable causes, meteorological or otherwise.

4th.—To note the ravages of hurtful insects whether in farm, orchard, or garden, and suggest remedies to counteract their influences.

DIURNI.

Of this division we have 43 species recorded from this district out of the 64 known British species. We have also records of three others, which we prefer to call doubtful until their occurrence has been verified. 1st, *Leucophasia sinapis* (the wood white), which is recorded as having been seen on the higher part of Riddlesdown, where it might be looked for. 2nd, *Melitæa artemis* (the greasy frittillary), which is recorded from Sandwich, Kent, rather beyond our limit. 3rd, *Apatura iris* (the purple emperor), a specimen of which is recorded as having been *seen*. It was flying round the tops of some oak trees at Selsdon in the year 1874. As it was seen at the same time by an experienced entomologist, who endorsed the opinion, we feel that we are justified in recording this fine insect.

Of the 43 species actually authenticated, *Pieris brassicæ* is noticed by many to have become much less common than formerly. *Colias edusa* and *C hyale* are remarkable for their erratic appearances, being abundant in some localities in some years, and extremely rare at others. Of the genus *Argynnis*, we have all the six species recorded in our district, although *one*, *A. Lathonia*, is entered as being recorded by *Newman* in August, 1868. We have a variety of *A. Selene* recorded by one of our members. We have also all the *Vanessas* recorded, although the rare *V. antiopa* has not fallen to the lot of any ot our committee, still the record is good, and no doubt this was one of its former haunts, being near the Camberwell district. *V. Cardui* (another erratic) is recorded as being very abundant in 1877. We have records of only two specimens of *Argi galathea*, and they are from Reigate. Of the genus *Satyrus* we again have all six species, *S. Semele* being very common at Riddlesdown. The hair streaks are well represented, and may be looked for in the Croham and Selsdon district, whence we have recorded *rubi*, *quercus* and *W. album;* of the blues, *Lycæna*, we have six out of a possible eight, *L. acis* and *L. arion*, being absent. *L. corydon* is confined entirely to the chalk, and is abundant at Riddlesdown. *L. Alsus* is recorded from the same place, and *L. Argiolus* frequents ivy, near which it is often taken. Of the *Hesperidæ*, skippers, we have five out of a possible seven, the best being *H. comma*, which is recorded as sometimes occurring in great abundance at Reigate and Box Hill. The unrecorded species are *H. linea* and H. *acteon*.

NOCTURNI.

Of the 102 species included in this sub-division we have 54, or rather more than one-half, recorded; one of these, *Deilephila livornica*, having been taken off some chalk in a barge near Sittingbourne, should perhaps not be included.

Of the Sphingidœ we have a good number in this district, the best being *atropos*, larva of which have been taken in a garden in North End; *S. convolvuli*, which is remarkable for its predilection for wet clothes, upon which it is often taken; *Chærocampa porcellus* and *elpenor*.

Of the *Sesias*, or clearwings, we have but few records, these insects being somewhat misleading in their appearance when flying.

Cossus ligniperda seems fairly abundant here, its remarkable larva being occasionally seen. *Procris globulariæ* is recorded from Lewes, and *Zygæna trifolii* from Caterham. Of the *Lithosias* we have eight out of eleven species, and of the genus *Arctia*, four out of five, *fuliginosa* and *mendica* being the best. The larva of *Bombyx rubi* has been taken at Ashburton farm, and *quercus* seems fairly distributed. The last and most beautiful insect of this division, *Saturnia carpini*, is to be taken on the Shirley Hills, often in considerable numbers, where also its larva may be obtained.

GEOMETRINA.

In this division we have 285 British species, of which 154, or again rather more than half, have been recorded in this district. The first, *Ourapteryx sambucata*, is common, and is a well known and beautiful insect in our gardens, especially near ivy, in the summer evening twilight. *Epione apiciaria* is recorded from South Park, Reigate; as also is *Pericallia syringaria*, *Himera pennaria* from West Wickham. *Phigalia pilosaria* is taken in Croydon, and is also very common in Richmond Park, as is *Hispidaria;* in fact out of the six *Amphidasidæ* are recorded from this district. They are early in appearance, and may therefore soon be looked for. Of the genus *Boarmia*, we have three out of six species, the best being *B. consortaria*, from West Wickham. *Tephrosia punctulata* is to be taken in Wickham Wood also.

Of the Emeralds, Genera *Geometra*, *Nemoria*, *Iodis*, *Phorodesma* and *Hemithea* we have six out of eight species, and of the genus *Ephyra* five out of six species. The rare *Aventia flexula* is recorded from Reigate and Dorking. *Fidonia piniaria* is to be obtained near the fir plantation of Shirley and Wickham, in abundance; *Scoria dealbata* is recorded from Rochester, and *Abraxas ulmata* from the Ballards, Addington. *Pachycnemia hippocastanaria*, a good insect, has been taken in abundance on Shirley Hills.

Of the genus *Hibernia*, the whole five species are recorded from this district, but of the *Eupithecia*, we have very few species, only 13 out of 50.

DREPANULÆ.

Of six species under this division, we have five recorded from our district. *Platypteryx lacertula* taken in Imago and larva stages at West Wickham: *P. falcula* being fairly common; *P. hamula*, one only, West Wickham, and *Cilix spinula* somewhat common, Addiscombe being mentioned as one of its localities.

PSEUDO BOMBYCES

Of these we have recorded 14 species out of 26, but a fifteenth *Notodonta carmelita* is known to occur at Shirley, which place in fact is perhaps one of the best localities for it in the country. *Dicranura bifida* is recorded from two or three spots. *Cerura Vinula* is very common since the introduction of so many poplars; *Stauropus fagi* has four records, which is good for so uncommon an insect. The Buff tip, *Pygæra bucephala*, is rather too common; its larva attacking willows and similar trees in gardens, by thousands, some years.

Of the prominents, besides the one alluded to, we have several records of *U. Carmelina*, *U. dictæa and U. dictæoides*, one larva from West Wickham, of *U. dromedarius*, and one imago of *U. ziczac*.

The figure of eight moth *Dioloba ceruleocephala* is common in the larval form, but although easy enough to rear, some seasons, they are not so at other times, and are known to spin up, but never live to assume the pupal stage.

NOCTUÆ.

We now come to the great division which embraces the night flyers, and in it we have 136 species out of 313, besides two from Hants. The first two, *Thyatira derasa and T. batis*, and perhaps the most beautiful, have been taken in several spots, although neither is common; Norwood, Croham, Wickham, and Addiscombe being given as localities. *Cymatophora flavicornis* may be taken near the pine woods, Shirley, in the early spring. *Acronycta leporina* is recorded from Shirley, also the Lansdowne Road, and the larvæ of *A. Aceris* is common in this district. *A. alni* is represented by one larva taken at Reigate and *A. rumicis* is not rare.

Of the genus *Leucania* we have only four out of 15 species, and of the genus *Nonagria* only one out of five, and this one is represented by a single specimen of *U. typhæ* taken at North End.

Of the genus *Xylophasia* we have five out of six species, *X. rurea* being taken at Reigate; the other four common. *Diptervgia pinastri* seems very abundant in this locality, although not generally so; it is recorded as being captured by sugar, by light, and at rest. *Neuria saponaria* is recorded from Addiscombe, and *Heliophobus popularis* from North End. *Luperina testacea* have been taken in three localities. Of the genus *Mamestra* we have two troublesome representatives, *M. brassicæ* and *M. persicariæ*, as our cabbages and other plants testify.

Of the seven species of the genus *Apamea* we have three. *A. ophiogramma*, the best perhaps, from Upper Norwood and Addiscombe. *Grammesia trilinea* is common on long dry grass in the early evening in June.

One specimen of *Caradrina cubicularis* is recorded from Addiscombe. Of the genus *Agrotis* we have 10 out of 23 species, *suffusa*, *saucia*, *segetum*, *exclamationis*, and others coming freely to sugar; *A. agathina* is found on the hills of Shirley as also is *A. porphyrea*. *A segetum* is the species whose larvæ feed inside turnips, and it is considered as a farmer's pest.

Of the six species of the genus *Tryphæna* we have five. These are the Yellow Underwings and *T. fimbria*, a fairly good insect, has been taken freely at sugar at Addiscombe, the larvæ was taken at sugar also at Shirley. The large Yellow Underwing, although a common insect, is an interesting one, owing to the variety it presents in colour and markings.

Noctua brunnea is recorded from West Wickham, and *N. festiva* from that place and Ashburton Park; we have, however, but few of this genus. *Trachea piniperda* may be found on or near pine trees in March and April; numbers are annually taken at Shirley and West Wickham pine woods. It is an interesting insect, as it closely resembles a bit of chipped fir tree bark or a segment of a fir cone.

Of the pretty genus *Tæniocampa* we have eight out of 11. Many species of this genus may be beaten off the sallow as soon as it blooms, including *Stabilis*, *instabilis*, *gothica*, *cruda*, and *munda*. A good locality for these is near Ashburton farm, on the right in the main road.

Orthosia lota is recorded as having been taken on Croydon Common in November, 1879. No other record.

Of the chestnuts genus *Anchocelis* we have three out of four species. *A. rufina* and *A. pistacina* coming freely to sugar and *A. Lunosa* to light. This latter is not a common insect, but about the year 1876 it was remarkably abundant upon lamp posts in the Upper Addiscombe Road, where a large number were captured varying remarkably in colour from red to grey, brown, tawny, and almost black. *Cerastis vaccinii* is also common generally. Of the genus *Xanthia*, we have four out of six species, and of the genus *Cosmia* three out of four, the pretty *C. diffinis* and *affinis* being taken at sugar even in our gardens. *Eremobia ochroleuca*, a good insect has been taken at Reigate, also at Caterham, on thistle heads. The genus *Dianthecia* is not well represented, four out of eight being the number recorded ; *D. conspersa* is known to occur on a fence near Caterham Junction Station, near which spot its food plant grows. *Phlogophora meticulosa* is one of our most common late summer moths, flocking to sugar with *Saucia* and other frequenters of treacle. *Euplexia lucipara* however is rarer, but we have several records of its capture. *Xylocampa lithoriza* may be taken in West Wickham and Shirley roads at sugar early in the year, even when the snow is on the ground. The larvæ of *Cucullia verbasci* has been taken on the mullein in the chalk pit, Park Hill Road, and other spots

Anarta myrtilli, the beautiful little Yellow Underwing may be taken plentifully on the top of Shirley in April and May. It flies with great rapidity over the heather in the bright sunshine. Its larvæ may be obtained with the aid of a sweeping net. *Heliodes arbuti* is recorded from fields near the Ashburton Road.

Brephos parthenias may be seen, sometimes in swarms, in West Wickham Wood, wherever the birch tree grows, in the month of March. It flies in the sunshine, and generally at a considerable height from the ground. *Abrostola urticæ* and *triplasia* both occur, and *Plusia festucæ* is recorded from a garden in North End. *Plusia iota* has been taken at Reigate, South Croydon and Addiscombe, and the common silver Y *P. gamma* occurs in extraordinary numbers, some seasons flying about in our gardens, not only in the evening, but in the full blaze of the sun. *Gonoptera libatrix*, the herald moth, seems to have been often captured. It has the peculiarity of hybernating soon after it emerges from the pupa, hence it is most frequently found in stables, barns, out-houses, &c. *Amphipyra pyramidea*, may be frequently taken at sugar, in the autumn, Croham Hurst and West Wickham being good localities. *Nœnia typica* is very common, in gardens especially, and *Mania Maura* is fairly abundant, often coming into dwelling-houses ; some good varieties of this moth have been taken.

Catocala Nupta, the red underwing is plentiful ; it comes to sugar in gardens, and may often be found on palings in the morning.

Euclidia mi and *E. glyphica* have been taken at Croham Hurst, Reigate, near Warlingham, and in other spots, and *Phytometra œnea* have been obtained commonly from Reigate. From this we see that out of 796 species belonging to the six groups already named, we have records from this district of 405, and five others which may be considered as not authenticated, being rather more than one-half. This number, we have reason to believe, will be considerably augmented even this season, but of course there are a large proportion of insects which we may not expect to obtain here, but whose habitats are either northern, marshy, littoral, or confined to that El Dorado of entomologists, the New Forest.

N.B.—The list referred to in this paper can be examined or added to upon application to any member of the Zoological Sub-Committee.

EDWARD LOVETT.

February, 1883.

36.—PARASITES ON SOME MOLLUSCA.

BY THE REV. GEORGE BAILEY, M.A.

[*Read* 14*th March*, 1883.]

Last August I took a number of *Limnea stagnalis* from the pond at Croham Hurst, and kept them alive in a bell-glass for observation. I soon noticed what appeared like a delicate fringe about the neck, head, and tentacles. A closer examination made it manifest that these mollusca were infested with creatures, we may conveniently term parasites, which waved to and fro continually, as though feeding upon something they obtained in the water. The Limneæ gave no signs of discomfort, though there must have been many scores of these "hangers on" attached to each mollusc. Several were detached by means of a fine sable brush, and I carefully watched their movements, and was for some time puzzled by their appearance and method of locomotion. They resembled worms in the form of their bodies, and in the fact that numerous setæ were visible, but they moved after the manner of leeches, attaching themselves to the glass cell, and not attempting in any way to swim freely.

Thus far I had used a 1 inch Obj. Then they were examined under $\frac{1}{5}$ Obj., and I soon felt convinced that the subject of enquiry was a Naid Worm. Naid worms are described as "aquatic animals, living among plants or burrowing in mud." One species, however, is affirmed to have parasitic propensities—attaching itself usually to Limnea, and feeding on animalcules. I conclude that our so-called parasite is one of this class, and think it answers fairly well to the description given by Grube, and others, of *Chætogaster vermicularis.* Johnston, in his "Catalogue of Annelids," thus describes the genus *Chætogaster*—"Body cylindrical, truncate in front, eyes none, mouth terminal, barbed underneath, bristles all forked spineti."

Various synonyms are used by different authors, evidently describing the same worm, e. g. *Nais vermicularis*, *Nais diaphana*, *Chætogaster Limnei*, *Chætogaster diaphana*, as well as *Chætogaster vermicularis.*

In all naid worms it appears that the sexes are distinct, and that propagation is both by ova and spontaneous transverse division. Dr. W. B. Carpenter gives a somewhat minute account of the remarkable process of non-sexual multiplication of these creatures. A bud is thrown out between two rings near the middle of the body, and ultimately developes into a distinct individual.

I trust it will not be deemed presumptuous on my part if I express surprise that Dr. Williams in his Report on the British Annedida, which he presented before the British Association in 1851, should "declare with deliberate firmness that there is not one word of truth" in the descriptions which Professor Owen, Dr. Carpenter, and others had given of the reproduction of Naid worms, by a process of fission.

On the 9th day of September, 1882, I was favoured with the sight of a process which Dr. Williams so confidently asserts does not occur; one of the *Chætogaster vermicularis*, divided while I was examining it under the microscope.

In the middle of February, 1882, I was charmed the unexpected division similarly effected by another Naid—*Stylaria paludosa.* I gave one of the specimens resulting from that division to my friend, Mr. Arthur Hammond, F.L.S., who has described and figured what he saw of this process a few days later. See "The Journal of the Postal Microscopical Society," Vol. I, page 81.

Returning to the subject of our notes, the bristles or setæ are moved by muscles, and to some extent answer the purpose of legs. I was able to see distinctly that these bristles were the instruments used as hooks for the purpose of hanging on to the body of the mollusc. They are well adapted for such purpose. They are forked hooks, in bundles of about ten hairs or setæ; and the bundles are opposite each other, about twelve fascicles on each worm. *Stylaria paludosa* has similar hooked and forked setæ, which it uses in clinging to aquatic plants; but it has in addition long filiform setæ, which *Chœtogaster* does not possess.

The contents of the stomach of the specimen of *Chœtogaster*, in which the division occured, furnish interesting data respecting the food of these worms. Most numerous were some oval bodies—transparent sacs, filled with very minute green cells, doubtless cells from some small plants. Tolerably plentiful were some circular bodies, of a deep brown colour; perhaps seeds of some type. Several species of diatoms were nicely cleaned, and very perfect; especially some small Navicula and Cononema.

37.—Romano-British Interments.

By Mr. George Payne, F.S.A.

[*Read* 11*th April*, 1883.]

I fear that my subject is one which is not altogether in accordance with the work of your Club, but your President assured me that it would not be unacceptable to you.

I selected the subject of Roman Interments, having had considerable experience in discoveries of that kind, and have explored numerous graves near Sittingbourne, in Kent. As much information concerning the manners and customs of the early inhabitants of Britain is obtained from the contents of their tombs, it is necessary that we should give these matters our careful attention.

I propose to bring before your notice this evening some of the various kinds of interments of the Romano-British period with which we are acquainted, illustrated as far as possible by my own discoveries. When cremation was resorted to, we usually find a group of vases placed around the cinerary urn, the latter, which is either of glass or pottery, containing the calcined bones. The number of vessels found in each grave varies very much, and possibly indicates the worldly rank of the deceased. In 1877 and 1879 two remarkable interments were met with twenty yards apart, at Bayford, Sittingbourne, containing respectively, twenty-two and thirty vessels. The following is a list of the objects:—

Grave I (1877).

Glass vessel containing calcined human bones.
Fragments of two glass vases.
Bronze goblet with handle
Bronze lamp stand with crescent shaped handle.
Bronze jug with mouth in the form of a strawberry leaf; upon the base of the handle is the figure of a siren, in relief.

Glass flagon.
Bronze patera with handle; the latter terminates with the head of a deity (Pan).
Bronze guttus, ornamented with four slaves' faces, in high relief.
Iron strigil and ring, for suspension.
Nine pateræ and cups of Samian ware.
Two minute urns.
Bones of sheep.

GRAVE II (1879).

Glass vessel containing calcined human bones.
Three elegant glass vases.
Fragments of a glass vase.
Iron lamp-stand.
Bowl of delicate white clay.
Two urns of Upchurch ware.
Pitcher of red clay.
Three bronze strigils, with ring for suspension.
Fifteen pateræ, and cups of Samian ware.
Bronze vase with highly decorated handle.

The importance of these discoveries will be readily understood from the above list, and points clearly to the graves being those of affluent persons who were accustomed to the luxuries of a refined life. The "strigils" found in each grave were used to scrape the body with after bathing or gymnastic exercises, their edges being moistened with oil which was carried in a "guttus;" the oil was also used for anointing the body. Interesting examples of these bathing requisites have been found near Latum, not far from Urdingen.* Battely figures a strigil from Reculver; † there are also some good specimens in the British Museum from Herculaneum and Pompeii. It is worthy of note that objects of so costly a nature as those from Bayford should have been buried simply in the ground, without covering or protection of any kind. One would have expected to have found them in a cist or sarcophagus as discovered at Avisford, Sussex, in 1817.‡ The extensive Roman Cemetery discovered at East Hall, near Sittingbourne || furnished numerous interments of probably the members of the rural population of the district. The mode of burial was uncommon, inasmuch as the calcined bones were not placed in urns, but in most cases lay in heaps,

* Archæologia, Vol. xliii, pp. 252 to 257.
† Antiquitates Rutupinæ, pl. xii, p. 115.
‡ Collectanea Antiqua, Vol. i, pl. xliv, p. 123.
|| Archæologia Cantiana, Vol. x, pp. 178 to 183.

surrounded by four or five vases. In some instances a bronze fibula was laid upon the bones. Another kind of sepulchre hitherto not met with in Kent is the "Tile tomb." At Litlington,* in Cambridgeshire, two vases with two cinerary urns containing bones were found covered with a large roof tile. At York † it appears to have been the custom to place the tiles over the deposit in the form of a house roof, the ridge being covered with ridge tiles. Stone sarcophagi are of rare occurrence in this country; examples have been discovered at Keston,‡ York,§ and London.|| Some of the latter are inscribed, one as follows:—

D. M.
AVR. SVPERO. CENT.
LEG. VI QVIVIXITANIS
XXXVIII MIIII DXIII AVRE
LIA. CENSORINA CONIVNX
MEMORIAM POSVIT.

Diis Manibus. Aurelio Supero Centurioni Legionis Sex tex, qui vixit annis xxxviii, Mensibus iiii, Diebus xii. Aurelia Censorina Confunx Memoriam Posuit. To the Gods of the Shades. To the memory of Aurelius Superus, Centurion of the Sixth Legion, who lived thirty-eight years, four months, thirteen days. Aurleia Censorina, his wife, set up this.

Stone coffins usually contain burials by inhumation, as do the Roman leaden coffins. The latter are of much interest, and generally highly ornamented; the principal decoration consists of various kinds of bead, fillet and cable moulding, with medallions of Medusa, Pallas, and Minerva, disposed between the bands of moulding the escallop shell was also a favourite design. At Bexhill, Milton,¶ we found the head of Medusa in combination with lions. A mile to the west of the town of Sittingbourne, and a few yards from the Watling Street road a child's coffin was discovered, ornamented with cable moulding and oxen yokes. It contained the bones of a very young child, together with two gold armillæ, a gold finger ring, and a jet armilla outside the coffin; at the head and foot were two earthen vases and a white clear glass cup.

Mr. Roach Smith has published accounts of most of the discoveries of leaden coffins found in this country, and in

* Collectanea Antiqua, Vol. i, pl. xii.
† Eburacum, pl. xi.
‡ Archæologia, Vol. xxii, pl. xxxii.
§ Eburacum, pl. xii.
|| Collectanea Antiqua, Vol. iii, pl. xiii.
¶ Archæologia Cantiana, Vol. ix.

France,* to which the student should refer. Leaden "ossuaria" are of rare occurence. Our acquaintance with this mode of sepulture has recently been added to by important discoveries made upon the premises of Messrs. Tylor, in Newgate Street, where two or three of these curious cists were brought to light, each enclosing a glass cinerary vase of great beauty. They may be seen in the Anglo-Roman room at the British Museum. The amphora tomb next claims our attention ; it consists of a large earthenware amphora, or wine vessel, in which was deposited a glass vase, containing the calcined bones, accompanied by vases and other articles. The neck of the amphora was broken off to admit of the funereal vessels being placed inside. Such interments have been met with at Colchester, Lockham Wood, near Maidstone, Buckland, near Dover, and elsewhere.

During the past year, my friend, the Rev. F. T. Vine, vicar of Patricksbourne, Kent, opened three barrows in Gorsley Wood, near Bridge, on the property of the Marquis Conyngham, revealing a stone cist in the centre of each mound, of the following dimensions.

INTERIOR.

Cist A and Cist B.—Length 4-ft., Breadth 2-ft. 6-in., Depth 2-ft. 6-in.

Cist C.—Length 3-ft., Breadth 2-ft. 3-in., Depth 3-ft.

These cists were formed with six slabs of sandstone, *i.e.*, four for the sides, one for the base, and one as a capstone, the side stones were neatly joggled together, the insides of the cists having been carefully tooled. The slabs measured from five to 11 inches in thickness.

Cist A contained a few ashes ; on the capstone a human skull was found.

Cist B contained pieces of charred bone, a piece of a bronze ornament, and fragments of thin glass.

Cist C contained a quantity of bones, which appeared to have been partially burnt, a fragment of bronze and fine glass.

The skilful manner in which the cists were fitted, the presence of glass inside them, together with the numerous Roman tiles and fragments of pottery around them is sufficient evidence to warrant these interesting monuments being assigned to the Romano-British period. Mr. Roach Smith, who visited the spot with me, suggested that the graves might be those of British chiefs, erected at an early period of the Roman occupation. In all probability similar interments

* Collectanea Antiqua, Vols. iii and vii.

would be met with close at hand, but unless covered with mounds, it would be in vain to search for them, as where tumuli have not been protected by mounds, they have become levelled by atmospheric agencies or agricultural operations.

The Marquis Conyngham's estate has yielded a rich store of archæological treasures from time to time, most of which are preserved in the mansion at Bifron's, near Canterbury; they are chiefly of Anglo-Saxon date, and were exhumed by the late Mr. Godfrey Faussett, F.S.A.*

To return to the discoveries at Bayford, near the two graves mentioned in the early portion of this paper, we found, what upon careful examination, proved to be the site of the "bustum," where the actual cremation took place. For several yards around the earth was very black, and when removed was found to contain broken tiles, potsherds, portions of bones, and antlers of old red deer, jaw bones and horn cores of ox, long iron nails and fragments of bronze ornaments, oyster shells, &c. The custom common to the Romans of throwing potsherds and trinkets upon the pile during the burning of the body, was well illustrated at Bayford, and helps to explain away the oft quoted passage in Shakespeare,

> "Shards, flints, and pebbles should be thrown on her."—
> *Hamlet*, Act v, Scene 2.

The presence of animal remains by the funeral pile would indicate sacrifices and feasting. A word may be said about the various vessels placed upon the tables for your inspection. We are inclined to look upon the bronze jug from grave No. I as the "præfericulum" for the sacrificial wine, and the bronze patera for pouring the libations. The glass vessels are so delicate that they must have been made either for ornamental or sepulchral purposes. Strabo was informed by a glass maker of Alexandria, that a peculiar earth was found in Egypt without which it was impossible to manufacture certain kinds of glass of a brilliant and valuable quality, and some vases presented by an Egyptian priest to the Emperor Hadrian were considered so curious and valuable that they were only used on grand occasions.† The Roman glass vases found in graves in Britain must have been costly, and highly prized, and would therefore naturally be selected to contain aromatics, perfumes, and other funeral balsams, which were deposited with the dead, as propitiatory offerings to the manes. I have by no means exhausted the number of different modes of burial practised by the Romans, but I trust enough has been said to

* Archæologia Cantiana, Vols. vi and x.

† Wilkinson's Ancient Egyptians.

give you renewed interest in these precious relics of the past. Whenever I lecture upon archæology I feel it my duty to ask all classes to assist in the preservation of these ancient remains, which speak to us forcibly of the early history of our country. I hope I have shewn that they are worth preserving, and have a value far beyond a pecuniary one.

38.—List of Species of Ephemeridæ found in the Neighbourhood of Croydon.

By Rev. A. E. Eaton.

1.—*Ephemera danica*, Müller (Mayfly). The Ravensbourne above Lewisham.

2.—*Habrophlebia fusca*, Curtis. Near Dorking and Reigate in small streams.

3.—*Cœnis macrura*, Stephens. In a pond near the footpath and wood between Plaistow, Kent, and Grove Park.

4.—*Ephemerella ignita*, Poda. The Ravensbourne, near Southend.

5.—*Baëtis rhodani*, Picket. Common in streams at Bromley.

6.—*Centroptilum luteolum*, Müller. Ditto.

7.—*Cloëon dipterum*, Linné. Small ponds at Lewisham. Likely to occur in the remains of the Surrey Canal.

8.—*Cloëon simile*, Eaton. With No. 3.

9.—*Cloëon rufulum*, Müller. With the preceding species; also at Keston Ponds.

10.—*Heptogenia elegans*. In the river near Dorking.

39.—A Week in the Country of the Broads.

By A. B. Farn, Esq.

[*Read* 10*th October*, 1883.]

Geologists tell us that the true fens in this country are confined to the great peaty and alluvial flats of Cambridgeshire, Lincolnshire, and the Wash, having an extreme length of 73 and an extreme breadth of about 36 miles, and do not include the marshes and broads of Norfolk. The title, therefore, which your secretary has put down on the notice is not strictly a correct one, as my paper is really on a portion of the Country of the Broads.

One July, more than 12 years ago, I paid my first visit to the Country of the Broads, and made the little village of

Horning my head-quarters. It is situated on the River Bure, some miles N.E. of Norwich, and at the time of my visit but few entomologists had systematically worked the district. I had anticipated much pleasure from capturing rare lepidoptera, but I pictured the locality as being flat and uninteresting. I was agreeably disappointed with the physical features of the country, for, although in the valley of the Bure the ground is flat enough, yet it is margined by hilly and well wooded country, and the marshes themselves do not present the dreary aspect of Thames marshes, but are broken up by clumps of trees, here called "carrs," consisting of alders, birch, buckthorn, and sallows, varied by beds of reeds, mingled with reed-mace, and by dykes bordered by the waterdock, the purple loosestrife, the meadow-sweet, and the flowering rush. Here and there too are windmills used for pumping the water from the marshes into the dykes and rivers, for much of the surrounding ground is below the level of the stream. The Bure itself is a fine wide, though sluggish, river, margined by all sorts of aquatic plants, among which the bull-rush, or bolder, as it is here called, rises to the height of several feet. The tide, so far up as Horning, rises and falls some eight or nine inches. A typical view of the Broad Country is from the high road between Wroxham and Horning, just past the church of Hoveton, or Hofton as the country people call it. From this point one can see parts of both Great and Little Hoveton Broads, the windings of the Bure enlivened by the tan-sails of the barges or wherries. On the two broads I have named, as indeed on other broads, the *Typha angustifolia*, or lesser reedmace, seems to be extending in all directions, threatening entirely to overgrow them. On the larger of these broads the blackheaded gull breeds, and I am told, in increasing numbers since the Birds Protection Act has been in force.

Not far from the village of Horning are the remains of Holme, or St. Benet's Abbey, founded, it is said, in the year 800, and raised into a mitred abbey in 1020 by Canute, who strongly fortified it.

The inhabitants of Horning viewed with considerable amusement, bordering on contempt, my green butterfly net, and used to enquire whether I was going "mingen-catching," but yet the marsh-men were not above collecting "cankers" for me—the larvæ of *Papilio Machaon* and *Chærocampa Elpenor*—the Swallow-tailed Butterfly and the Elephant Hawk Moth. The former of these they said they detected by the smell emitted by them when disturbed by the mowing down of their food plant, an odour like decaying apples. As regards the food plant of the larvæ of *Machaon*, it is frequently stated to be the wild carrot—*Daucus Carota*—but in reality it is the *Peucedanum palustre* or Hog's Fennel.

Where rivers and broads team with fish, it is natural to expect the presence of the otter, and it is found in the neighbourhood of Horning, but from the large amount of cover afforded by the reeds and the rank vegetation, it is not often seen; their nests are occasionally found in the dense reed beds. The polecat is occasionally seen, and I was informed that an animal which, judging from the description, would appear to have been a marten, was noticed running along the ground and up the stem of a fir tree, mobbed by the sparrows of the neighbourhood. The Norfolk list of birds is notoriously a rich one, emulating that of Cornwall. The marsh harrier may be seen almost any day, but they are as a rule immature birds. When slowly flying at a distance, it may readily be passed by as a heron, as it often flaps along in a lazy manner. One evening I was standing up, concealed by bushes, for ducks, and had shot four garganey teal, all of which had fallen into and were floating on a small broad. Before the keeper could come up to me with the retriever, a marsh harrier managed to take up one of the teal and to steal off out of gunshot before I discovered it. The garganey annually breeds in the reed beds, but I am told they are diminishing in numbers; on the other hand, the full snipes breeding in the district increase. The inhabitants protest against the shooting season commencing so late as the 1st August, and say that the duck and snipe bred in their marshes go away in July, and are shot in other districts.

The bearded tit or reed pheasant is very scarce in the district round Horning. I was much pleased on one occasion in watching a small family party of six flying from bulrush to bulrush along the edge of Malthouse Broad. I also met with the grey-headed wagtail, *motacilla neglecta*, the nest of which I found with five eggs, and captured the male bird for identification. I exhibit two nests of what are supposed to be those of the sedge warbler, but I would remark that while sedge warblers were breeding round the edges of the dykes, these nests were found near together on the ground in the open marsh. They appear to be flatter than those usually built by sedge warblers, and the eggs are much paler, and are decidedly larger than the usual run of that species.

As for the fish, the water teams with them. Bream run to a large size, as do the roach, perch, pike, and tench, but these large fish are not to be caught every day. The pope, or ruff, is very common too.

As regards the lepidoptera, my anticipations were not disappointed. For some three weeks I saw the sun rise each morning as I was returning home, having been out all night. *Papilio machaon* is common, flying slowly about and fond of resting on the flowers of the ragged robin ; and in early morning *hyria auroraria* the purple bordered gold, is seen flitting over the shortest herbage. But it was at night that I worked the hardest. At dusk, round the swallow bushes, *Lobophora sexalisata*, the small seraphim, would fly rapidly. *Lithosia muscerda*, the pearl footman, found, I believe, only in Norfolk, is common in company with *L. griseola*, the dun footman, and its variety, *Stramineda*, the straw footman, and at the blossom of the yellow iris, *Chœrocampa Elpenor*, would be seen hovering. *Nonagria despecta*, the lineated wainscot, was to be seen in myriads, together with *Scoparia pallida* and *Nudaria senex*, the scarce muslin. Round the bushes hovered *Epione apiciaria*, the bordered beauty, and *Cidaria pyraliata*, the straw spinach moth.

In long grass *Acidalia immutata*, the lesser cream wave, and *Phibalapteryx lignata*, the oblique striped carpet, may be walked up. *Senta ulvœ*, the silky wainscot, occurs in all its various forms, the plain, striated, the two spotted, and the rare dark lined form, called *Wismariensis*. In the shoots of the reeds the larvæ of *Leucania phragmitidis*, a white larva with chocolate coloured blotches, are found, inside the upper portions of the reeds, the larvæ of *Nonagria neurica*, a pale rosy larva much attenuated, as all the *Nonagria* larvæ are. In the lower parts and roots of the reeds feed the larvæ of *Nonagria lutosa*, and the larvæ of *Chilo Phragmitellus*. On the leaves of the reeds feed larvæ of *Leucania straminea* and *Leucania pallens*. The reed therefore has many enemies among the lepidoptera alone, and I have by no means exhausted the list. The stems of reed mace, are mined by larvæ of *Nonagria Typhœ* and *Cannœ*, the reed moth. It is easy to distinguish the pupæ of the two species, as the chrysalis of *Typhœ* has its head downwards, whilst that of *Cannœ* is upwards. One of the greatest rarities in those days was *Nonagria brevilinea* or Fenn's Wainscot—named after the gentleman who first took a specimen of this species. In my opinion this species has been placed in the wrong genus, and should be placed as a *Leucania*. Its structure is certainly more like that of *Leucania*, and its larva is an external feeder, whereas the larvæ of the *Nonagriœ* are internal feeders. I shall never forget taking my first specimen ; it was worn, it was jagged as regards its wings, but it was a veritable *brevilinea*, and that was the only specimen I took my first season. Subsequently by working the honey dewed sallows, I took other specimens. My first season at Horning I captured upwards of 300 species, which number I could readily have increased, but at that time I was more interested in the Macrolepidoptera, than in the smaller species. I may mention that on the meadow-sweet the beautiful larvæ of *Saturnia Carpini*, the Emperor moth, is common, and that I have never found it elsewhere on this plant. If any of my auditors here should be induced to try the Norfolk Marshes and Broads, I would caution them on the matter of the morass. It is awkward walking in very many places, and positively dangerous in some; there are many parts inaccessible. It is a curious feeling, walking over a place which rises and falls with your every step, and you can see a very large space rising and falling as you progress. In fact you are walking over a mass of vegetation, floating over liquid mud, and are upheld solely by the entangled roots. Once break through them, and you would rapidly disappear.

40.—The Fauna of Spain.

By Howard Saunders, F.L.S., F.Z.S., &c.

[*Read 14th November*, 1883.]

In commencing my short paper upon the fauna of Spain, it is desirable to make a few remarks upon the natural features of that country. Owing to the fact that the majority of tourists confine their visits to Andalucia, and other southern provinces, or to the fertile belt which runs along the east coast of the Peninsula, somewhat erroneous ideas are often formed as to the remaining and far larger portion of the country. In the south and east, irrigation, and the warmth of a sheltered situation on the shores of the Mediterranean, allow of the cultivation of the date-palm, the sugar cane, cotton, and other plants associated with warm climates, but all of them introduced by man; and the confusion of ideas as to the *natural* products of Spain is increased by the presence, in the south, of hedges of cactus and the tall-stemmed aloe, both of which are frequently termed "so thoroughly *oriental*," the speaker or writer forgetting that these plants are essentially natives of tropical America. But fertile as the soil of Spain can prove itself, it is essential to remember that the greater part of this compact peninsula is a lofty table-land divided into sections by somewhat symmetrical ranges of mountains, and furrowed, rather than intersected, by rivers, few of which unfortunately are navigable. The fatal interference of man has stripped the once-existing forests from hill and mountain, thus laying open the slopes to be parched by drought, or denuded of their soil by rain and melting snow; and watercourses which might have rendered service to commerce and agriculture are alternately scanty streams or raging torrents. The physical conditions of the *greater* part of Spain are, therefore, those of a somewhat cold country, owing to the high average elevation, tempered by the heat incidental to the unobstructed rays of the southern sun, and the fauna might, therefore, be expected to correspond in the main with that of Central Europe.

The visitations of great cold, alternating with more temperate periods which affected the North of Europe during the glacial epochs, do not seem to have exercised any important influence upon the country to the south of the Pyrenees. It is true that signs of glaciation are not altogether wanting in the vicinity of such lofty ranges as the Sierra Nevada and the Guadarrama, but they are merely partial, and no ice cap seems to have overspread the entire country. The reindeer and the musk-sheep *(Ovibos moschatus)* came down to the south of France, but no further. On the other hand several species of extinct and living animals are found in Spain which are entirely or nearly absent from other parts of Europe, and all these are African forms. There is geological evidence that the Spanish Peninsula was formerly united to Africa at a point about 50 miles to the west of Gibraltar, where, at the present day, the maximum depth of the sea does not exceed 200 fathoms. A similar union existed between Sicily and Northern Africa, and as is shown by the African elements in the fauna of the southern portions of these two countries, they were at one time disconnected from the Northern portions of Europe. In Spain this disconnection appears to have prevailed over the district at present comprised between the Sierra Nevada, the Sierra Morena, and the Sierra Guadarrama.

Time will only permit of a brief glance at the more interesting features in the distribution of the Spanish fauna, and it may be as well to commence with a species peculiar to the northern portion of the country. The chamois *(Antilope rupicapra)* called "*isard*" in the French Pyrenees, and on the Spanish side, known as "*rebeco*," ranges along the whole Northern chain, from Mont Canigou, within sight of the Mediterranean, as far as Galicia on the Atlantic; but no trace of it has ever been found to the South of the Valley of the Ebro. One is *said* to have been seen at daybreak on a very misty morning in the Sierra Nevada, by a distinguished member of the Alpine Club, but twenty years of research have failed to confirm his statement, and with every respect for his judgment, I think he must have been misled by a young female Ibex. The distribution of the latter member of the Goat family is somewhat interesting. The Pyrenean Ibex, which is recognisably different from the Alpine form, is found down to the Guadarrama and the extensions of that range which are known as the Sierra de Avila, Sierra de Gatos, and the Sierra da Estrelha, in Portugal. There this species ends ; and in the mountains of Andalucia, especially in the Sierra Nevada, we meet with a form (*Capra hispanica*), which differs sufficiently in the shape of its horns to be considered a distinct species, or sub-species ; remains of this latter form are found in the bone-caves of Gibraltar. Of the Mouflon (*Ovis musimon*), of Sardinia and Corsica, represented in the Atlas by *O. tragelaphus*, there is no trace in Spain.

The Lynx which is found (although nearly extinct) in the Pyrenees, is the same as that of Northern Europe ; but in Andalucia a well marked and quite distinct species is found, *F. pardina*. The Wild Cat is generally distributed throughout the forests, down to the extreme South. Wolves are still to be found all over the country, even in places where it is wonderful how they can find a living. They are not often seen, but a sharp spell of severe weather soon betrays their existence. Except when driving the country for them, I have never seen but one. The long snouted Genet (*Genetta vulgaris*) is also generally distributed, both in Spain and Southern France. There is, however, a very interesting Ichneumon found in Spain, but no where else in Europe, namely, *Herpestes Widdringtoni*, a species closely allied to, if indeed distinct from *Herpestes ichneumon* of North Africa ; and so far as I know, the Guadarrama and its ramifications form the Northern frontier of its distribution.

The brown bear (*Ursus Arctos*) is only found occasionally on the French side of the Pyrenees, but on the Spanish side it is far less rare, and its present range extends throughout the Cantabrian Mountains. Three centuries ago, before the great forests had been cut down, it ranged as far south as the Guadaramma and Madrid, for the old books of *veneric*, published in the capital, state that the woods afforded excellent cover for "puerco y oso" (wild boar and bear), and the arms of that city are a bear climbing a "madrono," or wild strawberry tree. But beyond the Guadaramma Mountains there is no record of the existence of the bear, certainly none in the Sierra Nevada during the domination of the Moors, who were great sportsmen, nor does there seem to be any trustworthy evidence of its asserted presence in the Mauritanian Atlas within historic times. The jurassic limestone caves of Gibraltar have, it is true, afforded remains of *Ursus Arctos*, with those of extinct species of bears, but the question of non-existent animals is far too wide to be treated here. All that can be said is that according to Professor Busk, the remains do not include those of the great cave bear *Ursus spelæus*, which are so common as far as the northern side of the Pyrenees.

Gibraltar cannot be dismissed without a word about the Barbary apes now living upon the Rock. No remains of this species have been found in the bone-caves, and although there are said to have been monkeys on the Rock when our forces captured it, early in the last century, there can be little or no doubt that their presence there is not due to any communication with Africa, either above or *below* ground, as some writers have asserted, but to the intervention of their superior relations. Another and very different animal which may occasionally be seen wild in the wooded plains of the south-west of Spain is the camel, the descendants of some which were allowed to escape during political commotions many years ago. I saw some in May, 1868, and a friend has seen two this year. They "take the wind" like deer, and are almost as wild.

The rodents of Spain have been but little studied, and all that I dare say of them is, that whilst many northern species are, present the Alpine marmot is absent, even from the Pyrenees. Many other European animals of general distribution must be left unmentioned, but among the *Insectivora*, allusion may be may be made to a very remarkable creature *Mygale pyrenaica*, or "Desman," which may be described as a large water-shrew about the size of a mole, with a prolonged, flexible snout. It is not uncommon on the French side of the Pyrenees, although, owing to its nocturnal habits, it is supposed to be rarer than it really is, and it is said, and no doubt correctly, to be found on the Spanish side of that range. The interesting fact about it is that its only congener, *Mygale Muscovitica*, is confined to Southern Russia.

Passing to the birds, we find, that in spite of their natural facilities for dispersal, several species are almost entirely restricted to the Peninsula; whilst several others stop at, or even a little short of, the Pyrenees. Among the former is the Iberian representative of the Imperial Eagle, a white shouldered bird resembling in that respect its congener of Eastern Europe and Asia, but differing in some other respects, especially in its immature plumage, in which it approaches, and was long supposed to be identical with, *Aquila rapax*, a truly African bird. The green woodpecker of Spain *(Gecinus sharpii)* is distinguished from that of the rest of Europe by its pale grey and not black cheeks, thus forming an interesting link between the northern form, and *G. vaillanti* of Algeria. The rosy-breasted *Lanius meridionalis*, the Iberian representative of the great shrike of Northern Europe actually nests within sight of the African coast, yet he has never been known to cross the narrow Straits of Gibraltar; nor does his pale grey, heavy billed cousin *L. algeriensis* ever fly over to visit him from Tangiers. For complete isolation the most remarkable bird is the Spanish azure-winged magpie *(Cyanopica cooki).* It differs but slightly in tint, and in a smaller amount of white on the tips of its tail feathers, from *Cyanopica cyanea* of China and Japan, and considering the time which must have elapsed since the communication between the two species was cut off, the smallness of variation which has yet been produced may convey a lesson to those who ask for a sign, and will not believe in evolution, unless they see it performed within the brief span of observation allotted to human life.

Another bird of the same family, which exhibits some interesting gradations, is the Magpie. The common species of the West of Europe is found throughout the Peninsula, but in the district between the Sierra Nevada and the Mediterranean is found a bird (which I now exhibit), which is distinctly a connecting link between the Northern form and the Moorish Magpie, *Pica Mauritanica*. The latter has become so distinct since the separation of Spain and Africa, as to be considered a valid species; the intermediate form is nearer, and naturally so, to the dominant species in the Peninsula. Among the *Alaudidæ*, there is one well-defined species of shorted toed Lark, namely, *Calandrella bætica*, which appears to be peculiar in Spain, but a very closely allied form *C. reboudia* inhabits Northern Africa. And there is a very peculiar Desert Lark, *Certhilauda duponti*, with the curved bill characteristic of the purely African forms, which appears to visit Spain from Africa on the autumn migration. Why it migrates *Northwards* in autumn, I cannot say; it is possible that it breeds in Spain, but beyond the fact that several examples were obtained in Malaga, all in November, and all young birds, we know nothing.

One more bird may be mentioned as showing the connection between Africa and Southern Spain, and that is the Andalusian Hemipode. It occurs in Spain, over a limited area, along the south coast, just where we know that the latest union with Africa existed; it also occurs under precisely similar conditions in the south of Sicily. It has never been known to straggle to any other countries, its real home is in the two mentioned, and along the coast of North Africa.

It has only been possible to glance at a few of the more remarkable birds, and I am compelled to abstain from noticing the reptiles, because I do not possess sufficient knowledge of the facts regarding their geographical distribution in relation to Northern Europe on the one side, and to Africa on the other. I can only hope that within the brief limits at my disposal I have been able to bring before your notice some of the salient features of the distribution of the mammals and birds in the Peninsula.

Croydon Microscopical and Natural History Club.

OFFICERS FOR 1884.

President:

JOHN BERNEY, F.R.M.S.

Vice-Presidents:

ALFRED CARPENTER, M.D., J.P., &c.
PHILIP CROWLEY, F.Z.S.
HENRY LEE, F.L.S., F.G.S.

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CHARLES PRICE TURNER.

PROCEEDINGS & TRANSACTIONS

OF THE

CROYDON

MICROSCOPICAL & NATURAL HISTORY

CLUB.

FEBRUARY 13, 1884, TO JANUARY 13, 1886.

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Sparganium-neglectum. *Beeby.*

PROCEEDINGS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1884–85.

ORDINARY MEETING.—FEBRUARY 13TH, 1884.

JOHN BERNEY, Esq., F.R.M.S., President, in the chair.

Conformably with the notice given at the last meeting of the Club, the President moved as follows:—

"That the rule relating to the management of the Club be rescinded, and that the following be adopted in its place:—

"The business of the Club shall be conducted by a Committee (four to form a quorum), consisting of a President, four Vice-Presidents (to be elected from past Presidents), a Treasurer, an Hon. Secretary, and nine other members."

"The officers of the Club shall be elected at the General Annual Meeting. The President shall not hold office for more than two years in succession. Of the nine members of Committee, two shall retire each year, and shall not be eligible for re-election that year. The retiring members shall be (*a*) the one who has attended the smallest number of Committee meetings during the past year, (*b*) the one who has served on the Committee the longest. The remaining seven shall retain office without re-election. If two or more members have attended an equal number of Committee meetings, that member shall retire who has served longest. If two or more members have served an equal length of time, that member shall retire who has attended the Committee least often during the past year."

Dr. Strong withdrew the amendment, with regard to the election of Vice-Presidents, of which he had given notice at the Annual Meeting.

Fifteenth Annual Meeting,

Held at the Public Hall, Croydon, Wednesday, January 14th, 1885.

John Berney, F.R.M.S., President, in the chair.

The President announced that the following gentlemen had been nominated for the respective offices of the Club for 1885, and that no other nominations had been received :—

President.—Henry Tuke Mennell, F.L.S.
Vice-Presidents.—John Berney, F.R.M.S.; Alfred Carpenter, M.D., J.P.; Philip Crowley, F.Z.S.; Henry Lee, F.Z.S., F.G.S., &c.
Treasurer.—Kenneth McKean, F.L.S.
Committee.—J. G. B. Brewer; H. S. Cowdell; Henry S. Eaton, M.A., F.R. Met. Soc.; E. M. Geldart, M.A.; Edward Lovett; Edward Straker; Edward B. Sturge; H. G. Thompson, M.D.; Henry Turner.
Hon. Secretary.—William Low Sarjeant.

Upon these names being put to the meeting they were declared duly elected.

Dr. Carpenter proposed the following resolution :—

"That a cordial vote of thanks be given to the retiring President and Officers for their services during the past year."

The motion having been seconded by Mr. Philip Crowley, and supported by Mr. Mennell and Dr. Thompson, was carried unanimously.

The Balance-sheet was taken as read. Mr. Gibson having asked for an explanation of certain items, and statements having been made by the President, Dr. Carpenter, Mr. Mennell, and Mr. Crowley in reply, the Balance-sheet was passed.

The President, John Berney, Esq., F.R.M.S., then delivered his Address.

The President's Address.

Gentlemen,—My two years of office as your President being now at a close, it is my duty to address you, and, although I feel the task a difficult one, the ground having been so often before trodden by your past Presidents, I still venture to hope that the few remarks I have to make may interest you. I will commence by giving you a few particulars of our Club and its last year's work. Our Club was originally inaugurated on the 6th April, 1870, and was then known as "The Croydon Microscopical Club," and during its first year numbered 108 members. It has from that time continued to increase, and during the past year

27 new members have been elected. Eleven members have withdrawn, and the Club has, I regret to state, been deprived by death of four members, namely, Mr. A. A. Campbell, Mr. William Drummond, Mr. J. Spencer, and Mr. Alfred Tylor, F.G.S. Mr. Tylor was a member who had contributed much to Science. One of his latest publications was his description, in the 'Archæologia,' vol. xlviii., of the remarkable Roman remains excavated on land in Warwick Square, in the City, and now deposited in the British Museum. I am sure we must all regret these losses, more especially when the list contains such men as Mr. Tylor. The total number of our members on the 31st December last was 251 ordinary members as against 238 the previous year, four honorary members, and two associates.

In January, 1877, the title of the Club was changed to that of "The Croydon Microscopical and Natural History Club," and I am sure you will all agree that this altered title was more in accord with its works, as under its present rules it embraces not only Microscopy, but Meteorology, Geology, Botany, and Zoology, most of which sciences depend so much on the assistance of the microscope for their proper elucidation.

Judging from the work which our Club has done this past year, I think I may say it has not been idle; the papers have been of a very interesting character, and I am sure many of our members must have gained much useful information from those papers and the discussions on them. Referring to papers at our meetings, I should just like to impress on our members, especially the younger ones, that short papers may be quite as interesting, instructive, and acceptable as long ones, and that there is frequently more gathered from a short paper, as it affords a longer time for discussion; it also frequently happens that with a long paper some of our members living outside Croydon have to leave before the paper is ended, and lose nearly all the benefit which they would otherwise derive from its discussion. I mention this, as I think there may be many members who think it useless to prepare a short paper, fancying it would not be acceptable. The following is a list of the papers read before the Club during the last year:—

Feb. 13*th*.—"The Natural History of the Hydra," by Mr. Turner.

March 12*th*.—"The Flora of Surrey," by Mr. W. H. Beeby; a most interesting paper by a very hard-working member, and who has been very successful in finding new plants. It is only lately that Mr. Beeby has met with a plant new to Science, *Sparganium neglectum*, sp. nov. This new species of *Sparganium* was exhibited by Mr. Beeby at a meeting of the Linnean Society held on the 18th December, 1884. The plant was first noticed in October, 1883, at Albury Ponds, near Guildford, but the few specimens obtained were too imperfect to admit of determination. The immature fruit, however, differed from those of *S. ramosum*, Huds., and this led to investigation during 1884, with the result that Mr. Beeby had found widely distributed in Surrey the plant to which he had given the above name; although apparently confused by other authors with *ramosum*, it has certainly never been separated from that species. It differed from *ramosum* in various ways, but chiefly in the form of the fruit, which was ovate or obovate, somewhat acuminate, with a long beak, instead of being obversely pyramidal, with a very truncate or somewhat rounded apex and short beak. The present plant was only known with certainty to occur in Surrey, but was likely to prove widespread both in Britain and on the Continent. Mr. J. G. Baker, F.R.S., of Kew, has stated that he had carefully examined the plant, and it was certainly distinct. (Trans., art. 41).

April 9*th*.—"The Physical Geography and Geology of Italy," by Mr. Topley, F.G.S. (Trans., art. 42).

May 14*th*.—"On Pond Life," by Mr. Low Sarjeant. (Trans., art. 43).

Sept. 10*th*.—"On the Edible Mollusca or Shell-fish of the British Isles," by Mr. Edward Lovett. (Trans., art. 44).

Oct. 8*th*.—"On the application of the Microscope to the Study of Rocks," by Mr. F. Rudler, F.G.S. (Trans., art. 45).

Nov. 12*th*.—"On the Great North-West of Canada." Geology and Physical Geography, by Mr. Topley; Botany, by Mr. Henry Tuke Mennell. (Trans., arts. 46, 47).

Dec. 10*th*.—"A short visit amongst the Spoonbills of Holland," by Mr. Philip Crowley. (Trans., art. 48).

I may mention, in addition to Mr. Beeby's work in Botany, the good work done in Conchology by Mr. Kenneth McKean, who was fortunate enough to obtain, in the year 1884, in the neighbourhood of Croydon, as well as at Mitcham, in considerable numbers, *Testacella haliotidea*, the subterranean worm-eating slug. He was also fortunate enough to meet with *Clausilia Rolphii* (a mollusc which has long been known to inhabit Sussex) in Surrey in several localities. Now such things as these show us that we possess in our Club really working naturalists who take a lively interest in their work, and whose example may well be followed by others. It occurs to me that it would be well if, when any member finds a new thing, whether animal or vegetable, and he has more than he requires for his own use, he would prepare and mount for our cabinet a specimen, labelling it, stating its name, when and where found, and by whom found, and, if it should be considered inadvisable to state the exact locality, to name merely the town or village near to the locality. A collection such as this would much tend to benefit the Club; we should by this means obtain a cabinet full of valuable material, and form excellent references for our present and future members. I merely throw this out as a suggestion, which I hope to see many make use of.

I should have been glad to have recorded some papers on the use of the microscope, as it is very essential that that instrument should be kept to the fore. It would much benefit our members to have from time to time papers illustrating the use of the microscope, not merely showing how to use the instrument under the best conditions of illumination, but also to show the use the instrument may be turned to for the purpose of detecting the adulteration of food, fabrics, and other substances, &c. There are many of my fellow-workers, no doubt, who use the instrument merely as an amusement; but I am not prepared to blame them, for the very fact of the microscope revealing to them something with which they were not before acquainted may induce them to make further search, and finally lead them to take up the study in earnest; even if it does not do this it will unquestionably reveal to them the beauty of the Almighty's work, which without the instrument would be invisible. Who has ever for the first time examined the peristome of a *Funaria*, the stellate hairs of a *Deutzia*, or the pollen of the mallow, without expressing astonishment at the marvellous beauties here depicted, and to think that the object under observation is merely one of our common plants is hardly to them credible; but so it is, and the more we examine them the greater will be our astonishment.

Our Fifteenth Annual Soirée was held at the Public Hall on Wednesday, the 19th November last, when eleven clubs, societies, private exhibitors, and opticians rendered valuable aid.

The following list gives a statement of the clubs represented, and the microscopes and other objects of interest exhibited at the Soirée:—

In the Large Hall.—The Croydon Microscopical and Natural History Club, 46; the Royal Microscopical Club, 5; the Quekett Microscopical Club, 26; the South London Microscopical Club, 13; the New Cross Microscopical Club, 7; the Greenwich Microscopical Club, 5; the Sydenham and Forest Hill Microscopical Club, 4; the Tower Hill Microscopical Club, 4; the Sutton Scientific Society, 4; the Entomological Society of London, 1; other private exhibitors, 11. Total number of instruments, 126.

Members and Clubs exhibiting Objects in the Small Hall.—38 members of the Croydon Club; 1 member of the Royal Microscopical Club; 1, South London Club; and 1, Erith and Belvedere Club.

We may well be congratulated on the success of our last Soirée, on which occasion the number admitted to the halls was 881, being by far the largest number recorded at any previous Soirée, and showing most clearly that the interest taken in the Club, not merely by its members but by the public generally, is not flagging, but that it is really on the increase.

The excursions organised by the Club during the past year were as follows:—

April 14*th* (Easter Monday).—A whole day excursion to Hayes Common.

June 2*nd* (Whit Monday).—A whole day excursion to the Pilgrim's Way, in East Surrey, under the guidance of Mr. Topley.

Aug. 11*th.*—To Woking and Weybridge, under the guidance of Mr. Kenneth McKean.

There were also the following excursions organised by the Geological Association, in which we were invited to join, and of which our members took advantage:—

April 26*th.*—To Guildford.
May 10*th.*—To the Crystal Palace.
June 28*th.*—To Caterham and Merstham.

These excursions were mostly well attended, but I do not think the system of working them which we have followed is a good one, and I should suggest that in future (unless the excursion is for any one particular object) instead of the members keeping together, they should separate and divide themselves into the various geological, botanical, and zoological sections, this would afford every member the opportunity of following his own particular hobby. Under the present system, when all are supposed to keep together, it is quite impossible for any member to stop for the purpose of collecting either pond-life or any other special object for fear of losing his party. Now, if an arrangement is made at starting that each section takes its own course, and that all are to meet at the latter part of the day at some particular house or spot for refreshment, each section will in all probability have something to show for its day's work, and will be enabled to compare its various finds. By this system a great deal of knowledge and information may be obtained and disseminated, and a list may be made at the conclusion of the various things met with. One great benefit of these field excursions is that they strengthen friendship; members become better acquainted after being over the happy hunting-ground together; they exchange ideas, and mutually help each other and throw aside selfishness; they obtain wholesome exercise, and breathe pure air. When practicable and advisable I think we might join other societies in their excursions more than we do at present; it would tend to help our members especially in the study of pond-life, as I know so many of the members of the South London and the Quekett Clubs who are so well up in this particular branch.

The conversational meetings, your Committee regret to report, have not been so well attended as might have been anticipated. Whether this is owing to the want of a better room, or that the benefits of these meetings have not been sufficiently impressed on the minds of the members, I do not know: there is no doubt that from these meetings the members generally may, if they work well together, derive most important advantages. It has been suggested by Mr. Lovett that, if some of our members would come forward and undertake each to occupy an evening in working out any particular subject in connection with the work of our Club (such work not interfering with our regular meetings or papers), it would be of great advantage to us all. I am sure your Committee will at all times be glad to receive the names of any members who may be willing to take an evening for such a purpose. I may here suggest that the examination of articles of food, fabrics, sections of various woods, silk, jute, hairs of animals, scales of insects, would all be useful subjects, and if slides of such things were well mounted and a collection of them formed for our cabinet, properly labelled, and describing the real from the unreal, a great deal of valuable information might be collected, not merely useful to the Club, but for others outside the Club, who might wish to refer to them for information. This would make the Club not merely useful to itself, but to mankind in general. The microscope, we all know, is frequently used in the detection of crime and adulteration of food and fabrics, in examining crystals, and in the examination of the scales of butterflies to determine their sex, and in many other ways in connection with manufacture and Natural History. I well remember our mutual friend Henry Lee mentioning to me that he had once sent to him for examination three or four fine hairs, with a request that he would very carefully examine them, and, if possible, determine to what animal they belonged, as a question of great importance depended on the result of his examination. Mr. Lee understood the task, and carefully examined these hairs, and found they belonged to the common hare (*Lepus timidus*). Now it so happened that a poacher, who had a spite against a keeper, informed the keeper's master that he (the poacher) had seen the keeper take a fox out of a trap and kill it with his clasp-knife. The clasp-knife was examined, and there were certainly some brown hairs adhering to it; and these were the hairs submitted to Mr. Lee for examination. Now you see, Gentlemen, that had it not been for the use of the microscope, and a thorough knowledge between the difference of the hair of the hare and the hair of the fox, this poor man would in all probability have suffered through the vindictiveness of the poacher and lost his place. This special knowledge we may all some day be glad to possess; let us therefore strive to make a beginning. I am well aware there are amongst us many old microscopists who are well up in these matters, but there are many amongst us who, I am sure, will own that they are not, but who wish to be.

Our Club has during the past year received the following donations:—The Journal of the Royal Microscopical Society. The Proceedings of the Berwickshire Naturalists' Club. 'Science Gossip.' A paper upon an improved method of preparing Embryological and other delicate organisms for Microscopical examination, by Edward Lovett. A paper on the Flora of South Lincolnshire, by Mr. W. H. Beeby (reprinted from the 'Journal of Botany' for January, 1884.) A preliminary Report of the Local Scientific Committee of the British Association. Journal of the Northamptonshire Natural History Society. 'Greater London;' presented by Mr. Waterall. Annual Report of the Lewisham and Blackheath Microscopical Club. The Rosarian's Year Book for 1884; presented by Mr. Mawley. The weather of 1883, as observed in the neighbourhood of London; presented by Mr. Mawley. A new Flora of Surrey (reprinted from the 'Journal of Botany'), by Mr. W. H. Beeby; presented by the Author. Report of the Erith and Belvedere Natural History Society. Report of the New Cross Microscopical and Natural History Society. Report of the South London Entomological Society. 'Round Keston and Bromley'; presented by Mr. Brewer. Procès Verbal of the Belgian Microscopical Society. Reports of the Meetings of the British Association; presented by Mr. Cushing. Symon's Monthly Meteorological Magazine for May; presented by Mr. Sturge. Proceedings of the Norwich Geological Society. Report of the Hampstead Naturalists' Club. Transactions of the Norfolk and Norwich Naturalists' Club. Transactions of the Essex Field Club.

We have again to thank Mr. Mennell for editing the Proceedings and Transactions of the Club. We have also to thank Mr. McKean for the compilation of the Index to the Club Reports, from the first number to the present date.

Our meetings throughout the year have been well attended.

In conclusion, I have to express my sorrow for the inefficient manner in which I have performed the not very arduous duties of President, and I thank you all for the kindness and courtesy I have at all times received. I resign my office with the pleasure of knowing that it now falls into the hands of one who I am sure will make up the shortcomings of myself, and I congratulate you on your choice. I see before me a very happy two years, knowing that under the very able guidance of Mr. Mennell (your new President) the Club has before it a great future.

Members elected in 1884.

Feb. 13*th.*—John Farley, Silchester Lodge, Thornton Heath. John Moss, Brigstock Road. Charles W. Craig, Denia Lodge, West Croydon. Alf. Wills, 5, Cobden Villas, Selhurst. Dr. Parsons Smith, Addiscombe.

April 9*th.*—Alfred H. Allen, Wellesley Road.

Oct. 8*th.*—Richard Francis Backwill, Tennison Road, South Norwood. Ernest E. H. Thorne, Denia Lodge, West Croydon. John Mayson, 130, High Street.

Nov. 12*th.* — W. Whiteman Topley, Elgin Road. Alexander Bevington, Coombe Road. Edward S. Perry, Aberdeen House, Heathfield Road. John William Buckland, 130, Lower Addiscombe Road. John Wellington Buckland, 130, Lower Addiscombe Road.

Dec. 10*th.*—G. Keith Brebner, M.D., Benshaw Lodge. W. J. Allbright, 9, Broad Green. Ernest H. Willett, F.S.A., 6, Fairfield Road.

Presentations to the Club, 1884.

Preliminary Report of the Local Scientific Societies Committee of the British Association. Journal of the Northamptonshire Natural History Society. 'Science Gossip'; from the Publishers. A volume of 'Greater London'; presented by Mr. N. Waterall. Fifth Annual Report of the Lewisham and Blackheath Microscopical Club. Rosarian's Year Book for 1884; presented by Mr. E. Mawley. The Weather of 1883, as observed in the neighbourhood of London; presented by the Author, Mr. E. Mawley. Journal of the Royal Microscopical Society. A new Flora of Surrey: a paper by W. H. Beeby; presented by the Author. Sixth Annual Report of the Erith and Belvedere Natural History Society. Annual Report of the New Cross Microscopical Society for 1882 and 1883. Report of the South London Entomological Society, 1883. 'Round Keston and Bromley'; presented by Mr. Brewer. Procès Verbal of the Belgium Microscopical Society. Reports of the Meetings of the British Association; presented by Mr. T. Cushing. Symon's Monthly Meteorological Magazine for May; presented by Mr. Sturge. Proceedings of the Norwich Geological Society, vol. i., part 8. Fourth Annual Report of Hampstead Naturalists' Club. Transactions of the Norfolk and Norwich Naturalists' Society, vol. iii., parts 4 and 5. Annual Report of the Brighton and Sussex Natural History Society. Proceedings of the Berwickshire Naturalists' Club. Transactions of the Essex Field Club.

Exhibits, 1884.

Jan. 9*th.*—F. L. Berney, section of bone showing growth. J. Berney, eggs of parasite of Reeve's pheasant. W. Low Sarjeant, *Melicerta ringens.* K. McKean, odontophore of *Paludina vivipara.* E. Lovett, series of pectens from Jersey; volcanic dust from the Java eruptions. Rev. G. Bailey, Foraminifera from Red Chalk of East Yorkshire. E. B. Sturge, the Club's slides of Cole's preparations. W. R. Harwood fossil wood from the lower tertiaries, with borings of *Teredo navalis.*

Feb. 13*th.*—Philip Crowley, series of remarkable larva cases and ccooons, also the moths of *Costina endromia*, from Chili. J. G. B. Brewer, chalk fossils and iron pyrites from Craysford, and mammalian teeth, and worked flints from the brick-earth of the same district. K. McKean, *Hydra viridis*. R. J. Backwell, *Hydra vulgaris*. W. Low Sarjeant, *Hydra fusca*. E. Lovett, a pint marine aquarium, containing four anemones and four Mollusca, which had lived healthily since October, 1883. James Epps, theobromine from cacas leaves.

March 13*th.*—W. H. Beeby, plants new to the Flora of Surrey. E. Straker, plants from the Club district. E. Lovett, Gorgonias; pumice from the Java eruptions found floating in the Indian Ocean; larval form of shore-crab. E. B. Sturge, intermediate burdock from Leatherhead.

April 9*th.*—E. Lovett, rock specimens from Italy, but especially from Mount Vesuvius, to illustrate Mr. Topley's paper. W. Low Sarjeant, *Conochilus volvox*, *Actinospherium*, &c.

May 14*th.*—W. Low Sarjeant (to illustrate his paper), a series of miniature tanks, containing various examples of pond-life, the water in the tanks being aërated by a new system by the circulation of the water. J. Berney, fragment of stone from the old archway of the Palace. J. C. Oswald, live centipede from India. E. Lovett, mature eggs of *Gobius niger*, prepared by the picro-carmine process. T. M. Loftus, *Melicerta ringens*. W. M. Gibson, *Volvox globator*. K. McKean, specimens of *Testacella haliotidea*, probably thefirst recorded from this district; also odontophores of this mollusc.

Sept. 10*th.*—E. Lovett, collection of British edible shell-fish, recent and prehistoric; also a Shetland lamp formed by a whelk-shell. E. B. Sturge, series of igneous rocks from Scotland. H. Turner, fine fresh-water mussels from a lake at Norbury. K. McKean, transverse section of the foot of a mussel. W. Low Sarjeant, young fresh-water mussels; also a series of photographs taken during the Club excursions. J. Syms, section of shell (*Orithnum*).

Oct. 8*th.*—F. W. Rudler, series of rocks and sections, in illustration of his paper. E. B. Sturge, a collection of Fungi. R. J. Backwell, mica quartzite. F. L. Berney, small tortoiseshell butterfly, bred from larva found in Coombe Lane. W. Low Sarjeant, schorl granite and other rock sections. T. Cushing, specimens of rocks from the "Kicking Horse Pass," in the Rocky Mountains.

Nov. 12*th.*—W. Topley and H. T. Mennell, specimens of Indian work and of Natural History from the North-West of Canada, including Indian head-dress, mocassins, charm-bags, &c. H. T. Mennell, collection of plants from Canada, the Prairies, and the Rocky Mountains; also maps, diagrams, and photographs. E. Lovett, arrow-heads from earth-mounds of North America; photographs; series of fine shells, *Purpura lapillus*. W. L. Sarjeant, *Lacinularia socialis*, *Conochilus*, &c. Rev. G. Bailey, *Unigerina Schoodgeri* (new species). E. Straker, specimens of bones found at Russell Hill. J. Epps, galls of *Cynips rosæ* from a rose tree. J. M. Hobson, larvæ of butterfly, with ichneumon in various stages. F. Silverlock, auriferous quartz conglomerate. E. Collyer, an iron ball and two coins found at Haling Park.

Dec. 10*th.*—Rev. G. Bailey, section of the horn of the African rhinoceros. K. McKean, *Unio pictorum* from Leigh Mill Pond Surrey; remarkably fine specimens, the largest measuring $4\frac{8}{10}$ inch in

Croydon Microscopical and Natural History Club.—Balance Sheet for the Year ended 31st December, 1884.

Receipts.

	£	s.	d.
To Balance in hand	13	19	0
,, Subscriptions	107	10	0
,, Sale of Reports	0	4	0
,, Sale of Soirée Tickets	31	7	6
	£153	0	

To Balance brough down..£19 15*s*. 3½*d*

Expenditure.

	£	s.	d.	£	s.	d.
By Hire of Rooms				10	12	6
,, Postage				2	16	10½
,, Ditto (Postcards for Notices of Meetings, and Printing and issuing of the same)				14	15	6
,, Printing Transactions				30	13	7
,, Printing				1	5	0
,, Fire Assurance				0	7	6
,, Collecting Subscriptions				5	10	6
,, Attendance, Lamps, Oil, &c.				1	3	0
,, Stationery and Binding				1	0	9
,, Gratuities				1	8	6
,, Refreshments at Annual Meeting				1	10	0
,, Sundries				0	11	2
Soirée Account.	£	s.	d.			
By Hire of Rooms	7	14	6			
,, Decorating Platform	1	10	0			
,, Tables	10	15	0			
,, Music	6	0	0			
,, Police and Attendant	0	17	0			
,, Refreshments	18	4	2			
,, Printing	6	7	0			
,, Advertising	3	11	8			
,, Hire of Lamps	2	14	0			
,, Postage	3	10	0			
,, Sundries	0	7	0			
				61	10	4
Balance forward				19	15	3½
				£153	0	6

HENRY T. MENNELL, *Treasurer.*

We, the undersigned, having examined the above Accounts and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and to the Bankers' Pass Book.—*January 8th, 1885.*

GEO. BAILEY,
F. THOMPSON, } *Auditors.*

breadth, the average breadth of this species being 3 inches; also *Anodonta cygnea*, two varieties from Leigh Mill Pond. W. Low Sarjeant, ambulacral disc of *Echinus*. Philip Crowley, *Arctia fuliginosa*, bred from larvæ taken near Aberdeen; also specimens from the neighbourhood of Croydon; also some eggs of the spoonbills, in illustration of his paper. E. E. H. Thorne, longitudinal section of sugar-cane (stained).

ORDINARY MEETING.—WEDNESDAY, MARCH 11TH, 1885.

H. T. MENNELL, F.L.S., President, in the chair.

The President announced that an amateur photographic section of the Club was to be established, for the purpose of obtaining photographs of the natural features of our district, or of any object, microscopic or otherwise, deemed worthy of recording by this means. Such photographs to be placed in a portfolio or album for reference, and to be kept under the same rules as our reference books.

ORDINARY MEETING.—WEDNESDAY, SEPTEMBER 9TH, 1885.

H. T. MENNELL, President, in the chair.

It was proposed by Mr. Philip Crowley, and seconded by Mr. Henry Turner:—

"That Frederick Lee Berney be elected an honorary member of the Club."

The motion was unanimously carried.

Mr. John Berney replied, thanking the Club for the honour they had conferred on his son by electing him an honorary member.

Sixteenth Annual Meeting,

Held at the Public Hall, Croydon, Wednesday, January 13th, 1886.

HENRY T. MENNELL, F.L.S., President, in the chair.

The President stated that the following gentlemen had been elected for the respective offices of the Club for 1886, and that no other nominations had been received:—

President.—HENRY TUKE MENNELL, F.L.S.

Vice-Presidents.—JOHN BERNEY, F.R.M.S.; ALFRED CARPENTER, M.D., J.P., &c.; PHILIP CROWLEY, F.Z.S., F.L.S.; HENRY LEE, F.L.S., F.G.S., &c.

Treasurer.—Kenneth McKean, F.L.S.

Committee. — J. G. B. Brewer; H. S. Cowdell; Thomas Cushing, F.R.A.S.; John Henry Drage; Henry S. Eaton, M.A., F.R. Met. Soc.; Edward Lovett; Edward Straker; Edward B. Sturge; H. G. Thompson, M.D.

Hon. Secretary.—William Low Sarjeant.

The Balance-sheet was taken as read. The question was raised by Mr. Gibson, why the Club's share of the proceeds of the Bazaar held in 1882 does not appear in the Balance-sheet? In reply to which it was stated that the money had not yet been formally paid over to the Club, but was in the hands of Mr. Crowley, the late Treasurer, and was placed at interest, and that steps would be taken to have it transferred.

The Balance-sheet was then passed, and a vote of thanks was accorded to the Auditors.

It was then proposed by Mr. H. Turner, seconded by Mr. P. Crowley, and carried unanimously:—

"That a cordial vote of thanks be passed to the President for his very valuable services during the past year."

And it was proposed by Mr. J. Berney, seconded by Mr. Mennell, and carried unanimously:—

"That a cordial vote of thanks be passed to the other officers of the Club for their services during the year."

The President, Henry T. Mennell, Esq., F.L.S., then delivered his Address.

The President's Address.

The time has again come round when it is the duty of your President to review the proceedings of his year of office, and for himself and the committee and officers of the Club to give an account of their stewardship.

At the last Anniversary Meeting an unusually extensive change in the officers was rendered necessary, so that we have most of us been new to our duties. Mr. C. P. Turner, who had served the Club well in the position of Hon. Secretary for some years, then retired from the post, and we were fortunate in securing the services of Mr. Low Sarjeant, to whom I desire to express my personal indebtedness for the admirable discharge of the duties of a very onerous post, thereby lightening the duties and responsibility of my own position.

My election as President vacated the Treasurership, the duties of which were taken over and have been most efficiently discharged by Mr. McKean. He has been a really working Treasurer, not a mere banker to the Club, as most of us, who have preceded him in the office, had been, and he has thus in great measure relieved the Secretary of the work connected with the finances and accounts of the Club.

On entering upon their duties they found it necessary thoroughly to overhaul the list of members, on which were many names which should have been, for various reasons, erased. In this way the number which stood nominally at 251 on 31st December, 1884, was at once reduced to 239; and the same process has been continued in the present year, so that, with deaths and resignations, we have lost 31 members. On the other hand, an unusually large number of new members (30) have been elected, showing, indeed, a loss of one, but leaving the list in a much more healthy and genuine position than for some time past.

Death has not in the past year deprived us of any members who took an active part in the work of the Club, but among the removals from the district I cannot avoid mentioning that of an indefatigable worker and excellent naturalist and geologist, the Rev. George Bailey, who will be much missed at our meetings.

The finances of the Club are in a very sound position, as you have heard from the statement that has been submitted to you. The receipts have been £148 7*s.* 0*d.*, the expenditure £119 0*s.* 5*d.*, and the balance in hand at the end of the year is £49 1*s.* 11*d.*, as compared with £19 15*s.* 4*d.* at the same time last year, an improvement due, of course, mainly to the fact that we have not printed any Transactions during the current year.

In proceeding to review the meetings of the year, I will take first the ordinary monthly meetings in order. A new feature at these meetings has been the greater prominence given to the many interesting exhibits which are brought to them. Previously these had not received the notice they deserved, but an opportunity is now afforded before the reading of the paper for any member to bring before the notice of the Club and briefly to describe any objects of interest he may wish to exhibit. This has, I venture to think, added much to the interest of our meetings; it encourages our members to bring such objects to our notice, and leads to a larger number taking part in our proceedings.

At the first meeting after the Anniversary, held on the 11th February, Dr. Carpenter read a paper on Ethnological and Archæological observations and discoveries made during the formation of a new road at Purley, in which he described human and other remains of a very interesting character found in an ancient burying-place through which the road in question had been cut. The remains, consisting of human skulls and other bones, were exhibited, as well as a fine series of weapons, implements, and bones found some years ago at Beddington, belonging probably to the same historical period, but apparently not the spoils of a peaceful cemetery, but of a battle-field. The reflection is thus forced upon one, how much of interest and real scientific importance lies at our very doors, only waiting investigation and observation (Trans., art. 49). I was enabled on this occasion to further illustrate the subject of the paper by exhibiting a number of skulls and a very fine series of ornaments and implements, found by my relative, the late Mr. G. S. Gibson, of Saffron Walden, in an almost identical burying-place in his garden there. The interments there, as at Purley, were all in shallow trenches or graves scooped out of the chalk, which lies in both cases a foot or two below the surface. They were at Saffron Walden very numerous, as many as thirty to forty skeletons being exposed *in situ* at one time, photographs of which I exhibited. These remains at Saffron Walden are attributed by some antiquaries to the earliest Christian Saxon period. Dr. Carpenter is inclined, I believe, to ascribe an earlier date to the Purley remains; but whichever view may be correct, I think there can be little or no doubt that the two cemeteries were cotemporary.

In addition to those bearing specially upon the paper, the exhibits at this meeting were numerous and interesting. Amongst others I would especially refer to the specimens of a new British crustacean, *Sysmata seticaudata*, from Jersey, and to the fine series of prehistoric flints from Ireland, Yorkshire, and Eastbourne; all shown by Mr. E. Lovett.

At the second meeting, March 11th, the paper was by Mr. E. Lovett, "On the History and Evolution of the Fish-hook from the earliest Prehistoric to Modern Times" (Trans., art. 50). In this most interesting paper, Mr. Lovett showed that many rude flint and stone implements which have puzzled archæologists were used as fish-gorges and fish-hooks. His paper was illustrated by an admirable series of these early remains, chiefly from Jersey caves, opened and explored by himself; an equally fine set of similar implements used in more recent times by savage races; and further examples showing the gradual improvement and development of fish-catching implements, down to the elaborate and highly-finished salmon-hooks of our own day.

The Rev. George Bailey added a few remarks on an interesting series of similar flint fish-gorges, which he exhibited, from the Yorkshire wolds.

Dr. Franklin Parsons also exhibited and described a series of fossils collected by himself from the Devonian and Carboniferous strata of Somerset, Devon, and Wilts, amongst which were fine specimens from the latter strata at Frome, Somerset, of a crinoid (*Platycrinus*), with the stems, bodies, and feathery arms well preserved; another crinoid (*Apiocrinus rotundus*), found plentifully in the Lower Oolite at Bradford-on-Avon, at the junction of the Great Oolite with the superjacent Bradford Clay. In both cases the animals had lived and flourished under the conditions in which the calcareous sediment was deposited, and had been killed by a sudden eruption of muddy water, the mud deposited from which had enveloped and preserved them, and is now represented by the shale in which they are embedded. Fossil corals, *Lonsdalia floriformis*, from the Carboniferous Limestone, and *Thamnastræa arachnoides*, from the Coral Rag, were also shown.

Amongst the exhibits worthy of note was a specimen of a curious variety of the common agrimony (*Agrimonia eupatoria*), having a lax spike of flowers all on long pedicels, gathered and shown by Mr. James Epps.

At this meeting also the photographic section was inaugurated, a very valuable addition to the work of the Club, which has borne excellent fruit at subsequent meetings, and through which we may hope that a pictorial record of many objects of interest will be preserved for the benefit of the members of the Club. With this object it is proposed to form a Club Album, in which photographs of this description taken by our members will be preserved.

The third meeting, April 8th, was devoted to an address on "Hawks and their Allies," by Mr. J. G. Goodchild, F.L.S., F.G.S., of the Geological Survey, in which he described the classification of this interesting family of birds, the relation and sequence of the various groups into which it is divided, and the points in their structure and plumage on which this classification is based. His description of the mode of capture of the larger hawks in Holland for hawking purposes was most graphic and interesting, and it is no exaggeration to say that the Club has never listened to an address so admirably and copiously illustrated by drawings. In these all the leading and typical species of the family were represented; many of them were taken from the life-like and artistic drawings of Woolf, the well-known delineator of birds and animals, but many more were original drawings by Mr. Goodchild himself, taken from the life. (Trans., art. 51).

Mr. Philip Crowley added much to the interest of the meeting by exhibiting a complete series of the eggs of the British birds of prey.

Amongst other exhibits, Mr. McKean showed living specimens of the smooth slug, *Limax lævis*, from St. Mary Cray, a species not previously found in the S.E. of England.

Specimens of very rare starfishes, *Goniaster Templetonii* and *Ophiocoma brachiata*, were shown by Mr. Lovett, both from Pendean, near Tenby, South Wales.

At the fourth meeting, May 13th, Mr. W. H. Beeby communicated to the Club his discovery of an undescribed species of *Sparganium* or bur-reed, allied to the common *Sparganium ramosum*, but differing in a very marked way in its seed from that species. The new species he has named *Sparganium neglectum*. He has found it in more than one locality in the county of Surrey, and I have specimens of it in my herbarium, gathered some years ago at Fairlight Glen, near Hastings. In the South of England it appears to be at least as generally distributed as the common form. It is greatly to Mr. Beeby's credit that he has discriminated this thoroughly good and well-marked species, which has doubtless passed unobserved through the hands of many excellent botanists before him.

Mr. Beeby also described other additions he has made to the Surrey Flora during 1884, illustrating his remarks by excellent specimens of all the species referred to (see TRANS., art. 41).

Mr. Straker exhibited fresh specimens of *Dentaria bulbifera*, *Myosotis sylvatica*, and other rare plants from Surrey localities.

Mr. Bennett and Mr. Epps also exhibited rare plants.

Dr. Carpenter exhibited a fine series of Upper Greensand Fossils from Haldon Hill, near Exeter, and Devonian fossils from Teignmouth and Dartmoor; he addressed the members upon them, and has kindly furnished the following summary:—

"Haldon Hill is a furze-crowned hill between Teignmouth and Dartmoor, which reaches an elevation of 870 feet above the sea level. The fossils are found on the top of the hill in the Upper Greensand overlying the Gault, but intermixed with masses of flint from which the chalk has been washed away, apparently by the action of rain rather than of the sea, pointing to the cotemporaneous formation of the Upper Greensand and the Lower Chalk, rather than the one antecedent to the other. Another point of interest is that the hill must apparently have been slowly raised out of the ocean, so as to have preserved the delicate corals exhibited, which seemed to be found exactly in the position in which they lived and were fossilized. Amongst the species exhibited were *Exogyra conica* and *Pecten quadricostus*, fossils characteristic of the Upper Greensand, *Isostræa oblonga*, *Gervillia anceps*, *Ostræa carinata*, *Trigonæ* (spec.), *Spongia ramosa*, and others."

An interesting discussion followed Mr. Beeby's and Dr. Carpenter's communications.

Our new photographic section put itself *en évidence* by the exhibition of a most interesting series of local views, chiefly taken by Messrs. Low Sargeant, Allen and Collyer.

The fifth ordinary meeting, being the first after the summer recess, was held on September 9th. No formal paper was read, but the meeting was an interesting one, and had ample matter brought before it to occupy the evening.

Mr. A. Warner exhibited and described Suffolk's new collecting bottle, which is made with flat polished sides, and of such a thickness that it can be placed on the stage of the microscope and the contents viewed with a low power.

Mr. Crowley exhibited a fine series of *Attacus Atlas* and other moths, bred by himself.

A discussion followed, on the entomological characteristics of the year, in which many members took part, and it appeared that the death's-head moth (*Acherontia Atropos*) had been unusually abundant, both in the neighbourhood of Croydon and elsewhere. Several captures of *Sphinx Convolvuli* were also mentioned, and Mr. Low Sarjeant exhibited and distributed a large number of fine larvæ of *Sphinx ligustri* (the privet hawk).

The President exhibited a series of dried specimens of rare plants, collected this summer among the Norfolk Broads, and briefly described the physical features of this interesting district, with its long navigable waterways, widening at short intervals into lake-like expansions, some of them of large area, locally known as Broads, so rich in birds, insects and plants.

Amongst the plants I exhibited the most interesting were (1) *Senecio palustris*, a very handsome composite plant, apparently rapidly approaching extinction. (2) *Liparis Lœselii*, the fen orchis, a very rare plant, and interesting from the fact that it was for many years lost to view and considered to be extinct, but was refound in several localities in the fens of Cambridgeshire, Norfolk and Suffolk about three or four years ago. (3) *Naias marina*, the new British water-plant discovered by Mr. Bennett in 1884, and happily now found by me in a second locality in East Norfolk. (4) *Potamogeton trichioides*, a very rare pond-weed, which I found in an entirely new locality considerably north and east of previously recorded stations.

At the sixth meeting, held Oct. 14th, Mr. Lovett read an excellent paper on "The Glacial Deposits and other interesting geological features of North Yorkshire," specially referring to the ancient moraines of the Yorkshire dales, which often give rise to lakes and tarns by blocking up the valleys, and to the great deposits of glacial clay which overlies so large an area of the east coast of Yorkshire and Durham (see Trans., art. 53). A fine series of scratched boulders illustrated the paper.

A very interesting discussion followed (in which many members took part) on the formation and motion of modern glaciers, as illustrating the history of the ancient ones, and their important influence and that of the glacial period generally on the present physical features of the country.

A beautiful series of varieties of *Limnæa peregra* (the common pond snail), including reversed and other monstrous forms, were shown by Mr. McKean, and in the discussion which followed it was pointed out that these varieties are often confined to a single pond, or are at any rate exceedingly restricted in their range; and have therefore probably descended from a single abnormal or accidentally deformed progenitor.

Mr. Low Sarjeant showed some excellent examples of the new platinotype process of photography and explained its method.

The seventh meeting was held on Nov. 11th. An excellent address was delivered by Mr. Alfred W. Bennett, of London, on "Plant Life in our Ponds and Bogs." This most interesting address dealt chiefly with the *Desmidiæ*, and was admirably illustrated by diagrams and microscopic slides. The structure and classification and the varied and interesting modes of reproduction of these fresh-water Algæ were fully described. A good discussion followed, and it will I hope lead to some of our members taking up the study of these interesting organisms, in which there is an ample field for further research (see TRANS., art. 54).

Mr. Lovett exhibited two remarkable abnormal varieties of *Buccinum undatum*, the common whelk, from Ramsgate.

At the eighth meeting, Dec. 9th, Mr. W. H. Beeby read a few notes on additions to the Flora of Surrey, made in the season 1885, including the re-discovery of *Eriophorum gracile*, a beautiful species of cotton-grass, of very great rarity (see TRANS., art. 55). Mr. Beeby also described the three forms of helleborine (*Epipactis latifolia*) found in Surrey. He stated that he proposed devoting another season to the further careful examination of the less well-searched parts of the county, but did not anticipate that he should make much further additions to the Flora. He hoped then to proceed with the publication of his new Surrey Flora, which he trusted would not be long delayed. Mr. Beeby was congratulated by the President and others on this announcement, which will be received with satisfaction by all our local botanists.

A fine series of rare plants, recent additions to the British Flora, was exhibited by Mr. A. Bennett.

The second paper of the evening was by the distinguished geologist, Mr. W. Whitaker, B.A., F.G.S., "On some Surrey Wells and their Teachings." Mr. Whitaker produced and placed at the disposal of the Club, the records of a great number of well-sinkings, chiefly in search of water, made in the London Basin, with accurate measurements of the strata through which they passed. These data, so valuable to the local geologist and civil engineer, will, I am glad to say, be published in our Transactions (see TRANS., art. 56). Mr. Whitaker then proceeded to give a most interesting *résumé* of the lessons to be learnt from these records, and on the light they have thrown on the condition of the strata underlying London and our own district. Amongst the most interesting facts thus laid bare is the discovery that, after passing through the various beds of the London Clay and its congeners, vast series of strata which should underlie them are found in the London area to be entirely absent, and consequently strata of much earlier geological age are found immediately beneath the comparatively modern tertiary beds. The important bearing of these facts on water supply was pointed out.

Mr Baldwin Latham followed with remarks on the bearing of the facts of Mr. Whitaker's address on our own immediate neighbourhood and its water-bearing capabilities. He agreed with Mr. Whitaker in the extreme uncertainty of the Greensand as a water-bearing strata, and animadverted on the popular idea that the deeper we go the greater is the chance of obtaining water, whereas, as he stated, the exact opposite is nearer the truth. He condemned the site of the new wells now being sunk by the Corporation at Addington. He was followed on the same subject by Mr. Walker, the borough engineer, Mr. Morland, chairman of the Borough Water Committee, and other gentlemen. Mr. Topley added some very interesting and important remarks on the frequent failure to obtain water in the Greensand.

A third paper was read by Mr. W. F. Stanley, "On the Evolution of the Highest Types of Man within Historic Times." Mr. Stanley's conclusions were chiefly founded upon a careful series of observations made by him of ancient representations of men, whether in statues, wall-paintings, or hieroglyphics, and go to show that considerable changes have taken place within recent times in the facial angle, the position of the ear, the comparative length of the upper and lower limbs (the difference between these becoming more marked as we approach our own time), and in the shortening and diminished mobility of the toes, in all of which respects the modern man is developing a type further and further removed from his quadrumanous congeners. Time did not allow of a full discussion of this interesting subject, which is one to the elucidation of which every one can add something, if he will carefully observe all ancient representations of men which he may come across, with a special view to the points referred to by Mr. Stanley. For this purpose Mr. Stanley uses a small graduated scale of ivory, with the principal measurements of the human figure according to Marshall's scale of proportion marked on it. This is held up before the eye so as to cover the object looked at, and the divergences from the standard proportion can be readily and accurately noted (see Trans., art. 57).

From this brief summary it will be seen that the monthly evening meetings of the Club have well maintained their interest. The discussions have, I think, been better sustained than heretofore, a feature which is of great importance to the interest of the meetings and to the information which may be gained at them.

The opportunity afforded to exhibitors of objects of interest to describe them, which is a new departure, has been strikingly successful, and has added greatly to the interest of our gatherings. As your President I have often to regret on these occasions my want of that knowledge of many departments of Natural History, the possession of which is of such advantage to the chairman of meetings like ours, in enabling him to give an intelligent direction to the discussions.

Conversational meetings have been held on the alternate fortnight between our ordinary meetings. The attendance has greatly varied, and on the whole has been somewhat disappointing. The want of a more convenient and comfortable room to hold them in militates greatly against them; even success kills them by overcrowding, and is not unnaturally followed on the next occasion by a discouraging paucity of attendance.

The subjects treated of have been of much practical interest and importance, both to the microscopical student and the naturalist, and the Club is much indebted to those gentlemen who have freely placed at the disposal of their fellow-members the knowledge and experience and the technical skill which they have acquired by long practice and labour.

I am indebted to our Honorary Secretary for the following notes of these meetings which, as my address is running beyond the limits I had proposed to myself, I must put in a very condensed form.

Feb. 25th.—Mr. McKean explained his method of preparing shells for the cabinet, and of dissecting the animals for the purpose of extracting the lingual ribbon or odontophores, which form very interesting objects for the microscope.

March 25th.—"Preparation and Mounting of Fossils and Foraminifera for the Microscope." Mr. Low Sarjeant kindly took the place of the Rev. George Bailey, who was prevented from attending. He explained his methods as follows:—"When from the Chalk: Take some soft friable chalk from the hollows of freshly excavated flints; suspend it in a fine cambric bag in water, and agitate till it ceases to render the water milky. Thoroughly dry the residue; place it in a test-tube with a little turpentine, and boil carefully for a few minutes to expel all the air from the chambers of the organisms; then mount in balsam or damma. When wishing to obtain them from sandy deposits, thoroughly dry the material, then throw it into water, stir rapidly and skim off the surface. The foraminifers, being dry and their chambers full of air, will naturally float on the surface.

April 22nd.—"Demonstration of the Anatomy of the Sheep's Heart," by Dr. Franklin Parsons, who very clearly explained the action of the valves and muscular structure.

May 27th.—Photography: interchange of information on methods of development, printing, &c.

Oct. 28th.—"Illumination of Microscopical Objects." A very good meeting. The various methods of illumination were discussed and demonstrated, Mr. Low Sarjeant taking the chief share in the proceedings. He explained how to arrange the lamp and mirror, in order to obtain a parallel central beam of light, and also how to test the light to show that the adjustment is correct. The various ways of using the bull's-eye condenser, and especially how to obtain a black ground illumination for medium and low powers, quite equal to that obtained by the Webster or other achromatic condensers were explained, Mr. Low Sarjeant's principal object being to show that excellent illumination can be obtained without the use of expensive apparatus.

The field meetings of the year have been as follows:—

The first was on Whit Monday, to Oxted, Woldingham and Limpsfield. The day unfortunately was very stormy, in spite of which a party of nearly twenty assembled.

Oxted Church was first visited; the high downs beyond were then climbed. The orchids which abound in the woods and banks by the way were but just appearing. On the top of the downs a gale of wind with driving rain was encountered. The little church of Woldingham offered some shelter to the party, and lunch was partaken of beneath its protecting walls.

The plantations on the downs were full of spring flowers in the richest profusion and beauty, and the botanists were gratified by the sight of blue sheets of the lovely wood forget-me-not, *Myosotis sylvatica*, a scarce and very local plant in the South of England; and it was their unanimous opinion that they had never seen the blue-bell in such luxuriant profusion. A very robust form, with long leaf-like floral bracts, was noticed.

On a fine day the excursion would have been a most attractive one. The views from the North Downs, which here attain their highest elevation of about 880 feet, are most commanding and extensive. The churches of Oxted, Woldingham and Limpsfield present many features of interest to the archæologist, and the botanist, entomologist, and geologist would alike find much to interest him.

On June 27th the excursion in conjunction with the Geologists' Association was to East Grinsted and West Hoathley, and the party had the advantage of the guidance and direction of Mr. Topley, President of the Association, and Mr. Ed. Easton. It was chiefly occupied with the geological features of the county, which are of considerable interest. Sections of Grinsted Clay and Lower Tunbridge Wells Sand were encountered in the early part of the route, the former yielding numerous specimens of *Cypris*. The central line of the watershed of the Weald was followed to Selsfield Common. The surface here is rather over 600 feet above the sea; a fine view across the Weald is obtained, the Lower Greensand escarpment of Leith Hill and Hindhead standing out in a very striking manner. Here Mr. Topley gave an address on the geology of the Weald, sketching out the mode of formation of the beds, the successive physical disturbances to which they have been subjected, and the mode by which the present surface-features have been produced.

Mr. J. W. Hulke, F.R.S., also described the Wealden Reptilia, referring especially to *Iguanadon*.

Professor T. R. Jones followed with some remarks on the invertebrata of the Wealden beds, showing that most of the shells are such as lived in fresh water, which was either the estuary of a large river or had connection with it.

The party then walked to Rockhurst, and were there received by Mr. Charles Hill, F.S.A., who conducted the members through the grounds. The natural rocks are very fine, formed of the upper beds of the Lower Tunbridge Wells Sand. The beds are jointed, the joints having been widened out by weathering, and partly also by gradual slipping. Mr. Hill during thirty years has noticed a considerable increase in many of the spaces.

The most famous rock, "Great upon little," is a mass of stone weighing between 400 and 500 tons, poised upon a small pedestal. This rock is covered with inscriptions, some of them dating 1622, 1702, 1705; the names of Pitt and Fox, who are known to have visited the spot, were inscribed here, but, being on the side most exposed to the weather, they are now effaced.

On leaving the grounds of Rockhurst the walk was continued to West Hoathly Station, where tea was provided at the Railway Inn. South of the station is a tunnel through the Wadhurst Clay, from the waste-heaps of which *Cypridea*, *Cyrena*, *Paludina*, with sun-cracks and other markings, were obtained.

On Saturday, 18th July, an afternoon excursion was made, in conjunction with members of the Holmsdale Club, to Guildford and Shalford. The day was very fine, and the party enjoyed the pleasant and picturesque walk by the river side, ascending St. Katherine's Hill by the way, whence an extensive view was obtained. The distance to be traversed being short, abundant time was afforded for collecting. The river is very rich in microscopic life, and the microscopists gathered an abundant harvest. Water plants, including several species of pond-weed (*Potamogeton*), were also found in profusion.

On Monday, August 3rd (Bank Holiday), a whole-day excursion was arranged. I regret I was unable to join the party, and am indebted to Mr. Low Sarjeant for the following notes:—

Seventeen members assembled at the station, and on arriving at Merstham proceeded to Gatton Church, which they went over, admiring the fine oak carving, and the comfortable arrangement of the squire's pew, provided with a cosy fireplace for its own benefit. Thence to Gatton Hall, with its well-known and magnificent marble hall and staircase, and fine statuary. The park was crossed, refreshment obtained at a roadside inn, and the party then made their way over Banstead Common by Tadworth Court and Burgh Heath to Banstead Downs, and so home by Sutton. Photographs of Gatton Church and other objects of interest were taken by the way, and the day proved a very pleasant one.

On Saturday, Aug. 29th, a very pleasant half-day's excursion took place, to Caterham and Godstone. The walk over Whitehill to Godstone is always a charming one, the view southward from the high ground being one of the finest in the district; but it was grievous to see the havoc which some new comer (said to be an artist) has wrought on the beautiful War Coppice on the top of the hill. A more lovely bit of ground it would have been difficult to find. Now it is robbed of all its beauty; its ruthless owner has literally flayed it alive, skinning off the turf which used to be carpeted with flowers, and leaving bare the chalk rubble. Here used to be our best ground for numbers of beautiful orchids, and especially our only station for the rare musk orchis, *Herminium monorchis*, now, alas, hopelessly destroyed. The deadly nightshade (*Atropa belladonna*), the ploughman's spikenard, and other plants, were gathered on the southern slope of the hill.

At Godstone the fine series of millponds were visited, and yielded several interesting freshwater Algæ.

Here also I found Mr. Beeby's new *Sparganium neglectum* growing abundantly, *Mentha paludosa*, and other plants.

A large party sat down to an abundant, well-served tea at the village inn, and a pleasant walk back by the road to Caterham in the evening was much enjoyed.

Our last excursion was on Saturday afternoon, Sept. 26th, in which we were joined by members of the Holmesdale Club. The gathering was at the Addington Hills, and by the courteous permission of the Archbishop, Mr. Goschen, and Mrs. Sutherland, we were able freely to range where we listed. The wooded triangular piece of ground with the pond at its apex, now enclosed by wire fencing, is very rich in Fungi, and the party spent some time in searching it, passing thence by the pine wood to the lodge and so into the park, which was in its autumnal beauty. A large variety of Fungi were gathered. Superb masses of the handsome scarlet *Agaricus muscarius* were especially admired.

In addition to the ordinary field meetings, several photographic excursions have taken place, at which a large number of excellent views have been taken, and those who have had less experience and practice have been able to profit by the advice and assistance of more experienced members.

The Photographic Committee especially desire the members of the Club to bring to their notice any objects of special interest worth recording in photographic form,—fine trees, geological sections, and the like,—and they will endeavour to make an early visit to them with their cameras.

This closed the year's campaign, and if they have not added greatly to our knowledge of the natural features and productions of the district, our excursions have been thoroughly enjoyed by those who took part in them. They have on the whole been fairly attended, though in this respect there is doubtless room for improvement, and there would seem to be something lacking in our arrangements to account for the comparatively small proportion of our members who take part in them. Whether more complete and detailed arrangements for leading and guiding the party and for its commissariat would help us, experience only could show. On some occasions this has been ably done for us by Mr. Topley and others, to whom the Club is much indebted. On other occasions I fear it has been lacking, for which your President must take his full share of blame.

Clubs like the Tyneside, the Woolhope, and others whose excursions or field meetings are their most important gatherings, have a great advantage over ours in having a large country as well as town membership, including the county clergy, gentry, &c., so that wherever they go they are pretty sure to find resident members, well acquainted with all the local features and objects of interest, and not only willing to lead the party for the day, but to take some pains beforehand to plan the route and make all the needful arrangements.

In thus briefly sketching the proceedings of the Club during my year of office, it only remains for me to speak of the Soirée.

We are so accustomed to success on this occasion, that it seems almost superfluous to record our sixteenth success in 1885; but when so many Clubs round London have from one cause or other had to abandon their annual soirées, we may well congratulate ourselves on this continued success. The attendance was slightly larger than on any previous occasion, mounting up to 893.

We had 157 exhibitors in various departments, with 137 microscopes. Amongst these were members of eleven Clubs besides our own, *viz.*, the Royal, Quekett, South London, New Cross, Greenwich, Sydenham and Forest Hill, Sutton, Walthamstow, South London Entomological, Tower Hill, and Holmesdale; and in addition 28 exhibitors not attached to any club.

The arrangements were excellent, for which we have chiefly to thank our late President, Mr. Berney, and his zealous coadjutors on the Soirée Committee, together with our Honorary Secretary, Mr. Sarjeant. Great complaint was, however, made of the ladies' cloak-room arrangements, which will doubtless have the attention of the Committee another year.

Amongst the exhibits the place of honour was distinctly due to Mr. Crowley's magnificent collection of Palæarctic Diurnal Lepidoptera, a most instructive and admirably-arranged series.

Mr. Lovett's ethnological exhibits were, as usual, of great interest, and the labours of our photographic section, in which Messrs. Allen, Brewer, Jaques, McKean, and Low Sarjeant have taken an active part, were admirably illustrated on the walls.

The platinotypes exhibited by Mr. Low Sarjeant, and the practical exposition of this method of photography by the Platinotype Company, excited much interest and attention; as also did the living ants, pursuing their industrious labours, shown by Mr. E. Skinner.

It is impossible to enumerate the many interesting objects exhibited, and I can only briefly refer to the pictures kindly contributed by Mr. Page, Mr. Lucas, Mr. J. H. Drage, and other local artists; the admirable photographs shown by Mr. Collyer, Mr. Major, Mr. A. Pye Smith, and other gentlemen; the well-mounted botanical specimens of Mr. Epps; the rain and tide gauges of Mr. Baldwin Latham; and the basket of freshly-gathered flowers numbering not less than 68 species, all gathered in his own or neighbouring gardens at Addiscombe, in the open, by Mr. W. F. Miller. This number compares with 44, 53, 99, and 134, exhibited under similar circumstances in the four preceding years.

Many other interesting exhibits will doubtless occur to my readers, which I have overlooked. The microscopic department was generally pronounced to be of unusual interest, the objects being well selected, well shown, and illuminated with judgment and effect.

In thus reviewing at some length the doings of the past year, I fear I have somewhat trespassed on your patience; but it is, I think, a record on which we may look back with satisfaction, and it shows at any rate that the Club offers to such of its members as choose to avail themselves of them, abundant opportunities of exchanging information and increasing their knowledge, of pleasant rambles in good company and often under able guidance to the most interesting spots in the beautiful country by which we are surrounded.

Those who are beginners, or less experienced in almost any department of natural science, have the vast advantage of finding amongst their fellow members some of the best authorities upon it in the country, ever willing and ready to assist them. In Botany, Mr. Arthur Bennett (whose opinion on certain classes of plants is sought for by botanists in all parts of the world), and Mr. Beeby, whose knowledge of the botany of our county is unrivalled. In Geology we have Mr. Topley; in Ornithology and Oology, Mr. Crowley; for the British Crustacea and Marine Zoology generally, Mr. Lovett; for Land and Freshwater Mollusca, Mr. McKean; in Meteorology, Mr. Eaton; for Practical Microscopy, Mr. Low Sarjeant. I might, in fact, go on enumerating the names of many equally able in their various departments, and I only name these gentlemen as an example, to illustrate my contention as to the great advantage to those who are taking up any scientific study, of membership in a Club like ours.

If the admirable plans of our ex-President, Dr. Carpenter, had met with the liberal support they merited, and been carried into effect, we might now also have been in possession of an excellent museum, and of suitable and convenient rooms for our meetings. If we are ever in the position to congratulate ourselves on the possession of these, the advantages I have referred to would be immensely increased, and I can, in conclusion, only hope that they may at no distant period be secured. It only remains for me, gentlemen, to thank you for your patient hearing, and for the courtesy and support I have met with from all the members of the Club (official and otherwise), with whom I have been brought in contact during my year of office.

Members elected, 1885.

Jan. 14th.—John Philip Read, "Eversfield," South Park Hill Road. Thomas Dodgson Saunders, Park Hill Rise. Harry Douglas Gower, 16, Wandle Road. Lester Reed, South Park Hill Road.

March 11th.—Morgan Hughes, 4, Wellesley Road. Joseph John Gill, 74, St. James Road.

April 8th.—John Dixon, C.E., High Towers, Park Hill. Richard F. Grundy, Melton Lodge, Addiscombe. Cecil Laufear, Rockwood, Chichester Road.

May 13th.—Alfred Bishop, Ringstead Lodge. T. J. Witt, 44, Dingwall Road. Frank Allen, Warrington Road. Peter Thomas Duncan, M.D., Park Lane. E. L. Shore, Millbrook House, North Park.

Sept. 9th.—John Wood Young, Tavistock Road. John H. Barber, 119, St. James Road.

Nov. 11th.—W. Terry, Camborne Road, Sutton. Alfred Thompson, 43, Carmichael Road, South Norwood. William Pool, 53, Thornton Heath. George Theodore Crosfield, Hurstleigh, South Park Hill Road. Henry Berney, 61, North End. Dr. Walter Gripper, Manor Road, Wallington.

Dec. 9th.—Osborne G. W. Trenow, Helstone Lodge, Addiscombe. William Cooke, 2, Gwydor Road, Elmers End. P. W. Perkins Case, M.D., Oakfield Road. Charles M. Ellborough, the Town Hall.

Presentations to the Club, 1885.

'Science Gossip'; from the Publishers. The Journal of the Royal Microscopical Society. Address of the Treasurer of the Royal Society, delivered at the Annual Meeting. Proceedings of the Holmesdale Natural History Society. Parcel of stationery; presented by E. Straker. Journal of the Postal Microscopical Society. Slide of Sponge Spicules; presented by G. Hind. Journal of the Quekett Microscopical Society. Transactions of the Eastbourne Natural History Club. Journal of the Northamptonshire Natural History Society. Notes on British Stalk-eyed Crustacea, by Edward Lovett; presented by the Author. The Weather of 1884, by Edward Mawley, F.R. Met. Soc.; presented by the Author. Two objects boxes for Coles' slides; presented by W. F. Stanley. Transactions of the Belgium Microscopical Society. Twenty-seventh Report of the East Kent Natural History Society. Annual Report of the South London Microscopical and Natural History Club. Report of the West Kent Natural History and Microscopical Society. Natural History of the Nests and Eggs of British Birds (Rev. F. O. Morris), 3 vols.; British Birds' Eggs and Nests (Atkinson), 1 vol.; List of British Birds, compiled by a Committee of the British Ornithological Society, 1 vol.; Birds of Middlesex (J. E. Harting, F.L.S.), 1 vol.; Natural History of British Fishes (Buckland); Charles Darwin, Nature series; Natural History of Selborne; Life of a Scotch naturalist; Zoologist for 1883;—presented by F. Lee Berney. Sketch of the Geology of Ealing, and notes on Flint; presented by G. J. Allen Brown. Burton's Modern Photography; presented by K. McKean.

Exhibits, 1885.

Jan. 14th.—J. F. Rymer, *Trichina spiralis* and *Bacillus anthrax*. F. G. Pocock, collection of birds' eggs. W. Low Sarjeant, ova of toad injected with chrome-yellow.

Feb. 11th.—Dr. Carpenter, human bones and skulls from the interments discovered at Purley; also iron weapons, &c., found near Beddington. H. T. Mennell, skulls, pottery, metal knives, glass beads, rings, &c., from interments at Saffron Walden. K. McKean, early form of lamp from Cyprus; curious pearl from oyster. E. Lovett, *Sysmata seticaudata*, a crustacean new to the British seas; also prehistoric flint arrow-heads from Yorkshire. A. Warner, Cathcart's freezing microtome. F. L. Berney, specimen of pied sparrow from Croydon. A. H. Allen, white starling from Suffolk. J. Epps, horseworm (*Ascaris*), twelve inches in length. H. D. Gower, larvæ of *Ephemera*.

March 11th.—E. Lovett, flint gorges and fish-hooks from Jersey cave; shell-hooks from the islands of the N. Pacific; bone, wood, and metal hooks from N. America; fresh and salt water artificial trolling baits, salmon and trout flies, &c. Dr. Franklin Parsons, Devonian and carboniferous limestone fossils. J. H. Drage, drawings of abnormal forms of fish. J. Epps, jun., varieties of *Agrimonia eupatoria*. Rev. G. Bailey, flint gorges and hooks from Yorkshire. W. Low Sarjeant, a new species of *Polycistina* (unnamed).

April 8th.—J. G. Goodchild, drawings of birds of prey. K. McKean, the smooth slug (*Limax lævis*), alive, from St. Mary's Cray, being the first specimens from the S.E. of England. Philip Crowley, typical collection of eggs of British birds of prey. E. Lovett, skulls of albatross, and two rare starfish (*Goniaster templetoni* and *Ophiocoma brachiata*). E. B. Sturge, butcher's broom from Croham Hurst.

May 13th.—W. H. Beeby, *Sparganium simplex*, *S. ramosum*, *S. neglectum*, and other plants to illustrate his lecture. Dr. Carpenter, series of Upper Greensand fossils, Devonian rocks, and corals. E. Lovett, harpoons of walrus ivory, bows and arrows, from Norton Sound, Alaska; flint-pointed arrows from Patagonia. K. McKean, a species of *Atax* parasitic on *Unio pictorum*. W. Low Sarjeant, A. H. Allen, H. C. Collyer, a large series of photographs of spots of interest in the neighbourhood of Croydon. J. Epps, plants of *Paris quadrifolia*, with 3, 4, 5, 6 leaves respectively. E. Straker, some rare Surrey plants. A. Bennett, *Carex buxbaumii* from an island in Lough Meagh, Ireland, the only British station, and *Hierochloe borealis*.

Sept. 9th.—H. T. Mennell, plants from the Norfolk Broads. E. B. Sturge, an enormous puff-ball (*Borista nigricans giganticum*). Philip Crowley, *Attacus Atlas*, and other moths. A. Warner, Suffolk's collecting bottle. R. J. Backwell, Coles' slides (under the microscope). J. J. Gill, slides of potato fungus. W. L. Sarjeant, a large number of the larvæ of *Sphinx ligustri*, which were distributed amongst the members. H. C. Collyer, J. G. B. Brewer, W. L. Sarjeant, photographs.

Oct. 14th.—E. Lovett, striated boulders from glacial clay, Yorkshire; ammonites and jet, Whitby; galena or lead ore, and freshwater crayfish from Yorkshire. K. McKean, reversed forms and varieties of *Limnea peregra*. W. L. Sarjeant, platinotype photographs. E. Straker, buragong fruit, and Cicad or lantern-fly. N. Waterall, wood and leaves from peat-bed of the old Thames Valley.

Nov. 11th.—A. W. Bennett, various forms of plant-life under the microscopes of Messrs. McKean, Lovett, Sarjeant, and Backwell, which were kindly placed at his disposal. E. Lovett, prehistoric stone flaked implements from the Cape of Good Hope; also two remarkable abnormal forms of *Buccinum undatum*.

Dec. 9th.—W. H. Beeby, plants new to Surrey. A. Bennett, a series of rare Surrey plants. K. McKean, eastern examples of the genus *Helix*, chiefly from Ceylon. Prof. Judd, slides of oolitic shells.

Croydon Microscopical and Natural History Club.—Balance Sheet for the Year ended 31st December, 1885.

Receipts.

	£	s.	d.
To Balance in hand	19	15	4
,, Subscriptions	110	10	0
,, Sale of Publications	0	2	0
,, Sale of Soirée Tickets	37	15	0
	£168	2	4

Expenditure.

	£	s.	d.	£	s.	d.
By Rent of Club Room				10	0	0
,, Hire of Room for Meetings				5	12	6
,, Postages				12	6	3
,, Printing				6	9	0
,, Books and Binding				8	14	8
,, Attendance and Collecting Subscriptions				6	10	6
,, Refreshments at Annual Meeting				1	10	0
,, Stationery				1	2	8
,, Sundries				4	4	0
Soirée Account.	£	s.	d.			
By Hire of Rooms	7	14	6			
,, Tables	10	15	0			
,, Lamps	2	18	6			
,, Police and Attendants	1	2	0			
,, Printing	5	12	0			
,, Advertising	4	17	4			
,, Refreshments	18	7	2			
,, Music	6	0	0			
,, Postages	2	5	1			
,, Sundries	2	19	3			
				62	10	10
Balance brought down *				49	1	11
				£168	2	4

* Not including postages in hand, £1 11*s.* 3*d.*

KENNETH McKEAN, *Treasurer.*

We, the undersigned, having examined the above Accounts and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and to the Bankers' Pass Book.—*January 4, 1886.*

F. THOMPSON,
WALTER M. GIBSON, } *Auditors.*

LIST OF MEMBERS.

Alldridge, Wm., Westow-street, Upper Norwood, S.E.
Allen, Frank, Warrington-road, Duppas-hill.
Allen, A. H., Wellesley-road.
Albright, W. J., Broad-green, Croydon.
Archbishop of Canterbury, His Grace The, Addington-park.

Backwell, Richard, Tennison-road, South Norwood, S.E.
Backwell, Richard Francis, 1 Tennison-road, South Norwood.
Baddeley, T., 60 London-road.
Bailey, Edwin, Lansdowne-road.
Bailey, Rev. George, M.A., The Manse, Finchingfield, Essex.
Baker, Samuel, Lansdowne-road.
Baldiston, Frederick, Glastonbury-lodge, Sydenham-road.
Baldock, J. H., F.C.S., 3 High-street, South Norwood, S.E.
Balfour, J. Spencer, Wellesley House, Wellesley-road.
Barber, J. H., 119 St. James Road.
Barnes, Thos. H., M.D., London-road.
Barrow, Reuben Vincent, Engadine, Park Hill Road.
Bayard, F. Campbell, LL.M., Oaklands, Harcourt-road, Wallington.
Beard, G. W., High-street, South Norwood, S.E.
Beeby, William H., F.R.M.S., 14 Ridinghouse-street, London, W.
Bennett, Arthur, F.L.S., 107 High-street.
Benson, Edward Fredk., Addington Park.
Berney, Edward, M.R.C.S., Kirby Bedon, Lower Addiscombe-road.
Berney, Henry, 61 North End.
Berney, John, F.R.M.S., 61 North End.
Bidwell, Edward, Twickenham, and 1 Trig-lane, Upper Thames Street, E.C.
Binyon, Thomas W., Chichester-road.
Bishop, A., Ringstead Lodge, Whitehorse-road.
Blake, W. J., High-street.
Bonella, John, Duppas Hill.
Braithwaite, Rev. J. M., M.A., Vicarage, Croydon.
Brebner, G. Reith, M.D., Bensham Lodge, West Croydon.
Brewer, J. G. B., Havelock-road.
Brock, Geo. E., South Park Hill Road.
Brodie, Robert, M.A., George-street.
Buckland, John Wm. 130 Lower Addiscombe-road, Croydon.
Buckland, John Wellington, 130, Lower Addiscombe-road, Croydon.
Budd, Percy, High-street.
Burbidge, W. H., Stanley House, Alleyn Park, West Dulwich, S.E.

Carpenter, A. B., B.A., M.R.C.S., F.R.M.S., Dingwall-road.
Carpenter, Alfred, M.D., J.P., Duppas House.
Carter, Jas. A., Reedham, Purley, Surrey.
Chambers, W. E., J.P., Eversfield, Sutton.
Cheeswright, Fred., Maythorne, Birdhurst Rise.

Chisholm, Jas., 21 Outram-road.
Chumley John, Worcester Lodge, Canning-road.
Clarke, Josiah, 20 George-street.
Clayton, Charles, Chatsworth-road.
Coates, W. N., Fairfield-road.
Collyer, Henry C., Beechholm, Park Hill Road.
Cooke, William, 2 Gwydor-road, Elmer's End, S.E.
Cooper, John, Jun., Hooley House, Purley.
Corden, George, F.R. Met. Soc., Katharine-street.
Corry, John, J.P., Rosenheim, Park Hill Road.
Cowdell, H. S., Bramley Hill.
Craig, Chas. W., 75 St. James Road.
Crosfield, G. T., Hurstleigh, South Park Hill Road.
Crowley, E. A., 62 High-street.
Crowley. Jonathan S., A.M. Inst. C.E., F.G.S., 3 Park Hill Rise.
Crowley, Philip, F.Z.S., Waddon House.
Cullis, William Henry, 7 Gresham-road, South Norwood.
Curling, George, Elgin House, Addiscombe-road.
Cushing. Thomas, F.R.A.S., 1 Southside, Chepstow-road.

Davies, Arthur Capel, Arundel House, Duppas Hill.
Davies, James, 26 South End.
Dickinson, William, M.A., F.G.S., Warham-road.
Dixon, John, C.E., High Towers, Park Hill.
Dix, T. H., 36 High-street.
Drage, John Henry. Tamworth-road.
Drage, John, Tamworth-road.
Drummond, A. W. B., 6 Walpole-road.
Drummond, H., 6 Walpole-road.
Duke, M. Charles, M.D., Wellesley-road.
Duncan, Peter Thomas, M.D., Park-lane.

Eastty, Alfred, Addiscombe-grove.
Eaton, H. S., M.A., F.R. Met. Soc., Chepstow-road.
Edridge, T. R., J.P., The Elms, High-street.
Elborough, C. M., Town Hall.
Epps, James, Jun., The Homestead, Ross-road, South Norwood, S.E.

Fagg, Edward, 7 Canning-road.
Fairey, J. W., "Lovell," Kenley.
Falk, Ferdinand, 14 Wellesley-road.
Farley, John, Silchester Lodge, Thornton Heath.
Fenn, W. G., 100 George-street, Croydon.
Field, William, Oval-road Schools.
Foss, Fredk., Dingwall-road.
Freeland, A., Fairfield-road.

Gibson, John, 10 Canning-road.
Gibson, Walter M., 20 Outram-road.
Gill, Edmund, Linn Villa, Sutton Hill, Sutton.
Gill, J. John, 74 St. James-road.
Gower, Harry Douglas, 16 Wandle-road.
Gripper, Dr. Walter, Wallington, Surrey.
Grundy, Charles, Melton Lodge, Havelock-road.

GRUNDY, RICHARD F., Melton Lodge, Havelock-road.
GUIMARAENS, P. G., Warham-road.
GURNEY, GEORGE, Canning-road.

HADDOCK, ROLAND, Park Hill Road.
HALL, ROBERT, Garth Villas, Clyde-road.
HANCOCK, CHAS. WM., Mona House, Havelock-road.
HART, P., "Lyndhurst," Fairfield-road.
HARWOOD, W. H., Glebelands, Mitcham.
HENMAN, CHARLES, "Streatley," Friend's-road East.
HINTON, JAMES T., M.D., High-street.
HOBSON, J. M., M.D., Addiscombe Villas, Addiscombe.
HOLMES, W. MURTON, Glenside, St. Peter's-road.
HORSLEY, HENRY, M.R.C.S., London-road.
HOVENDEN, R. G., Heathcote, Park Hill Road.
HOVENDEN, T., Arbor End, Selhurst-road, South Norwood, S.E.
HOWELL, ALBERT D., 9 Fairfield-road.
HUDDLESTON, Rev. GEORGE HENRY, 106 St. James-road.
HUGHES, MORGAN, 4 Wellesley-road.
HULBERT, JOHN, Fairfield-road.

INGRAMS, WILLIAM, Whitgift Schools, Church-road.

JAQUES, JOHN, Duppas Hill.
JARRETT, C., St. John's Grove.
JENKINS, B., Bramley Hill.
JONES, E. F., 34 Eastcheap, London, E.C.
JONES, SAMUEL, Trelawny, Addiscombe-road.
JOHNSON, J. S., M.R.C.S., 105 High-street.
JUSTICAN, J. W., B.A., Outram-road.

KÜSTER, GUSTAV, Park-lane.

LAING, R. A., St. Peter's-road.
LAMBERT, A., Jun., High-street.
LANE, HARRY, Havelock-road.
LANFEAR, CECIL, Rockwood, Chichester-road.
LATHAM, BALDWIN, C.E., Park Hill Rise.
LEE, HARRY, 43 Holland-street, Blackfriars-road, S.E.
LEE, HENRY, F.L.S., F.G.S., F.R.M.S., 343 Brixton-road, S.W.
LEE, J. R., 115 High-street.
LERÉSCHE GEORGE HENRY, Fallowfield, Bramley Hill.
LINNEY, GEO. F., Saffron Walden, Essex.
LINTON, FRANCIS J. G., 18 Fairfield-road.
LOFTUS, T., Outram House, Lower Addiscombe-road.
LONG, HENRY, 90 High-street.
LOVETT, EDWARD, West Burton House, Outram-road.
LUDLAM, FELIX, Shirley, Surrey.

MAJOR, CHARLES M., Duppas Hill-terrace.
MARKS, J. G., 115 Waddon New-road.
MARSHALL, EDWARD, M.R.C.S., Church House, Mitcham.
MARSHALL, ROBERT, Broomfield, Duppas Hill.

Mather, C. W., 47 Dingwall-road.
Mawson, Matthew, Albert-road, South Norwood, S.E.
McKean, Kenneth, F.L.S., Warham-road.
Mead, Frank, Sutton, Surrey.
Mennell, H. T., F.L.S., Park Hill Rise.
Miller, William F., Canning-road.
Milln, James Stocks, Morland-road.
Mordaunt, G., Glenearn, Epsom-road.
Morgan, James Henry, F.S.S., 124, 126 Narrow-street, Limehouse, E.
Morland, Charles C., Rastrick Lodge, Morland-road.
Morland, Charles Ernest, Rastrick Lodge, Morland-road.
Morris, A., Beddington, Surrey.
Morton, Shadforth, M.D., Wellesley Villas, Wellesley-road.
Moss, John, Hirdir Lodge, Brigstock-road.
Muggeridge, T. Benjamin, The Vale, Sydenham.

Nation, W. J., Thornton-road.
Newton, Charles, Crossland Villa, Broad-green.
Noble, John, Wilton-road, Merton, Surrey.
Norris, Arthur J., The Waldrons.

Odling, A., Wickham House, Lennard-road.
Oldfield, John, 16 Tamworth-road.
Overton, S., Selsdon-road.
Owst, Robert Clement, 51 Thornton-heath.

Packham, James, Katherine-street.
Paget, Peter, Coombe-lane.
Paget, Peter, Jun., Coombe-lane.
Parsons, Franklin, M.D., F.G.S., 13 Whitworth-road, S. Norwood, S.E.
Peek, Sir Henry W., Bart., Wimbledon.
Perkins-Case, P. W., M.D., Oakfield-road.
Perry, Edward Seager, Aberdeen House, Heathfield-road.
Pelton, John, Warrington Lodge, Waddon.
Petherick, H. W., Maple Lodge, Havelock-road.
Phillips, James, Woodlands, Wellesley-grove.
Philpot, Charles W., M.D., 58 North End.
Pool, W., 53 Thornton Heath.
Price, George N., High-street.
Price, Herbert D., Chandos Villa, Sydenham-road.
Puxon, E. W., Wintons, Park Hill Road.
Pye-Smith, Arnold, Fairfield-road.

Ranger, A. Washington, Warham-road.
Read, John Philip, Eversfield, South Park Hill Road.
Reed, Lester, Hursthof, South Park Hill Rise.
Rich, Alfred William, Oak Villas, Fell-road.
Richardson, T. A., 24 London-road.
Ridge, Byron, 60 North End.
Roberts, H., Hazeldean, Benhilton, Sutton, Surrey.
Roberts, Rev. George R., D.D., The Limes, High-street.
Robinson, G. E., Lee Villas, Canning-road.
Robinson, W. Mosse, Kenley, Surrey.

Robinson, Wm. Jas. Palmer, Lee Villas, Canning-road.
Roby, R. F., Shirley House, Selhurst, S.E.
Rosser, Walter, M.D., Wellesley-road.
Rostron, Simpson, Beddington-lane.
Rowland, Percy I., F.R.C.S., Hillside, Addiscombe.
Rowland, William H., Tavistock-road.
Rowland, William, Tavistock-road.
Ryder, Thomas, 3 Tennison-road, South Norwood.
Rymer, Jas. F., Wellesley-road.
Rymer, S. L., Wellesley-road.

Sarjeant W. Low, 7 Belgrave-road, South Norwood, S.E.
Saunders, Thomas Dodgson, Twyfordbury, Park Hill Rise.
Shore, E. L., Millbrook House, North Park.
Skinner, Edgar, Bramley Hill House, Bramley Hill.
Sly, Alfred L., Lauristone House, Tavistock-road.
Smith, Dr. S. Parsons, Addiscombe.
Smith, Thomas Wm., Spring Lodge, Dean-road.
Stanley, Joseph, 17 Belgrave-road, South Norwood, S.E.
Stanley, W. F., F.G.S., Cumberlow, South Norwood, S.E.
Stow, Isaac, Verulam Villa, Nicholson-road.
Straker, E., Hazelshaw, Kenley, Surrey.
Strong, Henry J., M.D., George-street.
Sturge, Edward B., The Waldrons.
Swaine, J. C., Park Hill Road.
Syms, John E., Nithsdale, Thornhill-road.

Terry, W., Cambourne-road, Sutton.
Thompson, A., 43 Carmichael-road, South Norwood.
Thompson, H. G., M.D., Addiscombe Villas, Lower Addiscombe-road.
Thompson, Francis, St. Peter's-road,
Topley, William, F.G.S., Hurstbourne, Elgin-road, Croydon.
Topley, W. Whiteman, Hurstbourne, Elgin-road, Croydon.
Trenow, Osborne W. G., Helstone Lodge, Addiscombe.
Trew, Thomas N., M.D., Park Hill Rise.
Turner, Charles Price, 43 Carmichael-road, South Norwood, N.E.
Turner, Henry, 3 Somerset Villas, Parson's Mead.
Turner, W. Castle, 6 Dagnall Park Terrace, Selhurst, S.E.

Walker, Thomas, Warrington-road.
Walker, Thomas, 32 Sumner-road.
Walton, A., Tavistock-road.
Ward, Jesse W., Katharine-street.
Warner, A., 2 Grosvenor Villas, Holmesdale-road, Selhurst, S.E.
Waterall, Nathaniel, Waddon Lodge.
Webb, W., Jun., Lanoy Cottage, Duppas Hill.
Wenham, William P., 114 Waddon New Road.
West, Frederick, The Waldrons.
Whealler, G. Anson, Elgin-road.
Whitling, Henry T., F.R.C.S., F.R.M.S., High-street.
Williams, Bertram Alex., L.D.S., 11 Wellesley-road.
Willoughby, C. W., Ivy Cottage, Parson's Mead.
Worsley-Benison, H. W. S., F.L.S., Lulworth, Sutton.
Wells, Alfred W., 5 Cobden Villas, Selhurst.

Witt, S. J., 44 Dingwall-road.
Witt, Thomas J., 44 Dingwall-road.
Woodward, John, 1 Lee Villas, Canning-road.

Youle, A. P., Chepstow Rise.
Young, John Wood, Heathcot, Tavistock-road.

Honorary Members.

Berney, Frederick Lee.
Cameron, Commander V. Lovett, R.N., C.B., Kwinhata, Epsom-road.
Cole, R. Beverley, M.D., San Francisco, California, U.S.A.
Evans, John, D.C.L., F.R.S., Hemel Hempstead, Herts.
Flower, W. H., LL.D., F.R.S., Natural History Museum, South Kensington, London, S.W.
Prestwich, Joseph, St. Giles', Oxford.

Associates.

Collyer, Edward B., Selsdon-road, Croydon.
Rodbourn, J., The Gardens, Coombe, Coombe-lane.

TRANSACTIONS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1884–85.

41.—A New Flora of Surrey.

By W. H. Beeby.

(Read March 13th, 1884.)

The period—over twenty years—that has elapsed since the publication of Brewer's 'Flora of Surrey,' and the advance that has been made since 1863 in the study of botany, both as regards plant distribution and the better understanding and separation of allied forms have created a desire for a new flora of the county, approximating more closely to our present knowledge, besides including old records which are not to be found in the work above alluded to, and giving an accurate account of the distribution of the common plants; due attention being also paid to the history of the progress of botanical investigation in the county. The first distinct effort in this direction was made by Mr. Arthur Bennett, who some years since published a list of plants absent from Surrey, but found in one or more of the adjacent counties; at the same time inviting information. Since then Mr. Bennett has found himself unable, from want of time, to continue the work which, at his request, I have undertaken.

It was at first proposed to adhere to the divisions devised by Salmon and used by Brewer, which, as more or less artificial districts, are good ones. Various considerations, however, seemed to point to the river-basin system as the most natural, and, at the same time, most scientific basis for a division of the county, and it has accordingly been adopted. A strong desire was felt to avoid, if possible, a division of the chalk range from east to west, and to draw the line separating the upper and lower districts at the foot of the chalk escarpment instead of along its crest; but to do this would unfortunately have interfered with the main principle on which the districts are planned, by cutting off from the Eden district a portion of its natural drainage basin; and for this and other reasons it has been found necessary to draw the line as described. The districts are named after the rivers draining their respective areas; the basins of the River Wey and River Mole, which include some two-thirds of the whole county, have each been divided into upper and lower districts; the Upper and Lower Wey, the North-east streams, and Arun districts, have further been divided into subdistricts. This subdivision was imperative in the latter case, the two Arun subdistricts being naturally separated by the overlapping of the River Wey.

I am greatly indebted to Mr. Boulger for his most valuable assistance in devising and working out the different districts, which, in this county, present unusual difficulties.

In the following brief description the main object has been to give such information as will enable anyone to trace on a good map the various districts and subdistricts, which are as follows:—

Thames.—1. Blackwater. 2. Upper Wey; *a.* west, *b.* east. 3. Lower Wey; *a.* north-west, *b.* south-east. 4. Upper Mole. 5. Lower Mole. 6. North-east Streams; *a.* Hogg's Mill Stream and Beverley Brook, *b.* Wandle and Metropolitan Streams. 7. Eden.

Channel.—8. Arun; *a.* Ockley, *b.* Chiddingfold.

1. Blackwater is bounded S. by a line starting from the Hants border at Lower Old Park, passing N.E. through Upper Old Park and Upper Hale, thence S.E. through Hale and Badshot, crossing the railway and following the Guildford road to a point on the Hog's Back a little N.E. of Seale; thence the E. boundary runs N. to Ash Green station, then by the workhouse, Fox Hills, Chobham Ridges and through Paschal Wood to the borders of Berks. The further boundaries are formed by the adjoining counties of Hants and Berks.

2. Upper Wey is bounded N. by District 1 to the point N.E. of Seale, thence by the road along the Hog's Back to Guildford, where the line passes through the town and is continued along the crest of the chalk escarpment past Albury Downs, Netley Heath and Hawkhurst Downs to White Downs; thence the E. boundary runs S. through Wootton, by Broadmoor, to its junction with the boundary of District 8 *a*, at Coldharbour. The rest of the E. as well as the S. boundaries are formed by District 8 (*a* and *b*), and by the county of Sussex. The county of Hants forms the W. boundary. The two subdistricts, *a* (west) and *b* (east), are separated by the water-parting of the two main branches of the River Wey; the dividing line leaves District 8 *b* near Hambledon, and passes by Munstead Heath to the junction of the two streams, and thence by the River Wey itself to

Guildford. The west subdistrict lies almost exclusively on the lower Greensand formation, and abounds in extensive heaths and commons, with considerable elevations, as at Hind Head. It is here, and in Districts 1 and 8 *b*, that several species which occur in the adjoining parts of Hants should be sought; the Bramshot station for *Lycopodium complanatum* is but a few yards from the county border, while there is reason to hope that *Eriophorum gracile*, now extinct at Whitemoor Pond, may be found elsewhere in this region. *Pinguicula lusitanica* and *Utricularia intermedia* also may possibly occur.

3. Lower Wey is bounded W. and N. by District 1, the county border and River Thames; E. by a line running N. from Hawkhurst Down to Effingham Common, thence by Ockham and Cobham Commons, St. George's Hill and Oatlands Park to the River Thames; S. by District 2. Two subdistricts are separated —*a* (north-west) and *b* south-east. The former contains chiefly the basin of the Bourne Brook, and is marked by a line starting from the Blackwater boundary on Hag Thorne Moor, thence passing through Bisley to the Basingstoke Canal at Woking, and following the northern bank of the canal to Ham Haw, and thence N.E. till it meets the River Thames midway between the River Wey and Bourne Brook. Subdistrict *a* is all but untrodden ground, and offers a wide field for investigation. The River Thames itself deserves further attention, and *Potamogeton prælongus*, which requires confirmation for the county, will probably be found there.

4. Upper Mole is bounded N. by the continuation of the line along the chalk crest from White Downs by Ranmer Common, Box Hill, Pebble Hill, Reigate Hill and Gatton to the Merstham tunnel, and thence by Tolhurst and Willey farms to White Hill; E. by a line running S. from White Hill through Bletchingley, thence E. by Coldharbour, and again S., passing a line W. of Horne and across Copthorne Common to the Sussex border; S. by the county of Sussex, and W. by Districts 2 and 8 *a*.

5. Lower Mole is bounded N. by the River Thames; S. by District 4; W. by District 3; and E. by a line starting from the point where Districts 4, 5 and 6 meet on Merstham tunnel, thence N.W. through Chipstead, W. to the Reigate and Banstead road, which is followed N. to Tadworth, then past Epsom Downs and Epsom Common to Esher Common, thence following the railway northward to Claygate, and through Long Ditton to the River Thames.

6. North-east Streams is bounded N. by the River Thames; W. and S. by Districts 4, 5 and 7; and E. by the county of Kent. The two subdistricts are *a* (Hogg's Mill Stream and Beverley Brook), and *b* (Wandle and Metropolitan streams). The water-parting dividing them runs N.E. from a point a little

E. of Burgh Heath to Banstead, and thence through Sutton, Morden and Wimbledon to the River Thames. *Medicago minima*, which has not been found in the county for some years, should again be looked for at Epsom Downs and in the vicinity. It is desirable that any plants which may be peculiar to either of the river-basins in Subdistrict *a* should be noted, as it may be found advisable to keep the two basins distinct.

7. Eden is bounded N. by District 6; S. by the county of Sussex; E. by that of Kent; and W. by District 4. This district has produced several species new to the county, including *Potamogeton Zizii* and *Viola lactea*, and is rich in ferns, carices and aquatics.

8. Arun is bounded S. by the county of Sussex. The line enclosing Subdistrict *a* (Ockley) runs N.W. from Cowick, on the Sussex border, passing a little E. of the railway which is crossed N. of Ockley station, and thence to Coldharbour; then W. past Leith Hill tower to Holmbury Hill, and S. past Coophurst Farm to the county border. The boundary of Subdistrict *b* (Chiddingfold) passes from the Sussex border N. to Alfold Crossways; N.W. by High Loxley to a point S. of Hascombe, thence by Hambledon, Brook Street and Emily Farm to Gibbet Hill, thence S.E. by Haslemere and over Lythe Hill to Sussex. Dr. Trimen's prediction that *Dentaria bulbifera* would be found in this part of the county has been confirmed by Mr. E. Straker, who, in 1882, found that plant abundant on the Surrey side of the county boundary in Subdistrict *a*. This is indeed the only station for it in the county, for the single locality quoted by Brewer appears to belong to *Lathræa Squamaria*.

I have alluded to one or two of the rarer species to be found in Surrey, and any further information respecting such will be gladly received; at the same time, information as to the occurrence in, or absence from any of the districts or subdistricts, of the usually common plants is particularly invited. Confirmation of the occurrence of the following plants is particularly required:—

Erodium moschatum.	Potamogeton prælongus.
Trifolium ochroleucum.	P. zosterifolius.
Vicia lathyroides.	Orchis hircina.
Callitriche vernalis.	O. purpurea.
Parnassia palustris.	O. Simia.
Galium anglicum.	Ophrys arachnites.
Carduus eriophorus.	O. aranifera.
Erica ciliaris.	Scirpus pauciflorus.
Mentha gentilis.	Carex strigosa.
Rumex maximus.	Calamagrostis lanceolata.
Salix ambigua	Briza minor (as a wild plant).

An outline map, showing the districts and subdistricts, is in preparation, and I shall be happy to send a copy of the same, together with any further information that may be desired, on application to me at my address, 14, Ridinghouse Street, London, W.

42.—Remarks on the Physical Geography and Geology of Italy.*

By William Topley, F.G.S., Geological Survey of England, President of the Geologists' Association.

(Read April 9th, 1884.)

43.—Pond-Life.

By W. Low Sarjeant.

(Read May 14th, 1884.)

I have several times been asked, when exhibiting pond-life at our meetings, where I procured it, or whether it had been supplied by Bolton, the well-known collector, the question seeming to imply that it is of no use looking in the ponds in our immediate neighbourhood for any good micro-material, an idea which I hope to dispel. As a matter of fact there is not an object described in 'Slack's Pond-Life' which I have not taken in this district, and the captures form a very small portion of the good things that may be found.

All I shall attempt this evening is simply to enumerate a few of the most interesting forms taken within an easy walk of this building, and to mention where I have generally found them, after which I think it may be useful to make a few suggestions on collecting and illuminating such objects.

I will take first the ponds in the fields lying to the left of the Morland Road, Addiscombe, proceeding from Croydon to South Norwood, which are the nearest. These ponds are in an old brick-field, and they contain at times very interesting specimens, *Volvox globator* being frequently in great abundance. If we are fortunate in procuring *Volvox*, either late in the autumn or early in spring, the embryo plants contained in the mother cell are of a bright orange colour, and of quite a different character to the ordinary embryo. The contrast between the orange colour of the young plant and the green of the mother cell renders it a

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* Abstract not received in time for printing.

much more beautiful object than when the whole plant is green, as we find it in the ordinary summer gatherings. *Melicerta ringens* and *Stephanoceros Eichornii* are two good forms which may be found here. These are, of course, attached to the weeds, more particularly to the submerged fine leaves of the water crowfoot and the star-weed. Here also *Floscularia ornata*, *Œcistis crystallinus*, and several other tube-dwelling rotifers may be found; *Actinospherium*, which is like a very large *Actinophrys sol*, is generally abundant, and is a most beautiful object. *Daphnia*, *Cyclops*, *Hydra viridis*, and *vulgaris*, several free-swimming rotifers, two or three species of *Vorticellæ*, and many kinds of Infusoria are also to be taken.

Some of the tube-dwelling rotifers, such as *Stephanoceros*, *Floscularia*, &c., on account of their extreme transparency, are at times very difficult to find; a piece of weed having many specimens attached to it may be passed over as valueless if simply held up to the light and examined. The best method of detecting these delicate forms is to use a black-ground illumination, which may very easily be accomplished if the bottle is large enough by placing the finger or fingers at the back of the bottle, and then holding it up rather obliquely to the brightest light obtainable. The curvature of the glass bottle condenses the marginal rays of light on the object, while the finger stops out the central rays, or, if the bottle is small, a piece of stick or any other opaque object proportionate to the size of the bottle will answer. One or two trials will enable any one to obtain a dark background in this manner, and it is surprising with what ease organisms can be detected that are practically invisible by transmitted light only.

Upon dipping in a pond near Tunbridge Wells last Easter, I came upon *Volvox* in enormous numbers, a large proportion of which contained the orange-coloured young. This orange-coloured variety is probably a kind of winter or resting stage in the development, somewhat similar to the statoblasts of the Polyzoa. I then noticed what I have often before observed, although never in so marked a manner, how very locally, even in a pond of small area, its inhabitants are sometimes congregated. In one part of this pond there were thousands of *Volvox* in every ounce of water,—in fact the water appeared green with them, whilst a few paces further on, after straining several pints of water through my collecting-bottle, I could not obtain a single specimen either of *Volvox* or any other form of life. A short distance further the water was teeming with *Daphnia*, *Cyclops*, and other similar forms, but no *Volvox*. I mention this to show how necessary it is in collecting not to rest satisfied with dipping in one place only, but to try in various parts of a pond.

Proceeding from the Morland ponds, there is a large pond close to the railway, about midway between Woodside and Elmer's End; this contains a great many of the commoner forms, but I have never succeeded in taking anything rare here; there are plenty of rotifers, such as *Rotifer vulgaris*, *Pterodina patina*, *Philodina*, and sometimes *Brachionus*; the last named—on account of its large size, well-developed gizzard, and strong ciliary crown—is one of the best, as well as the easiest, of all the rotifers for structural examination. Gosse, in his 'Evenings at the Microscope,' devotes two or three pages to this particular species. The scarlet water-mites are also tolerably abundant here, as is also, at the present time, *Melicerta ringens* on the water crowfoot. The tanks on the side-table represent a single gathering from this pond.

The only locality in our neighbourhood where the rare *Hydra fusca* may be taken in any numbers, so far as I know, is the River Ravensbourne, between Elmer's End and Beckenham. It is well worth looking for, being by far the most interesting of the genus, both on account of its elegant shape and the length of its tentacles when fully developed. I have several times met with specimens an inch and a half in length, measured when the hydra was perfectly quiet and undisturbed.* Its favourite position in confinement is at the bottom of the aquarium, perched on the top of a stone, the body erect and stretched to its utmost extent, with the tentacles drooping gracefully round it. When, as is sometimes the case, the specimen has four or five young ones attached to it, the fishing-ground of the family covers a large area. Of course, when the tentacles are extended to this great length they become very much attenuated, so much so that it is almost impossible to trace them to their extreme points; but this very attenuation is of advantage to the microscopist, for it enables him to see with distinctness the stinging organs coiled up in their cells, the skin covering them being so tightly stretched as to be quite transparent. I have noticed in the tentacles of this hydra what I think proves that the tentacles are hollow, and contain water, and that is the presence of small Infusoria. I have frequently, when using a high power, seen them swimming about, and very amusing it is to watch them shot backwards and forwards by the motion of the water in the tentacles as these contract and expand; and I think, although not quite certain on this point, that the expansion and contraction of the tentacle is due as much to the injection or ejection of water as it is to muscular action.

For the collection of Rhizopods, the bed of *Sphagnum* on

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* Carpenter says the tentacles reach the length of 7 or 8 inches; I have never seen them anything like this length.

Keston Common is the best hunting-ground. *Arcellæ* and *Difflugia* are very abundant there, and the *Amœbæ* are of large size. This is also a good spot for Desmids.

The various ponds in the gravel-pits about Selhurst and Thornton Heath are well worth visiting, especially those in which the *Anacharis* is growing; *Melicerta*, *Stephanoceros*, *Stentor*, *Carchesium*, *Epistylis*, *Alcyonella*, and occasionally *Plumatella*, occur, besides a host of commoner forms.

In the direction of Beddington and Mitcham all the forms previously mentioned may be taken, with the exception perhaps of *Hydra fusca*. Magnificent specimens of *Carchesium polypinum* may generally be found attached to the weeds in the slow-running streams, and in the ditches near Beddington Park.

A nearly circular pond on Mitcham Common, on the right-hand side of the road before you reach the windmill in going from Croydon to Mitcham, frequently contains *Volvox*, and is, I think, the best pond on the common, although it is small. Just after passing the windmill there is a large duck-pond, which, in the autumn especially, swarms with a giant race of *Daphnia*, many of them exceeding an eighth of an inch in length, and I have taken them three-sixteenths of an inch in length, which is an enormous size for a *Daphnia*.

Now a few words on collecting: to obtain a good gathering of free-swimming forms it is necessary to use some kind of straining apparatus. Wright's collecting-bottle is perhaps the one most generally used; but for its size it is very heavy. I always use an apparatus of my own construction and design, and, as it answers its purpose well, is easily made, and is very light and portable, I will fully describe it:—I fit a wide-mouthed bottle of from 2 to 4 oz. capacity with an india-rubber stopper having two holes through it (an ordinary cork will do, but an india-rubber stopper is preferable, as it always fits water-tight and lasts longer. I then coil up a piece of wire into a spiral rather smaller in diameter than the neck of the bottle, but of sufficient length to reach about two-thirds down the bottle when in its place. I solder one end of it to the extremity of a short piece of brass tube, which fits tightly into one of the holes in the stopper, into which it is pressed. I now cover the spiral of wire with a piece of muslin (coarse for the capture of large, fine for small, organisms), and place the cork in the bottle with the muslin strainer inside. If we now place a small funnel into the other hole in the stopper and pour water into it, the water must pass through the strainer before leaving the bottle, and everything larger than the mesh of the muslin will be left in the bottle. That the apparatus may be as complete as possible, I make a zinc case, into which the bottle just fits, the lid of which is a funnel; the case forms a very convenient dipper when attached to a walking-stick. The principal advantages of this apparatus are its large straining surface (and therefore rapidity of action) and its portability. For the collection of those forms which are attached to water-plants, a small piece of the plant must be placed in a bottle and examined with a pocket-lens in the manner indicated in the early part of this paper. It is never advisable to mix the gathering taken from one pond with that taken from another. Whenever we come across a good form of micro-life it is advisable to take plenty of it, as the minuter forms of life are very uncertain in their habits; one week a pond may be teeming with some much-valued form, and the next not a specimen may be found. I have many times been disappointed in this very respect, thinking I knew the exact locality of some particular species. Such forms as *Melicerta* or *Carchesium*, which may generally be found a second time in the same spot, sometimes disappear in a most unaccountable manner. Most micro-organisms may be kept for a considerable time in captivity in any sized vessel from a test-tube to an aquarium holding gallons of water, the great secret of success being to preserve the water at an equable temperature, and not in too strong a light; for this reason a window having a northerly aspect is the best for aquaria. To maintain life in so small a vessel as a test-tube a hole of the same diameter as the test-tube should be bored through a large cork, the tube pushed through, and the whole floated in a larger body of water. Another point to be observed is not to use deep vessels; as a general rule the depth of the water ought not to be more than half the diameter of the vessel containing it, unless special means of aërating the water be adopted.

I may here remark that if an object is worth examining under the microscope it is worth being properly illuminated; in fact it cannot otherwise be satisfactorily examined. I think that our Annual Soirée might be made much more interesting if exhibitors would take a little more trouble in this respect. I am quite aware that it is not very easy to properly exhibit an object in a crowded room, but still a decided improvement might be made in this direction. I have one other suggestion: our visitors are not all microscopists, and the mere name of an object oftentimes carries no meaning with it; the object is looked upon as a pretty thing and forgotten, but if in addition to the name there was a short description, it would certainly be viewed with more interest.

I find, as a general rule, that pond-life is best seen on a dark background when using the low or medium powers of the microscope; and this may be done in various ways. Undoubtedly the most satisfactory way of working is to employ a high angle achromatic condenser with both central and marginal rays stopped out to suit the objective; a good achromatic condenser yields better results than the parabola, and with greater ease and distance in working. It only requires the stop to be changed or removed to adopt any other kind of illumination. The spot lens, which is in reality a small bull's-eye condenser with the central rays stopped out, is very effective, but an ordinary stand bull's-eye condenser will give equally good results if a disc of black paper about two-thirds (more or less according to the angle of the objective) of the diameter of the lens is pasted on the plane side; or a very fair effect may be obtained by simply using the oblique light reflected from the mirror when pushed to one side, although by this method the image is very apt to be blurred.

With a quarter-inch objective, or one of higher powers, black-ground illumination is out of the question; and to get clear definition with a delicate structure an achromatic condenser of some kind is necessary. A good condenser is an expensive piece of apparatus, but an ordinary microscopic objective reversed is an excellent substitute, and it may be fitted very simply, either under and attached to the stage, or to the substage. In using an objective as a condenser, let it be of lower power than the objective on the microscope; thus with the quarter-inch objective on the microscope the half-inch or two-third inch should be adopted as the condenser. A small cap with a pin-hole in the centre, dropped over the condensing objective, materially aids its definition when employing direct light.

In examining pond-life of any description the great point towards successful illumination is to keep the object or objects as much as possible in one plane by a cell as shallow as the size of the organisms will permit. I have constructed a simple form of compressor for this special purpose; it has thin glass both above and below, thus enabling it to be used with high powers and with very oblique light, or to be reversed, should it be required to examine both sides of an object. It is sometimes rather a difficult matter to keep free-swimming rotifers, &c., in the field; but this may be generally overcome by fraying out a very small portion of cotton-wool, placing it on an ordinary slip, and dropping a little water containing the rotifers in the centre of the wool, and covering it with an ordinary cover-glass; the network of woolly fibres prevents the rotifers from wandering very far. Of course the amount of wool should be adapted to the size of the objects, the main point being that it should be just sufficient to restrain their movements without crushing them.

When the construction of the microscope admits the use of polarised light in conjunction with illumination on a black ground, this is undoubtedly the best method of examining the muscular structure of aquatic larvæ, as we then get the solidity of illumination on a black ground, with the colouring of the different sets of muscles; the muscles which move the large sickle-shaped mandibles of the larvæ of the various water-beetles are particularly well worth examination by this method.

I am afraid my Paper has been of somewhat a rambling nature, but shall be content if it has done service in showing that plenty of interesting microscopic organisms are to be found in ponds within the scope of an ordinary walk from Croydon, and that they may be examined with ease by such apparatus as our members generally possess.

44.—The Edible Mollusca, or Shell-fish of the British Islands. [Abstract.]

By Edward Lovett.

(Read September 10th, 1884.)

One of the great results of scientific work is to produce some good for the benefit of mankind; we see this in so large a number of instances that it is utterly needless to refer to any but the one before us, namely, the question of our food supply as derived from the sea.

The great International Fisheries Exhibition of 1883 teemed with examples of the way in which science was tending, not only to instruct in the way to draw our food supply from our seas and rivers, but also how to cultivate, so to speak, the particular species and sorts that are more especially valuable as articles of food.

At first sight it would appear as if the shell-fish or mollusca, such as whelks, mussels, &c., formed a very small and unimportant section of marine food supply; but this is far from being the case, for, although the majority of molluscs are seldom eaten except by the poor, or by fishermen and their families, yet they are of enormous value wherewith to catch valuable fish on the deep sea night lines.

To give a slight idea of this value, I may mention that Great Grimsby is stated to supply 3,180,000 quarts of whelks annually, value £22,500, of which 1-25th is used as food, and the remaining 24-25ths as bait for cod, ling, and haddock. But it is not so much as regards their use for bait, but as regards their value as food themselves, that I have written this paper.

I am inclined to believe that molluscs formed one of the earliest kinds of food of prehistoric man, that is for those who were not vegetarians; for abundant evidence still exists all over the world of mounds of shells, called kitchen middens, in which have been found flaked flints, fashioned in the rudest manner, and forming the earliest type of human handicraft of which we have any knowledge.

One of the causes that induced primæval man to eat molluscs was possibly this: Shell-fish are about the only animals that require no hunting, trapping, or catching. There they were lying about at low water, and to be got for the picking of them up; I refer, of course, to littoral species, and I think therefore that they date back as articles of food to that very remote period when prehistoric man had not even learnt how to hunt quadrupeds, kill birds, or trap and spear fish.

I must here mention that almost all settlements of palæolithic and neolithic man bear evidences of having been situated near seas, estuaries, rivers, or lakes, which still further illustrates the value they attached to shell-fish.

However, to return to our subject, I am inclined to think that the mollusca of our seas are not sufficiently appreciated, and the reason I believe to be that we as a nation do not understand how to cook them. You will observe how many times I shall allude to species being much used in Mediterranean towns, when the same species is hardly tolerated in this country.

Pliny often refers to the value of certain mollusca as food, and, to judge by his language, he highly appreciated them, and the only reason we can give for this is that it must have been in the cooking.

In collecting together the following notes I have been assisted by a work on edible shells, by Mrs. Lovell; by a valuable paper on whelks and mussels, read by Mr. Harding before the Fisheries Exhibition; and by the Fisheries publications of the United States, China, and Russia. I have also obtained some valuable information from many of my correspondents upon this subject.

Although the land and fresh-water molluscs have a history, and are and have been largely used as food, I have confined my notes to marine forms only. In arrangement I have put them as near as possible in order of merit as food material, or really in relative market value, disregarding altogether their general classification, as this paper does not in any way relate to their scientific history, but to their economic.

Mr. Lovett here described nearly thirty species of mollusca or shell-fish used for food in various parts of the British Islands, from the delicate oyster to the somewhat coarse octopus, giving the local names and modes of capture of each, and information of interest regarding their folk-lore, natural history, and value as articles of food.

45.—On the Application of the Microscope to the Study of Rocks.

By F. W. Rudler, F.G.S.

(Read October 8th, 1884.)

The subject was introduced by a brief sketch of the history of microscopic petrography, with special reference to the work of Dr. H. C. Sorby in this country, and of Prof. Zirkel and Prof. Rosenbusch in Germany. In order to explain the methods of modern petrography the speaker selected a piece of granite as a well-known rock, and pointed out the characters of the constituent minerals, first as seen by the unaided eye or "macroscopically," and then as viewed under the microscope.

Granite, in its typical varieties, is a crystallo-granular aggregate of felspar, quartz, and mica. These minerals make up the entire rock, without the presence of any amorphous matter representing an original vitreous magma; and hence such a rock is said to be *holocrystalline.* The felspar is generally the most conspicuous mineral in a granitic rock, and may occur in well-defined crystals, especially in those varieties which are *porphyritic*, or display distinct crystals embedded in a fine-grained base. However fresh the felspar may appear to the naked eye, it usually exhibits in microscopic sections a nebulous appearance, due to incipient alteration into china-clay or kaolin—a process termed *kaolinisation.* The felspar often encloses *microlites*, or microscopic crystals of foreign substances.

In most granites there are representatives of two types of felspar, distinguished from each other by differences in the direction of cleavage. There are in all felspars two well-marked cleavages, and in one type these cleavage-planes are absolutely rectangular to each other, whence this kind is termed *orthoclastic* or *orthotomous ;* while in the second type the two cleavages make angles which are never exactly right angles, whence such felspars are termed *plagioclastic* or *clinotomous.* The plagioclastic felspars are also known, from the system in which they crystallise, as *triclinic* or *anorthic;* whereas the orthoclase is a *monoclinic* felspar. For the discrimination of these two types of felspar the petrographer relies not so much on the angles of cleavage as on certain structural peculiarities which are easily detected under the microscope. The plagioclase is almost invariably twinned in a marked manner, the plane of junction being generally that known to crystallographers as the *brachypinacoid.* If, therefore, a section be cut parallel to this plane the twinning is not discernible; but cut in any other direction, the section must needs cross the edges of the component laminæ, and consequently, when viewed between crossed Nicols, the mineral exhibits a succession of coloured bands, indicating its composite structure. If cut parallel to the macropinacoid, or directly across the lamellæ, the striation comes out remarkably sharp, and sometimes as many as fifty parallel bands or lines may be detected in a single crystal. In orthoclastic felspars such striation is not seen. They present, between crossed Nicols, either a uniform sheet of colour or a separation into two tints by a median divisional line. The twins of orthoclase are generally constructed on what is termed the "Carlsbad type," fine twins of this character being common in the granite of Carlsbad in Bohemia. Here the two crystals are juxtaposed parallel to the face known as the *clinopinacoid*; hence, when cut parallel to this plane, no twin-structure is revealed; but when cut parallel to the orthopinacoid the line of junction is directly medial. The orthoclase never shows the repeated twinning, or *polysynthetic* structure, so marked in plagioclase.

Some granites also contain a triclinic felspar termed *microcline*, which exhibits in certain sections two sets of twin-striæ at right angles to each other, thus producing a cross-hatched or grating or chequered structure.

It was shown some years ago by Prof. Reusch, of Tübingen, that pressure applied to calc-spar may induce a twin structure; and hence it has been suggested that in certain rocks the structure of the felspar may in like manner have been develoved by mechanical means. This is especially probable in felspars in which the twin-bands end with abruptness.

Although it is difficult to distinguish the different species of plagioclase by microscopic means, yet some approximation may be made by the "method of extinctions." The Nicols are crossed, so that the field becomes dark; the section is then introduced, and in consequence of depolarisation more or less light is admitted. One of the spider-lines of the eye-piece is so adjusted that it runs parallel to a selected edge of the crystal under examination. The stage bearing the crystal is then rotated, until extinction occurs; that is to say, until the field again becomes dark. The amount of rotation is then measured on the graduated edge of the stage, and this gives the angle of extinction in relation to the edge in question. Professor Max Schuster, of Vienna, has drawn up a table of extinctions for the diagnosis of the felspars.

Quartz, as a constituent of granite, occurs in the form of crystalline grains rather than as distinct crystals. Unlike the felspar, which is generally turbid, the quartz is pellucid; but it usually contains pores or cavities, disposed in linear series, looking like lines of dust. These cavities frequently enclose liquid, with a movable bubble, like that in a spirit-level. In polarised light the quartz displays vivid colours, which generally shade off round the margin of the grain into a fringe of another tint. In some rocks the grains of quartz, though apparently homogeneous, split up by polarised light into a chromatic mosaic —a phenomenon known as "aggregate polarisation." Each grain is, in fact, made up of a number of distinct elements, or *crystalloids*, with their optic axes variously orientated.

The Mica of Granite is generally either colourless or dark brown, the former being commonly referred to the species *Muscovite* and the latter to *Biotite.* In many granites both micas coexist. The biotite, or dark iron-magnesian mica, is strongly dichroic. To observe this *dichroism* plane polarised light is transmitted through the section, and the analyser is removed. On rotating either the section or the polariser below the change of tint is very marked, varying between a pale yellowish brown and a dark, almost black, colour. The mica frequently exhibits a dappled or flecked appearance, and the edges of sections across the basal plane seem to be ragged, while the perfect basal cleavage is revealed by longitudinal striation. The biotite frequently suffers alteration, and is converted more or less completely into a green chloritic mineral, sometimes called *viridite.* The determination of the exact species of mica requires refined examination in convergent polarised light, and it is therefore only in general terms that the two characteristic micas of granite can be called muscovite and biotite. Hence French petrographers, like MM. Fouqué and Lévy, generally content themselves by referring to them simply as *mica blanc* and *mica noir*.

In addition to the felspars, the quartz and the micas, most granites contain certain accessory minerals. *Apatite*, or phosphate of lime, is commonly present in small six-sided acicular prisms, perfectly clear and colourless. *Hornblende* is common in syenitic granites, and may sometimes be mistaken for biotite, but is readily distinguished by its angle of extinction. It is either green or brown in colour, and is strongly dichroic. The simplest method of determining hornblende is to find a basal section which exhibits the edges of the prismatic cleavage-planes; these edges form by their intersection lozenge-shaped patterns, with the characteristic wide angle (rather more than 124°) of the fundamental prism. *Epidote* occurs as a secondary product in many granites, and may be distinguished by its clear pale greyish yellow colour, and its high index of refraction, which causes it to stand out prominently in the field. Sometimes it occurs in curiously aggregated gum-like masses. *Garnets* are frequent constituents of granite, and occur either as distinct crystals, colourless or of pale pink tint, or as gummy blebs, which seem to stand out in high relief. Since garnet crystallises in the regular or cubic system it is *isotropic;* that is to say, the crystals in their normal condition present equal elasticity in all directions; hence, when placed between crossed Nicols, they exhibit no depolarising action, and the field consequently remains dark throughout a complete revolution of the stage.

46.—Notes on the Physical Geography and Geology of Western Canada.

By W. Topley, F.G.S., Geological Survey of England, President of the Geologists' Association.

(Read November 12th, 1884.)

The object of this address was to give a brief account of the Physical Geography and Geology of Western Canada, and more especially of such parts of the country as were seen during the excursion of the British Association to the Rocky Mountains. Starting from Toronto, the party took rail to Owen's Sound; then steamer over Lakes Huron and Superior to Port Arthur; then again the railway past Winnipeg, and over the prairies to the Rocky Mountains.

The country between Lake Superior and the Rockies may be divided into four zones, each corresponding with geological structure.

(*a*). The most easterly zone is that between Lake Superior and the Red River Valley. This is a wooded hilly region, formed chiefly of crystalline Laurentian rocks, the oldest rocks known. The rocks lie at steep angles, often almost vertical, the edges of the beds having been worn away by long continued denudation. In long past geological times these Laurentian rocks may have stood up as great mountain chains; but what we now see are only the stumps and cones of the old mountains. The latest denudation has been that of the glacial period, when a great sheet of ice overspread the whole of Canada, and stretched far into the United States. The evidence of this is seen in the grooved and polished surface of the rocks, when these are freshly exposed, and in the deposits of boulder clay and gravel which overspread the country.

These deposits, over the district traversed by the Canadian Pacific Railway, are not sufficient to entirely cover up the solid rocks; the general character of the country is rocky with marshy hollows, which are in some cases due to ice-worn hollows in the solid rock, and sometimes to deposits of drift blocking the drainage. In these marshy hollows the vegetation is peculiar, as is described by Mr. Mennell in the next paper. The whole of this area is unsuited for settlement, the soil being poor and thin, and the woods thick; but it contains many districts of great natural beauty. The neighbourhood of the Lake-of-the-Woods being especially fine.

(*b*). The next zone is that of the prairies, which stretch across the continent to the "Foot-hills" of the Rocky Mountains. These prairies may be divided into three parts. In the east there is the Red River Valley, in which Winnipeg (the old Fort Garry) stands. This is a great plain, opening out to the north to include Lake Winnipeg and the neighbouring lakes. It is entirely formed by alluvial deposits of the Red River, and contains some of the most fertile soil in the world. In many farms large crops have been raised continuously for sixty years without any manure. Land of a similar character stretches up the North Saskatchewan River; and again, further north-west, along the Peace River.

The western limit of the Red River Valley is a low range of hills, the eastern limit of the second prairie level on which Regina stands. This prairie is formed of a variety of drift deposits, mostly loamy and of good quality. A series of hills rise from the plain; these are mostly formed of gravel, and when so are generally wooded, but the normal character of the prairie is a vast grassy plain.

West of Regina we come to another belt of rising land, which extends southwards into the States, and is known as the "Missouri Coteau." This forms the eastern limit of the third prairie level. The solid rocks are rarely exposed across the prairies, but may be seen in the river valleys. They are mostly of Cretaceous and Eocene Age, with some of an intermediate age. In fact, the great gap in time which in Western Europe exists between the chalk and the beds next above is here bridged over. The beds of this doubtful age contain important seams of coal, which are now being largely opened out. Near Medicine Hat the coal is bituminous, and lies in a nearly horizontal position beneath the drift soils of the prairies.

Where the cretaceous and tertiary rocks come to the surface the soil is sometimes alkaline, and much difficulty is found in obtaining pure water. But alkaline soils are also formed where the drainage has been blocked by drift deposits, and where evaporation has taken place, leaving the solid matter of the river-water in the soil. In these places the flora is very peculiar and interesting.

(*c*). The third zone is that of the "Foot-hills" of the Rocky Mountains. It has no strongly marked boundaries; it shades off into the prairies on the east, and into the wilder regions of the mountains on the west. The rocks comprising it are of various ages, but are often greatly disturbed. The coal is here a true anthracite, the change in character being probably due to the great disturbance of the beds. These "Foot-hills" contain districts of great natural beauty. Scattered woodlands, open glades, meadows with rushing streams, rapidly succeed each other. This is the great "ranching" district of the north-west.

(*d*). The last and most westerly zone is that of the Rocky Mountains, in which the scenery is exceedingly wild and beautiful. The rocks, chiefly of Palæozoic Age, are deeply carved into precipitous valleys and gorges. They are thickly covered with forest in their lower parts, but the higher regions are bare, whilst the peaks are snow-covered.

47.—On the Flora and Vegetation of Western Canada. [Abstract.]

By H. T. Mennell, F.L.S.

(Read November 26th, 1884.)

Mr. H. T. Mennell followed Mr. Topley; his address, on the Flora and Vegetation of the Canadian Dominion, being chiefly directed to show their dependence on the geological features of the country as described by Mr. Topley.

The Eastern and Central Regions of Canada, including the great lakes (consisting chiefly of Laurentian Rocks, overlaid over a large area, especially on the eastern section, by glacial deposits, boulder clay, and drift), are still, to a great extent, and have formerly been universally clothed with forest; where the rocks crop out, as they do in the Central Region, stretching from Ottawa westward nearly to Winnipeg, they are rounded, and worn into hollows of varying size, with little or no drainage from them. The larger of these hollows form lakes and pools; the smaller and more superficial depressions, bogs and marshes, or "swamps," as they are called in America. Here we find the characteristic swamp flora of the American continent, consisting largely of flowering ericaceous shrubs, *Kalmias*, *Andromedas*, *Vacciniums*, including the great American cranberry, *V. macrocarpon*, *Ledum*, *Chiogenes*, &c., familiar to us as the "American" plants of the nurseryman; with these are a rich flora of reeds, sedges, and rushes, three species of *Osmunda* abound, and the noble carnivorous pitcher-plant (*Sarracenia purpurea*) is a striking feature of the wetter portions of the bog.

The forests consist, besides numerous coniferous trees, of a large variety of species of maples, birches, poplars, with oaks, walnuts, hickories, &c., in the southern portions. The trees are mostly ill-grown, crowded, and comparatively small. The undergrowth and wood margins are rich in shrubs, *Corni* (including the beautiful dwarf *C. canadensis*, with its brilliant crimson berries), guelder roses, elders, &c.

The vastly greater number of species of trees in Eastern America strikes a stranger. In Europe not more than a dozen or twenty species of trees would be met with in an ordinary ramble, but in America three or four times that number might be observed. The explanation of this fact is connected with the oscillations of temperature and climate, to which the world has been subjected. In glacial periods the trees were driven southward, both in the Old World and the New; but when a warmer era set in, in the former, the Mediterranean in Europe, and the mountain ranges running from east to west in Asia, presented an impassable barrier to their return northward; whilst in America, the mountain ranges all running north to south, no such obstacles existed, and they readily followed the warmer wave northwards again, so that we have not only all the hardier northern forms and families, but a vast number of southern and semi-tropical ones.

The herbaceous flora of forest regions is always poor both in species and individuals; hence, when the land is cleared, as a large portion of the eastern states of the Union and of the Dominion was, by forest fires during the Indian occupation, and later by the settler, a floral vacuum resulted (as Prof. Asa Gray well describes it), and to fill this, northern, southern, and to a large extent introduced foreign plants rushed in; hence we have here, in the main, a derivative, non-indigenous flora, and we see a vast number of the most familiar weeds of the Old World flourishing in abnormal vigour. The mullein, the common plantain, and many of our most familiar garden pests, thus everywhere abound.

Passing westward beyond the lakes to the great prairies, consisting largely of rich alluvium resting on cretaceous clays, we have an entirely distinct and thoroughly indigenous flora, presenting in spring and early summer a carpet of brilliant and beautiful flowers. Leguminous plants, especially species of *Astragalus*, *Petalostemon*, *Lupinus*, and *Lathyrus;* Composites, of the great American genus *Aster*, *Solidagos* or golden-rods, *Erigerons*, —which in America replace our ragworts (*Senecio*), and hawkweeds (*Hieracium*),—*Gaillardias* and *Rudbeckias;* and *Œnotheras*, or evening primroses, are the most striking features.

This flora is of interest as containing so large a number of plants, recently introduced into our gardens, among the now fashionable "hardy perennials." Some, however, such as species of *Aster* (Michaelmas daisies), golden-rods, and sunflowers, are among the oldest denizens of our gardens.

The tree flora of the prairies is extremely meagre; chiefly clumps of small poplar by the river-banks and round the pools. This absence of trees is, however, attributed, by so excellent an authority as Prof. Macoun, rather to the constant fires which have swept the prairie than to actual unsuitability for their production and growth.

In certain tracts of the prairie, where the underlying cretaceous rock has been denuded of the alluvium and eroded, or where we have small isolated drainage areas without any outlet except evaporation, a saline condition is found greatly modifying the flora. The genera are mostly the same as in the surrounding region, but the species are distinct, and all assume a grey-green, mealy, or hoary appearance, which distinctly marks the landscape. This is the so-called "sage-scrub." The most striking plants here are the aromatic *Artemisias*, and two dwarf Cacti, *Opuntia missouriensis* and *Mamillaria vivipara.*

Passing from the prairie, with its entirely American flora, to the Rocky Mountains, a remarkable change is at once observed. As the flora becomes alpine the genera and species approximate more and more closely to our Swiss and Scotch alpine flora; this alpine flora is therefore of great antiquity, and has survived the climatical changes of long ages—changes the operation of which have been common to the whole northern continental area of the world. In one long day's ramble among the mountains from the summit of the Kicking Horse Pass up to the snow-line, 196 species of plants were gathered by us and named; of these about 40 per cent. were European. Among them were many of our most familiar and beautiful alpines, such as *Silene acaulis*, *Saxifraga oppositifolia*, *Lychnis alpina*, *Dryas octopetala*, *Draba incana*, *Oxytropis campestris*, *Potentilla fruticosa* (a Teesdale plant, there growing on or near basaltic intrusive dykes, as it does also on the shores of Lake Superior), a *Trollius* closely allied to ours, *Carex atrata*, &c. The ferns also are identical with our own; and include the holly fern, parsley fern, *Asplenium Trichomanes* and *viride*, *Cystopteris montana*, *Woodsia*, *Lycopodium annotinum.*

The most marked absentees are the *Primulas* and *Gentians*, which form so striking and beautiful an element of the European alpine flora.

Among distinctive plants are three species of *Bryanthus* or *Menziesia*, which take the place of our true heaths, which in America are entirely absent. Several liliaceous plants, as *Smilacinas* and *Veratriums*, are also conspicuous.

The forest trees here are almost all Coniferæ, and attain a large size, though far short of their brethren on the Pacific slope of the mountains. We observed ten species of conifers, amongst which may be noted the Banksian pine, Douglas' and Engelmann's spruce, *Larix Lyallii*, &c.

Speaking broadly, we find in the journey across the continent four floras, viz., the eastern mixed flora of the cleared lands; the forest and swamp flora of the lake region from Ottawa to Winnipeg; the prairie flora; and the alpine flora of the Rocky Mountains. Their boundaries are well marked and definite. The railway is, however, a great leveller, and it was interesting, not only to see our common weeds rapidly spreading along the track westward, but also to find some western types and species travelling eastward, as, for example, the very singular grass, *Beckmannia erucæformis*, which we found at Port Arthur, on Lake Superior, many hundreds of miles east of any previously recorded habitat.

It is matter for congratulation to the naturalist that the flora of the Dominion has been thoroughly examined and recorded by Prof. Macoun and others before its lessons have been obliterated or confused.

48.—A Visit to the Breeding-quarters of the Spoonbill in Holland.

By Philip Crowley, M.A., F.L.S., F.Z.S.

(Read 10th December, 1884.)

Having read the accounts in the 'Ibis' of a visit made by Messrs. Sclater and Forbes to Hoorster Mere to see the spoonbills (*Platalea leucorodia*) in their breeding-quarters, and in 'The Zoologist' that of Messrs. Seebohm and Elwes, I thought it would make a most interesting excursion; so this year, having occasion to visit Amsterdam, which is only about twenty miles from the place, I asked Mr. Sclater for some particulars, and he most kindly gave me a letter of introduction to Mr. Westerman, Director of the Zoological Gardens at Amsterdam.

In company with my brother, we left Victoria Station on the evening of the 26th of May last, and reached Amsterdam at noon on the following day. In the course of the afternoon I called at the Zoological and sent in my letter to Mr. Westerman, who received us most cordially and at once brought for my inspection their egg of the great auk (*Alca impennis*), which is however rather a poor specimen, being very dirty and small. Mr. Westerman informed us that the Hoorster Mere was now drained, and he believed the spoonbills were now breeding at Naarden Mere, about fifteen miles north-east of Amsterdam, but that a Mr. Blaauw, who resided near Naarden and was studying at the Gardens, would know. I therefore arranged to call on the 29th and see what could be done. On calling I was introduced to Mr. Blaauw, who had written to the keeper of the Mere to meet us at the Keverdyke roadside station of the steam-tram line, for which place we started from Amsterdam at 10.30. Naarden Mere is some 2300 acres in extent, consisting of water, beds of reeds some eight to ten feet high, and marshy and boggy ground, of which about 1000 acres are now being drained, and the owners hope to be able to drain the remainder next year. Large pumping-engines are fixed near Naarden, and are continually pumping the water out of the mere into Zuyder Zee, the ground being raised to prevent it from returning.

Close to the station, in a bed of reeds, I made my first acquaintance with the great reed warbler (*Acrocephalus arundinaceus*), which was singing very lustily, but we could not then find the nest.

After lunch at the keeper's cottage we—that is Mr. Blaauw, my brother, myself, Hutner the keeper, and two assistants—set out on our journey, and after nearly three miles walk most of the way over very springy ground, that would if properly worked prove very rich for the entomologist (where I saw thousands of the green forester (*Procris globularia*) and dragonflies, and I might say acres of *Lastrea Thelypteris*), we came to a punt and small boat. Into the punt we got and took the small boat in tow and punted across the mere. Skimming over the water we saw many swifts, martins, common and black terns, black-headed gulls, and heard, in the reeds, coots, grebes, sedge and reed warblers, great sedge warblers, &c. In the distance we saw, rising occasionally, a spoonbill or purple heron; altogether the scene was getting interesting. On nearing a large bed of reeds one of the men struck his pole against the side of the punt, when up rose some fifty spoonbills and eight or ten purple herons (*Ardea purpurea*). The excitement of the scene increased as we got up close to the reeds and had the pleasure of seeing hovering overhead, all within easy shot, some two hundred spoonbills and fifty or sixty purple herons. Strange to say, as mentioned in one of the former notices, the spoonbills maintained a ghostlike silence, not a note, a sound, escaped them, and only an occasional croak from the herons. On reaching the reeds we moored our punt, and two of the men wading in the mud some two feet or so deep, took Mr. Blaauw in the small boat through the reeds to the breeding-station, where he landed. They then returned for my brother and me, and pushed the boat with us on board some fifty yards through the reeds. At this spot we found spoonbills' nests on every side, and many purple herons; the spoonbills' nests were placed on the ground and were formed of a heap of rotten or decaying reeds, about two feet in diameter at the bottom, tapering to about one foot at the top and about eighteen inches high. On the top was a slight depression in which lay four eggs, or rather,—unfortunately for me,—in most cases four young, for we were too late; many, indeed, jumped up and ran away on our approach. In the nests with young there was a great difference in age and size, one being perhaps a day or two old and the largest in the same nest say a fortnight or nearly fledged; so that evidently the birds lay their eggs at intervals of some days, and begin to sit on depositing the first. Very probably this is a provision of nature, to enable the old birds to maintain all the four young, they being great feeders; so that should all require at one time a large amount of food, the efforts of the parents to procure it would be unavailing. After wandering about (which was a matter of difficulty owing to the nature of the mud), we found a clutch of only three eggs, which I secured, and also one of four, which I managed to blow. We also obtained two clutches of purple herons', but we were also too late for these. A great many nests contained the full complement of eggs, but too far set for specimens. These nests are built about three feet above the water, by some fifteen to twenty reeds being bent at right angles to form a platform, and the nest of reeds placed on this. All but one of the nests we examined contained four eggs or young, that one only three. Hutner said he thought about two hundred pairs of spoonbills were breeding there this year. We caught two young ones almost fledged, which we took back to Amsterdam and deposited at the Gardens. On leaving this part of the mere on our homeward journey, one of the assistants said he thought the black terns had begun to breed, so he took Mr. Blaauw and me in the small boat some distance to the spot, and I had the pleasure of taking a clutch of three eggs from a little nest of rotten reeds floating on the surface of the water, kept from blowing away by being placed at the point of contact of three water-lily leaves; we saw another similar nest, but not quite finished. We then walked back to Keverdyke, and asked the men with their high boots on to search the bed of reeds for the great reed warblers' nests. These reeds were some nine feet high and grew in an unknown depth of water. The nest was quickly brought me,—a very beautiful one it was, when first taken,—suspended between four reeds, about two or three feet from the water and five or six from the top. We again reached Amsterdam about six o'clock, having had a most enjoyable excursion.

On calling on the following Saturday to take leave of Mr. Westerman, I found the young spoonbills had taken most kindly to their quarters, and readily swallowed the fish placed in their mouths; and on June 16th I heard from Mr. Blaauw that they had got on splendidly and fed themselves freely.

For this most delightful day I have to heartily thank Mr. Sclater for his introduction, Mr. Westerman for his kind reception, and Mr. Blaauw for his kind escorts, for without him we could have done nothing, our guide the keeper, and assistants speaking only an unknown tongue—that is Dutch *patois*, which Mr. Blaauw rendered into exceedingly good English.

I would add, in conclusion, that any ornithological friend wishing to follow in my footsteps had better do so the the second week in next May, as after next season I much fear Naarden Mere will be drained, and the spoonbills driven from this their last breeding-station in Northern Europe.

49.—Recent Observations made in the New Road at Purley: Archæological and Ethnological.

By Alfred Carpenter, M.D., F.R.M.S., &c.

(Read 11th February, 1885.)

It is always advisable to place on record the ancient history of our own land, when it can be obtained from the memorials of the past. These memorials are occasionally disinterred, and facts, the knowledge of which has in past times often been lost, are again exposed to view. Such a fact has been brought to light on the hill which lies parallel with the Brighton Road, as it runs by Purley Oaks towards Smitham Bottom.

There is an open expanse of chalk down between Haling Grove and Russell Hill. This down has only a few inches of Eocene formation and vegetable mould upon it above the chalk; there is no soil for forest trees, and scarcely enough for brushwood. When Russell Hill Schools were built near Beggars Bush, several skeletons were disturbed, which showed that the hill had been a burial-place, and from the character of the interments I conclude that it was probably a battle-field. Similar evidence has been afforded in different parts of the down. Some graves were found a few years ago, when the Bramley Hill Road was extended; and I am informed that when the Whitecliffe Road was made at Purley, several similar graves were disturbed. These two roads have now been connected by a road which runs southward and to the west of Haling Grove, terminating on the side of the down to the west, considerably above the level of Purley Church. At the north end of the Whitecliffe Road the down has been lowered, so as to allow of a satisfactory gradient. There is a cutting through the chalk in places some fourteen or fifteen feet deep. In forming this cutting the surface mould has been removed from the chalk, and in the removal of this upper crust of soil several graves have been disturbed. It is to these I beg to draw attention. I have the history of nearly twenty of them. The bodies were put into the ground some two feet deep, of which eighteen inches was in the chalk, in a trench cut out clearly and sharply. They appear to have been placed in these trenches on the hard, bare chalk, without any coffin. No evidence of clothing of any kind has been discovered in any of those which I have examined, although I have carefully looked for it; and with a single exception no weapons, ornaments, or pottery have been found. I have not the evidence of an eye-witness; but the general consensus of opinion, among those who saw the bones disinterred, is that they were laid straight in the graves, and that the heads were placed towards the west and the feet to the east. There was no evidence of barrow or mound above the graves, although this may be easily accounted for in consequence of the down having been under cultivation as far back as the memory of the present generation extends. The bones which I have been able to examine are of men, of women, and of children. My attention was directed in the first instance to some sharply-defined, square-shaped excavations, in the sections which had been made in sinking the level of the road. The sides had not then been sloped. Observing these sections, I was interested in making out a reason for them, supposing them to have been continuous trenches. Poking among the broken-up chalk, I observed two round objects, which appeared at first to be fossil, but on examination they were shewn to be sections through natural bone, and I gradually worked out the shafts of the thigh-bones of a young person.

A further examination showed that in each of the square sections, of which there were five, a grave had been cut transversely across in sinking the road, and a skeleton disturbed. An examination of the heaps of mould which were cast aside showed that portions of human bones had been thrown up, and it was not long before several almost perfect bones were brought together. I afterwards visited the road when workmen were about, and gathered some of the facts I have mentioned above.

A careful enquiry on another occasion led to my making the acquaintance of a gentleman living in Whitecliffe Road (Mr. Cluse), who showed me some portions of another skeleton, and also the remains of a knife, which was taken out of one of the graves, and it is the only portion of metal which has been discovered.

The point of most importance in this discovery appears to be, that this down was a cemetery belonging to some town situated in the neighbourhood, the evidence of the superficial existence of which has been entirely blotted out. There is no history of any church at this spot, which might account for the graves, and it is certain that at the time of the Conquest none existed in the neighbourhood, as we gather when Domesday Book was compiled. We have to go beyond the Norman Invasion for any conjecture as to their source. The fact that these interments had taken place without coffins, or weapons, or ornaments, and their position being east and west, goes to prove that they were early Christian burials. That it was a cemetery and not a battle-field is shown by the remains being those of all classes, men, women, and children. The skull and thigh-bone exhibited are the bones of a powerful man with a good cerebral development. We may assume, therefore, that the remains are of people of some position. I am inclined to think that these burials were before the retirement of the Romans, and when the town of Noviomegus, or some similar important place, existed between Barrow Hedges and Beggars Bush. The knife which was found in one of the graves is of an unusual form; it differs very materially from the ordinary dagger, or short sword, which is found in Roman and Anglo-Saxon graves. I found one precisely similar to it in shape at Beddington, among the weapons which were discovered there some years ago. Its character assists me to assign the date of these burials as decidedly pre-Augustine, and most probably anterior to the Anglo-Saxon and during the Roman occupation. The knives are both together upon the table, with a number of weapons, Roman in character, which were taken out of a bed of gravel at Park Farm, by the side of the Wandle, ten years ago.

These burial-places, when exposed, showed eight skeletons. They were buried upon the field of battle, in no order as to east and west position, and with their accoutrements. They were probably the remains of men who fought at the Ford of Beddington, either in defending that ford, or in forcing a passage across it, against Celtic antagonists.

The hills on all sides of Purley have been places in which the dead were interred in ancient British, in Roman, and in Anglo-Saxon time. The name indicates "The Pure Ley," or open field or greensward, and the family who held it drew their name from the place itself. The oaks in this neighbourhood have been grand monarchs, though now only pollards and fast disappearing.

There are two skulls on the table which are nearly perfect. A fine specimen of a thigh-bone, which belonged to the male skeleton in companionship with the larger skull, and many other bones of different kinds. The wonder is that bones should remain in the soil without being utterly destroyed. We must, however, remember that the down has probably only been cultivated within this century, and that it was "Pure ley" —pure greensward—from the time of the interments until it was ploughed up; that the chalk with which the bodies were covered would have no action upon the bones; that the rain would dissolve all organic matter, and carry it away to the springs of the Wandle in the form of harmless salts; that the phosphate of lime would alone remain; that this salt makes up nearly two-thirds of the bony tissue, and that it has not been acted upon by the carbonic and nitric acids, which are the only acids which would be likely to come into contact with it in the minute quantities in which they exist in rain-water. The covering of chalk above the bodies saved the bones from the action of these acids, for their acidity was at once neutralized by the calcareous earth. Those bones which had no chalk above them crumbled away as soon as they were exposed to the air. This also happened to the skeletons at Beddington; they rapidly broke up as soon as they were exposed to the air, and they could not be preserved.

The male skull is a fine specimen. The cranium is more elongated than is generally found among people of the present day. There is a considerable cerebellar development and a strong supra-orbital expression. But what is most remarkable is the condition of the teeth; they are all sound, though very worn, and the canines, which are often pointed, are in this case well worn, and each in complete apposition with its fellow. It would appear as if the habits of our predecessors were more frugivorous than carnivorous in choosing their food. I have not found a decayed tooth among any of them. The thigh-bone is a remarkable one. Dr. Taylor, in his work on Forensic Medicine, gives the average length of the femur or thigh-bone of men of 6 feet in stature as 19½ inches. I think this must have been at least 21 inches. The height of this man, therefore, was probably 6 feet 5 inches, and he was also very muscular, as shown by the distinct ridges upon the bones. I may mention, that a grave upon Farthing Down, which was examined by the late Mr. J. Flower, contained bones which Professor Rolleston concluded to have been those of a man at least 6 feet 5 inches in stature. Most of the graves which were opened by Mr. Flower on Farthing Down were in Christian form, without ornaments, but others were clearly Anglo-Saxon, with characteristic ornaments and weapons. I have had the opinion of Professor Flower, of the Natural History Museum, South Kensington, upon these skulls, where I propose to consign them for safe keeping.

On the hill to the south of Beggars Bush is Cane Hill. The flint now shown was found there. It is a fine specimen of casts of the *Cliona cretacea*, and belongs to a genus of marine sponges. They burrow into the shells of the oyster, or, as in this case, the inoceramus, by means of spicules embedded on their surface. The cavities left by them have been filled up by silica. There is only one example in the British Museum which approaches to it, in preservation, and Dr. Woodward has persuaded me to deposit this specimen also at the Natural History Museum, South Kensington.

Dr. Hinde, a gentleman living at Mitcham, has made this part of geological research his special study, and produced a magnificent work upon the subject, and he has forwarded a letter, which I propose with your permission to include in our 'Transactions,' and the shell itself in our cabinet.

Copy of Dr. G. J. Hinde's *Letter to* Dr. Carpenter.

Feb. 9, 1885.

I thought perhaps it might prove interesting to you and the members of your Club to see some of the sponge spicules from the chalk, which are occasionally found in the interior of flints, and I forward you a slide containing an assortment of them, which I have collected and mounted. They are of various species of silicious sponges; their surfaces you will find are peculiarly eroded. These spicules are larger than those which belong to existing species of *Cliona*, and if the sponges which made the borings in the chalk fossils possessed spicules similar to those of the recent forms, they would be quite destroyed by the erosive action which has indented these larger spicules, and therefore it is not surprising that the minute pin-shaped spicules of the forms common to recent *Clionas* should have not yet been found fossil. In the absence of the spicules there is room for doubt whether the borings might not have been produced by other organisms than sponges, but in the case of *Cliona cretacea* the probabilities are in favour of their being veritable sponge burrows.

Very truly yours,

George J. Hinde.

50.—The Evolution of the Fishing-hook from the Flint Hook of Prehistoric Man to the Salmon Hook of the present Day. [Abstract.]

By Edward Lovett.

(Read March 11th, 1885.)

Although the subject of my paper is hardly within the scope of natural history, it is nevertheless one of very great interest as connected with Anthropology; and, as my principal observations will refer more especially to the "Stone Age" and the relation that recent works of man bear to it, my subject is one intimately connected with the early races of mankind, and consequently with natural history in its highest form.

Some years ago I had the pleasure to examine the undisturbed floor of a cave in the island of Jersey, which cave had been the residence, and undoubtedly the workshop, too, of prehistoric flint-workers. It would entail too much time to give a proper description now of our investigations, but I will very briefly describe the "find."

The cave itself was difficult of access and hard to find; it was in the face of the present granite (or more correctly speaking syenite) cliff, and the sea which broke on its torn and rugged base was deep water even at low tide.

The floor of this cave was composed mainly of felspathic clay, the decomposition of the syenite rock; in this clay was embedded a large boulder of a hard sandstone, unlike any other stone in the island, and distributed through the clay floor were thousands of chipped flints, most of them struck off in the manufacture of weapons, and some, no doubt, weapons themselves. Spear-heads, arrow-points, scrapers, knives, drills, &c., were the chief, but there were a great number of curved fragments with a sharp point, and others that were long narrow flakes, commonly called knives, but which would have made but a poor implement in this respect. It is to these latter two forms that I wish more especially to refer.

(Mr. Lovett here referred in detail to the food of primitive man, showing how his first desire to catch fish prompted him to use a flint-flake as a "gorge." He exhibited a number of these, together with recent gorges of stone and bone from the Indian tribes of North America.)

The "gorge," not being suitable perhaps for all kinds of fish, was rapidly improved upon, and the first real fish-hook appeared; it, too, was made of flint, but a somewhat clumsy concern, and, as man had become better able to make use of his surroundings, there is no doubt that the rude stone hook soon gave way to hooks of shell and bone.

The hooks on the table are restored from specimens found in the Jersey cave also; there are several of them, and they all possess many peculiar characteristics, which show that whatever they were used for there was a method in their manufacture, and this method seems to point to one conclusion only, namely, that they were fish-hooks. The points of resemblance are these: each specimen has an apex, or a proof that it had one once; it has also a flattened shank, by which it could be fixed to a wood or bone shaft; it has also a notched surface opposite to the shank to enable it to be bound with fibre to the shank; and it has also a slight projection corresponding to the apex, enabling a cross binding of fibre to strengthen the first lashings.

When I restored these specimens I took for my pattern a hook from Fiji, made of the shell of a species of *Haliotis*, and lashed my barbs in the same manner as it had been; when finished I tested their strength, and I found that these flint hooks could land a fish of fifteen pounds dead weight, and I believe if bitumen was used, as it is used by the Borneo Dyaks to finish off their obsidian weapons, that a shark or a sturgeon could have been brought ashore with one of these flint hooks. These restored hooks have no barb, but that is not important, as many shell and bone and even iron hooks have none either.

(Mr. Lovett here described in detail a large series of shell and bone hooks from the South Sea Islands, as well as from North America, tracing the alteration in form and the gradual introduction of metal, referring also to hooks discovered in Swiss lake-dwellings.)

Coming now to the continent of Europe, and more especially to this country, we do not find any very abundant traces of hooks anterior to the iron age. This is probably owing to the fact that metals were known and used in this region before any other parts of the world.

(Mr. Lovett concluded by a description of hooks of the iron and steel period, explaining the peculiarities of many modern hooks, and the curious forms and colours of "flies" used for salmon fishing.)

51.—Hawks and their Allies, with Notes on Hawking. [Abstract.]

By J. G. Goodchild, F.Z.S., F.G.S., Member of the British Ornithologists' Union; Geological Survey of England.

(Read April 8th, 1885.)

The lecturer began by some observation upon the zoological position of the birds of prey or *Ætomorphæ*, based upon the researches of Huxley, Parker, Garrod, Forbes, Nitzsch, and others, and illustrated his remarks by reference to various tables and diagrams upon the screen. Contrary to the view generally held, the lecturer maintained the opinion that the *Ætomorphæ*, although undoubtedly presenting many points of agreement amongst themselves in regard to both their external characteristics and their mode of life, do not form a really natural group like the Passeres or the Psittaci, but that the group really comprises several assemblages of raptorial forms evolved independently, and at various times in the past, from widely-separated Sauropsidan ancestors. He regarded their present outward similarity of form as due to morphological convergence accompanying progressive adaptation to a common mode of life. The earlier stages of changes of habit likely eventually to lead to such outward changes of form as those referred to may be observed in many widely-separated forms of birds at the present day. It is quite conceivable, for example, that one of the Passeres, such as a shrike, might, under particular conditions of environment, take to living entirely on small mammals and birds. In such a case, if the competition with other birds leading a similar mode of life were severe, any slight modification of form, amongst the offspring of such shrikes as would enable the younger generation to compete successfully with their fellow-birds in the struggle for existence, would be a manifest advantage to the possessor, and would enable that bird to hold its own while others around it would be driven out of the field. Such beneficial modification of form would, of necessity, lead by slow degrees to the assumption of the external characteristics of the birds of prey, for the simple reason that those external characteristics are just such as best suit the mode of life of the possessor. Taking the case of the same birds, again, we find many of them, the common barn-door fowl for example, and the currasows especially, feeding occasionally upon small mammals or birds. The currasows at the Zoological Gardens will catch and kill and eat a mouse in almost as systematic a manner as the Kestrel does; and the same may be said of many allied forms. It is quite conceivable that, under changed conditions of their normal surroundings, the currasows might be compelled to subsist entirely on small mammals or birds of their own catching, and in this case such of their descendants as developed characteristics better fitting them for their raptorial mode of life would be more likely to survive and to leave numerous descendants than the birds that did not vary in that direction from the parental form. The case of the currasows is especially interesting, because in many of their structural characteristics they closely approach some of the aberrant Ætomorphs—the Polyborines and the allied forms, for example. Then, again, there is the case of the now well-known carnivorous parrot, which has made quite a new start in life within the last fifty years, and given up a diet of fern-roots for a more substantial one of mutton. No one can for a moment doubt that, if its former diet failed, this particular form of parrot could soon pick up a living by preying upon other denizens of that part of the world; and even if deprived of sheep-flesh it could supply its need just as adroitly by attacking other animals as it does now with the colonist's sheep. In course of time, unless external circumstances intervened to prevent it, Natural Selection would develop a bird that might still retain some of the internal structural characteristics of the Parrots, and yet be, externally, and in all essential points in its habits, a veritable bird of prey. No one, again, who will study the appearance and the habits of the remarkable Cuvier's *Podargus*, now (1885) living in the Zoological Gardens, can doubt that this very owl-like bird represents either one of two things: it is either a comparatively unmodified descendant of the common ancestors of the owls and goatsuckers, or else it is a raptorial type developed from a goatsucker stock. Similar observations apply also to birds like the skuas, albatrosses, storks, and other birds that stand close upon one part or another of the *Ætomorphæ* as at present recognised.

Bearing these facts in mind, and taking into account the sum-total of the facts revealed by a careful study of all the structural features presented by the *Ætomorphæ*, the lecturer considered that we are justified in recognising the representatives of five such stocks or parent sources whence the birds under consideration have been derived. These are:—

1. The Accipitres, represented by the Old World vultures, the eagles, buzzards, kites, hawks, and falcons.
2. The Striges, represented by the owls.
3. The Pandiones, represented solely by the osprey.
4. The Serpentarii, now only represented by the secretary bird.
5. The Cathartæ, embracing the vultures of the New World.

If our schemes of zoological classification were complete and perfectly consistent, the *Ætomorphæ*, as a whole, should take no higher than family rank, and the foregoing five subdivisions should rank merely as subfamilies; but it is more in accordance with the practice of ornithologists to regard the *Ætomorphæ* as an Order, and to rank the five subdivisions just referred to as suborders. Of the 11,000 species of birds recognised by ornithologists, the *Ætomorphæ* embraces 510, which are distributed through the suborders as follows:—Accipitres, 300–320 species; Striges, 400–410; Pandiones, 1; Serpentarii, 1; Cathartæ, 9 or 10.

In regard to their geographical distribution, it may be said in general terms that the Accipitres have a world-wide distribution, except that no true vultures are found in either America or in Australia. The Striges also are represented over almost all the known parts of the earth's surface. The osprey, again, is very widely distributed. The secretary bird is at present limited to the southern part of Africa. And, lastly, the Cathartæ are mainly confined to the southern states of North America and to South America.

Regarding the external characteristics of the *Ætomorphæ*, as related to their habitat, the lecturer drew attention to the fact that nearly all the birds of prey that are decorated with occipital or other crests (not including under this term the frontal tuft of certain owls) are restricted to the southern regions of the globe. He then proceeded to describe in general terms the habits and mode of life of some of the leading forms of birds of prey, paying special attention to the natural history of the hawks and falcons, and illustrating his remarks by reference to a large series of drawings from living birds. After appealing to his hearers to obtain more protection for these interesting birds the lecturer went on to describe the methods adopted in capturing or otherwise procuring hawks and falcons for the purpose of falconry, and then concluded by giving an outline of some of the processes adopted in training falcons, and in afterwards making use of them in the field for hawking and falconry.

52.—On Sparganium neglectum, *sp. nov.*, and other new Surrey Plants.

By W. H. Beeby.

(Read May 13th, 1885.)

Plate I.

I propose first to speak of the *Sparganium*, which I have the pleasure of exhibiting this evening, and to conclude with some brief remarks on other recent additions to our Surrey flora.

This bur-weed, which I have called *S. neglectum*, was first noticed at Albury Ponds, near Guildford, in October, 1883. The plants then observed had the general habit of *S. ramosum*, but attracted my attention by their much smaller heads of fruit. On examination the small size of the heads proved to be due to the fact that most of the fruits were abortive, but the few partially ripe ones seemed to me to differ considerably from those of *ramosum*. Although the Albury plants were considered by those to whom they were shown to be merely an abnormal condition of *ramosum*, I did not feel satisfied on this point, and was thus led to investigate the matter during the past year. In August I noticed, near Ockley and at Reigate, plants that seemed the same as the Albury one, and eventually, on obtaining specimens at Reigate, Blackwater, Byfleet, and various other places in good ripe fruit, but small doubt was left that they represented a species hitherto undescribed and unnoticed as distinct from *ramosum*. This opinion has now been very generally endorsed by nearly all the British and continental authorities who have seen the plant, and I may mention that when I showed specimens at a meeting of the Linnean Society in December last, Mr. J. G. Baker, of Kew, stated that after careful examination of the plant he considered it undoubtedly distinct from all described species.

S. neglectum has various characters in common with *S. ramosum*, and these two form a section very distinct from our other British species, *simplex*, *affine*, and *minimum*, which also group naturally together. *S. neglectum* and *ramosum* are both invariably characterised by a strikingly erect and rigid habit, and neither in small forms, nor when growing in running water, do the leaves ever show the slightest approach to a floating or even flaccid state. In both the branching of the inflorescence is identical, there being in both a large and a small form, the large form bearing 2–3 female heads on each branch, and the small form but one on each branch, in each form the branch being continued beyond the female head, and bearing numerous male heads. The most marked *difference* between the two species is to be found in the ripe fruit, which in *neglectum* is obovate with a very long beak, smooth, almost round in transverse section, or slightly obtusangular by compression; while in *ramosum* the fruit is obscurely conical or pyramidal, with a short beak, very angular, and wrinkled between the angles, giving a very irregular transverse section. This difference in the external appearance of the fruit is due to the structure of the epicarp.

In the fruit of both plants the endocarp is hard and stony, but a wide difference is found in the structure of the epicarp, or outer layer of the pericarp. In *S. neglectum* this is much thickened, and is composed of small dense cells which do not shrink when the fruit ripens, but remain compact, and thus conceal the angles of the endocarp. In *S. ramosum* the epicarp is thin, and composed of a few large loose cells, which in the ripe fruit shrivel up into the furrows of the endocarp, allowing the ridges of the latter to project, and thus giving to the fruit its well-known angular and wrinkled appearance.

These observations on the epicarp are not founded on a few examples, but on a very large number of sections cut from fruits collected in various localities. It should be stated that good ripe fruit should be chosen for comparison, as unripe fruits that have been dried, or abnormal and imperfect fruits (which are of frequent occurrence), are liable to mislead unless the characters afforded by the perfect fruit of each species are first well grasped. As may be seen by the examples shown this evening, the leaves of the two plants dry a very different colour. Those shown were collected about the same time, and were dried under precisely similar circumstances, *viz.*, side by side in a south window. The leaves of *ramosum* dry a deep olive or blackish green, while those of *neglectum* assume a pale yellowish green tint. This difference is not always so striking as in the specimens before you, and is probably partially due to soil, but there is usually a decided difference to be observed. The leaves of *ramosum*, and especially the bracts, are also usually of a more leathery indiarubber-like texture, the leaves being but slightly keeled above, while the bracts are mostly quite without a keel; on the other hand, in *neglectum* the texture of the leaves and bracts is much more harsh, the keel being frequently distinct even to the apex of the latter. Not having had any means of recognising the plants apart while in flower, I have not been able to make any observations in that respect, but localities have been noted in which each plant occurs alone, and I hope to investigate the matter during the coming summer. The only other character to which I need draw attention is afforded by the female perianth scales—in *neglectum* these are narrowly linear with a much broadened spathulate apex, while in *ramosum* they are ligulate, thinner and more membranous, scarcely or not at all enlarged at the apex. Those of the female flower are excellently shown in the plate in Curt. Flo. Lond., but curiously enough the *male* perianth scales of *ramosum* in the same plate almost exactly resemble the female ones of *neglectum*. This I hope to verify this year. The form of these scales is liable to some variation, but the broad ligulate female scale is decidedly characteristic of *ramosum* and the linear spathulate scale of *neglectum*.

As *S. neglectum* has been repeatedly referred to *S. simplex*,—that is, has been considered to have affinities with that species rather than with *ramosum*,—I will conclude this portion of my paper with a comparison of the two plants. On looking at a head of fruit of each of these, a very considerable outward resemblance is found in the pointed apex to the fruit and in its long beak, but here the resemblance ceases. The colour of the ripe fruit (a character which is of considerable value in this genus) is quite different, as also is the shape. In *S. neglectum* the broadest part is above the middle, and from this broad part the fruit slopes off gradually by straight or slightly convex lines to its base. In *simplex* the fruit is about equally broad at top and bottom (oblong-fusiform, as Syme well calls it), with a slight constriction in the middle; the fruit is rounded below and then contracted, so that the basal lines show a concavity. The endocarp of *simplex* is also much softer—rather woody than stony,—being composed of larger, less dense cells, and is also without prominent ridges. *S. simplex* has also not unfrequently long, semi-pellucid, floating leaves. A consideration of the characters afforded by the leaves and fruit led me to see that the genus falls naturally into two sections, and I afterwards found my conclusions only corroborated those of the American botanists, who follow a similar arrangement. The distinction made in some continental works founded on the sessile or stalked fruit is of little value, this being a character liable to great variation. I might say much more, in detail, in support of the American system of dividing this genus into two sections, did time allow of it.

Since writing this paper I have examined many plants in flower, and the chief difference between them when in that state appears to be found in the anthers, which in *S. neglectum* are borne on much longer filaments than in *S. ramosum*. The distribution of the latter plant appears to be much more general than that of *S. neglectum*, which does not seem to extend north of the Midlands, or into the Eastern Counties.

I will now briefly allude to some of the plants which have been added to our Surrey list since I last had the pleasure of addressing you.

Hypericum dubium.—This I recorded on a single specimen fonnd at Hedge Court. While out with Mr. Arthur Bennett last August he observed several specimens by the River Arun, near Sidney Wood, and I have since found about a dozen plants near my original station, so that we may now undoubtedly claim it as an inhabitant of the county.

Vicia lathyroides, for which confirmation was wanted, has been sent me by Mr. Thomas Howse, F.L.S.

Sanguisorba officinalis I found in August last, in small quantity, in one spot, in marshy meadows by the River Blackwater. It was undoubtedly wild, growing with indigenous plants, but the day being very wet it was not further sought for.

Potamogeton nitens was found by Mr. Straker in the Canal near Pirbright, in 1883, and first recorded in 3rd ed. Hooker's 'Students' Flora.' A very interesting addition, not being known elsewhere in England south of Northumberland, though it occurs in Wales.

P. decipiens I found last June, in the Canal, near Tickner's Heath, and on revisiting the spot with Mr. A. Bennett in August, we observed some four or five tufts only, so that the plant is very rare, as is the case also with *P. nitens.*

Scirpus pauciflorus I have found abundant on Birley Common and sparingly near Aldershot. This has been reported from Esher, by the late Jos. Woods, but has never been confirmed by Watson, who does not include it in Top. Bot.

Carex dioica, included in Top. Bot. on printed authority only, but of which no specimens were known to exist, was found by me abundantly at Bisley Common.

C. fulva, found some years since by the Rev. Mr. Nicholson on Sheen Common, but not recorded, has been found in three other stations.

C. strigosa, included in Brewer on insufficient evidence was, after many searches, found by me in a wet copse near Ockley, in August last.

Description of Plate.—Reproduced from 'Journal of Botany,' July, 1885, by permission of James Britten, Esq. 1. *Sparganium neglectum*, from a Reigate specimen (about three-fourths natural size). 2. Ripe fruit of the same. 3. Ditto, of *S. ramosum.* 4. Ditto, of *S. simplex.* (2, 3 and 4 natural size).

53.—Notes on the Glacial Deposits and other interesting Geological Features of North Yorkshire. [Abstract.]

By Edward Lovett.

(Read October 14th, 1885.)

During a recent visit to Yorkshire, I made a few rough notes on some of the chief points connected with the Geology of the localities I was in; and I have collected these, together with a few extracts from the work of one of our earliest geologists, whose remarks upon the same features of the same locality are somewhat curious when considered from the position to which later geologists have raised our knowledge.

The features to which I refer, as forming the chief subject of this paper, are the glacial deposits of Yorkshire, both on the coast and also inland. My first acquaintance with these was made at a charming spot known as Wensley Dale, situated in the west of Yorkshire, near to Lancashire and Westmoreland.

This splendid locality is a series of hills and dales, moors and woods, rivers and waterfalls innumerable. I do not think that I have ever seen more romantic scenery than I did in this country of gigantic valleys, for this is not too exaggerated a term to use, the chief dale being thirty-six miles in length.

The river which drains this locality is the Ure, and its numerous tributaries, known as becks, are an interesting and beautiful addition to the landscape; for it is quite the exception to find a level or slow-running stream; on the contrary, their beds are filled with rocks and boulders, the strata over which they flow are shelving and ledge-like, and their course is so winding and often so steep that they present an almost uninterrupted series of cascades and rapids throughout their whole length. Even in summer, when the water is low, the roar of these cascades can be heard for some distance; but in the winter, when they become flooded, or when there is a spate, their appearance and sound is really grand.

The ranges of hills, too, that form these dales are of a considerable height. I ascended one of these, called Pen Hill, which is 1800 feet above the sea-level, and it was from this point that I was able to obtain a general view of the surrounding country. Being especially interested in glacial phenomena, I naturally paid most attention to this subject; and I noticed that along the valleys were large undulating stretches of pasture-land, somewhat irregularly distributed, and contrasting in a marked degree with the flanks of the adjacent hills; for whilst the latter were rugged crags, sparsely covered with poor sedgy grass and heather, and capped with extensive moorland, the former were rounded knolls and gentle slopes covered with rich grass, and occasionally supporting small woods and copses of rich growth. It was amongst these that the quaint grey stone villages and sleepy little farm-houses nestled, hardly distinguishable at a distance from the bare crags on the hills above them.

There was no doubt that this luxuriant pasture-land was not bare rock, but a more congenial soil, and I concluded that it was drift or glacial clay. For some time I was unable to find any section of these mounds exposed, for the numerous streams, although in some cases cutting through them to the underlying rock, presented no favourable sections, as the clay had slipped in so as to form a slope, which had rapidly become clothed with thick undergrowth and trees. Later on, however, I found an excavation which had been made for the purpose of obtaining road-material at an accessible spot, the excavators being probably prompted by the fact that the field, being particularly stony, the clay would yield the material required. I found this to be a moraine, but of a silty character, and containing numerous subangular fragments of the local rocks, mountain limestone, &c. I was unable to trace any granite, but quartzite was represented.

I next ascertained that at a distance of seven miles from where I was staying was a lake of some 150 acres, known as Semerwater, about which there is a curious legend. Like many continental lakes, Semerwater covers a submerged city, at least so tradition informs us. I need hardly say that it is a thoroughly typical glacial lake. It lies in a long valley flanked by high hills, and narrows off towards some much higher ground. I examined the stones on the shore of that end of it which trended towards the river, but found none scratched or striated.

I observed, however, that at a short distance, probably reached by the lake at flood periods, was a long ridge or mound, like a large earthwork, which I found was the terminal moraine that had originally formed the lake. Upon examining this carefully I dug out some fine examples of limestone blocks striated, grooved, and scratched by the action of ice. These I exhibit here. So much for the local legend. I may here remark that I found the fresh-water Crayfish (*Astacus fluviatilis*) living in the lake.

I next visited Saltburn, on the Yorkshire coast. The cliffs to the north of Saltburn are composed of glacial clay, forming a deposit as large as that at the mouth of the River Tyne.

This glacial clay is very tenacious, and is thickly interspersed with limestone and other blocks, most of which were very decidedly striated, grooved, and scratched. Some were of great size; but I obtained a few good specimens of portable bulk, which I also exhibit. There were also numerous fragments of quartzite, which I believe assisted materially in scratching the transported blocks during the period of the glaciers.

Although I found one or two fragments of igneous rocks of a basaltic nature, I failed to find any blocks of granite, such as were found in some excavations in the glacial clay in the city of York, although of course such were probably there, for the exposed surface is but a very small percentage of the actual bulk of these deposits. I next examined the glacial deposits near Whitby. These lie also to the north chiefly, and overlie, and in some instances cover, the face of the older liassic rocks between Whitby and Sandsend. The clay here was very similar to that of Saltburn, and probably formed one of the arms of a bifurcating glacier. The lecturer then quoted several extracts from the works of early geologists upon the same subject, and concluded his paper with a reference of the Geology of Whitby.

54.—Plant-Life in our Ponds and Ditches. [Abstract.]

By Alf. W. Bennett, M.A., B. Sc., F.L.S.

(Read November 11th, 1885.)

Mr. A. W. Bennett gave a description of some fresh-water Algæ, illustrated especially by species met with by himself during a stay last summer in Westmoreland.

He spoke first of all of the genus *Nostoc*, of which several species (*N. communis*, *humifusum*, &c.) are familiar terrestrial Algæ, consisting of minute interwoven strings of green cells imbedded in masses of yellowish jelly. One or two aquatic species are known, but none have hitherto been recorded in Britain. Mr. Bennett described a new species of this set (*N. hyalinum*), which he found floating on bog-pools. It is an extremely minute nearly spherical mass of colourless hyaline jelly, floating freely in the water; in the jelly is imbedded a single thread of green cells, among which are here and there the larger cells known as "heterocysts."

The principal part of the lecture was devoted to the class of *Conjugatæ*, distinguished by its peculiar mode of reproduction by "conjugation." The class is divided into three families, the *Zygnemaceæ*, *Desmidieæ*, and *Diatomaceæ*. No special reference was made to the diatoms; but the process of conjugation in the filamentous *Zygnemaceæ* was described, as illustrated in the well-known genera *Zygnema* and *Spirogyra*.

The Desmids are an extremely interesting class of fresh-water organisms, to which a comparatively small amount of attention has been paid in this country since the publication of Ralfs's great work on the British *Desmidieæ* in 1848. The species are numerous, very abundant in fresh water, both stagnant and running, and many of them extremely beautiful and very easy to distinguish. As many as six or eight hitherto undescribed species were met with during a six weeks' stay in Westmoreland, chiefly in bog-pools and the smaller mountain-streams. Several of these were described: and the two processes of reproduction, by division and by conjugation, dwelt on. The process of division or fission was illustrated in the case of a common mountain species, *Staurastrum teliferum*, and a description given of the mode in which the spiny processes on the mature frond may be seen to develop under the microscope, affording one of the most rapid instances of growth in the vegetable kingdom.

The lecturer concluded with some general remarks on the distribution of species. As regards the *Desmidieæ*, many of the commonest species are cosmopolitan, while others appear to be found exclusively or chiefly in particular countries or at particular altitudes. The theory of the evolution of species by natural selection is in no way opposed to the fact of the constancy of species from age to age, where the climatic conditions which have surrounded that species have been constant. The wide diffusion of extremely well-marked species over the whole globe presents a much greater difficulty. It was suggested that possibly the explanation might be found in the comparative quiescence of cosmic phenomena in the present age as contrasted with those which prevailed in past geological ages.

The lecture was illustrated by diagrams and microscopical specimens.

55.—On some Recent Additions to the Flora of Surrey. [Abstract.]

By W. H. Beeby.

(Read December 9th, 1885.)

On the last occasion that I had the pleasure of reading a paper before you, I was able to record that during the year 1884 about ten species had been added to our Surrey list, these being either entirely new records or confirmations of old records made on very doubtful or insufficient authority. The result of the past season's work presents a considerable contrast to that of the previous one. Apart from critical forms and varieties, there are no additions whatever to be recorded; and as the time given to investigation has been quite as great as in 1884, I think we may fairly conclude that our list is now a tolerably complete one, so far as the ordinary plants of the county are concerned—of course excepting critical forms and great rarities, a few of which may yet turn up in isolated localities. Still, notwithstanding the absence of any new species records, some interesting confirmations have resulted from the past year's work, as well as the re-discovery of one species which had become extinct in its original station.

The first plant to which I would draw attention is the common lady's mantle, *Alchemilla vulgaris.* Though said to occur near Reigate, Dorking, and elsewhere, I have never been able to find it, nor has Mr. Crosfield, of Reigate; and no Surrey specimens seem to exist in herbaria or to have been seen by any botanist with whom I am acquainted. I was therefore very glad to receive a specimen last summer from Mr. Thomas Howse, who gathered it in a wood near Horsley, where it was first noticed by the Rev. George Sawyer.

One of our rarest plants, not only from a county point of view, but having regard to the whole of Britain, is the slender cotton-grass, *Eriophorum gracile.* Formerly known only in this country as a native of Yorkshire and Surrey, and occurring but in a single locality in each county, it has long been extinct in both. A few years since it was discovered in Hampshire, and last June I had the good fortune to meet with it in some abundance in a *Sphagnum* bog near Aldershot. Unlike our other species of cotton-grass, the present one does not grow actually on the peat, but apparently entirely among the *Sphagnum* and roots of bog-plants, at a distance of several feet above the soil. This peculiarity in its habit fully accounts for its disappearance on the approach of drainage. The others are not infrequently seen on almost dry peat; but this is never the case with *gracile*, which is only to be found in the very wettest parts of the bog.

Among varieties new to Surrey I may mention a mint which is supposed to be very rare, and indeed no locality was known for it until it was re-discovered in Norfolk a short time ago. It is the *Mentha hircina*, and Mr. Baker considers it to be exactly the plant of Hull. It is usually placed as a variety of *Mentha pubescens*, but it so much more nearly resembles the common peppermint, *Mentha piperita*, under which species I should have placed it, that it seems more than probable that its supposed rarity is due to its having been passed over as the latter plant.* It occurs in three stations in Surrey,—in a ditch at Daw's Green, near Reigate; near Holmwood Station; and near Chiddingfold, —and is a doubtful native in all of these localities.

A good deal of misunderstanding has existed as to the different forms of *Epipactis* found in this country. This I believe to be partly due to want of opportunity to compare the different plants in the fresh state, herbarium specimens being mostly quite useless for this purpose. Though some attention was paid to these plants last year, I was unable to come to any satisfactory conclusion as to our Surrey forms, owing to the absence of

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* Since reading this paper I have had an opportunity of examining a specimen of *M. piperita-sylvestris*, Sole (*M. hircina*, Hull), and cannot refer the Surrey plant to that form.

Epipactis media of Fries. This plant appears to be very rare in Surrey, and I met with it for the first time last August, not far from Witley. The discovery of this plant made it plain that, besides the marsh helleborine, we have three plants in Surrey, *viz.*, the more common broad-leaved helleborine, *Epipactis latifolia*, and also *E. media*, Fries, and *E. violacea*, Durand. Even the late Mr. Watson appears to have misunderstood these plants, and the only satisfactory description we have of them is that found in the 8th edition of Babington's 'Manual of British Botany.'

Special attention has been given this year to the brambles, and, without going into detail, I may say that of the twenty-four subspecies into which Mr. Baker divides the fruticose *Rubi*, twenty-two are represented in Surrey by one or more of their forms. Probably one of Brewer's species will have to be cut out as an error, but, on the other hand, a dozen or more new forms have to be added. Owing to the valuable assistance of Mr. Baker, both in examining plants submitted to him and in himself studying the Surrey forms out of doors, the account of this most difficult group bids fair to be a most satisfactory one.

I may mention a new station for the great hairy wood-rush, *Luzula sylvatica*, previously only known from one locality. It occurs abundantly in a dry wood by Leigh Mill-pond, near Godstone.

The last plant I have to speak of is the common buttercup, *Ranunculus acris*. The varieties *Steveni* and *vulgatum*, the *a*. and *b*. of Syme's 'English Botany,' together constitute the common plant of the county. These two varieties, however, do not seem to be always readily separable, and not infrequently present intermediate characters. They are both characterised by a creeping rootstock.

But, besides these, we have a very distinct form, which will perhaps eventually be conceded subspecific rank. I allude to the *Ranunculus Boræanus* of Jordan. This has been looked for in Surrey, but, as far as I know, has not been met with until this year, when I found it by the Thames side near Runnymede, and also near Byfleet. It is distinguished from the last chiefly by its rootstock being vertical instead of creeping.

In conclusion, I may say that I fully expect that next year's work will suffice for the completion of the necessary out-door work in connection with the Surrey Flora. A few only of the twelve districts require working, both as regards some critical and some common plants, and this I hope to complete in the course of next summer.

56.—Some Surrey Wells and their Teachings: with Sections of Wells and Deep Borings in the Surrey Part of the London Basin.

By William Whitaker, B.A., F.G.S., Assoc. Inst. C.E.

(Read December 9th, 1885.)

Since the publication of the Geological Survey Memoir on that part of the London Basin which includes Surrey[1] a great number of additional well-sections in the tract therein described has come into my hands. It was hoped that these might be printed by the Geological Survey; but, as there now seems little chance of that, I am glad to offer such of the sections as belong to Surrey to the Croydon Microscopical and Natural History Club, in order that they may no longer remain unprinted.

Amongst them are some old wells, recorded in the MSS. of the late Dr. J. Mitchell, for the use of which I have to thank Professor Prestwich. I have also to thank the engineers, well-sinkers and others who have so kindly given me information.

In most cases, where details have been preserved, the wells begin in the London Clay (or in some overlying gravel or sand), and are carried through the underlying Lower London Tertiaries into the Chalk by boring; but in cases the wells begin in lower beds, sometimes in the Chalk.

The chief geological value of the wells lies of course in the details given of the nature and thickness of the beds passed through; but, besides this, in many cases we gain information as to the underground water-level, and, to some extent, as to the yield, both matters of no little importance.

It will be seen that in the great majority of cases the Chalk is aimed at as a source of supply, and in three cases only is a boring carried through that formation. The chief case is at Richmond, and though the section of the deep boring there has but lately been published,[2] yet, as it is of great interest and importance, and as the details are scattered through many pages, I have thought it well to collect the whole together and to include it with the unpublished sections. Two formations not before known in the county, and below any seen at the surface in the county, have been found, namely, Great Oolite, and the red rocks, perhaps of Triassic age, in which the boring ends.

It is not, however, from the occurrence of these two formations that this, the deepest boring in the South of England, is remarkable; its chief lesson is to enforce the teaching of other deep borings in and near London, namely, the northerly thinning underground of the Lower Cretaceous divisions that

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[1] Vol. iv. of the 'Memoirs' (1872). Surrey well-sections are described on pp. 537—563.

[2] Prof. Judd, Quart. Journ. Geol. Soc., vols. xl., xli.

occur in such force not so very many miles to the south, where they crop out to the surface.

Thus the Lower Greensand, some 300 feet or more thick in its range through Surrey, has almost disappeared, being represented, and that somewhat doubtfully, by only ten feet of limestone (with a little clay). The still thicker mass of the next underlying formation, the Weald Clay, has wholly disappeared, as also is the case with the next succeeding Hastings Beds, which are some hundreds of feet thick at their outcrop, in Sussex. We have therefore a thinning of 1200 to 1500 feet, or more; and in this we do not reckon the great thickness of Upper and of Middle Jurassic beds, proved in the Subwealden boring, near Battle, the latter division having also been found lately at Chatham, where a boring at the Dockyard Extension has proved the presence of Oxford Clay next beneath Lower Greensand.[3]

The Caterham well has pierced the greatest thickness of Gault yet found in England, far in excess indeed of any estimate that could have been made a dozen years ago. The persistence of this formation in all the deep borings in the London Basin is noteworthy. To the base of the Gault we find constancy, and a proper regard for the geological sequence of formations; but after passing that limit we encounter irregularity of a most unpardonable kind (to those who expect an orderly succession), so that no man can tell what may be found at any spot several miles from the outcrop of the Gault.

The figures stand for feet, unless otherwise stated. [Remarks in square brackets have been added by me to the accounts of the sections.]

Anerley.—*North Surrey District School, Anerley Road.*

Communicated by the Board of Management.

		FT.	IN.
[London Clay, 228 ft.]	[Clay]	220	0
	Blue clay	8	0
[Woolwich and Reading Beds, 26½ ft.]	Clay and shells	5	6
	Plastic clay	7	6
	Shells	1	6
	Shells and clay	2	4
	Mottled clay	7	0
	Sand	0	2
	Pebbles	2	6
[Thanet Sand, 48½ ft.]	Green sand	17	6
	Grey sand	19	0
	Dead sand	9	0
	Flints	3	0
Chalk		109	6
		412	6

[3] See 'Guide to the Geology of London and the Neighbourhood,' Ed. 4, pp. 19—21. (1884).

I believe that this well was not successful in getting the supply needed.

Bermondsey (8 wells).

Nos. 1 to 5 sunk and communicated by Messrs. S. F. Baker & Sons. Further particulars from Mr. J. Lucas (Journ. Soc. Arts, vol. xxv., p. 609).

No. 1.—*Long Lane. Messrs. Hepburns.* 1860.

About 12 feet above Ordnance Datum.
Shaft 80½ feet; the rest bored.
Water-level, 1877, before pumping, 58 feet below surface; reduced 20 feet by pumping. Yield over 4000 gallons per hour.
To chalk, 184 feet; in chalk, 104½ feet; total, 288½ feet.

No. 2.—*Willow Walk. Beach's Tan-yard.*

About 10 feet below Ordnance Datum.
Bored throughout.
Water rose to a height of 3 to 4 feet from the surface.
To chalk, 111 feet.

No. 3.—*Market Street. Mr. Matthews, Leather-dresser.* 1820.

About 12 feet above Ordnance Datum.
To chalk, 160 feet.
Messrs. Baker think that there must be some mistake in this depth, as it is close to the next well. Mr. Lucas gives it as 170 feet, and in chalk 60 feet.

No. 4.—*Ditto. Second well.* 1876.

Peat and made ground		12
[Valley Drift.]	Sand	6
	Gravel	9
[London Clay.]	Blue clay	61
	Pebbles (basement-bed)	2
[Reading Beds.]	Coloured (mottled plastic) clay	42
	Pebbles	7
Green and grey	[Thanet] Sand	42
	To chalk	181

No. 5.—*Willow Walk. Messrs. Oastler & Palmer.* 1862.

About 9 feet above Ordnance Datum.
Bored throughout.
Supply about 100 gallons a minute.
To chalk, 127 feet; in chalk, 206 feet; total, 333 feet.

No. 6.—A later well at the same place.

Communicated by Messrs. Easton & Anderson.
Shaft and cylinders throughout.

Gravel with water		21
[London Clay or Reading Beds.]	Clay	12
	Sand	3
[Reading Beds.]	Mottled clay	16
	Conglomerate	2
	Hard green sand	6
	Hard stones (? flint pebbles)	2
[Thanet] Sand		46
Chalk		66
		174

No. 7.—Messrs. Peak, Frean & Co.'s Biscuit Works, Drummond Road. 1878.

Communicated by Messrs. Peak, Frean & Co., and by Messrs. F. Baker & Sons.

Supply abundant. Highest water-level 20 feet from surface.
Shaft and cylinders to the Chalk; the rest bored.

Made ground, loam, &c.		12
Gravel or ballast, surface water		18¾
[Woolwich and Reading Beds, 30¼ ft.]	Shelly clay	¾
	Close bed of broken shells	8
	Very hard clay	½
	Pebble-bed, red	1
	Mottled clay	1
	Very hard conglomerate, with traces of iron-pyrites	2
	Hard green sand	4
	Large pebbles	½
	Hard green sand	1¾
	Hard green sand, with pebbles	1¾
	Hard green streaky sand	6½
	Green sand and pebbles	2½
[Thanet Beds, 46 ft.]	Grey sand	6
	Hard sand	38
	Flints ... about	2
Chalk, with beds of flints from 6 to 18 inches apart		215
		322
	? Deepened later	158
		480

8.—*Messrs. E. Pink & Son's, Staple Street.*

Made and communicated by Messrs. G. Isler & Co.

Shaft 12 feet; the rest bored.

Water-level 73 feet down. Yield (minimum) 3000 gallons an hour.

			FT.	IN.
Made ground			3	0
Clay (? brick-earth)			6	6
Gravel or ballast			17	0
[London Clay, 38½ ft.]	Blue clay		37	6
	Basement-bed	Black pebbles	0	8
		Clay with black pebbles	0	6
[Woolwich and Reading Beds, 48 ft.]	Sandy clay and shells		4	6
	Mottled clay		11	0
	Sand		12	6
	Yellow mottled clay		11	0
	Mixed pebbles...		1	9
	Mottled clay and stones		2	3
	Green mottled clay and stones		2	0
	Mixed sand and shells		3	0
[Thanet Sand, about 38¾ ft.]	Green sand		11	0
	Sand and pebbles		8	10
	Live sand		19	0
Chalk and flints			95	3
			247	3

There may be some slight error in the figures, as the depth to the Chalk is given as 155 feet, and the total as 250 feet 3 inches.

Brookwood.—*Lunatic Asylum.* 1885 ?

Communicated by Sir F. Bramwell, F.R.S.

About 150 feet above Ordnance Datum.

Shaft 186 feet; the rest a bore of large diameter.

Large quantities of water found, from 17 feet below the surface, in the beds over the London Clay. A large quantity also met with in the sands from 602 to 634 feet down.

Water, from the Chalk, has overflowed at the rate of 9 gallons an hour. When the boring was at 784 feet pumping-experiments were tried, and, with the water kept at 25 feet down, the delivery was about 13 gallons an hour: by pumping the water down to 200 feet the quantity was not quite 300 gallons an hour. Since the boring has been at 884 feet experiments show that, with the water kept at 25 feet down, 15 gallons an hour were got.

[Bracklesham Beds and Lower Bagshot Sand.]—Sand, mixed with marl, shale, and clay .... about		171½
[London Clay, 394 ft,]	Clay, with pyrites, stones (septaria), and pebbles .... about	372½
	Sandy clay [this may belong to the Reading Beds]	22
[Reading Beds, 68 ft.]	Red clay	17½
	Red sandy clay	7½
	Fine sand	8
	Red sandy clay	8
	Coarse red sand	22
	Loose grey sand	10

Chalk, 250 ft.	Chalk, with very many flints	220
	,, with less flints	30
		884

Caterham.—*Waterworks.*

From a tracing communicated by Mr. E. Easton.

About 707 feet above Ordnance Datum.

Old well in engine-house. New well about 20 feet from engine-house, and 30 feet from old well.

Shaft of old well about 480 feet; shaft of new well a little less; the two connected by adits at about 275, 360, and 440 feet (top of each).

Highest normal water-level from Chalk about 306 feet down: lowest, 410 feet down; normal water-level from Lower Greensand, 395 feet down.

Old shaft has a boring of a few feet, in Upper Greensand; new shaft, one about 50 feet, into Gault, and another to Lower Greensand.

Gravel [Blackheath Beds]	149
Chalk	307
Upper Greensand	55
Gault clay	343
Rock (with phosphatic nodules)	$\frac{1}{2}$
Lower Greensand	$19\frac{1}{2}$
	874

Another well, 213 (or 220?) feet deep, with a boring, made in 1878, gave the following section (J. Barrow, Proc. S. Wales Inst. Eng., vol. xi., no. 7, p. 324, pl. 52):—

Gravel and flints [Blackheath Beds]	67
Chalk and Chalk Marl	400
Upper Greensand	53
Gault Clay	331
Lower Greensand	11
	862

Chelsham.—*In the valley N.W. of Warren Barn.* 1884.

$478\frac{3}{4}$ feet above Ordnance Datum.

Made and communicated by Mr. J. Taylor, of Reigate.

Shaft of 6 feet diameter to 170 feet, and then of 10 feet diam.

Water found at 161 feet, and the work stopped by water at 163 feet, pending the fixing of temporary pumps. On leaving off in February, at $184\frac{1}{2}$ feet, water rose 54 feet in some days. In the autumn the water sank, and at last disappeared; the well was then deepened. In the spring of 1885 the water stood 82 feet up.

[Valley Deposit.]	Light soil and flints	8
	,, merging into rubbly chalk	10
Chalk.	Rubbly chalk	31
	Hard chalk	9
	Very hard chalk	26
	Rotten clayey chalk	1
	Grey chalk	139
		224

Chertsey.—*Brewery.* 1872. *About* 100 *yards from the western side of Guildford Street, about midway between the church and the railway-station.*

Communicated by Mr. E. Swain.

Water overflows at the rate of about 600 gallons an hour.

Shaft 40 feet (1867); the rest bored.

Surface-mould and loamy clay	about	5
Gravel and sand		35
Dark sand		4
Blue [London] Clay, with many beds of Clay-stone [septaria]		386
[Reading Beds, 93 ft.]	Mottled clay (perhaps the top part may belong to the London Clay)	50
	Greenish sand, with water	6
	Brown clay	25
	Hard green sand	12
Chalk and flints		151
		674

Mr. T. Tilley tells me that he found chalk at 517 feet in a well at Chertsey.

Coulsdon.—*Asylum* (*Smitham Bottom*). 1878.

Sunk and communicated by Messrs. T. Docwra & Son.

Shaft throughout.

Water found at 97½ feet.

Loose ballast		6
Chalk	Loose chalk	30
	Chalk	5
	Hard grey chalk and flints	13
	Hard chalk, with two layers of flints	43½
	Chalk and flints	1
		98½

Croydon.—*Gas-works* (*Waddon*). 1868.

Communicated by Mr. B. Latham.

Shaft about 40 feet; the rest bored.

A failure as regards water-supply from the Chalk. Bore-hole filled up, and water got from Tertiary sands.

Black clay		16
Yellow clay		6
[Reading Beds, 68 ft.]	Black sand [Oldhaven Beds]	20
	Mottled clay	38
	Oyster-bed [? clayey green sand]	10
[Thanet Sand, $18\frac{3}{4}$ ft.]	Mouse-coloured and black sand and pebbles	12
	Green sand	6
	Green flints	$\frac{3}{4}$
Chalk and black flints		138
		$246\frac{3}{4}$

Workhouse, Queen's Road. 1883.

162 feet above Ordnance Datum.
Communicated by Mr. H. Klaassen.
Shaft 63 feet; the rest bored.
Water-level 70 feet down.

Mould		2
Gravel		9
[London Clay, $55\frac{1}{2}$ ft.]	Mouse-coloured clay	3
	Clay, with septaria a foot thick, 6 feet down	29
	Sandy clay	1
	Clay	4
	Sandy clay	3
	Clay	6
	Sandy clay	3
	Clay	2
	Sandy clay and septaria	1
	Sand } [? Oldhaven Beds]	2
	Sand & pebbles } [? Oldhaven Beds]	$1\frac{1}{2}$
[Woolwich and Reading Beds.]	Blue clay (*see Note*)	25
	Mottled clay	16
	Dark sand (= lavender-coloured sandy pebble-bed of Park Hill section)	1
	Green sand and pebbles	14
[Thanet Beds, 54 ft.]	Light-coloured sand	43
	Loamy sand, with water	10
	Flints	1
Chalk and flints; no water		$281\frac{1}{2}$
		458

Note.—One would take the blue clay to be London Clay but for the bed above. Perhaps it is only the shell-beds in great thickness. Mr. Klaassen tells me that in 1866 a well was dug and abandoned, 100 feet to the west, in which, instead of the blue clay and the two beds above it, the following were found:—

Dark sandstone	2
Light-coloured sand	5
Stone	1
Pale sand	1

Black sand	4
Sandstone	5
Sandy clay	3
Shelly bed	2
Black sandy clay and sand	6
	29

He infers that, if both sections are right, the fault shown in the Park Hill railway-section (1883) extends northward.

Denbies, *near Dorking.*

Dr. J. Mitchell's MSS., p. 248.
About 600 feet above Ordnance Datum.
Water-level, 424 feet down. September, 1876 (J. Lucas).

Gravel, abounding in small flints of the size of peas	26
Clay, like pipe-clay	1
Chalk, with and without flints	343
	370

Has been deepened to 444 feet, with good supply.

Egham.—*Staines Waterworks.* 1883.

Sunk and communicated by Mr. T. Tilley.
Shaft 260 feet; the rest bored.

Sand-spring, at a depth of 306 feet, yielded 30 gallons a minute, at a depth of 16 feet (cloudy). Another, at 337 feet, yielded 4 gallons a minute at the surface (bright). At 97 feet from the surface about 7 gallons a minute was found to be the yield of the water from the Chalk (October, 1882). At 130 feet from the surface the yield of the sand-springs was 400 gallons a minute (April, 1883).

Ground made up...		4
Sand and gravel [River Drift]; bottom part coarse, with large flints and large clay-stones [septaria] on the clay		20
Blue [London] Clay; with pebbles at 162, 172, and 251 feet from the surface, and slight soakage at 178 feet		235
[Reading Beds, 96 ft.]	Mottled clay	47
	Red sand (with water)	14
	Red sand rock	1
	Red sand	1½
	Mottled clay	16
	Sandy clay (with water)	14
	Sandy clay and chalk, mixed	2½
Chalk specimens, from 700 feet, very hard and greyish... about		346
		700

Epsom.—*Waterworks.*

Information got by Mr. J. Lucas from the Engineer.

About 150 feet above Ordnance Datum.

Three wells:—1. In the engine-house: shaft 50 feet; then two bore-holes to 84 feet. 2. To the south-east: shaft 40 feet; then three bore-holes to 84 feet. 3. In the garden, further south-east: shaft 51 feet; the rest bored. (Section of this well given below). The three are connected by a pipe 45 feet below the surface.

Yield 14,000 gallons an hour; in summer, 12,000. The engineer says that the springs are equal to a supply of 25,000. A bore-hole close by, to the north-east, used to overflow before the pumping began.

Mould		2
Gravel		3
[Reading Beds. $27\frac{1}{2}$ ft.]	Red clay	$7\frac{1}{2}$
	Mottled clay	6
	White fire-earth	$2\frac{3}{4}$
	Green sand	10
	Oyster-shells	$1\frac{1}{4}$
[Thanet Beds, $29\frac{3}{4}$ ft.*]	Slate-coloured sand	10
	Grey sand	18
	Coarse sand and flints	$1\frac{3}{4}$
Chalk		$123\frac{3}{4}$
		186

In the engine-house well a thin bed of grey clay comes in below the gravel, otherwise the same section is given by all the wells. As the dip is north-westward, the same horizons occur rather lower in 2 than in 3, and in 1 than 2. In 1 the depth to the Chalk is 66 feet.

Harvey's, late Chandler's, Brewery.

Information got by Mr. J. Lucas.

Three wells, one giving the section below.

Shaft 35 or 40 feet, then bored to 90 feet.

Water 3 feet from the surface (Feb., 1873); falls to 30 feet in dry seasons.

Gravel	15 or 16
Clay	35 or 40
Sand.	
Chalk.	

A bed of oyster-shells was passed through, but its depth was not recorded.

* This seems too great a thickness for the Thanet Beds.

Fetcham.—*Mr. Hankey's.*

Dr. J. Mitchell's MSS., vol. 2, p. 263.

Gravel		8
Blue [London] clay		20
[Reading Beds.]	Sand	38
	Sand, with oyster-shells (some $7\frac{1}{2}$ inches across)	7
Chalk		3
		76

Forest Hill.—*Mr. Swansborough's.*

Dr. J. Mitchell's MSS., vol. 4, p. 201.

Mould and yellow clay	about	1
Black [London] clay		200
Then bored for		75
To gravelly sand and water		276

Another well on the hill dug through 300 feet of black clay to coarse sand and black pebbles.

Frimley.—*Mytchett Place.* 1882?

Rev. A. Irving, Quart. Journ. Geol. Soc., vol. xli., p. 496 (1885). 250 feet above Ordnance Datum.

Upper Bagshot, 65 feet.	White sand	53
	Loamy sand	12
Middle Bagshot, 28 feet.	Light-green sand	2
	Dark green sand	26
Lower Bagshot, 102 feet.	Sharp light-green sand	87
	Light-green and sharp sand, with shells, &c.	15
London Clay, 67 feet.	Blue clay, with smooth pebbles	33
	Green loamy sand	2
	Blue clay, with pebbles	4
	Blue clay	11
	Dark green sand and clay	17
Reading Beds, 68 feet.	Dark green sand	23
	Brown sand, marl and clay	23
	Very fine sharp sand	22
		330

Though this section has been published only lately, it may be well to reproduce it here, for, if Mr. Irving is right in his classification of the beds, we have a most unexpected decrease in the thickness of the London Clay, which has been proved to be 300 feet and more in other wells at no very great distance. This great and sudden thinning-away of a formation not in the habit of doing that sort of thing, save in a very gradual fashion, leads me to doubt the classification, and to suggest that the reading may possibly have to be altered, even to the following extent:—

Upper Bagshot and Bracklesham Beds (Middle Bagshot)	? 245 or 262
Lower Bagshot	? 85 or 68

Without, however, a precise knowledge of the site, it is difficult to understand the section, and the above suggestion is offered only as a caution against the too ready acceptance of the published classification, which latter would lead one to expect the occurrence of the Chalk within 30 feet; whereas, on the other view, it would not be reached in 300.

Garrett.—*The Willows.*

Specimens shown me by Mr. Hallett.
About 38 feet above Ordnance Datum.
Well (sunk by Eastell) 235 feet deep.
Water overflows.

London Clay.
Reading Beds. { Variously coloured mottled clays. Pebbles. Green and red mottled clayey sand.
Fine grey Thanet Sand.

According to Mr. J. Lucas, this bore is 256 feet deep, and reaches the Chalk.

Guildford.—*Castle Brewery.* 1883.

Sunk and communicated by Mr. R. B. Paten.
Shaft $17\frac{1}{2}$ feet; the rest bored.

Gravel and sand......	12
Chalk and flints	263
	275

Hatchfold.—*Lord F. Egerton's. About* $1\frac{1}{2}$ *miles S.W. of Cobham, on a hill higher than the top of the house.* 1843.

Sunk and communicated by Mr. C. Page.
Shaft 45 feet; the rest bored.
At a depth of 625 feet the water rose to within 25 feet from the surface.

[Bagshot] sand, the lower part with water............	80
Blue London Clay	362
Coloured grey clay [? partly London Clay]	100

[Reading Beds.]	Plastic clay	14
	Black and green sand	4
	White marl and shells	2
	Pebbles and green sand	8
[? Thanet (or Reading) Beds.]	Green sand	8
	Grey clay, with sand	5
	Black flint-rock	1
Chalk, with flints at intervals		66
		650

Lambeth.—*Lion Brewery. Second well.* 1883.

Communicated by Mr. E. Easton.
Shaft 231 feet.

Surface [made ground, &c.]		15
Clay [Alluvium]		9
Thames ballast [River Gravel]		12
[London Clay, 104 ft.]	Clay	94
	Loamy clay	4
	Large pebbles and clay	6
[Woolwich and Reading Beds, 63 ft.]	Sandy clay	6
	Firm clay	4
	Mottled clay, the bottom 4 ft. less firm	7
	Loam and sand	3
	Mottled loam and sand, the bottom 5 ft. of higher colour	7
	Jointy clay	5
	Clay and shells	4
	Mottled sandy clay	7
	Mottled clay	4
	Large black pebbles	3
	Pebbles and oyster-shells	2
	Green sand and pebbles	6
	Mixed pebbles	2
	Grey sand and pebbles	3
[Thanet Sand, 28 ft.]	Grey sand	2
	Grey sand and iron-pyrites	22
	Dark silty sand	4
	To Chalk and flints	231

Lambeth. — *Messrs. Oakey's Emery Mills, Westminster Bridge Road.* 1873.

Sunk and communicated by Messrs. S. F. Baker & Sons.
About 12 feet above Ordnance Datum.
Shaft 105 feet; the rest bored.
Water rose to 63 feet below the ground.

Made ground and black ballast	15
Gravel, with much water	11

[London Clay, 82 ft.]	Clay	79
	Sand and water [? basement-bed]	3
[Reading Beds, 64 ft.]	Mottled clay	8
	Sand (very strong spring)	3
	Mottled clay	16
	Very hard white stone	6
	Pebbles in sand	31
Grey [Thanet] Sand		40
Chalk		108
		320

Lambeth.—*The New Union.* 1872.

About 12 feet above Ordnance Datum.
Sunk and communicated by Messrs. S. F. Baker & Sons.

Gravel		25
London Clay		51
[Woolwich and Reading Beds, and Thanet Sand.]	Bed of oyster-shells	2½
	Solid stone, with small shells	2
	Sand, like Thanet Sand, with an immense body of water	26½
	Mottled clay	14
	Green sand and pebbles [? wholly or in great part Thanet Sand]	47
	To Chalk	168

According to Mr. J. Lucas (Journ. Soc. Arts, vol. xxv., p. 610), carried to a depth of 300 feet. Water-level before pumping, in April, 1877, 68 feet below ground. Pumped at the rate of 3800 gallons an hour.

Leatherhead.—*St. John's Foundation School.*

Communicated by the Head Master, the Rev. E. C. Hawkins.
Average daily consumption about 1000 gallons.

Surface mould	about 30 ft.
Loam and flints	
Sand, perhaps nearly 10 feet	
Blue Clay [? clayey green sand]	
Chalk	„ 70 „

Malden.

Dr. J. Mitchell's MSS., vol. ii., p. 217.
Water rose to the surface.
Through blue clay to black sand, 401 feet.
[This thickness must include both London Clay and Reading Beds.]

Malden.—*Mostin (? Mosper) Farm, Mr. Blake's.* 1865.

Sunk and communicated by Messrs. S. F. Baker & Sons.
Water within 4 feet of the ground.

Clay (? Blue clay 228 feet, then plastic clay)	304
Sand (full of water)	6
Coloured [mottled plastic] clay, not bottomed	4

Merton. — *Sewerage Works (Croydon Rural Sanitary Authority), north of Wandlebank House.* ? 1879.

Communicated by Mr. W. S. Crimp.
36 feet above Ordnance Datum.
Bored throughout (6 inches diameter).

Water overflows at the rate of about 40,000 gallons a day (recorded as over 52,000 in Proc. Assoc. Municipal and Sanitary Engineers for 1879, p. 21), at a temperature of about 54°.

Alluvium	....	10
Ballast [River Gravel]	....	$1\frac{1}{2}$
London Clay	....	51
[Woolwich and Reading Beds, $62\frac{1}{2}$ ft.*]	Shells	1
	Brown sand	5
	Blue clay and shells	7
	Shells	$1\frac{1}{2}$
	Dark clay	8
	Blue clay	3
	Black clay	3
	Yellow clay	3
	Purple clay	3
	Red clay	4
	Brown and green sand	$1\frac{1}{2}$
	Brown sand	$9\frac{1}{2}$
	Brown clay	5
	Pebbles	$1\frac{1}{2}$
	Green sand	$6\frac{1}{2}$
Grey [Thanet Sand]	....	$39\frac{1}{2}$
	To Chalk	$184\frac{1}{2}$

Mitcham.—*Collierswood.*

Communicated by Mr. W. S. Crimp.
$52\frac{1}{2}$ feet above Ordnance Datum.

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* I am in doubt as to referring the whole of this to this series. In the abstract account in the Proc. Assoc. Municipal Engineers (and 'Iron,' vol. xv., no. 366, p. 44, 1880) the thickness of the formations differ, London Clay being given as 80 feet, Woolwich Beds as 40, and Thanet Sand as 47, the depth to theChalk being 179, and in Chalk 51.

Surface soil		4
Blue [London] Clay		96
[Woolwich and Reading Beds, 57 ft.]	Blue clay and shells	20
	Coloured clay	28
	Pebbles and green sand	9
Grey [Thanet] Sand		26
	To Chalk	183

Mitcham.—*Phipp's Bridge.*

Communicated by Mr. W. S. Crimp.
46 feet above Ordnance Datum.

Alluvium		5
Ballast [River Gravel]		14
Blue [London] Clay		151
[Woolwich and Reading Beds, 57 ft.]	Shells	1
	Coloured clay	13
	Shells	1½
	Coloured clay	10
	Shells	½
	Coloured clay	14
	Brown sand	4
	Brown clay	5
	Pebbles	2
	Green sand	6
Grey [Thanet] Sand		28
	To Chalk	255

Norwood. — *W. side of Grange Road, just S. of Sylvan Road.* 1881. [? *Monteagle, Harold Road.*]

Communicated by the owner, Mr. R. W. Wheeler.
Shaft 120 feet (of which 4 feet were filled up); the rest bored.
Water-level about 100 feet down.

[London Clay.] Specimens of brown clay from 190 to 255 feet, the last slightly sandy. At bottom a few pebbles	about 270 ft.
Fine sand, with some clay	
Dry sand, about 8 feet	
Sand, with water, about 5 feet?	

Old Kent Road. — *Britannia Brewery* (*Malt Street, near Canal Bridgé*). *Tube-well.* 1877.

Sunk and communicated by Mr. G. Hawksley.
Water rose to within 11 feet of the surface; temperature 52°; yield 800 gallons an hour.

Soil		6
Yellow gravel		12
[Thanet Sand.]	Light-coloured fine compact sand, without water	$16\frac{1}{2}$
	Dark sand	$4\frac{1}{2}$
Chalk and flints, ending in hard continuous flint		$22\frac{3}{4}$
		$61\frac{3}{4}$

Peckham.—*Brewery, Hill Street.* 1876.

Communicated by Mr. J. Brooks.
About 17 feet above Ordnance Datum.
Shaft 8 feet; the rest bored.

Water rose to 23 feet below the surface, and is not lowered more than a foot when pumping at the rate of 3600 gallons an hour.

Top [made] ground		2
[? Valley Drift.]	Sand and loam	13
	Ballast [gravel] and sand	11
[? Woolwich Beds.]	Fine sand, with few pebbles	2
	Conglomerate	2
	Green sand and pebbles	8
[Thanet Sand, 48 ft. ?]	Grey sand, with pebbles*	46
	Muddy clay	2
Chalk and flints		167
		253

Peckham.—*Mr. Griggs's, Hanover Street, Rye Lane.*

Made and communicated by Messrs. G. Isler & Co.
Water-level 40 feet down; supply abundant.

Shaft (the rest bored), through made ground, clay, and sand		23
Blue [? London] clay		2
[? Woolwich Beds, $35\frac{1}{2}$ ft.]	Grey sand and small pebbles	15
	Grey sand	2
	Brown sand and pebbles	14
	Large ballast [? pebbles]	$4\frac{1}{2}$
Grey [Thanet] sand		$30\frac{1}{2}$
Chalk and flints		33
		124

* Part of this may belong to the Woolwich Beds.

Peckham.—*Lyndhurst Road. Messrs. Gordon's Brewery.* **1876.**

Sunk and communicated by Messrs. Docwra & Son.

About 50 feet above Ordnance Datum.

Shaft (chiefly cylinders) 115 feet; the rest bored.

Water-level, after pumping 9 hours, about 53 feet down; supply equal to 185,000 gallons in 24 hours. According to Mr. J. Lucas (Journ. Soc. Arts, vol. xxv., p. 608), the water-level before pumping, in 1877, was over 48 feet down, and the yield 7700 gallons an hour.

[London Clay, 22 ft.]	Clay and sand	7
	Yellow clay	9
	Blue clay	6
[Woolwich and Reading Beds, 54 ft.]	Running sand	2
	Clay and sand	5
	Shells	3½
	Mottled clay	3½
	Live sand	6
	Black sand	2
	Dark sand	3
	Brown sand, mixed with shells	2
	Mottled clay	2½
	Clay and shells	2
	Hard shell-bed, mixed with pebbles	1½
	Mottled clay	11
	Pebble- and shell-bed	5
	Live sand	1
	Pebbles and shells (hardened)	4
[Thanet Sand, 48 ft.]	Dark soft sand	25
	Live sand	14
	Hard sand	3
	Dark sticky sand	5
	Flints	1
Chalk		111½
		235½

Reigate Hill.—*Manor Farm.*

614¼ feet above Ordnance Datum.

Made and communicated by Mr. W. Taylor, of Reigate.

Shaft of 6 feet diameter, to 260 feet; then gradually enlarged to 10, with a heading 12 feet long.

When at rest, 43 or 44 feet of water, at all seasons: will stand 10 hours' pumping, at the rate of 10,000 gallons an hour, and then takes 3 days for the water to rise to its former level.

	FT.	IN.
Clay, with flints [on one side]	4	0
Chalk on one side of the well, the clay ending off at 32 feet	28	0

	FT.	IN.
Chalk, much shattered	6	4
Very hard chalk	4	8
Chalk, very much shattered	6	3
Moderately hard chalk	21	9
Hard chalk	13	5
Very hard chalk	6	7
Very rotten chalk, with much bad air...	2	0
Shattered chalk, with much gas: a few round flints about 100 feet down...	51	0
Very hard chalk, increasing in hardness [downwards]	85	0
Extremely hard chalk	8	0
Very rotten clayey chalk	1	0
Grey chalk; water at 256 feet	62	0
	300	0

Richmond.—*Waterworks, about* 160 *yards below the Bridge.* 1876–1884.

Prof. Judd (Quart. Journ. Geol. Soc., vol. xl., pp. 724, &c.; vol. xli., p. 524).

About 17 feet above Ordnance Datum.

Shaft (and cylinders) 253 feet; the rest bored.

		FT.	IN.
Made ground		10	0
Sandy gravel		0	10
London Clay		160	0
Reading Beds, 59½ ft.	Mottled red and green clays	44	0
	Yellow sand	8	0
	Sandstone	4	0
	Light-coloured clay	2	0
	Clay, with much lignite, and with pebbles at the base	1	6
Thanet Sand, 22½ ft.	Light-grey sand	13	6
	Dark clayey sand, with much glauconite ...	8	0
	Green-coated flints	1	0
Upper Chalk, 300 ft.	White chalk, with layers of flint ...... about	200	0
	White chalk, with few flints .... about	100	0
Middle Chalk.	Cream-coloured hard nodular bed (? Chalk-rock), not over 5 feet; Greyish chalk, without flints, about 20 feet down, a hard bed, 137 feet; Hard yellowish crystalline chalk, partly nodular, partly conglomerate, not over 15 feet (Melbourne Rock)	about 150	0
Lower Chalk.	Grey marly chalk, without flints, more clayey and darker lower down, and passing into:— Chalk Marl, not less than 50 feet	about 220	0

		FT.	IN.
Upper Greensand, 16 ft.	Hard micaceous calcareous sandstone	6	0
	Softer calcareous sandstone	6	0
	Rock like the top bed, but with more glauconite	4	0
Gault.	Pale blue clay, with few fossils .... Dark blue pyritous clay, with many fossils. At the bottom a sandy bed, with glauconite, passing down into :— Nodule-bed, with phosphatic nodules and fragments of various rocks	201	6
? Neocomian, 10 ft.	Limestone, rather sandy, with particles of glauconite: made up of water-worn fragments of fossils in a subcrystalline matrix; like Kentish Rag; passes into the next..	0	6
	Limestone, consisting of a fine-grained calcareous paste, with oolitic grains and fragments of shells, &c. 4 feet down, a 9 inch bed of clay, with many water-worn fragments of shells, &c., grains of glauconite, particles of iron-pyrites, of coaly material, of anthracite, &c. About $1\frac{1}{2}$ feet below this, a half-inch layer of pyrites. At the base a 6 inch bed of clay, with oolitic grains, fragments of fossils, pieces of sandstone and of other rocks, some particles of anthracite, and phosphatic nodules	9	6
Great Oolite, $87\frac{1}{2}$ ft.	Dark limestone, made up of oolitic grains and water-worn fragments of fossils ...	5	0
	Paler and more marly limestone, with scattered oolitic grains and many Foraminifera	22	6
	Dark oolitic limestone	10	0
	More shelly rock, with fewer oolitic grains and many Foraminifera.....................	11	0
	Rock, of calcareous paste, with scattered oolitic grains. Fragments of fossils abundant	5	0
	Dark blue clay, with limestone bands, and in places crowded with fossils	3	6
	Oolitic and shelly limestone	17	0
	Fullers' earth	0	6
	Fine grained oolitic limestone, with much pyrites, more sandy downwards; at the base a fissile calcareous micaceous sandstone, like Stonesfield Slate	9	0
	Oolitic limestones, with many fragmentary shells	3	6
	Limestone of more open texture, made up of water-worn fragments of shells, with a few grains of quartz and particles of anthracite	0	6

		FT.	IN.
Pockilitic beds. With dips (? false-bedding) from 21° to 45°, 207½ ft.	Alternations of red sandstone and variegated marls	16	0
	Hard sandstone	1	0
	Marls, with occasional beds of sandstone ...	10	0
	Alternations of sandstone and marls	21	0
	Solid sandstone	4	0
	Red marls	2	6
	Hard sandstone	4	6
	Soft sandstone, with many seams of marl ...	5	0
	Hard red and white sandstone, partly coarse, with some bands of clay	17	0
	Red marls, with beds of sandstone	15	0
	Red sandstone	13	0
	Red and variegated marls	3	0
	Red sandstones	3	0
	Red and variegated marls	2	0
	Beds of very hard red and white sandstone, sometimes laminated, sometimes with little sign of bedding, with many vertical joints	19	0
	Very hard grey sandstone	1	6
	Hard red sandstone	2	0
	Softer red and white sandstone, laminated in places ... about	32	0
	Mottled sandstone, very hard at the base ...	4	0
	Softer mottled sandstone, with clay-galls ...	6	0
	Finely laminated soft mottled sandstones ...	12	0
	Very hard red sandstones, the joint-planes coated with green incrustations	1	3
	Soft green shaly rock	0	9
	Hard red sandstone, like the last	1	3
	Softer dark red sandstone	1	9
	Very fine-grained red sandstone	1	0
	Very hard red sandstone; had to be ground away, and could not be brought up in cores	4	0
	Hard white fine-grained sandstone, with a rude dip	4	0
		1445	4

The total depth is given as 1447 feet (Quart. Journ. Geol. Soc., vol. xli., p. 523).

The above measurements are taken from the details (down to over 1400 feet) in pp. 731–735, 738, 739, 741, 749, 750 of Prof. Judd's paper, except for the Gault, in which the section (opp. p. 744) gives more detail than the text. These measurements differ, however, slightly from those of the section, in which, moreover, there is some discrepancy between the thickness of the beds, on the left of the column, and the depths, on the right; the latter at first erring by a slight excess on the right, then by a slight defect, and again by a slight excess.

A tracing communicated by Mr. S. C. Homersham differs in the following details:—

1. As to the junction of Reading and Thanet Beds, as follows:—Instead of "light grey sand," classed as Thanet, gives "green sand, clay, and pebbles," which would be classed as Reading. This is succeeded by "grey sand" which of course falls into the classification above, as Thanet.

2. Makes the flints end about 246 feet down in the Chalk, and shows a 3-inch layer of dark clay some 7 feet lower.

3. For the depths to the base of the Chalk and of other underlying formations agrees with the figure in Prof. Judd's paper, which, as above noted, differs slightly from the text.

According to a communication from Mr. W. Russ, in the earlier days of this well, when it left off in Upper Chalk, at a depth of 439 feet, the water rose slowly to the surface, on pumping being ceased, and overflowed at the rate of 2 gallons a minute; whilst the yield was about 300 gallons a minute when the water was pumped down to below 130 feet.

Southwark.—*Barclay and Perkins's Brewery. New well.* **1871.**

Sunk and communicated by Messrs. Docwra & Son.

About 12 feet above Ordnance Datum.

Shaft (and cylinders) 211 feet; the rest bored. Connected with the old well (disused) by a gallery, near the bottom of the London Clay.

Water-level 72½ feet down. [113 feet during pumping, April, 1877, according to Mr. J. Lucas.]

Made ground			15
[Alluvium, 20 ft.]	Black peat		3
	Blue bungham [? clay]		2
[Valley Drift, 7 ft.]	Sand		1
	Gravel		6
Blue [London]	Clay		79
[Woolwich and Reading Beds, 59 ft.]	Mottled clay		4
	Sand		6
	Mottled clay		14
	Sand		3
	Dark shelly clay		5
	Blue shelly clay		2
	Mottled clay		4½
	White sand and pebbles		3½
	[Bottom bed]	Green sand and pebbles	10
		Brown sandy clay	4
		Blue sandy clay	3
Grey [Thanet] Sand			37½
Chalk, with flints			235
			437½

Southwark.—*Belfast and London Aërated Water Company, 29, Bankside.*

Made and communicated by Messrs. G. Isler & Co.

Shaft 12 feet; the rest bored.

Water-level 114½ feet down. Yield (minimum) 3000 gallons an hour.

		FT.	IN.
Made ground		7	0
[River Drift, 27 ft.]	Grey sand	20	0
	Ballast [gravel]	7	0
Blue [London] Clay		75	0
[Reading Beds, 56¾ ft.]	Mottled clay	22	9
	Stone	1	0
	Sand and mud	4	6
	Mottled clay and pebbles	14	3
	Congealed ballast [pebble-conglomerate] ...	1	6
	Pebbles	0	9
	Sand and ballast [pebbles]	3	3
	Clay and pebbles	8	9
Green [Thanet] Sand		37	5
Chalk and flints		97	0
		300	2

Streatham Common.—*Southwark and Vauxhall Water Co.*

Communicated by Mr. J. W. Restler, Engineer to the Company. 110 feet above Ordnance Datum.

Gravel, &c.	10
London Clay	153
Woolwich and Reading Beds	? 43 (+)
Thanet Beds	? 35
Chalk	623
Upper Greensand	29 (−)
Gault (not bottomed, January, 1886) ...	147
	1040

I had hoped that Prof. Prestwich would give a detailed account of this important work to the Geological Society; but from pressure of work he has felt obliged to give up the task, and has asked me to take it up. Pending the completion of the boring it is enough to note the thickness of the formations passed through.

Thames Ditton.—*Lambeth Water Works. Trial-boring.* 1879. *W. side of Filter-bed, and a little S. of the Thames.*

Ground-surface of Engine-yard over 35½ feet above Ordnance Datum.

Communicated by Mr. J. Taylor, Engineer to the Company.

Top soil and loam			2
Gravel			20
London Clay			263
[Woolwich and Reading Beds, 74½ ft.]	Mottled clay		50
	Very fine sand		6
	Sandy mottled clay		5
	Dark green sandy clay		13½
[Thanet Sand, 25½ ft.]	Coarse sand, full of water		20½
	Dark loamy sand		3
	Green sandy clay, and red mottled clay		2
	Layer of flints.		
		To Chalk	385

Thorpe.—*Holloway Sanatorium. Less than a quarter of a mile N.N.E. of Virginia Water Station.* 1884.

Sunk and communicated by Messrs. T. Tilley & Son.

Shaft 115 feet; the rest bored.

Water-level (from the Chalk) about 40 feet down; but the yield, at 360 feet, not more than 2 gallons a minute.

[Lower Bagshot Sand, and passage-beds into London Clay ?]		110
[London Clay.]	Clay, with beds of stone [septaria], pebbles and pyrites	325
	Sandy clay, and vein of hard stone	4
[Reading Beds, 86 ft.	Mottled clay	32
	Dirty sand, beds of clay, and some water	20
	Sand	2
	Sand rock and water	9½
	Live sand	1½
	Dark clay, with brown spots	13
	Clay, with veins of sand, and some chalk	8
Chalk		275
		800

Tooting.—*The Brewery* (*Atlie's*). 1874.

Sunk and communicated by Mr. G. Eastell. See also Mr. J. Lucas, Journ. Soc. Arts, vol. xxv., p. 610.

52 feet above Ordnance Datum.

Water rose 8 feet above the ground. Supply plentiful.

To Chalk, 114 feet; in Chalk, 14 feet; total, 128 feet.

Vauxhall. — *Messrs. Barrett & Co., Zoedone Works, Bond Street.* 1881.

Sunk and communicated by Messrs. Legrand and Sutcliff.

Shaft 13½ feet; the rest bored.

Water-level 52 feet down; in July, 1885, according to Mr. W. H. Dalton, 57¾.

Gravel		15
[London Clay, 110 ft.]	Blue clay	106
	Stones [? flint-pebbles. Basement-bed]	4
[Woolwich and Reading Beds, 45 ft.]	Mixed clays	18
	Sand	7
	Limestone [? race] and mottled clay	1
	Clay and stones [? flint-pebbles]	19
Green [Thanet]	Sand and stones	37
Chalk and flints		77½
		284½

Walworth.—*White & Co.'s Mineral Water Works, Victory Place, Rodney Road.* 1884 ?

Sunk and communicated by Messrs. Legrand and Sutcliff.

		FT.	IN.
Soil and sandy gravel		18	6
Blue [London] Clay		25	0
[Woolwich and Reading Beds, 64¾ ft.]	Grey sand	5	0
	Grey stone	0	5
	Blue sandy clay and shells; Light-grey clay	1	4
	Brown and grey clay	1	0
	Brown clay	7	0
	Brownish-red and grey clay	3	0
	Brown and grey clay	12	0
	Blue clay and shells	3	0
	Yellow and grey clay, with gravel	6	0
	Mottled clay	5	0
	Grey sand	2	0
	Mottled clay, with black pebbles	6	0
	Grey sandy clay, with white pebbles	7	0
	Dark green sandy clay	6	0
[Thanet Sand, 38¾ ft.]	Hard dead grey sand	20	0
	Live grey sand	18	0
	Flints	0	9
Chalk and flints		64	0
		211	0

I have some doubt as to the division between the London Clay and the Woolwich and Reading Beds, which may perhaps be a little lower than above.

West Molesey.—*Lambeth Water Works. Trial-boring.* 1879.

Made and communicated by Messrs. T. Docwra and Son.

By the side of the Thames, at the E. edge of the new reservoir, about 33½ feet above Ordnance Datum.

Water overflowed.

Made ground		$9\frac{1}{2}$
[? Alluvium or artificial] clay and loam		$6\frac{1}{2}$
Gravel		10
Blue [London] Clay		300
[Woolwich and Reading Beds, 86 ft.]	Mottled clay	35
	Mottled clay and green sand	23
	Sand and loam	7
	Mottled clay	10
	Dark sand and clay	1
	Green sand and clay	10
[Thanet Sand, 14 ft.]	White sand	2
	Light-coloured sand and loam	12
Chalk		36
		462

Wimbledon. — *Sanitary Laundry. By the London and South Western Railway,* 700 *yards W. from the Station.* 1882 or 1883?

Communicated by Mr. W. S. Crimp.

70 feet above Ordnance Datum.

Shaft 60 feet; the rest bored.

Water rises to $14\frac{1}{2}$ feet below the surface. Yield about 30 gallons a minute.

London Clay		168
[Woolwich and Reading Beds, 51 ft.]	Light-green fine sand	1
	Brown mottled sand	1
	Green mottled sand	1
	Green and buff sand	5
	Shells	2
	Dark red mottled clay	16
	Dark red and buff mottled clay	7
	Fine green sand	18
[Thanet] dark greenish grey sand		44
Chalk		150
		413

Wimbledon. — *Sewage Works, Hayden's Lane (E. side, N. of Railway Station).* 1875.

Sunk and communicated by Mr. T. Tilley.

About 52 feet above Ordnance Datum.

Shaft 25 feet; the rest bored.

Water rose nearly to the surface. Yield under 10 gallons a minute.

[London Clay, 186 ft.]	Dull red clay	22
	Blue clay	164
[Reading Beds] Mottled clay		56
Green and grey [Thanet] Sand		37
Chalk, with flints		121
		400

Worcester Park Station.—*London and South Western Railway.*

Communicated by Messrs. S. F. Baker & Sons.
About 70 feet above Ordnance Datum.
Water overflows.
To sand, with water, 281 feet; to mottled clay, 289 feet.

57.—Notes upon the Evolution of the Highest Types of Human Form, within historical times, in the most highly civilized nations. [Illustrated].

By W. F. Stanley, F.G.S.

(Read December 9th, 1885).

It is quite evident and naturalists are agreed that human beings are of one species, although there are great variations in size, form, colour, and intellectual capacity, this last being the special mark of humanity. As these variations have no doubt come about in the course of time, I thought it would be interesting to our Society to make a few notes on such variations as are evident within a relatively recent period, since man attained that high form of intellectual development in which he was able to delineate his own image, or by his knowledge of arts to preserve the remains of his own body.

The earliest record of man's presence on the earth is found in the Upper Tertiary strata, which extend for a period in the past that has been estimated by Dr. Croll at within a quarter of a million to half a million of years. In this early period man has left no higher record of his presence than a large number of flakes of flint which he probably split off by the aid of another flint to form such tools and weapons as his intelligence demanded. From this flint implement period until the present time he appears from his remains to have been a slowly progressive being, and has left permanent records of his progression. The rough flint implements disappear in the more recent strata, and we then have the ground flint shaped to superior form, and the invention of simple articles of domestic use in bone and pottery. Then later we find he has the knowledge to reduce and cast metals, and form alloys (bronze) which melt at a moderate temperature, and afterwards to produce and work iron, which relatively late discovery was possibly nearly contemporary with the power of recording permanent architectural monuments of his skill.

The period at which man possessed the power of delineating his own form with approximate accuracy is possibly within

6000 years, and it is within this period only that I wish to offer some notes of progressive changes which have occurred in the most highly civilized types of man of which we have record, according to man's own delineation of his form at the time. These changes have no doubt been greatly varied in separate races, and in separate individuals in each race; but of race distinction I am unable to take recognition in this paper, as we have no historical record, in continuous types, in any one race who have remained progressive throughout the whole historical time. I am able, therefore, only to follow such races as happened to possess artistic skill, and which may be therefore assumed to be of the highest human types of the period considered, and in this I will confine myself to the inhabitants of the shores of the Mediterranean, the Aryan and Semitic groups only.

By the term *progressive development* I wish to indicate the adaptability of the human form to its most perfect modern uses in securing man the moral and intellectual superiority he possesses above all other members of the animal creation. The natural direction of this progressive development may be found as an illustration in the progressive development of man in his embryo state, in which he progresses through higher types of animal forms, until he becomes the perfect human being. In this development, as with other animals, the brain system developes most rapidly at an early stage, so as to indicate that nervous systems are hereditary in a high degree, whereas the osseous and muscular system is slowly progressive throughout the embryo state, and until perfect maturity. Upon this principle the brain of an infant is large in proportion to its body, whereas the limbs are more nearly proportional to the ancient type.

The progressive development of race as a natural condition is secured by the fact that any superiority, mental or physical, gives to the race in competition the means of living, whereas the lower race is compelled to die out. This superiority runs throughout all conditions, as we find man, even of a low or savage type, attains a mastery over an inferior race. The superior man attains also more perfect mastery over the lower animals upon which he feeds, as also of the vegetable kingdom, by clearing useless trees and plants, and planting fruit-bearing or edible ones; so in like manner any higher type of man replaces the lower type, and gains a still more perfect mastery over the vegetable, animal, and mineral world, as we find where civilized man plants his foot in any country the lower human type dies out. This fact is quite evident in America, Australia, Tasmania, the Sandwich Isles, and otherwise, with the British race, and has no doubt been the constant rule, so that the result must be that the former lowest types are lost by invasion of more intelligent and necessarily migratory races which finally prevail.

It is no purpose of my present paper to discuss man's progressive evolution from a lower animal type than man,—this has already been done by numerous philosophers, headed by the late Charles Darwin; neither is it my purpose to correlate the higher types of man with savages, to point out variations intermediate between the highly civilized races and the more animal types,—this has already been done, to the satisfaction of naturalists generally, by Mr. Wallace, Mr. Romains, and others. But it will be necessary briefly to refer to such work as we find generally accepted by naturalists, to point out the direction in which the changes I wish to note in the progressive form of man have taken place, and carried man in his later development (as possibly at all former periods), farther and farther from some common animal type.

We may briefly define the laws affecting man's form, which the evolutionist has apparently established to the satisfaction of the modern naturalist, as—

1. That his development is progressive from the embryo to the perfect form. Thus, assuming man originally derived from a lower animal type, then through his first life period in an early fœtal state until his perfect manhood, he moves progressively to more man-like proportions. Therefore, on this principle, the child is nearer to the lower animal form than the adult.

2. That the progress or variation made by the parents is afterwards transmitted in a certain degree to the offspring, so that the offspring may be in a state to attain as high a development as the parent.

3. That qualities or powers which are practised advantageously to the being will be accelerated in development during life, and those that are disadvantageous and neglected will be retarded.

Following physical conditions only, and assuming our modern manhood in its most perfect form as imitated by our eminent sculptors and painters at present to be the highest type, the points most marked in which man has progressed from a lower or more animal type of form in relation to his separate parts within recent or historical times, according to representations of ancient art, may be stated as follows:—

HEAD. — Large frontal brain. Less retreating forehead. Relatively more backward position of the ear in the skull. Smaller face. Less prominent jaws. Less projecting cheek-bones. Less angle to the edges of the jaws. Smaller mouth. Larger chin.

BODY. — Greater entire stature. Greater differences in the form of the body in the two sexes. Absence of hair on the body.

LIMBS.—Shorter arms. More opposable thumb. Greater difference in the length and size of the fingers. Longer legs. Shorter feet. Shorter toes; the first toe generally longer than second toe, formerly the reverse.

The earliest records of the human form, by fairly correct drawing or sculpture of the most civilized nations, are the Egyptian, both of themselves and of surrounding nations, and then the Abyssinian, after which follows the more perfect work of the Greek artists. The Egyptian and Abyssinian depicted forms are nearly all in profile. They were possibly first drawn from the shadow. It is for this reason possibly we find very correct and recognizable profile types of the Arab, Jew, and Negro; but in these drawings the eyes are placed flat on the profile and out of perspective; on the other hand the ears are correctly drawn, being possibly traced round an amputated ear.

The notes I have made are principally on original works and copies in the British Museum and Crystal Palace. In the latter buildings we have possibly the finest collection in the world of models taken directly from the antique. In these we may observe:—

The Head.—In the Egyptian, Arabian and Persian figures, drawn in relief upon the walls of tombs, as at Memnonium, Thebes, B.C. 1200, of which we have a model at the Crystal Palace, we find the foreheads all very low; the ear is also large and much more forward than its modern position; the facial angle is also lower than in the modern civilized man, and it is well known that this angle has increased within quite recent times, but as this angle depends partly on the projection of the jaws, it should rather be taken in relation to the vertical than the facial angle, as a mark of progressive development.

Heads of Jews, Memnonium, Thebes, B.C. 1260; showing low facial angle. (Crystal Palace).

In skulls of Egyptian mummies the internal capacity is a mean of about 52 cubic inches, and smaller internal capacity holds in antique skulls generally, wherever found. In modern

European skulls the brain measures about 66 inches. There are, however, variations in this particular, both ancient and modern, so that we can only estimate from the mean, which indicates with certainty a smaller capacity in ancient skulls. In the ancient skulls generally there is greater development in the jaws, the cheek-bone projects more, the teeth generally project more, the chin less, and the lower jaw is wider and stronger.

Body.—Greater entire stature. This matter is somewhat difficult to follow with certainty, as the scale to which the human figure is represented in paintings and sculpture varies, being often much exaggerated for the figures of important persons. We have, however, on this subject, the important evidence of the bodies of great men and women preserved as mummies, and as it is the rule that the aristocracy of any nation are the tallest and finest human forms, we may assume this rule always held. Thus, in the British Museum we have twenty-five mummies exhibited of important persons, which I have measured as carefully as I can; allowing for wrappings, the average height of the bodies are, — males 61 inches, females 55 inches. The mummy of the celebrated Cleopatra measures 54 inches; the body is represented on the bottom of the coffin about 4 feet 4 inches, which was possibly her true height, the feet being extended as much as possible. This is about the average height of an English girl of eleven. In some very ancient mummies' coffins recently found in the Third Pyramid, about 3000 B.C., a King Menkaura measured 52 inches; a king of Sixth Period measured 56 inches. That the Egyptian of the period depicted was of average height to surrounding nations may be inferred by sepulchral paintings, where the Egyptian, Negro, Jew, and other nations are represented of about equal height, as seen in the painting over the doorway in the Egyptian room of the British Museum. The same may be observed in the Abyssinian monuments, where Egyptians and other nations are represented of about equal height. By inference, the average civilized man has increased in height not less than 6 inches within 4000 years.

As regards the form of the two sexes, it appears from Egyptian and Grecian monuments that the waist of the two sexes was equal in proportion to the general dimensions of the body. The man's waist in the Egyptian monuments was comparatively smaller, and the woman's waist larger than the modern, but no doubt the modern female waist is much compressed below its natural size by stays. The Venus di Medici is 36 inches, the modern lady 28 inches.

Absence of smooth hair on the body as a general feature.—We may infer from early writers, Aristotle and others, that infants were very frequently born covered with hair. I think we may accept the narrative of Jacob and Esau as indicating this as a common occurrence at the time this narrative was written, as the circumstance is mentioned without comment as anything remarkable. The state of hairiness of Esau is very clearly defined, in that Rebekah put the skin of a kid upon Jacob's hands and upon the smooth of his neck to deceive Isaac, and we are told the device answered perfectly. Very few races, even of savages, retain hair over the body at the present time, and no races possess it in the animal-like form of the kid here inferred.

Proportion of limbs.—The arm in all antique works appears longer in proportion than in the modern figure. The cause of this is generally that the legs have increased in length, more particularly the thigh-bone. The short thigh-bones are very evident in all Egyptian statues. The cast of Amnothph III. (B.C. 1260) in the Crystal Palace shows this in a marked degree, In the excellent bas-reliefs of Sennacherib's Palace (B.C. 800), in the British Museum, the arms of the figures approach nearly the length of the legs. This proportion, in diminishing ratio, is found to hold in Grecian works as well as with Abyssinian. Thus, in the Apollo Belvedere, which has been considered the most perfect form, the arm exceeds by nearly the length of the hand the proportions of the modern human figure given by Marshall, who is taken as the highest authority by artists. That this is a progressive variation is indicated in that the child at birth, as before mentioned, has arms and legs of equal length, the same as many of the apes.

The following are the modern proportions, according to Marshall, of the growth of an average individual (67 inches high), which I reduce from proportional scale of heads as given by Marshall * to inches.

	Entire Height.	Head.	Body.	Legs.	Arms.
Birth	21 ins.	4·5	8·5	8·5	8·5
1st year	28	6	11·5	12	11
4th ,,	37·5	7·5	14	17·5	15·5
9th ,,	48	8	17	25	20·5
15th ,,	59	8·5	21	32	22·5
25th ,,	67	9	24·5	36	29·5

The measurements of the legs are from the ball of the femur to the sole of the foot; the arm from the ball of the humerus to the tip of the longest finger. By this table we see the much

* 'A Rule of Proportion for the Human Figure,' by John Marshall, F.R.S., &c., 1879.

greater proportional growth of the legs than of other parts of the body, and these proportions fairly well indicate the direction of development from ancient to modern forms, as regard the dimensions of the body, not the head as before observed.

Typical Egyptian hand (Rameses I., B.C. 1170), showing long and large fourth finger. (Brit. Museum).

As regards the hands, these were formerly proportionally larger, and, if we may infer from Egyptian sculptures, flatter, the thumb being less opposable. The little finger was also larger and longer. In many of the Egyptian figures the fingers are nearly of one length. In a skeleton mummy hand in the British Museum the second and third fingers measure about $3\frac{3}{4}$ inches. The fore-finger and little finger, which are of about equal length, $3\frac{1}{4}$ inches, as nearly as I could measure though the glass case.

The feet were generally longer and flatter, the big toe never being the longest in the early works and scarcely above the others in size. This is no doubt partly due to pressure in boots but the development of the great toe has possibly been constant, and due to walking in an erect attitude. The modern toe is little over half the average length of the fingers. In Egyptian figures the toes approach more nearly the length of the fingers, as in the Quadrumana. In the statue of Rameses II., which is in the best style of Egyptian art, the second or longest toe measures $2\frac{1}{4}$ inches, the longest finger measures $2\frac{3}{4}$ inches. It is possible that the great toe, of which we have now lost the use, was at one period opposable in a certain degree as the thumb is, as we find in Egyptian monuments mechanics holding wood, leather, &c., between the first and second toe, for instance; a

Currier (Thebes, B.C. 1300), showing sitting position for work and use of toes. The engraver has cut the first toe of right foot much too thick.

currier dressing one end of a strap with his two hands, which is held by his toes at the other end. The Japanese and some Indians appear to have retained the use of the toes. Mechanical trades, at which it is now customary to work in a standing attitude, were formerly worked at in a sitting, squatting, or kneeling attitude, such as carpenters, cabinet-makers, masons, rope-makers, &c., as we find these trades depicted on the walls in Thebes.* So that we may assume that when the foot was more hand-like, and the leg more arm-like, the foot could be used as a hand, and the leg and foot were less developed for standing and walking, and that the sitting position was less fatiguing, particularly as a working position. Progressive development appears to have so far differentiated these members in our higher types that the hand has become perfect for work only, and the foot and leg have been developed for walking and standing only. The separate toes in highly civilized races are now useless, and will possibly in time be absorbed.

I have made these observations in what time I could spare on the subject, but I have no doubt they would bear some revision under more extended observation. The perfect development of the human being is under constant checks, which retard it in various directions. His development is also influenced by his average employment. Perfect development is only compatible with sufficient supply of nutritious food, and well-fed people are on an average taller. On the other hand, the selection of the tallest men for soldiers, who therefore do not enter domestic life to reproduce their forms, and are more exposed to danger and death, lowers the general average stature of the future race. The hand being used for refined operations, depends on a perfect thumb and forefinger; and as a prehensile hand is little used in civilized society, so the little finger especially diminishes. But the modern general practice of piano music may again develop this finger.

58.—Report of the Meteorological Committee on the Temperature and the Rainfall of the Croydon District, for the five years 1881–85.

By Henry Storks Eaton, M.A., F.R.Met.Soc., Secretary to the Committee.

In the Report of the Meteorological Sub-Committee, presented at the Annual Meeting of the Club on the 10th of January, 1885, an expectation was held out that the committee might ere

* Kings and important persons were always in ancient statues sculptured sitting.

long be in a position to lay before the members a statement of the main features of the climate of the Croydon district,[1] from observations then in progress. The sub-committee has now the pleasure of placing on record the air-temperature and the rainfall for the five years 1881–85 inclusive, at various stations in the Club district; and although a period of five years is far too short to afford fundamental data, either of the temperature or of the rainfall, yet comparing one station with another the results are of great interest.

The stations where trustworthy observations of temperature, conducted on the same systematic plan, have been made, are seven in number, namely, Park Hill, Croydon, 259 feet above sea-level; Addiscombe, 202 feet; South Norwood, 190 feet; West Norwood, 185 feet; Waddon, 156 feet; Wallington, 132 feet; and Beddington Lane, 102 feet. As given here they are in the order of their height above sea-level, commencing with the greatest elevation. The observers were respectively Mr. Baldwin Latham, Mr. E. Mawley, Mr. W. F. Stanley, Mr. W. Marriott, Mr. Philip Crowley, Mr. F. C. Bayard, and Mr. T. Rostron. The observers at Park Hill, Waddon House, and Wallington have communicated their observations directly to the committee. The results for the other stations have been compiled from 'The Meteorological Record' of the Royal Meteorological Society. The thermometers have all been tested at the Kew Observatory, and the necessary corrections, if any, applied to the observations. They are exposed on the stand recommended by the Royal Meteorological Society, namely, the Stevenson screen, which admits a free circulation of the air, and effectually cuts off reflected heat and rain.

Besides the above, corresponding records of temperature are given for the Royal Observatory, Greenwich, 159 feet above sea-level, and for the Kew Observatory, inasmuch as they are in the Club district, and are observatories of the first order. But the stands are of different construction; the one at Greenwich a revolving stand which has been employed, with trifling modifications, ever since the year 1841, neither protects the instruments from rain, nor from reflected heat, and in fine weather, when the sun is north of the equator, higher maximum readings are recorded there than elsewhere. At Kew, for the first two years of the series, the daily extremes of temperature were taken from the thermograph, and for the last three years by ordinary maximum and minimum thermometers suspended in the thermograph screen. In 1881, 1882, and 1883, temperature observations were also taken at Chelsham, on the North Downs,

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[1] The district is defined in the First Report of the Botanical Sub-Committee, read Dec. 18th, 1878, 'Transactions,' vol. i. p. 8.

610 feet above sea-level; but the thermometers were read only to whole degrees, and the minimum thermometer was liable to get out of order; the results must therefore be accepted with some reservation.

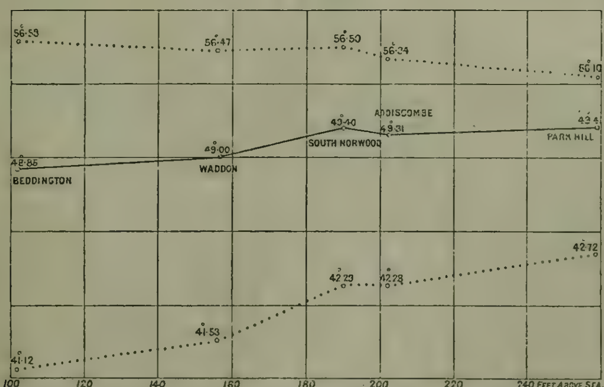
In regard to the positions of the stations, Park Hill, Addiscombe, and South Norwood are practically on the boundary separating the drainage areas of the Wandle and Graveney from the Ravensbourne. Park Hill station is near the top of the hill, and both it and Addiscombe have a northern exposure, the inclination of the ground at the former being the greater. South Norwood is on a slope facing S.S.W., near the bottom of Norwood Hill. Waddon, Wallington and Beddington are in the Wandle Valley. Waddon is on a knoll surrounded on all sides by slightly lower ground. The situation is a very open one on the eastern slope of the knoll. Wallington is on ground declining to the north. Beddington is on level ground, with Mitcham Common not far off to the north-west, and the Irrigation Farm to the west and south-west. The above are all included within an area measuring 4 miles from north-east to south-west—South Norwood to Wallington—by 2½ miles from south-east to north-west—Park Hill Rise to Beddington Lane, and the town of Croydon lies within this area on the eastern side of it. These stations are hereafter referred to as the Croydon stations. West Norwood is 4 miles north of Croydon, in the drainage area of the Effra, and is by so much nearer London. The Royal Observatory, Greenwich, is on a promontory jutting out from the table-land in the Park, the ground falling away quickly to the north and north-west. The Kew Observatory is in the Old Deer Park, Richmond, upon a low mound, on flat land adjacent to the Thames.

The monthly temperature tables accompanying this communication include the average daily minimum and the daily maximum, the absolute lowest and the highest temperature, the daily range of temperature, and the mean temperature, the latter being the simple mean of the daily lowest and highest temperatures (Table I.). The figures in italics for the first nine months of 1881, at Waddon, have been interpolated, as the Stevenson screen was not established till August of that year. They have been computed on the assumption that the temperature at Waddon for the months in question preserved the same ratio to that at South Norwood and Beddington combined, as in the other years of the series. For convenience of reference, separate tables have been prepared of the daily lowest (Table II.) and highest (Table III.) temperatures, and the daily range of temperature (Table IV.) at the five Croydon stations, and of the mean monthly and annual temperature (Table V.) at the eight stations where continuous records have been maintained.

As being closely connected with the range of temperature, a table of the mean humidity of the air at West Norwood is appended, which is sufficiently near to, and will serve for, all the stations in the district. It will be noticed that the mean temperatures at Greenwich and at West Norwood are the highest in the list. At the latter place this is probably attributable to its closer proximity to London. The excess is 0°·42 above the average of the Croydon stations, and varies from 0°·66 in June to 0°·15 in November. It does not depend upon difference of elevation, as the average elevation of the five Croydon stations is 182 feet, and of West Norwood 185 feet, a difference of only 3 feet.

At the Royal Observatory, Greenwich, another important and more potent factor comes in. There it seems that the recorded maximum temperatures are vitiated by the character of the thermometer stand, to which reference has been already made, whereby the readings of the thermometers exposed on it are raised above the true temperature of the air by reflected heat, when the sun is shining. The excess above the Croydon stations is small from October to March, 0°·20, and depends to a slight extent on the lower elevation of Greenwich above sea-level, but with the sun north of the equator it is accentuated, being 1°·29 for the six months, April to September, and in July it reaches 1°·67. In fact, in bright weather in the height of summer the maximum temperature, as recorded at the Royal

Fig. 1.



The upper dotted line shows the mean maximum daily temperature, the lower dotted line the mean minimum, and the continuous line the mean temperature from all the temperature observations, 1881—85.

Observatory, sometimes exceeds by several degrees that observed anywhere else in the neighbourhood.

The mean temperature at the Kew Observatory agrees closely with that of the Croydon stations, allowance being made for difference of elevation, but the daily range of temperature is smaller, partly from the sluggishness of the thermograph used in the first two years, partly from the construction and exposure of the screen, and partly perhaps from the modifying influence of the Thames.

Of the Croydon stations, the mean temperature at Beddington is 48°·84, then follows Waddon with a temperature of 49°·00, at Addiscombe it is 49°·31, at South Norwood 49·°40, and at Park Hill 49°·41. Park Hill, the highest station, is thus 0·56° warmer than Beddington, the lowest station.

The annexed table shows briefly the main features of the annual temperature at Croydon. (See also Fig. 1, page 79).

	Height. above sea.	Daily lowest.	Daily highest.	Daily range.	Mean.
	Feet.	°	°	°	°
Park Hill	259	42·72	56·10	13·38	49·41
Addiscombe ...	202	42·28	56·34	14·06	49·31
South Norwood	190	42·29	56·50	14·21	49·40
Waddon	156	41·53	56·47	14·94	49·00
Beddington ...	102	41·12	56·58	15·48	48·85

This subversion of the general rule, that the temperature diminishes with greater elevation, might possibly be attributed to sensible heat being abstracted from the lower ground in raising vapour from the water-meadows of the Irrigation Farm. But if that were the case the diminution of temperature at Beddington would be greatest by day, when the air is dry and evaporation active. On the contrary, the daily maximum temperature is highest at Beddington, 56°·58, and diminishes in a regular manner, with increasing elevation, to 56°·10 at Park Hill; while at night the temperature declines from 42°·72 at Park Hill to 41°·12 at Beddington. The phenomenon, however, may be due to the different positions of the stations referred to, Beddington and Waddon being on the floor of the Wandle basin, and South Norwood, Addiscombe and Park Hill on higher ground on the boundary between the valleys of the Wandle and the Ravensbourne. It has been shown on a former occasion,[2]

[2] 'Transactions,' 1881, p. 91.

from observations taken in the district, that in clear weather the air in contact with the ground is sometimes cooled and rendered denser by radiation, and gradually descends the hills to low-lying grounds, displacing the warmer air below, and in this way, by the accumulation of cold air in the valley of the Wandle, in fine dry weather the temperature at Beddington and Waddon is lowered at night below that of the other stations. Moreover, this hypothesis is confirmed by the table of relative humidity computed from the West Norwood observations, from which it will be seen that, roughly, the degree of humidity varies inversely as the extent of depression of temperature at the lower stations. Comparing Park Hill with Beddington, in the seven months ending March, the average minimum temperature at Beddington was less than that at Park Hill by 1°·8, the contemporaneous degree of humidity at Norwood having been 87 ; but from April to August, when the degree of humidity at Norwood was only 75, the average minimum temperature at Beddington was lower than at Park Hill by 2°·5. The driest month of all was July, 1881, and on that occasion the average difference amounted to 3°·5 and the extreme to 7°·1, and in January, 1881, the driest of the Januarys, the differences were respectively 2°·5 and 5°·8.

Conditions resembling these as regards the distribution of temperature exist without doubt in the valley of the Ravensbourne. In fact, very low temperatures have been recorded in the more contracted parts of the valley, as at Catford Bridge, the latent heat evolved on the descent of the air and its coming under higher pressure and contracting in volume being insufficient to counteract the cold produced by radiation.

At Chelsham, where temperature observations for two years and nine months are available for comparison, the average was 1°·85 less than at the Croydon stations for the corresponding period, showing a diminution of temperature at the rate of 1° per 231 feet increase of elevation, and the daily range of temperature was less at Chelsham by 0°·5.

As compared with the temperature of the air, the rainfall has been far more extensively observed in the Club district. Nearly all the hill stations were established several years ago, by Mr. Baldwin Latham, by whose assistance it has alone been possible adequately to investigate the rainfall of the North Downs. Mr. G. J. Symons, the well-known authority on British rainfall, has kindly permitted free use to be made of his annual publication, and wherever temperature observations were taken the rain was also observed.

In tabulating the returns, when two or more gauges have been maintained at the same place, only the records of the one nearest the ground have been included. With this deduction, no less than seventy separate records have been preserved, which have been arranged on the same plan as was adopted in the enquiry into the temperature, according to the elevation of the station above sea-level, from the highest to the lowest.

In the first table (Table VII.), the name of every station is included where observations of rain have been taken at any time during the five years, with a distinguishing number affixed to it; then follow the height of the gauge above sea-level, the height of the receiving-surface above the ground, the diameter of the gauge, the total rainfall for each year, and the average annual rainfall where the series has been complete. The succeeding table (Table VIII.) gives the monthly rainfall from about thirty stations for each year. A further selection has been made out of these, where the records have been continuous and the observations in other respects satisfactory. Table IX. includes twenty-one stations; it exhibits the average monthly and annual rainfall of each separately and with the stations grouped in zones for every 200 feet difference of elevation. The next table (Table X.), which is on a similar plan, records the number of days in the year on which rain fell at sixteen stations, being those where this feature of the climate of the district seems to have been observed with care. The number of stations is less than in Table IX., as it frequently happens, where the rain is the only meteorological element observed, that the fall of several days is allowed to accumulate before being measured, and, although the total depth may be correct, the record of rainy days is erroneous. Finally, the numbers in Table IX. have been converted into ratios of the monthly to the annual fall, and are given in Table XI.

In a few instances, when the position was an important one, and the 5-years' register complete all but a month or two, interpolations have been made on the same system as was adopted for computing the temperature at Waddon, By this method it is assumed that the fall of rain for the months when observations were lacking at a station, bore the same ratio to the depth of rain for the remainder of the year at that station as was observed at the adjoining station or stations where the register was uninterrupted. In every such case, or when any alteration has been made, the figures are given in italics, as are also those for the first nine months of 1881 at Waddon, when a different gauge was used to what was afterwards employed, and in a different position; and for the last five months of 1885, at Botley Hill Farm, where the returns seem incorrect.

An instructive instance of the importance of securing a good site for the rain-gauge occurred at South Norwood. Here, in 1884, the comparatively small annual rainfall attracted attention, and it was thought that the position of the instrument, on the top of a bank about 9 feet high, might account for it. The observer therefore established a second gauge at the foot of the bank some 20 feet from the old one, and registered the rain by both gauges. The result was, that in 1885 the amount collected by the new gauge was between 5 and 6 per cent. greater than by the old. In this case the bank faced S.S.W,; and there can be no doubt that, in a driving rain from the south-west, the up-draft of air caused by the bank carried some of the rain over and past the mouth of the old gauge without its entering it.

Simple and easy as it may seem to find the true rainfall for any place, it is not always so in practice. The gauge may be perfect, the observer most careful, and yet after all the record may be misleading. It is sometimes impossible to secure perfect exposure with adequate protection for the instrument. Again, the growth of trees may so influence local currents of air as to cause a greater or a less amount of rain to be collected on any one spot near them, although there has been no alteration in the total amount, only a different distribution. Some such causes seem to have been in operation in one or two cases, in consequence of which the returns have been excluded from the tables of selected stations.

The fall of rain was under the average if the 45-year mean at Greenwich be accepted as a standard for the district; for from 1841 to 1885 inclusive it was 24·67 inches, and from 1881 to 1885 only 22·97 inches. The annual rainfall of the twenty-one selected stations collectively was as under:—

	Depth.	Difference from average.	
	Inches.	Inches.	Per cent.
1881	28·79	+1·77	+ 7
1882	29·81	+2·79	+10
1883	26·45	− ·57	− 2
1884	21·60	−5·42	−20
1885	28·43	+1·41	+ 5

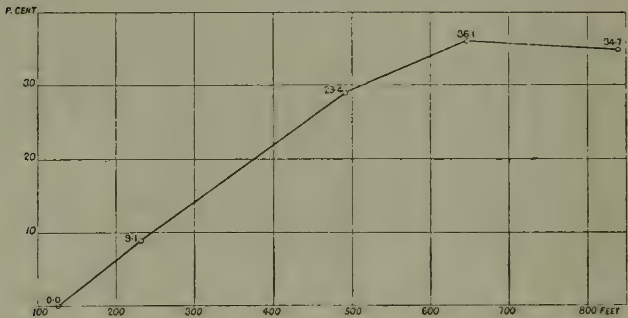
Mean 27.02

The chief point for remark here is the great deficiency of rain in 1884.

The grouping of the stations into zones in the latter tables brings out some very interesting results.

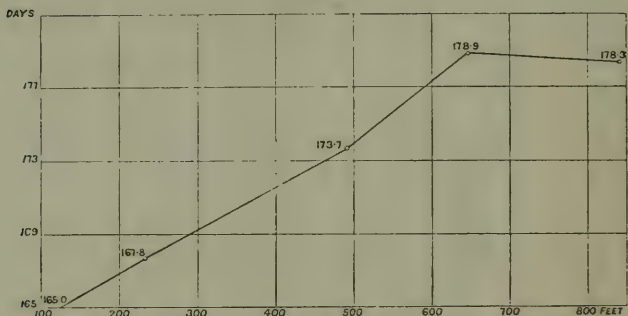
Taking the groups successively and representing the rainfall in the lowest group at the average elevation of 124 feet by 100, in the group at 234 feet it is 109·1; at 493 feet 129·4, and at 648 feet 136·1; from whence it diminishes at 841 feet to 134·7. Hence it follows that between 124 feet and 234 feet the rate of increase of depth of rain for 100 feet of elevation is 8·27 per cent.; between 234 feet and 493 feet this falls off to 7·84 per

Fig. 2.



Percentage of increase of rainfall with elevation, 1881—85.

Fig. 3.



Number of days annually on which not less than 0·005 inch of rain fell, 1881—85.

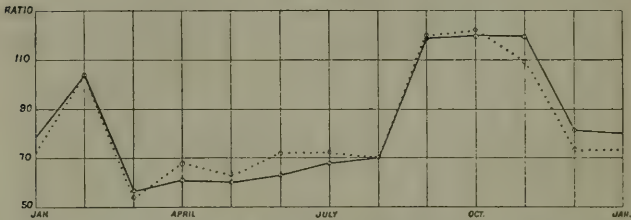
cent.; between 493 feet and 648 feet it further diminishes to 4·32 per cent.; and in the highest group of all at 841 feet the increase is altogether lost and is succeeded by a decline in the amount of rain from the preceding group to the extent of 0·37 per cent. for 100 feet. The foregoing results are shown by Fig. 2, page 84, and they may be taken as representing generally the distribution of the annual rainfall between the Thames and the southern escarpment of the South Downs and between the Rivers Mole and the Darent. The largest amount of rain then, and as will be shown presently the greatest number of rainy days, occurs, not on the ridge of the South Downs, but some distance on the lee side in regard to the prevalent rainy south-westerly winds. The amount at similar elevations above sea-level seems also to diminish from west to east, for in Surrey the mean annual rainfall at nineteen stations, having an average elevation of 304 feet, was 26·49 inches, while in Kent, at nine stations having an elevation of 313 feet, it was 25·29 inches. The number of rainy days, a rainy day being reckoned as one on which not less than 0·005 inch of rain is measured, has been similarly examined; the results given in Table X., and shown graphically by Fig. 3, indicate a close correspondence with the depth of rain. In the zone of greatest rainfall—600 to 800 feet—the number of rainy days in the year was 178·9, and in that of least rainfall—below 200 feet,—it was 165·0 days.

Briefly summarized, the rainfall in the district from 1881 to 1885 inclusive, was as under:—

Elevation above sea-level.	Depth of rain.	Rainy days.
Feet.	Inches.	
Above 800	31·36	178·3
Between 600 and 800	31·66	178·9
,, 400 and 600	29·12	173·7
,, 200 and 400	25·39	167·8
Below 200	23·27	165·0

The last point for consideration is the monthly rainfall in connection with the altitude of the stations above sea-level, and for this purpose they have been grouped separately into those above and those below 400 feet. The result is that in every month the depth of rain is greater in the upper group, which includes ten stations at an average elevation of 594 feet. But the table of ratios of the monthly to the annual fall shows that in spring and summer there is a larger amount of rain proportionately in the lower group of eleven stations at an average elevation of 193 feet (see Fig. 4, p. 86). This condition of the rainfall is associated with the relative humidity of the atmosphere. When that is low, or, in other words, when the air is dry, a relative excess of rain is experienced at the lower stations,

Fig. 4.



Ratio of the monthly to the annual rainfall, 1881—85. Continuous line, 10 upper stations; average elevation, 594 feet above sea-level. Dotted line, 11 lower stations; average elevation, 193 feet above sea-level.

while a high degree of humidity is favourable to a more copious precipitation at the upper stations. Numerically the proportion of the rainfall of the upper to that of the lower group for the five months, November to March, was as 106 to 100, the number of rainy days being as 107·7 to 100; and for the seven months, April to October, it was as 96 to 100, and the number of rainy days as 105·3 to 100, the relative humidity of the air for the corresponding periods being respectively 87 and 78.

TABLE I.—TEMPERATURE OF THE AIR, JANUARY.

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	23·5	33·2	35·1	..	..	..	34·2	42·2	43·8	..	..	..
Park Hill	26·3	35·9	36·6	39·3	32·0	34·0	36·0	43·9	44·7	47·2	39·8	42·3
Addiscombe	26·6	35·9	37·1	39·4	31·8	34·2	36·2	45·0	45·8	48·1	40·7	43·2
S. Norwood	25·5	35·3	36·4	38·6	32·1	33·6	36·3	44·8	45·9	48·3	40·8	43·2
W. Norwood	26·7	35·4	37·1	39·4	32·9	34·3	36·2	44·8	45·6	48·1	40·5	43·0
Waddon	*24·7*	35·5	36·5	38·5	31·4	*33·3*	*36·3*	44·9	45·4	48·5	40·3	*43·1*
Wallington	..	..	..	..	31·9	..	..	..	..	..	40·3	..
Beddington	23·8	34·6	36·1	38·8	31·1	32·9	36·4	44·6	45·7	48·0	40·4	43·0
Greenwich	27·3	35·3	36·3	39·2	32·3	34·1	36·2	44·4	45·4	47·8	40·2	42·8
Kew	27·2	35·7	37·2	39·8	33·5	34·7	36·1	44·7	45·7	47·6	40·3	42·9

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Lowest.						*Highest.*					
Park Hill	13·0	28·0	28·0	30·5	24·3	24·8	50·0	52·5	54·0	54·6	54·1	52·5
Addiscombe	11·6	26·9	26 7	31·0	23·0	23·8	50·4	53·5	55·1	54·9	51·5	53·1
S. Norwood	11·1	26·8	29·1	30·8	24·6	24·5	49·7	52·7	57·1	54·9	51·8	53·2
W. Norwood	10·8	25·2	28·1	31·4	22·0	23·5	49·7	53·0	54·7	55·0	52·6	53·0
Waddon	..	24·8	29·0	29·8	24·0	..	..	53·6	54·1	55·3	51·2	..
Wallington	..	..	..	..	22·2	..	..	..	..	..	51·8	..
Beddington	7·2	22·3	27·9	31·1	22·4	22·2	52·3	54·6	54·3	55·0	51·9	53·6
Greenwich	12·7	25·4	28·8	31·2	22·3	24·1	50·0	52·9	55·0	55·3	52·8	53·2
Kew	9·4	23·4	29·3	32·1	25·4	23·9	48·8	52·8	54·8	54·2	52·4	52·6

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	10·7	9·0	8·7	..	..	..	28·8	37·9	39·4	..	..	..
Park Hill	9·7	8·0	8·1	7·9	7·9	8·3	31·2	39·9	40·6	43·2	35·9	38·2
Addiscombe	9·6	9·1	8·7	8·7	8·9	9·0	31·4	40·5	41·5	43·7	36·3	38·7
S. Norwood	10·8	9·5	9·5	9·7	8·7	9·6	30·9	40·1	41·1	43·5	36·4	38·4
W. Norwood	9·5	9·4	8·5	8·7	7·6	8·7	31·5	40·1	41·3	43·8	36·7	38·7
Waddon	*11·7*	9·4	8·9	10·0	8·9	*9·8*	*30·8*	40·2	41·0	43·5	35·8	*38·2*
Wallington	..	..	..	..	8·4	..	..	..	..	..	36·1	..
Beddington	12·6	10·0	9·6	9·2	9·3	10·1	30·1	39·6	40·9	43·4	35·8	38·0
Greenwich	8·9	9·1	9·1	8·6	7·9	8·7	31·7	39·9	40·8	43·5	36·3	38·4
Kew	8·9	9·0	8·5	7.8	6·8	8·2	31·7	40·2	41·4	43·7	36·9	38·8

Table I.—Temperature of the Air, February.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	31·5	34·8	36·0	..	..	..	39·8	45·2	46·1	..	..	..
Park Hill	33·9	36·9	37·1	37·5	39·4	37·0	41·9	46·8	47·7	46·7	48·2	46·3
Addiscombe	33·6	37·3	37·8	37·3	39·4	37·1	42·6	47·9	48·6	47·9	48·6	47·1
S. Norwood	33·6	36·6	36·8	37·0	39·3	36·7	42·5	47·4	48·9	47·6	49·0	47·1
W. Norwood	33·6	37·0	37·6	37·6	39·1	37·0	42·3	47·9	48·6	47·9	49·2	47·2
Waddon	*33·6*	36·4	36·7	37·3	38·3	*36·5*	*42·0*	47·2	48·2	47·1	48·4	*46·6*
Wallington	..	..	..	..	38·3	..	..	..	..	..	48·7	..
Beddington	33·7	35·9	36·8	37·2	38·1	36·3	42·1	47·3	48·5	47·1	48·7	46·7
Greenwich	33·5	36·2	37·2	36·8	38·6	36·5	42·5	47·7	48·5	47·7	49·4	47·2
Kew	33·9	37·4	37·9	38·1	39·0	37·3	42·1	47·7	48·4	47·6	49·0	47·0
	Lowest.						*Highest.*					
Park Hill	28·0	25·4	31·1	27·9	26·0	27·7	51·2	55·0	53·0	55·2	56·8	54·2
Addiscombe	26·2	34·3	28·7	27·4	25·0	26·3	52·3	56·0	53·8	56·1	56·5	54·9
S. Norwood	25·9	24·1	29·7	27·6	24·7	26·4	51·9	55·9	55·4	56·7	56·2	55·2
W. Norwood	25·4	22·7	32·7	28·2	26·0	27·0	52·7	56·7	54·3	56·6	57·8	55·6
Waddon	..	23·0	30·4	29·0	24·2	..	..	54·9	54·1	54·9	56·7	..
Wallington	..	..	..	..	23·2	..	..	..	..	..	56·6	..
Beddington	25·4	22·1	30·2	27·4	23·2	25·7	51·8	57·5	54·0	55·1	57·0	55·1
Greenwich	26·1	24·8	30·9	27·8	26·9	27·3	54·0	55·4	55·2	57·6	58·3	56·1
Kew	26·4	23·2	29·4	29·8	27·6	27·3	52·3	55·1	54·7	54·8	56·1	54·6
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	8·3	10·4	10·1	..	..	..	35·7	40·0	41·1	..	..	..
Park Hill	8·0	9·9	10·5	9·2	8·8	9·3	37·9	41·9	42·4	42·1	43·8	41·6
Addiscombe	9·0	10·6	10·8	10·6	9·2	10·0	38·1	42·6	43·2	42·6	44·0	42·1
S. Norwood	8·9	10·8	12·1	10·6	9·7	10·4	38·1	42·0	42·8	42·3	44·1	41·9
W. Norwood	8·7	10·9	11·0	10·3	10·1	10·2	37·9	42·5	43·1	42·7	44·2	42·1
Waddon	*8·4*	10·8	11·5	9·8	10·1	*10·1*	*37·8*	41·8	42·5	42·2	43·4	*41·5*
Wallington	..	..	..	..	10·4	..	..	..	..	..	43·5	..
Beddington	8·4	11·4	11·7	9·9	10·6	10·4	37·9	41·6	42·7	42·1	43·4	41·5
Greenwich	9·0	11·5	11·2	10·9	10·8	10·7	38·0	42·0	42·8	42·3	44·0	41·8
Kew	8·2	10·3	10·5	9·5	10·0	9·7	38·0	42·5	43·1	42·9	44·0	42·1

Table I.—Temperature of the Air, March.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	34·1	36·0	28·6	..	..	..	48·5	51·6	40·5	..	..	..
Park Hill	35·9	38·7	30·1	38·0	33·5	35·2	50·2	53·7	42·2	50·9	47·6	48·9
Addiscombe	35·7	38·2	30·1	37·7	33·2	35·0	50·5	54·6	42·7	51·1	48·0	49·4
S. Norwood	35·8	38·0	29·7	37·3	33·1	34·8	51·1	54·3	43·1	51·6	48·2	49·7
W. Norwood	35·8	37·9	30·1	37·9	33·2	35·0	50·8	54·9	43·2	51·8	48·4	49·8
Waddon	*35·5*	37·4	29·6	36·7	32·4	*34·3*	*50·5*	54·1	42·5	51·0	47·3	*49·1*
Wallington	.	..	..	..	32·4	..	..	..	..	..	48·3	..
Beddington	35·2	36·8	29·4	36·4	31·7	33·9	50·9	55·1	42·5	51·2	47·7	49·5
Greenwich	35·5	37·6	29·3	37·4	32·5	34·5	51·1	55·1	44·1	52·7	49·0	50·4
Kew	36·0	38·2	30·1	38·1	33·6	35·2	49·9	53·9	42·9	50·9	47·4	49·0
	Lowest.						*Highest.*					
Park Hill	23·0	27·8	20·0	27·4	28·2	25·3	60·4	62·8	54·0	66·3	58·5	60·4
Addiscombe	23·2	28·2	20·9	26·6	26·7	25·1	61·4	64·0	55·3	66·8	60·0	61·5
S. Norwood	23·6	27·7	20·1	25·9	26·2	24·7	60·6	64·5	56·6	68·3	60·7	62·1
W. Norwood	24·0	27·0	19·9	26·8	26·2	24·8	59·9	64·8	53·6	67·6	59·5	61·1
Waddon	..	25·8	18·0	25·6	25·0	..	..	63·3	54·3	66·4	59·5	..
Wallington	..	..	..	..	23·7	..	..	..	..	..	60·1	..
Beddington	22·4	25·1	19·1	25·1	23·9	23·1	60·3	64·7	54·3	66·7	59·5	61·1
Greenwich	24·6	28·8	20·6	27·3	25·2	25·3	59·8	65·0	56·7	68·8	60·2	62·1
Kew	25·1	30·6	22·6	27·8	25·0	26·2	59·2	61·7	53·5	66·1	59·0	59·9
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	14·4	15·6	11·9	..	..	..	41·3	43·8	34·5	..	..	..
Park Hill	14·3	15·0	12·1	12·9	14·1	13·7	43·0	46·2	36·2	44·4	40·6	42·1
Addiscombe	14·8	16·4	12·6	13·4	14·8	14·4	43·1	46·4	36·4	44·4	40·6	42·2
S. Norwood	15·3	16·3	13·4	14·3	15·1	14·9	43·4	46·2	36·4	44·4	40·7	42·2
W. Norwood	15·0	17·0	13·1	13·9	15·2	14·8	43·3	46·4	36·6	44·9	40·8	42·4
Waddon	*15·0*	16·7	12·9	14·3	14·9	*14·8*	*43·0*	45·7	36·1	43·9	39·8	*41·7*
Wallington	..	..	..	..	15·9	..	..	..	..	..	40·3	..
Beddington	15·7	18·3	13·1	14·8	16·0	15·6	43·1	46·0	35·9	43·8	39·7	41·7
Greenwich	15·6	17·5	14·8	15·3	16·5	15·9	43·3	46·3	36·7	45·1	40·7	42·4
Kew	13·9	15·7	12·8	12·8	13·8	13·8	43·0	46·0	36·5	44·5	40·5	42·1

TABLE I.—TEMPERATURE OF THE AIR, APRIL.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	35·6	38·1	36·3	..	..	..	52·1	53·8	53·8	..	..	..
Park Hill	37·8	40·8	38·9	38·2	39·6	39·1	54·1	55·6	55·8	52·8	55·9	54·8
Addiscombe	37·4	40·2	37·8	37·1	39·3	38·4	54·4	55·9	56·0	52·4	56·7	55·1
S. Norwood	37·9	40·6	37·8	37·6	39·6	38·7	54·7	56·2	56·1	52·9	55·7	55·1
W. Norwood	37·6	40·0	38·1	37·6	39·6	38·6	54·5	56·4	56·6	53·0	56·4	55·4
Waddon	*37·3*	39·6	36·8	36·6	38·3	*37·7*	*54·5*	56·4	55·8	52·5	55·4	*54·9*
Wallington	..	..	..	..	39·0	..	..	..	..	..	55·9	..
Beddington	37·4	39·2	36·4	36·5	37·6	37·4	55·0	56·4	55·7	52·6	56·0	55·1
Greenwich	37·5	39·8	37·4	37·1	38·9	38·1	55·6	57·6	57·6	54·3	57·7	56·5
Kew	38·3	41·0	38·4	37·6	39·5	38·9	54·2	56·1	55·9	52·1	55·4	54·7
	Lowest.						*Highest.*					
Park Hill	25·6	32·0	28·2	27·3	26·9	28·0	66·0	63·0	65·9	65·9	72·0	66·6
Addiscombe	25·8	32·2	26·6	25·9	26·2	27·3	67·2	63·2	66·0	65·4	72·7	66·9
S. Norwood	25·9	31·9	28·1	24·5	26·3	27·3	66·3	63·3	67·0	67·0	71·6	67·0
W. Norwood	26·6	32·5	28·0	24·8	27·1	27·8	65·8	65·8	67·4	66·6	72·7	67·7
Waddon	..	31·2	24·0	21·8	22·0	..	..	63·1	65·9	65·9	71·9	..
Wallington	..	..	..	..	25·9	..	..	..	..	..	71·8	..
Beddington	23·2	29·7	25·4	22·0	22·6	24·6	66·3	64·1	66·1	66·8	71·4	66·9
Greenwich	29·3	31·8	28·2	27·0	28·1	28·9	66·1	65·7	69·1	68·7	73·6	68·6
Kew	29·9	33·6	29·8	27·9	31·2	30·5	66·8	62·7	64·9	65·3	70·2	66·0
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	16·5	15·7	17·5	..	..	..	43·9	45·9	45·0	..	..	..
Park Hill	16·3	14·8	16·9	14·6	16·3	15·7	46·0	48·2	47·3	45·5	47·8	47·0
Addiscombe	17·0	15·7	18·2	15·3	17·4	16·7	45·9	48·1	46·9	44·7	48·0	46·7
S. Norwood	16·8	15·6	18·3	15·3	16·1	16·4	46·3	48·4	47·0	45·2	47·6	46·9
W. Norwood	16·9	16·4	18·5	15·4	16·8	16·8	46·1	48·2	47·3	45·3	48·0	47·0
Waddon	*17·2*	16·8	19·0	15·9	17·1	*17·2*	*45·9*	48·0	46·3	44·6	46·8	*46·3*
Wallington	..	..	..	..	16·9	..	..	..	..	..	47·4	..
Beddington	17·6	17·2	19·3	16·1	18·4	17·7	46·2	47·8	46·1	44·5	46·8	46·3
Greenwich	18·1	17·8	20·2	17·2	18·8	18·4	46·5	48·7	47·5	45·7	48·3	47·3
Kew	15·9	15·1	17·5	14·5	15·9	15·8	46·2	48·6	47·1	44·9	47·4	46·8

Table I.—Temperature of the Air, May.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	41·7	42·1	41·5	..	..	..	60·4	60·6	59·7	..	..	..
Park Hill	44·1	45·2	44·1	45·2	42·1	44·1	63·9	63·7	61·2	63·7	57·1	61·9
Addiscombe	43·3	44·4	43·6	44·0	41·9	43·4	63·3	63·5	60·9	63·1	57·1	61·6
S. Norwood	43·9	44·9	43·5	43·8	42·2	43·7	63·8	64·1	61·1	63·6	57·0	61·9
W. Norwood	43·6	45·0	44·0	44·4	41·8	43·8	64·4	64·3	61·9	64·1	58·0	62·5
Waddon	*42·9*	43·7	42·7	43·5	41·1	*42·8*	*64·1*	63·7	61·3	63·9	57·6	*62·1*
Wallington	..	..	..	..	41·3	..	..	..	..	..	57·6	..
Beddington	42·1	43·0	41·7	42·7	40·8	42·1	64·2	63·8	61·4	63·7	57·6	62·1
Greenwich	43·6	44·2	43·5	43·8	41·3	43·3	65·8	66·2	63·7	65·7	60·3	64·3
Kew	44·0	45·9	44·2	44·7	42·3	44·2	63·3	63·4	61·1	62·8	57·1	61·5
	Lowest.						*Highest.*					
Park Hill	30·0	35·3	30·0	37·2	33·1	33·1	79·3	70·9	76·2	79·8	69·9	75·2
Addiscombe	28·6	34·5	29·9	36·9	33·0	32·6	76·3	71·2	75·8	78·4	69·1	74·2
S. Norwood	29·6	33·9	30·9	34·5	32·0	32·2	79·6	72·4	76·9	78·6	68·8	75·3
W. Norwood	28·4	32·8	30·5	36·0	32·0	31·9	77·7	72·8	77·9	79·6	71·1	75·8
Waddon	..	32·4	29·0	34·0	31·0	..	..	70·9	76·9	78·8	69·7	..
Wallington	..	..	..	..	32·1	..	..	..	..	..	69·8	..
Beddington	25·8	32·0	28·1	33·6	30·3	30·0	76·5	71·1	77·2	79·3	69·9	74·8
Greenwich	30·9	34·5	30·3	35·6	31·8	32·6	78·3	76·5	81·0	78·5	74·8	77·8
Kew	31·5	36·8	31·8	35·7	33·4	33·8	76·1	71·9	76·0	75·2	70·3	73·9
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	18·7	18·5	18·2	..	..	..	51·0	51·4	50·6	..	..	..
Park Hill	19·8	18·5	17·1	18·5	15·0	17·8	54·0	54·4	52·6	54·5	49·6	53·0
Addiscombe	20·0	19·1	17·3	19·1	15·2	18·2	53·3	54·0	52·2	53·6	49·5	52·5
S. Norwood	19·9	19·2	17·6	19·8	14·8	18·2	53·9	54·5	52·3	53·7	49·6	52·8
W. Norwood	20·8	19·3	17·9	19·7	16·2	18·7	54·0	54·7	52·9	54·2	49·9	53·1
Waddon	*21·2*	20·0	18·6	20·4	16·5	*19·3*	*53·5*	53·7	52·0	53·7	49·3	*52·4*
Wallington	..	..	..	..	16·3	..	..	..	..	..	49·4	..
Beddington	22·1	20·8	19·7	21·0	16·8	20·0	53·2	53·4	51·5	53·2	49·2	52·1
Greenwich	22·2	22·0	20·2	21·9	19·0	21·0	54·7	55·2	53·6	54·7	50·8	53·8
Kew	19·3	17·5	16·9	18·1	14·8	17·3	53·6	54·7	52·6	53·8	49·7	52·9

TABLE I.—TEMPERATURE OF THE AIR, JUNE.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	47·1	46·8	47·3	..	..	..	65·3	62·1	66·8	..	..	..
Park Hill	50·1	49·4	49·7	49·5	50·6	49·9	67·2	63·8	68·1	66·7	68·8	66·9
Addiscombe	49·3	49·3	48·9	48·8	50·2	49·3	66·7	63·6	67·7	66·1	68·3	66·5
S. Norwood	49·6	49·0	48·9	48·8	50·3	49·3	67·2	63·9	68·9	66·1	68·3	66·9
W. Norwood	49·4	48·8	49·6	49·6	50·4	49·6	68·2	64·7	69·1	67·1	68·7	67·6
Waddon	*48·7*	48·5	48·4	47·9	48·8	*48·5*	*67·9*	64·5	68·5	66·5	69·1	*67·3*
Wallington	..	..	..	..	50·0	..	..	..	..	..	68·5	..
Beddington	47·9	47·7	47·2	47·2	48·7	47·7	68·3	64·3	69·1	66·7	68·8	67·4
Greenwich	49·7	48·9	48·9	49·1	49·2	49·2	70·0	66·3	70·8	69·3	70·9	69·5
Kew	50·5	49·3	49·6	50·6	50·0	50·0	67·7	64·2	67·8	66·8	67·2	66·7
	Lowest.						*Highest.*					
Park Hill	36·2	41·0	40·1	43·0	39·4	39·9	80·0	72·0	79·1	80·3	80·6	78·4
Addiscombe	35·2	40·1	40·1	41·7	39·1	39·2	79·0	71·5	81·4	79·0	79·5	78·1
S. Norwood	37·6	40·1	40·1	41·6	38·8	39·6	80·6	71·6	83·5	80·3	79·7	79·1
W. Norwood	37·5	40·8	39·8	40·5	39·2	39·6	80·1	72·7	83·6	80·4	81·7	79·7
Waddon	..	38·0	36·2	39·8	37·0	..	..	72·9	81·2	78·8	79·6	..
Wallington	..	..	..	..	38·1	..	..	..	..	..	80·5	..
Beddington	31·9	36·8	36·0	37·9	36·7	35·9	81·9	71·3	82·8	79·9	81·0	79·4
Greenwich	38·5	40·9	40·4	42·7	39·4	40·4	83·9	74·1	84·8	82·6	84·7	82·0
Kew	38·5	41·3	41·1	41·1	41·2	40·6	78·2	72·2	83·4	80·1	80·4	78·9
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	18·2	15·3	19·5	..	..	..	56·2	54·5	57·0	..	..	..
Park Hill	17·1	14·4	18·4	17·2	18·2	17·0	58·6	56·6	58·9	58·1	59·7	58·4
Addiscombe	17·4	14·3	18·8	17·3	18·1	17·2	58·0	56·4	58·3	57·5	59·2	57·9
S. Norwood	17·6	14·9	20·0	17·3	18·0	17·6	58·4	56·4	58·9	57·5	59·3	58·1
W. Norwood	18·8	15·9	19·5	17·5	18·3	18·0	58·8	56·7	59·4	58·3	59·6	58·6
Waddon	*19·2*	16·0	20·1	18·6	20·3	*18·8*	*58·3*	56·5	58·5	57·2	58·9	*57·9*
Wallington	..	..	..	..	18·5	..	..	..	..	..	59·3	..
Beddington	20·4	16·6	21·9	19.5	20·1	19·7	58·1	56·0	58·2	56·9	58·8	57·6
Greenwich	20·3	17·4	21·9	20·2	21·7	20·3	59·8	57·6	59·9	59·2	60·0	59·3
Kew	17·2	14·9	18·2	16·2	17·2	16·7	59·1	56·8	58·7	58·7	58·6	58·4

TABLE I.—TEMPERATURE OF THE AIR, JULY.

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	52·2	50·6	49·4	..	..	..	73·5	65·9	66·3	..	..	..
Park Hill	55·4	52·9	52·2	54·5	53·0	53·6	74·8	68·1	67·1	72·2	74·5	71·3
Addiscombe	54·5	52·5	51·5	53·9	52·4	53·0	74·5	67·9	67·4	71·8	72·7	70·9
S. Norwood	55·1	52·5	51·5	53·3	52·7	53·0	74·6	67·8	67·6	72·1	73·4	71·1
W. Norwood	54·8	52·3	51·8	54·0	53·0	53·2	75·7	69·1	68·4	72·9	73·8	72·0
Waddon	*53·4*	51·5	50·3	52·4	50·4	*51·6*	*75·6*	68·7	68·5	72·9	73·6	*71·9*
Wallington	..	..	..	..	51·8	..	..	..	..	..	74·0	..
Beddington	52·9	51·4	50·2	52·1	50·5	51·4	76·1	68·4	68·5	73·4	74·0	72·1
Greenwich	54·9	52·5	51·3	53·5	52·5	52·9	77·7	71·1	70·7	75·3	77·0	74·4
Kew	55·1	53·3	52·0	54·3	53·6	53·7	74·5	68·8	68·1	72·1	73·0	71·3
	Lowest.						*Highest.*					
Park Hill	44·4	44·5	46·1	42·3	43·0	44·1	93·6	75·0	79·6	83·0	88·0	83·8
Addiscombe	42·1	44·1	43·1	42·4	42·6	42·9	92·4	75·4	80·2	83·0	85·3	83·3
S. Norwood	44·9	43·0	42·6	42·1	41·9	42·9	94·1	75·1	81·7	84·7	86·7	84·5
W. Norwood	43·9	43·7	42·9	43·0	43·0	43·3	93·4	77·2	82·4	84·1	87·1	84·8
Waddon	..	44·9	41·6	38·4	37·6	..	..	75·9	80·0	82·8	85·3	..
Wallington	..	..	..	..	39·1	..	..	..	..	..	87·8	..
Beddington	37·3	44·4	40·8	37·9	38·0	39·7	93·2	75·0	81·9	84·9	86·5	84·3
Greenwich	43·9	45·7	43·6	42·3	44·7	44·0	97·1	78·7	83·3	88·1	90·2	87·5
Kew	44·1	42·8	44·1	43·7	47·1	44·4	90·0	75·5	82·0	83·9	85·8	83·4
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	21·3	15·3	16·9	..	..	..	62·9	58·2	57·8	..	..	..
Park Hill	19·4	15·2	14·9	17·7	21·4	17·7	65·1	60·5	59·7	63·3	63·8	62·5
Addiscombe	20·0	15·4	15·9	17·9	20·3	17·9	64·5	60·2	59·5	62·9	62·6	61·9
S. Norwood	19·5	15·3	16·1	18·8	20·7	18·1	64·8	60·1	59·5	62·7	63·1	62·1
W. Norwood	20·9	16·8	16·6	18·9	20·8	18·8	65·2	60·7	60·1	63·4	63·4	62·6
Waddon	*22·2*	17·2	18·2	20·5	23·2	*20·3*	*64·5*	60·1	59·4	62·7	62·0	*61·7*
Wallington	..	..	..	..	22·2	..	..	..	..	..	62·9	..
Beddington	23·2	17·0	18·3	21·3	23·5	20·7	64·5	59·9	59·3	62·7	62·3	61·8
Greenwich	22·8	18·6	19·4	21·8	24·5	21·5	66·3	61·8	61·0	64·4	64·7	63·6
Kew	19·4	15·5	16·1	17·8	19·4	17·6	64·8	61·0	60·1	63·2	63·3	62·5

TABLE I.—TEMPERATURE OF THE AIR, AUGUST.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	49·8	49·9	51·4	..	..	..	64·5	66·5	70·5	..	..	..
Park Hill	51·9	52·4	53·9	54·2	50·5	52·6	66·9	68·0	71·6	76·0	68·1	70·1
Addiscombe	51·5	51·7	53·0	52·9	49·8	51·8	66·9	67·9	71·0	75·5	66·6	69·6
S. Norwood	51·6	52·2	53·3	53·3	50·4	52·2	66·8	67·8	71·5	75·8	67·0	69·8
W. Norwood	51·4	52·2	54·0	53·8	50·2	52·3	67·5	68·9	71·8	76·0	67·5	70·3
Waddon	*50·3*	50·4	52·0	51·5	48·8	*50·6*	*67·8*	68·4	72·0	76·5	67·3	*70·4*
Wallington	..	..	..	..	49·1	..	..	..	..	..	67·5	..
Beddington	50·3	50·4	51·6	51·2	48·5	50·4	68·2	68·0	71·7	76·9	67·6	70·5
Greenwich	51·6	51·7	52·8	53·6	49·8	51·9	69·7	70·5	74·0	78·7	69·8	72·5
Kew	51·6	52·5	53·4	53·8	50·4	52·3	66·6	68·2	70·8	75·4	66·6	69·5
	Lowest.						*Highest.*					
Park Hill	42·5	44·5	43·0	43·1	41·5	42·9	80·4	79·4	81·0	89·1	78·1	81·6
Addiscombe	42·0	43·8	42·3	41·8	39·1	41·8	80·7	79·4	80·6	88·8	78·0	81·5
S. Norwood	43·0	43·7	44·9	43·1	42·1	43·4	81·6	80·5	80·1	89·2	78·0	81·9
W. Norwood	42·9	42·9	45·0	44·6	40·2	43·1	82·9	80·4	81·6	89·7	79·4	82·8
Waddon	..	39·4	42·4	39·0	36·0	..	..	78·8	82·2	90·8	78·8	..
Wallington	..	..	..	..	36·4	..	..	..	..	..	78·8	..
Beddington	38·8	39·7	41·0	38·7	35·6	38·8	82·5	80·3	81·4	91·7	78·5	82·9
Greenwich	43·1	44·0	44·8	45·8	40·2	43·6	85·4	81·0	85·1	94·2	80·2	85·2
Kew	43·1	45·0	46·0	46·1	42·1	44·5	80·7	80·0	79·2	89·2	76·4	81·1
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	14·7	16·6	19·1	..	..	..	57·2	58·2	61·0	..	..	..
Park Hill	15·0	15·6	17·7	21·8	17·6	17·5	59·4	60·2	62·8	65·1	59·3	61·4
Addiscombe	15·4	16·2	18·0	22·6	16·8	17·8	59·2	59·8	62·0	64·2	58·2	60·7
S. Norwood	15·2	15·6	18·2	22·5	16·6	17·6	59·2	60·0	62·4	64·6	58·7	61·0
W. Norwood	16·1	16·7	17·8	22·2	17·3	18·0	59·4	60·6	62·9	64·9	58·9	61·3
Waddon	*17·5*	18·0	20·0	25·0	18·5	*19·8*	*59·0*	59·4	62·0	64·0	58·1	*60·5*
Wallington	..	..	..	..	18·4	..	..	..	..	..	58·3	..
Beddington	17·9	17·6	20·1	25·7	19·1	20·1	59·2	59·2	61·7	64·0	58·1	60·4
Greenwich	18·1	18·8	21·2	25·1	20·0	20·6	60·6	61·1	63·4	66·2	59·8	62·2
Kew	15·0	15·7	17·4	21·6	16.2	17·2	59·1	60·3	62·1	64·6	58·5	60·9

TABLE I.—TEMPERATURE OF THE AIR, SEPTEMBER.

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	47·4	44·7	48·7	..	..	..	60·7	60·3	63·5	..	..	..
Park Hill	49·6	47·2	50·8	52·7	48·6	49·8	63·1	62·3	65·0	66·7	62·8	64·0
Addiscombe	48·7	46·0	49·9	51·6	48·3	48·9	63·0	62·3	65·0	67·0	62·6	64·0
S. Norwood	49·4	46·6	50·3	52·3	48·0	49·3	63·4	62·6	64·6	67·8	62·7	64·2
W. Norwood	48·5	46·7	50·3	52·0	48·1	49·1	63·8	62·7	65·4	67·8	63·2	64·6
Waddon	*48·5*	45·3	49·3	51·0	46·9	*48·2*	*63·7*	63·1	65·3	67·6	63·2	*64·6*
Wallington	..	..	..	..	48·0	..	..	..	..	..	63·0	..
Beddington	48·2	44·7	48·9	50·4	46·6	47·8	63·4	62·5	64·9	67·7	62·8	64·3
Greenwich	48·8	46·6	49·7	51·3	49·8	49·2	64·6	64·0	66·4	69·2	69·8	66·8
Kew	48·8	46·7	50·2	52·0	50·4	49·6	63·1	62·4	64·9	66·8	66·6	64·8
	Lowest.						*Highest.*					
Park Hill	37·9	35·3	42·0	41·9	32·1	37·8	72·1	67·8	75·0	80·5	73·8	73·8
Addiscombe	36·7	33·6	40·4	41·1	31·1	36·6	72·7	68·7	74·7	80·9	73·5	74·1
S. Norwood	39·6	33·4	40·7	41·9	32·2	37·6	73·7	68·2	75·0	83·7	74·0	74·9
W. Norwood	37·5	33·0	41·2	40·8	32·0	36·9	73·8	68·5	74·8	82·8	74·9	75·0
Waddon	..	33·2	38·0	39·0	29·0	..	..	69·3	75·1	81·8	73·9	..
Wallington	..	..	..	..	30·1	..	..	..	..	..	73·8	..
Beddington	36·7	32·9	37·1	38·0	28·1	34·6	73·0	68·3	75·0	83·3	74·1	74·7
Greenwich	39·0	36·7	41·5	42·4	30·6	38·0	72·9	71·1	77·1	83·5	76·4	76·2
Kew	39·4	35·5	42·1	41·1	33·7	38·4	71·3	68·0	73·6	80·5	72·9	73·3
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	13·3	15·6	14·8	..	..	..	54·0	52·5	56·1	..	..	..
Park Hill	13·5	15·1	14·2	14·0	14·2	14·2	56·4	54·8	57·9	59·7	55·7	56·9
Addiscombe	14·3	16·3	15·1	15·4	14·3	15·1	55·9	54·1	57·5	59·3	55·4	56·4
S. Norwood	14·0	16·0	14·3	15·5	14·7	14·9	56·4	54·6	57·5	60·0	55·4	56·8
W. Norwood	15·3	16·0	15·1	15·8	15·1	15·5	56·2	54·7	57·9	59·9	55·6	56·9
Waddon	*15·2*	17·8	16·0	16·6	16·3	*16·4*	*56·1*	54·2	57·3	59·3	55·0	*56·4*
Wallington	..	..	..	..	15·0	..	..	..	..	..	55·0	..
Beddington	15·2	17·8	16·0	17·3	16·2	16·5	55·8	53·6	56·9	59·0	54·7	56·0
Greenwich	15·8	17·4	16·7	17·9	20·0	17·6	56·7	55·3	58·1	60·2	59·8	58·0
Kew	14·3	15·7	14·7	14·8	16·2	15·2	56·0	54·5	57·6	59·4	58·5	57·2

TABLE I.—TEMPERATURE OF THE AIR, OCTOBER.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	..	43·2	43·5	..	..	..	..	55·2	54·4	..	..	..
Park Hill	38·7	45·4	45·4	42·4	41·2	42·6	51·8	56·5	56·1	55·4	51·6	54·3
Addiscombe	38·4	44·4	44·6	41·9	40·7	42·0	52·1	57·1	56·8	56·0	51·6	54·7
S. Norwood	38·5	44·6	44·9	42·0	40·6	42·1	52·1	57·1	56·5	56·4	52·2	54·9
W. Norwood	38·8	44·9	44·9	42·2	40·7	42·3	51·9	57·0	57·0	56·3	52·0	54·8
Waddon	37·9	44·6	44·3	41·0	39·9	41·5	52·0	57·2	56·8	56·5	52·0	54·9
Wallington	..	..	..	40·8	40·4	..	..	..	..	56·2	52·0	..
Beddington	37·3	43·8	44·2	40·5	39·8	41·1	52·0	56·8	56·5	56·1	51·9	54·6
Greenwich	39·0	44·7	44·5	41·6	40·1	42·0	52·4	57·7	57·1	56·5	52·4	55·2
Kew	39·6	44·4	44·9	41·9	40·9	42·3	51·5	56·8	56·4	55·6	51·7	54·4
	Lowest.						*Highest.*					
Park Hill	28·0	34·2	38·8	33·6	32·5	33·4	61·9	68·1	62·7	61·9	59·0	62·7
Addiscombe	26·1	31·5	37·9	31·1	32·0	31·7	62·2	68·2	63·2	62·0	58·9	62·9
S. Norwood	26·7	31·8	35·2	33·8	32·1	31·9	62·8	68·7	63·6	62·1	59·8	63·4
W. Norwood	25·6	31·9	37·9	33·0	31·0	31·9	61·9	68·7	63·7	62·5	59·5	63·3
Waddon	26·0	31·2	35·2	31·4	30·0	30·8	62·9	68·9	62·9	62·9	60·9	63·7
Wallington	..	..	..	31·1	30·7	..	..	..	..	63·3	59·3	..
Beddington	24·2	30·2	34·2	31·1	28·8	29·7	63·1	67·8	63·6	62·3	59·7	63·3
Greenwich	26·2	30·6	36·7	32·1	31·5	31·4	63·0	71·1	64·6	62·7	59·9	64·3
Kew	25·4	29·9	38·4	33·6	32·8	32·0	61·7	68·6	62·6	62·4	58·9	62·8
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	..	12·0	10·9	..	..	..	..	49·4	48·9	..	..	..
Park Hill	13·1	11·1	10·7	13·0	10·4	11·7	45·2	50·9	50·7	48·9	46·4	48·4
Addiscombe	13·7	12·7	12·2	14·1	10·9	12·7	45·3	50·7	50·7	49·0	46·1	48·4
S. Norwood	13·6	12·5	11·6	14·4	11·6	12·8	45·3	50·8	50·7	49·2	46·4	48·5
W. Norwood	13·1	12·1	12·1	14·1	11·3	12·5	45·3	51·0	50·9	49·3	46·3	48·6
Waddon	14·1	12·6	12·5	15·5	12·1	13·4	44·9	50·9	50·6	48·7	46·0	48·2
Wallington	..	..	..	15·4	11·6	..	..	..	..	48·5	46·2	..
Beddington	14·7	13·0	12·3	15·6	12·1	13·5	44·6	50·3	50·4	48·3	45·8	47·9
Greenwich	13·4	13·0	12·6	14·9	12·3	13·2	45·7	51·2	50·8	49·0	46·3	48·6
Kew	11·9	12·4	11·5	13·7	10·8	12·1	45·5	50·6	50·7	48·8	46·3	48·4

TABLE I.—TEMPERATURE OF THE AIR, NOVEMBER.

STATION.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	..	37·3	36·2	..	..	..	..	46·6	47·6	..	..	..
Park Hill	43·9	38·6	38·0	37·2	38·2	39·2	53·5	47·9	49·1	46·7	48·0	49·0
Addiscombe	43·2	38·7	38·4	36·1	37·9	38·9	54·4	49·1	49·7	47·3	47·9	49·7
S. Norwood	43·4	38·4	37·3	36·9	38·3	38·9	54·2	48·9	50·5	47·3	48·2	49·8
W. Norwood	42·8	38·6	38·1	36·7	38·2	38·9	54·1	48·7	49·3	47·4	48·1	49·5
Waddon	42·9	37·9	36·8	36·0	37·9	38·3	54·2	48·9	49·6	46·9	47·9	49·5
Wallington	..	..	..	35·5	37·7	..	..	..	..	46·4	48·2	..
Beddington	42·4	37·5	36·1	35·1	37·4	37·7	54·5	48·7	49·6	47·1	47·9	49·6
Greenwich	42·8	38·4	37·8	36·8	37·8	38·7	54·0	48·7	49·6	47·6	48·1	49·6
Kew	42·7	38·8	37·6	37·0	39·0	39·0	54·0	48·5	49·2	47·1	48·1	49·4
	Lowest.						*Highest.*					
Park Hill	30·5	25·5	29·5	25·5	28·3	27·9	61·5	59·7	55·9	60·0	58·1	59·0
Addiscombe	30·0	23·9	29·0	25·2	26·1	26·8	62·2	60·2	56·1	60·4	59·0	59·6
S. Norwood	30·3	24·1	28·6	25·1	27·2	27·1	61·1	59·9	59·5	59·8	58·1	59·7
W. Norwood	31·7	24·0	28·8	24·0	27·3	27·2	62·5	60·3	56·5	60·5	58·3	59·6
Waddon	30·2	22·0	25·4	23·0	26·0	25·3	62·0	60·0	57·4	60·2	58·2	59·6
Wallington	..	..	..	21·7	26·2	..	..	..	..	60·4	58·4	..
Beddington	29·4	21·7	24·8	20·2	24·5	24·1	63·0	59·6	56·2	60·1	58·2	59·4
Greenwich	30·1	24·4	27·8	24·5	28·1	27·0	63·3	60·1	56·2	61·2	58·2	59·8
Kew	29·3	24·6	29·3	25·5	31·1	28·0	61·5	59·8	56·0	58·9	58·4	58·9
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	..	9·3	11·4	..	..	..	..	41·9	41·9	..	..	..
Park Hill	9·6	9·3	11·1	9·5	9·8	9·8	48·7	43·3	43·5	42·0	43·1	44·1
Addiscombe	11·2	10·4	11·3	11·2	10·0	10·8	48·8	43·9	44·1	41·7	42·9	44·3
S. Norwood	10·8	10·5	13·2	10·4	9·9	10·9	48·8	43·7	43·9	42·1	43·2	44·3
W. Norwood	11·3	10·1	11·2	10·7	9·9	10·6	48·5	43·6	43·7	42·1	43·1	44·2
Waddon	11·3	11·0	12·8	10·9	10·0	11·2	48·6	43·4	43·2	41·4	42·9	43·9
Wallington	..	..	..	10·9	10·5	..	..	..	..	40·9	43·0	..
Beddington	12·1	11·2	13·5	12·0	10·5	11·9	48·5	43·1	42·8	41·1	42·7	43·6
Greenwich	11·2	10·3	11·8	10·8	10·3	10·9	48·4	43·5	43·7	42·2	43·0	44·2
Kew	11·3	9·7	11·6	10·1	9·1	10·4	48·4	43·6	43·4	42·1	43·5	44·2

Table I.—Temperature of the Air, December.

Station.	1881	1882	1883	1884	1885	1881—85	1881	1882	1883	1884	1885	1881—85
	Means of Daily Lowest.						*Means of Daily Highest.*					
	°	°	°	°	°	°	°	°	°	°	°	°
Chelsham	33·3	33·7	..	..	..	..	40·7	43·1	..	..	..	..
Park Hill	35·7	35·1	36·2	36·8	34·1	35·6	43·1	43·3	42·9	44·3	42·7	43·3
Addiscombe	35·6	35·4	35·9	37·0	33·6	35·5	44·3	44·4	45·0	45·5	43·1	44·5
S. Norwood	35·1	35·2	35·8	36·8	33·8	35·3	43·9	44·8	44·2	45·1	43·7	44·3
W. Norwood	35·0	35·9	36·3	37·0	34·4	35·7	44·0	44·2	44·7	45·6	43·2	44·3
Waddon	34·8	35·2	35·6	36·5	33·0	35·0	44·1	44·6	43·7	44·9	43·0	44·1
Wallington	..	..	..	36·8	33·7	..	..	..	..	44·9	43·4	..
Beddington	34·3	34·8	35·6	36·5	32·4	34·7	43·6	44·6	43·9	45·1	42·9	44·0
Greenwich	34·9	35·5	36·1	36·5	34·0	35·4	44·0	44·0	44·1	45·1	42·9	44·0
Kew	34·4	36·0	36·6	37·0	34·2	35·6	44·2	44·1	44·2	45·4	42·6	44·1
	Lowest.						*Highest.*					
Park Hill	23·5	17·2	28·2	28·5	21·5	23·8	52·4	56·4	54·3	55·0	51·0	53·8
Addiscombe	22·7	18·2	28·2	27·8	21·7	23·7	54·2	56·9	54·9	55·2	51·6	54·6
S. Norwood	27·1	19·6	28·4	28·2	21·0	24·9	53·6	57·1	55·1	55·3	51·9	54·6
W. Norwood	22·7	22·4	29·0	28·7	21·3	24·8	53·7	56·8	54·6	55·3	50·3	54·1
Waddon	22·0	17·0	25·0	28·0	20·0	22·4	53·4	56·7	54·1	54·9	50·9	54·0
Wallington	..	..	..	28·6	21·1	..	..	..	..	55·1	50·1	..
Beddington	19·1	19·2	26·4	28·4	19·9	22·6	53·4	56·5	54·1	55·2	51·7	54·2
Greenwich	21·6	22·2	28·4	26·7	23·3	24·4	53·7	56·9	54·2	55·1	50·2	54·0
Kew	23·7	22·4	29·4	26·3	23·2	25·0	53·5	57·1	54·0	54·5	50·4	53·9
	Mean Daily Range.						*Mean Temperature.*					
Chelsham	7·4	9·4	..	..	..	..	37·0	38·4	..	..	..	..
Park Hill	7·4	8·2	6·7	7·5	8·6	7·7	39·4	39·2	39·5	40·6	38·4	39·4
Addiscombe	8·7	9·0	9·1	8·5	9·5	9·0	40·0	39·9	40·4	41·3	38·3	40·0
S. Norwood	8·8	9·6	8·4	8·3	9·9	9·0	39·5	40·0	40·0	41·0	38·7	39·8
W. Norwood	9·0	8·3	8·4	8·6	8·8	8·6	39·5	40·0	40·5	41·3	38·8	40·0
Waddon	9·3	9·4	8·1	8·4	10·0	9·1	39·4	39·9	39·7	40·7	38·0	39·5
Wallington	.	..	..	8·1	9·7	..	..	..	..	40·9	38·5	..
Beddington	9·3	9·8	8·3	8·6	10·5	9·3	38·9	39·7	39·8	40·8	37·7	39·4
Greenwich	9·1	8·5	8·0	8·6	8·9	8·6	39·4	39·8	40·1	40·8	38·4	39·7
Kew	9·8	8·1	7·6	8·4	8·4	8·5	39·3	40·0	40·4	41·2	38·4	39·9

Table II.—Means of Daily Lowest Temperatures for the Five Years, 1881–85.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
Park Hill	34·0	37·0	35·2	39·1	44·1	49·9	53·6	52·6	49·8	42·6	39·2	35·6	42·72
Addiscombe	34·2	37·1	35·0	38·4	43·4	49·3	53·0	51·8	48·9	42·0	38·9	35·5	42·28
S. Norwood	33·6	36·7	34·8	38·7	43·7	49·3	53·0	52·2	49·3	42·1	38·9	35·3	42·29
Waddon	33·3	36·5	34·3	37·7	42·8	48·5	51·6	50·6	48·2	41·5	38·3	35·0	41·53
Beddington	32·9	36·3	33·9	37·4	42·1	47·7	51·4	50·4	47·8	41·1	37·7	34·7	41·12
Average	33·6	36·7	34·6	38·3	43·2	48·9	52·5	51·5	48·8	41·9	38·6	35·2	41·99

Table III.—Means of Daily Highest Temperatures for the Five Years, 1881–85.

Park Hill	42·3	46·3	48·9	54·8	61·9	66·9	71·3	70·1	64·0	54·3	49·0	43·3	56·10
Addiscombe	43·2	47·1	49·4	55·1	61·6	66·5	70·9	69·6	64·0	54·7	49·7	44·5	56·34
S. Norwood	43·2	47·1	49·7	55·1	61·9	66·9	71·1	69·8	64·2	54·9	49·8	44·3	56·50
Waddon	43·1	46·6	49·1	54·9	62·1	67·3	71·9	70·4	64·6	54·9	49·5	44·1	56·47
Beddington	43·0	46·7	49·5	55·1	62·1	67·4	72·1	70·5	64·3	54·6	49·6	44·0	56·58
Average	43·0	46·8	49·3	55·0	61·9	67·0	71·5	70·1	64·2	54·7	49·5	44·0	56·40

Table IV.—Mean Daily Range of Temperature for the Five Years, 1881–85.

Park Hill	8·3	9·3	13·7	15·7	17·8	17·0	17·7	17·5	14·2	11·7	9·8	7·7	13·38
Addiscombe	9·0	10·0	14·4	16·7	18·2	17·2	17·9	17·8	15·1	12·7	10·8	9·0	14·06
S. Norwood	9·6	10·4	14·9	16·4	18·2	17·6	18·1	17·6	14·9	12·8	10·9	9·0	14·21
Waddon	9·8	10·1	14·8	17·2	19·3	18·8	20·3	19·8	16·4	13·4	11·2	9·1	14·94
Beddington	10·1	10·4	15·6	17·7	20·0	19·7	20·7	20·1	16·5	13·5	11·9	9·3	15·46
Average	9·4	10·0	14·7	16·7	18.7	18·1	18·9	18·6	15·4	12·8	10·9	8·8	14·41

TABLE V.—MEAN MONTHLY AND ANNUAL TEMPERATURE OF THE AIR FOR THE FIVE YEARS 1881–85.

	Park Hill.	Addiscombe.	S. Norwood.	W. Norwood.	Waddon.	Beddington.	Greenwich.	Kew.
	°	°	°	°	°	°	°	°
January	38·17	38·66	38·40	38·67	38·20	37·95	38·44	38·78
February	41·62	42·10	41·87	42·08	41·52	41·54	41·81	42·11
March	42·08	42·18	42·22	42·40	41·70	41·69	42·43	42·10
April	46·95	46·72	46·91	46·98	46·32	46·28	47·35	46·85
May	53·03	52·51	52·79	53·15	52·45	52·10	53·81	52·88
June	58·39	57·89	58·10	58·56	57·52	57·59	59·31	58·37
July	62·46	61·91	62·06	62·58	61·73	61·75	63·65	62·48
August	61·35	60·68	60·97	61·33	60·50	60·44	62·22	60·93
September	56·88	56·44	56·77	56·85	56·38	56·01	58·02	57·19
October	48·45	48·36	48·49	48·57	48·22	47·89	48·60	48·37
November	44·11	44·27	44·34	44·20	43·90	43·63	44·16	44·20
December	39·42	39·98	39·84	40·03	39·54	39·37	39·71	39·87
Year......	49·41	49·31	49·40	49·62	49·00	48·85	49·96	49·51

TABLE VI.—MEAN DEGREE OF HUMIDITY AT NORWOOD FROM OBSERVATIONS AT 9 A.M. AND 9 P.M. (SATURATION = 100).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1881	87	88	82	75	73	70	68	80	89	85	89	91	82
1882	91	88	82	78	73	78	77	77	84	89	85	92	83
1883	90	89	81	75	73	74	74	75	85	87	90	87	82
1884	89	86	80	77	73	76	76	72	83	84	88	86	81
1885	89	88	81	76	76	72	72	75	84	86	91	89	82
	89	88	81	76	74	74	73	76	85	86	89	89	82

TABLE VII.—TOTAL ANNUAL RAINFALL AND MEAN RAINFALL FOR THE FIVE YEARS 1881–85.

STATION.	Height of Gauge. Above Sea.	Height of Gauge. Above Ground.	Diameter of Gauge.	1881	1882	1883	1884	1885	1881—85
	Feet.	Ft. Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill, Titsey	870	1 0	5	34·69	35·40	28·04	*25·90*	35·67	*31·94*
2 Botley Hill Farm	864	1 0	5	33·70	34·57	26·43	24·90	*30·32*	*29·98*
3 Betsom's Hill, Westerham	811	1 0	5	31·50	35·72	28·97	25·37	32·36	30·78
4 Woldingham	774	1 0	5	..	..	..	..	..	..
5 Reigate Hill, Gatton	687	1 0	5	36·58	33·36	32·70	23·73	30·47	31·37
6 Chaldon Common	620	1 0	5	..	..	..	..	..	..
7 Caterham Asylum	610	1 0	5	..	31·53	28·98	21·35	30·16	..
8 Chelsham	607	1 0	5	34·52	35·53	31·52	24·88	33·28	31·95
9 Upper Warlingham	605	1 0	5	..	..	..	..	..	..
10 Lovelands, Kingswood, Reigate Hill ..	..	0 9	5	..	..	..	..	32·41	..
11 Leaves Green, Cudham..	536	1 0	5	28·33	28·59	28·48	22·09	29·15	27·33
12 Chipstead	506	1 0	5	34·66	36·18	31·15	25·16	31·71	31·77
13 Kenley	501	1 0	5	31·17	32·72	30·04	23·51	28·94	29·28
14 Layham's Farm, West Wickham ..	500	1 0	5	*27·35*	28·34	26·30	21·33	30·12	*26·69*
15 Caterham Valley	485	3 0	5	..	34·86	..	..	..	..
16 Birchwood House, Marden Park ..	471	1 0	5	31·17	32·78	28·70	22·50	29·00	28·83
17 Cambria House, Caterham	466	1 0	5	..	..	..	..	..	..
18 Titsey	448	1 0	5	33·02	36·00	29·53	24·91	30·72	30·84
19 Keston	420	0 6	6	..	..	25·00	20·50	30·85	..
20 Tyler's Green, Godstone	366	1 0	5	30·42	34·58	25·73	20·49	25·71	27·39
21 Shooters Hill	352	1 0	5	..	..	..	..	24·30	..
22 Keston Tower	351	0 8	6	..	..	28·00	21·92	30·17	..
23 Beulah Hill, Norwood	350	1 0	5	24·59	24·29	..	..	..	..
24 The Oast House, Hayes Common ..	340	1 1	5	..	..	23·53	..	..	..
25 Chislehurst	..	1 5	5	..	..	21·26	18·13	24·09	..
26 The Warren, Hayes Common	296	1 0	5	..	..	..	..	27·45	..
27 Hayes Common	289	1 0	5	..	..	..	20·42	28·04	..
28 Ashtead Rectory	..	..	5	..	28·52	..	..	..	..
29 Highfield, Bickley	285	1 2	5	29·23	26·61	23·16	19·99	25·44	24·89
30 Addington Park	268	1 0	5	27·54	29·51	25·36	21·08	27·94	26·29
31 Forest Hill..	260	0 11	5	..	25·53	23·61	19·42	26·16	..
32 Park Hill, Croydon	253	1 0	8	25·67	26·49	24·15	19·77	26·61	24·54
33 Bromley Common..	250	1 0	8	27·37	..	..	..	..	..
34 Grange Road, Sutton	248	..	..	..	..	25·86	..	..	..
35 Mulgrave Road, Sutton	230	7 3	5	25·34	26·92	24·90	18·64	26·90	24·54

Table VII. (*contd.*).—Total Annual Rainfall and Mean Rainfall for the Five Years 1881–85.

Station.	Height of Gauge. Above Sea.	Height of Gauge. Above Ground.	Diameter of Gauge.	1881	1882	1883	1884	1885	1881—85
	Feet.	Ft. Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
36 Sparrow's Den, West Wickham.. ..	230	1 0	5	24·86	26·50	24·37	19·21	25·40	24·07
37 Bromley	221	1 3	5	..	..	25·98	..	..	..
38 South End, Eltham	218	0 8	5	..	..	..	17·74	24·50	..
39 Caterham Junction	216	1 0	5	*28·67*	30·59	27·58	21·61	*29·44*	*27·58*
40 Coombe Lane, Croydon	213	1 0	5	..	..	25·09	..	27·15	..
41 Addiscombe	202	0 9	8	26·14	26·34	24·14	19·69	26·06	24·47
42 Katherine Street, Croydon	195	1 0	5	..	24·90	22·99	17·86	25·06	..
43 South Norwood	190	1 0	8	22·30	22·86	19·82	18·97	24·72	21·73
44 West Norwood	185	1 0	8	25·26	25·16	21·44	19·05	25·29	23·24
45 South Norwood	181	1 0	5	..	..	..	..	26·08	..
46 Bramley Hill, Croydon	179	1 0	5	26·84	..	..	..	..	..
47 Church Street, Croydon	169	20 8	5	26·97	..	..	..	..	..
48 Wimbledon..	157	3 0	12	24·46	24·79	21·79	16·80	23·48	22·26
49 Waddon House	156	1 0	5	*23·33*	24·80	23·81	19·62	25·45	*23·40*
50 Royal Observatory, Greenwich	155	0 5	8	25·72	25·18	21·91	18·05	23·99	22·97
51 Wandle Road, Croydon	155	1 0	5	..	..	..	..	..	..
52 Blackheath..	150	0 5	8	27·72	28·27	22·50	17·22	22·87	23·72
53 Belvedere, Erith	150	1 0	5	..	..	..	..	22·93	..
54 Fox Grove, Beckenham	142	0 5	5	24·51	24·87	21·79	19·70	24·37	23·05
55 Wallington..	140	0 9	5	..	27·69	26·79	..	..	..
56 Wallington..	137	4 1	5	..	..	..	..	25·49	..
57 Brimstone Barn, Croydon	130	1 0	5	24·39	25·67	22·33	18·87	24·99	23·25
58 Beddington Lane	102	1 0	5	24·58	25·45	22·48	18·36	24·18	23·01
59 Eltham Green	80	1 0	5	23·85	25·02	20·56	17·84	..	..
60 Acre Lane, Brixton	77	1 0	8	24·67	24·55	21·10	17·04	24·45	22·36
61 Sewage Works, Wimbledon	58	1 0	5	..	22·15	21·15	16·06	21·57	..
62 Ormond Lodge, Richmond	51	0 9	5	25·31	25·99	23·05	19·11	26·68	24·03
63 Woodburn House, Mitcham	50	1 0	5	22·86	..	..	..	..	..
64 Blessington Road, Lee	49	4 9	10	27·20	27·07	23·98	20·19	26·58	25·00
65 Vauxhall Cross, Effra Creek	48	30 9	8	21·58	21·73	18·46	15·85	22·11	19·95
66 Battersea Creek	41	27 2	8	22·86	22·84	19·74	15·97	24·38	21·16
67 Seething Wells, Surbiton	25	0 6	10	23·74	24·21	21·97	15·06	21·90	21·38
68 Kew Observatory	19	1 9	11	25·49	25·67	22·40	18·94	26·26	23·75
69 Deptford Pumping Station	18	0 4	10	28·69	28·05	23·68	20·41	..	..
70 Crossness, Erith	6	0 6	11	25·74	28·43	22·37	18·44	25·37	24·07

Table VIII.—Rainfall in 1881.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	1·84	3·54	2·48	·79	1·07	2·15	2·31	5·20	3·37	3·59	4·58	3·77	34·69
2 Botley Hill Farm .	1·83	3·66	2·38	·80	1·05	2·13	2·27	5·05	3·36	3·29	4·20	3·68	33·70
3 Betsom's Hill....	1·73	3·53	2·45	·75	1·03	1·95	1·68	4·36	3·03	3·32	4·37	3·30	31·50
5 Reigate Hill	1·27	3·49	2·74	·68	1·31	2·18	2·87	6·01	3·04	3·27	5·77	3·95	36·58
8 Chelsham	1·44	3·04	2·44	·71	1·39	2·11	3·31	5·28	3·29	3·26	4·79	3·46	34·52
11 Leaves Green	1·27	2·66	2·35	·62	1·08	1·82	1·75	3·66	2·60	2·80	4·35	3·37	28·33
12 Chipstead	1·67	3·49	2·41	·79	1·13	2·23	3·09	5·70	2·95	2·81	4·73	3·66	34·66
13 Kenley	1·68	2·70	2·11	·61	1·04	2·08	2·58	4·91	2·42	2·85	4·76	3·43	31·17
14 Layham's Farm..	*1·30*	*2·52*	*2·24*	·41	1·17	1·88	1·28	4·43	2·69	2·68	3·87	2·88	*27·35*
16 Birchwood House	1·22	2·95	2·12	·60	1·08	2·06	2·00	5·05	3·10	3·26	4·58	3·15	31·17
18 Titsey	1·41	3·31	2·45	·86	1·09	2·17	2·35	4·89	3·04	3·10	4·78	3·57	33·02
20 Tyler's Green	1·53	3·19	2·29	·57	·96	2·19	1·56	4·33	3·18	3·10	4·16	3·36	30·42
30 Addington	1·29	3·10	1·62	·57	·96	1·79	1·56	4·10	2·68	2·50	4·24	3·13	27·54
32 Park Hill	1·13	3·05	1·55	·49	·92	1·72	1·79	4·01	2·07	2·46	3·62	2·86	25·67
36 West Wickham ..	1·49	2·69	1·41	·52	1·01	1·64	1·52	3·78	2·49	2·20	3·33	2·78	24·86
39 Caterham Junc...	*1·52*	*2·46*	*1·92*	·45	1·04	2·04	2·27	4·45	2·33	2·41	4·60	3·18	*28·67*
41 Addiscombe	1·48	3·06	1·48	·50	1·01	1·71	1·86	3·93	2·13	2·44	3·69	2·85	26·14
42 Katherine Street..	..	..	..	..	..	..	..	..	..	..	..	2·65	..
43 South Norwood ..	1·45	2·59	1·20	·51	·90	1·66	1·79	3·68	1·83	2·35	1·96	2·38	22·30
44 West Norwood ..	1·59	2·81	1·64	·54	1·10	1·80	2·08	3·79	2·04	2·58	2·65	2·64	25·26
47 Church Street ..	1·07	3·16	1·62	·51	1·00	1·84	2·04	4·13	2·13	2·49	4·05	2·93	26·97
49 Waddon	*1·04*	*2·26*	*1·07*	*·34*	*·87*	*1·72*	*1·94*	*3·72*	*1·95*	2·32	3·48	2·62	*23·33*
50 Greenwich	1·66	2·45	1·83	·62	1·61	1·86	2·14	3·89	2·19	2·71	2·26	2·50	25·72
51 Wandle Road	1·60	2·95	1·40	·43	·85	1·68	1·64	3·88	1·88	2·38	..	..	..
57 Brimstone Barn..	1·02	2·69	1·37	·44	1·03	1·80	2·25	3·95	2·06	2·33	2·95	2·50	24·39
58 Beddington	1·54	2·81	1·37	·45	·94	1·65	2·14	3·96	2·11	2·43	2·67	2·51	24·58
63 Mitcham	1·20	2·69	1·64	·45	1·08	1·40	2·03	3·73	1·94	2·28	2·18	2·24	22·86
68 Kew	1·17	2·54	1·98	·77	1·11	1·62	1·92	4·77	2·21	2·40	2·49	2·51	25·49

Table VIII.—Rainfall in 1882.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	1·95	2·22	1·27	2·82	1·41	3·00	3·72	1·54	3·39	6·89	3·52	3·67	35·40
2 Botley Hill Farm .	1·50	1·96	1·16	2·91	1·35	2·81	3·51	1·97	3·21	6·97	3·43	3·79	34·57
3 Betsom's Hill ..	2·16	2·14	1·43	3·09	1·38	2·67	3·74	2·05	3·12	7·07	3·59	3·28	35·72
5 Reigate Hill	2·05	2·39	1·12	2·66	1·45	3·81	2·97	2·02	3·03	6·34	2·60	2·92	33·36
8 Chelsham	2·24	2·64	1·06	3·85	1·37	3·14	3·11	1·36	2·90	6·80	3·61	3·45	35·53
11 Leaves Green	1·79	2·27	·85	3·11	·81	2·31	2·59	1·59	2·58	5·50	2·76	2·43	28·59
12 Chipstead	2·04	2·75	1·06	3·21	1·36	3·99	3·16	1·84	2·94	6·94	3·48	3·41	36·18
13 Kenley	1·78	2·43	1·04	3·41	1·26	2·43	3·27	1·39	2·76	6·92	3·10	2·93	32·72
14 Layham's Farm..	1·75	1·97	·88	3·18	1·16	2·04	2·36	1·52	2·62	6·08	2·59	2·19	28·34
16 Birchwood House	1·98	2·20	1·20	3·33	1·40	2·89	3·26	1·72	2·67	6·48	3·13	2·52	32·78
18 Titsey	1·85	2·13	1·59	3·33	1·23	3·29	4·10	2·16	3·04	6·58	3·54	3·16	36·00
20 Tyler's Green....	1·66	1·75	1·04	3·00	1·23	2·82	3·55	1·81	4·31	7·66	3·15	2·60	34·58
30 Addington	1·42	1·99	1·00	3·45	1·32	2·36	2·90	1·48	2·53	6·17	2·57	2·32	29·51
32 Park Hill	1·24	1·75	·87	2·97	·90	2·44	2·43	1·31	2·57	5·69	2·23	2·09	26·49
36 West Wickham ..	1·14	1·60	·98	3·28	1·13	2·20	2·67	1·48	2·42	5·22	2·24	2·14	26·50
39 Caterham Junc...	1·42	2·39	·95	3·36	1·12	2·76	3·06	1·49	2·65	6·37	2·65	2·37	30·59
40 Coombe Lane	..	..	..	..	..	2·82	2·69	1·46	2·55	5·89	2·01	2·02	..
41 Addiscombe	1·24	1·75	·84	2·97	·89	2·31	2·33	1·28	2·59	5·75	2·24	2·15	26·34
42 Katherine Street..	1·07	1·60	·77	2·83	·83	2·32	2·08	1·10	2·64	5·62	2·02	1·02	24·90
43 South Norwood ..	·92	1·21	·64	2·77	·86	2·15	1·94	·89	2·66	5·30	1·92	1·60	22·86
44 West Norwood ..	1·27	1·24	·86	2·82	1·03	2·35	2·33	1·11	2·47	5·72	2·07	1·89	25·16
47 Church Street....	1·33	1·84	·85	2·97	·99	1·19	3·09	1·34	2·83	5·85	..	..	..
49 Waddon	1·10	1·58	·77	2·72	·94	2·19	2·18	1·06	2·67	5·48	2·20	1·91	24·80
50 Greenwich	1·35	1·15	1·14	2·40	1·37	2·36	2·45	1·16	2·41	5·42	2·20	1·77	25·18
57 Brimstone Barn..	1·22	1·58	·76	2·59	·98	2·44	2·30	1·11	2·95	5·61	2·19	1·94	25·67
58 Beddington.....	1·14	1·42	·75	2·79	·92	2·38	2·37	·97	3·08	5·65	2·15	1·83	25·45
61 Wimbledon......	1·08	1·13	·76	2·08	·90	1·84	1·78	1·00	2·15	5·21	2·20	2·02	22·15
68 Kew	1·26	1·52	1·04	2·62	1·24	2·03	2·21	1·15	2·38	5·77	2·34	2·11	25·67

Table VIII.—Rainfall in 1883.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	2·48	3·52	1·10	1·81	2·35	1·31	2·42	·81	3·86	2·38	5·25	·75	28·04
2 Botley Hill Farm.	2·51	3·57	1·11	1·77	2·30	1·18	2·11	·81	3·40	2·52	4·16	·99	26·43
3 Betsom's Hill....	2·77	4·14	·97	1·73	2·28	1·18	2·39	·83	3·28	2·55	5·80	1·05	28·97
5 Reigate Hill	3·23	4·42	·91	1·46	2·32	2·19	3·24	1·31	5·00	2·83	4·89	·90	32·70
8 Chelsham	3·52	4·81	1·26	1·74	2·47	1·63	2·68	1·04	3·35	2·88	5·16	·98	31·52
11 Leaves Green	2·33	5·14	·87	1·60	2·13	1·37	2·71	·62	3·68	2·34	5·04	·65	28·48
12 Chipstead	3·31	4·65	1·45	1·43	2·14	1·89	2·52	1·07	4·27	2·81	4·77	·84	31·15
13 Kenley	3·12	5·02	1·26	1·66	2·39	1·60	2·82	·85	3·36	2·53	4·68	·75	30·04
14 Layham's Farm..	2·34	3·94	·86	1·64	2·13	1·54	2·52	·77	3·11	2·34	4·47	·64	26·30
16 Birchwood House	2·83	4·30	1·21	1·59	2·19	1·50	2·19	·73	4·27	2·57	4·61	·71	28·70
18 Titsey	2·85	4·41	1·19	1·57	2·35	1·34	2·53	·77	2·88	2·65	5·91	1·08	29·53
20 Tyler's Green....	2·28	3·34	1·04	1·44	1·30	1·11	2·40	1·14	2·77	3·60	4·42	·89	25·73
30 Addington	2·25	4·34	·99	1·64	2·08	1·25	2·48	·81	3·41	1·73	3·75	·63	25·36
32 Park Hill	2·07	4·41	1·00	1·55	1·95	·85	2·21	·63	3·18	1·93	3·76	·61	24·15
36 West Wickham ..	1·96	4·05	·92	1·55	1·83	1·44	2·04	·79	3·45	2·05	3·75	·54	24·37
39 Caterham Junc...	2·86	4·87	1·01	1·45	2·26	1·09	2·63	·79	3·14	2·37	4·45	·66	27·58
40 Coombe Lane....	2·19	4·22	1·20	1·59	2·10	·88	2·47	·69	3·25	1·95	3·88	·67	25·09
41 Addiscombe	2·04	4·32	·97	1·56	1·96	·90	2·30	·59	3·27	1·86	3·75	·62	24·14
42 Katherine Street..	1·85	4·13	·94	1·44	1·84	·78	2·27	·53	3·43	1·87	3·38	·53	22·99
43 South Norwood ..	1·50	3·15	·76	1·52	1·76	·75	1·84	·49	3·00	1·62	2·87	·56	19·82
44 West Norwood ..	1·97	3·22	·78	1·52	1·88	·93	2·06	·65	2·94	1·85	2·94	·70	21·44
49 Waddon	1·98	4·03	·98	1·40	1·95	·77	2·50	·60	3·38	1·97	3·68	·57	23·81
50 Greenwich	1·70	2·89	·78	1·70	1·71	1·34	2·00	·71	3·82	1·59	2·84	·83	21·91
57 Brimstone Barn..	1·91	3·43	·96	1·40	1·90	·78	2·15	·59	3·06	1·77	3·68	·70	22·33
58 Beddington......	2·06	3·94	·89	1·36	1·90	·82	2·22	·59	3·18	1·74	3·22	·56	22·48
61 Wimbledon......	2·30	2·97	·65	1·38	1·73	1·25	2·29	·51	2·93	1·90	2·73	·51	21·15
68 Kew	2·22	3·41	·97	1·62	1·83	1·16	2·03	·93	3·28	1·75	2·54	·66	22·40

TABLE VIII.—RAINFALL IN 1884.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	2·79	2·00	*2·03*	*1·82*	*·97*	*1·54*	2·16	1·65	3·22	1·98	1·52	4·22	*25·90*
2 Botley Hill Farm.	2·73	1·83	1·95	1·75	·93	1·48	1·65	1·61	3·79	1·85	1·53	3·80	24·90
3 Betsom's Hill....	3·20	2·16	1·95	1·69	·87	1·25	1·89	1·68	4·07	1·81	1·14	3·66	25·37
5 Reigate Hill	3·71	1·82	1·93	1·73	·58	1·78	1·62	1·60	3·09	1·60	1·17	3·10	23·73
8 Chelsham	2·93	2·31	1·98	1·70	·65	1·35	1·74	1·82	3·27	1·70	1·85	3·58	24·88
11 Leaves Green....	2·47	2·26	1·43	1·68	·96	1·95	1·55	1·34	2·96	1·41	·73	3·35	22·09
12 Chipstead	3·16	2·24	2·31	1·71	·93	1·61	1·97	2·09	2·85	1·54	1·69	3·06	25·16
13 Kenley	2·89	2·16	2·18	1·71	·86	1·62	1·54	1·62	2·91	1·72	1·56	2·74	23·51
14 Layham's Farm..	2·42	1·98	1·98	1·87	·53	1·98	1·33	1·18	2·89	1·27	1·11	2·79	21·33
16 Birchwood House	2·32	2·04	2·12	1·70	·65	1·52	1·60	1·44	3·07	1·52	1·24	3·28	22·50
18 Titsey	3·34	2·32	2·00	1·61	·90	1·53	2·11	1·53	2·69	1·73	1·65	3·50	24·91
20 Tyler's Green....	3·05	1·90	1·67	1·30	·43	1·62	1·14	1·34	2·44	1·33	1·30	2·97	20·49
30 Addington	2·56	1·66	1·94	1·47	·46	2·30	1·50	1·38	2·62	1·29	1·46	2·44	21·08
32 Park Hill	2·56	1·77	1·69	1·29	·63	1·68	1·61	1·10	2·37	1·23	1·54	2·30	19·77
36 West Wickham ..	2·00	1·68	1·68	1·43	·51	1·95	1·47	1·04	2·67	1·22	1·34	2·22	19·21
39 Caterham Junc...	2·73	2·33	2·12	1·33	·61	1·44	1·38	1·47	2·47	1·48	1·55	2·70	21·61
40 Coombe Lane	2·61	..	1·80	1·49	·71	1·75	1·89	1·23	2·57	1·33	1·58	2·32	..
41 Addiscombe	2·58	1·78	1·46	1·32	·56	1·90	1·59	1·07	2·38	1·20	1·57	2·28	19·69
42 Katherine Street..	1·84	1·54	1·59	1·30	·64	1·73	1·57	1·14	2·03	1·17	1·41	1·90	17·86
43 South Norwood ..	2·04	1·89	1·28	1·06	·59	2·25	1·95	·96	2·07	1·41	1·32	2·15	18·97
44 West Norwood ..	1·96	1·44	1·37	1·20	·91	2·18	2·66	·98	1·76	1·17	1·30	2·12	19·05
49 Waddon	2·53	1·81	1·63	1·38	·72	1·81	1·54	1·03	2·15	1·29	1·52	2·21	19·62
50 Greenwich	1·77	1·50	1·37	1·11	·96	2·24	1·77	·67	2·09	1·04	·99	2·54	18·05
56 Wallington......	..	..	..	..	..	..	..	..	..	1·30	1·40	2·31	..
57 Brimstone Barn..	2·30	1·68	1·53	1·33	·66	1·70	1·84	1·00	2·17	1·26	1·30	2·10	18·87
58 Beddington......	2·27	1·51	1·42	1·49	·84	1·61	1·59	·91	1·85	1·32	1·37	2·18	18·36
61 Wimbledon......	1·94	1·14	1·04	1·43	·75	1·83	1·60	·85	1·49	1·03	1·14	2·01	16·06
68 Kew	2·29	1·40	1·24	1·26	·63	2·20	2·24	·96	1·69	1·12	1·77	2·14	18·94

TABLE VIII.—RAINFALL IN 1885.

STATION.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	2·96	4·44	2·10	2·02	3·80	1·20	·19	1·81	5·53	5·32	4·61	1·69	35·67
2 Botley Hill Farm .	2·84	4·03	1·69	1·77	3·27	1·22	·18	*1·57*	*4·57*	*3·54*	*3·94*	1·70	*30·32*
3 Betsom's Hill....	2·52	3·67	1·70	2·11	3·67	1·33	·21	1·73	5·31	4·49	4·00	1·62	32·36
4 Woldingham	..	..	..	..	..	..	..	..	..	..	..	1·69	..
5 Reigate Hill	3·09	3·28	1·61	1·46	3·46	1·64	·44	·96	5·20	4·16	3·64	1·53	30·47
6 Chaldon Common	..	..	..	..	..	..	..	..	..	..	..	1·80	..
8 Chelsham	2·73	4·07	1·65	1·87	4·16	1·34	·34	1·40	5·90	4·53	3·61	1·68	33·28
9 Up. Warlingham .	..	..	..	..	..	..	..	..	..	..	..	1·71	..
11 Leaves Green....	2·49	3·19	1·72	2·05	3·31	1·07	·25	1·74	4·81	3·61	3·47	1·44	29·15
12 Chipstead	2·68	3·92	1·92	1·67	3·36	1·74	·44	1·18	5·84	3·87	3·45	1·64	31·71
13 Kenley	2·03	3·49	1·90	1·80	3·66	1·42	*·61*	*1·46*	4·64	2·89	3·37	1·67	*28·94*
14 Layham's Farm..	2·37	3·05	1·63	2·14	3·40	1·20	·23	1·87	5·24	3·89	3·44	1·66	30·12
16 Birchwood House	2·60	3·03	2·08	1·66	3·22	1·35	·19	1·16	4·82	4·13	3·16	1·60	29·00
17 Cambria House ..	..	..	..	..	..	..	..	..	..	..	..	1·91	..
18 Titsey	2·45	3·70	1·80	1·87	3·31	1·31	·22	1·58	5·03	4·24	3·70	1·51	30·72
20 Tyler's Green	2·33	3·39	1·53	1·32	2·55	1·34		1·25	4·41	3·51	2·76	1·32	25·71
30 Addington	2·43	2·98	1·90	2·05	3·06	·96	·21	1·99	4·58	3·67	3·15	·96	27·94
32 Park Hill	2·03	2·77	1·69	2·01	3·14	1·69	·25	1·41	4·23	3·45	2·77	1·17	26·61
36 West Wickham ..	1·96	3·03	1·39	2·09	2·96	·98	·23	1·92	4·00	3·30	2·55	·99	25·40
39 Caterham Junc...	2·47	3·33	1·98	1·84	3·90	1·77	·17	1·20	4·60	3·59	3·15	1·44	29·44
40 Coombe Lane	2·05	2·74	1·52	2·08	3·55	1·47	·29	1·26	4·34	3·56	2·87	1·42	27·15
41 Addiscombe	2·07	2·73	1·70	2·03	2·93	1·40	·24	1·47	4·08	3·41	2·77	1·23	26·06
42 Katherine Street..	1·81	2·44	1·65	1·87	3·09	1·59	·27	1·21	4·03	3·36	2·67	1·07	25·06
43 South Norwood ..	1·50	2·30	1·50	1·87	2·54	1·65	·29	1·29	4·62	3·36	2·65	1·15	24·72
44 West Norwood ..	1·55	2·57	1·69	1·98	2·39	1·66	·49	1·07	4·35	3·57	2·81	1·16	25·29
45 South Norwood ..	1·71	2·48	1·62	1·93	2·71	1·70	·31	1·32	4·75	3·51	2·84	1·20	26·08
49 Waddon	1·75	2·56	1·33	1·85	3·31	1·63	·30	1·49	4·13	3·32	2·63	1·15	25·45
50 Greenwich	1·42	2·33	1·50	2·05	2·10	1·67	·50	1·32	3·73	3·41	2·83	1·13	23·99
56 Wallington	1·84	2·64	1·55	1·67	3·45	1·98	·33	1·04	4·10	3·05	2·72	1·12	25·49
57 Brimstone Barn..	1·71	2·37	1·47	1·79	2·91	2·24	·27	1·37	4·04	3·16	2·56	1·10	24·99
58 Beddington	1·68	2·24	1·58	1·70	2·57	2·02	·39	1·13	4·12	3·02	2·59	1·14	24·18
61 Wimbledon	1·34	2·16	1·29	1·58	2·07	1·16	·47	·75	3·88	3·09	2·75	1·03	21·57
68 Kew	1·53	2·86	1·48	1·78	2·89	1·84	·47	1·09	4·32	3·87	2·97	1·16	26·26

TABLE IX.—MEAN RAINFALL FOR THE FIVE YEARS 1881–85.

STATION.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1 Botley Hill	2·41	3·14	1·80	1·85	1·92	1·84	2·16	2·20	3·87	4·03	3·90	2·82	31·94
3 Betsom's Hill....	2·48	3·13	1·70	1·87	1·84	1·68	1·98	2·13	3·76	3·85	3·78	2·58	30·78
5 Reigate Hill	2·67	3·08	1·66	1·60	1·82	2·32	2·23	2·38	3·87	3·64	3·62	2·48	31·37
8 Chelsham	2·57	3·38	1·68	1·97	2·01	1·91	2·24	2·18	3·74	3·84	3·80	2·63	31·95
11 Leaves Green	2·07	3·10	1·45	1·81	1·66	1·70	1·77	1·79	3·33	3·13	3·27	2·25	27·33
12 Chipstead	2·57	3·41	1·83	1·76	1·78	2·29	2·24	2·38	3·77	3·59	3·63	2·52	31·77
13 Kenley	2·30	3·16	1·70	1·84	1·84	1·83	2·17	2·05	3·22	3·38	3·49	2·30	29·28
14 Layham's Farm..	2·04	2·69	1·52	1·85	1·68	1·73	1·54	1·95	3·31	3·25	3·10	2·03	26·69
16 Birchwood House.	2·19	2·90	1·75	1·78	1·71	1·86	1·85	2·02	3·59	3·59	3·34	2·25	28·83
18 Titsey	2·38	3·17	1·81	1·85	1·77	1·93	2·26	2·19	3·34	3·66	3·92	2·56	30·84
30 Addington	1·99	2·82	1·49	1·84	1·58	1·73	1·73	1·95	3·16	3·07	3·04	1·89	26·29
32 Park Hill........	1·81	2·75	1·36	1·66	1·51	1·68	1·66	1·69	2·88	2·95	2·78	1·81	24·54
36 West Wickham ..	1·71	2·61	1·28	1·77	1·49	1·64	1·59	1·80	3·01	2·80	2·64	1·73	24·07
39 Caterham Junc...	2·20	3·08	1·60	1·68	1·79	1·82	1·90	1·88	3·04	3·24	3·28	2·07	27·58
41 Addiscombe......	1·88	2·73	1·29	1·68	1·47	1·64	1·66	1·67	2·89	2·93	2·80	1·83	24·47
44 West Norwood ..	1·67	2·26	1·27	1·61	1·46	1·79	1·92	1·52	2·71	2·98	2·35	1·70	23·24
49 Waddon	1·68	2·45	1·16	1·54	1·56	1·62	1·69	1·58	2·85	2·88	2·70	1·69	23·40
50 Greenwich	1·58	2·06	1·33	1·58	1·55	1·90	1·77	1·55	2·85	2·83	2·22	1·75	22·97
57 Brimstone Barn..	1·63	2·35	1·22	1·51	1·49	1·79	1·76	1·60	2·86	2·83	2·54	1·67	23·25
58 Beddington......	1·74	2·38	1·20	1·56	1·44	1·70	1·74	1·51	2·87	2·83	2·40	1·64	23·01
68 Kew	1·69	2·35	1·34	1·61	1·54	1·77	1·77	1·78	2·78	2·98	2·42	1·72	23·75
Mean	2·06	2·81	1·50	1·73	1·66	1·82	1·89	1·89	3·22	3·25	3·10	2·09	27·02
Feet above Sea.													
Above 800 ...... (Mean, 841)	2·44	3·13	1·75	1·86	1·88	1·76	2·07	2·17	3·82	3·94	3·84	2·70	31·36
Between 600—800 (Mean, 648)	2·62	3·23	1·67	1·79	1·91	2·12	2·23	2·28	3·81	3·74	3·71	2·55	31·66
Between 400—600 (Mean, 493)	2·26	3·07	1·67	1·81	1·74	1·89	1·97	2·06	3·43	3·44	3·46	2·32	29·12
Between 200—400 (Mean, 234)	1·92	2·80	1·40	1·72	1·57	1·70	1·71	1·80	3·00	3·00	2·91	1·86	25·39
Below 200 ...... (Mean, 124)	1·66	2·31	1·25	1·57	1·51	1·76	1·78	1·59	2·82	2·89	2·44	1·69	23·27
Above 400 ...... (Mean, 594)	2·37	3·12	1·69	1·82	1·80	1·91	2·04	2·13	3·58	3·60	3·58	2·44	30·08
Below 400 ...... (Mean, 193)	1·78	2·53	1·32	1·64	1·54	1·73	1·75	1·68	2·90	2·94	2·65	1·77	24·23
Greenwich 1841—85	2·02	1·53	1·43	1·66	1·98	2·03	2·36	2·35	2·36	2·93	2·23	1·79	24·67

Table X.—Mean Number of Days on which Rain fell for the Five Years 1881–85.

Station.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
1 Botley Hill	15·6	15·8	10·8	11·6	11·8	13·4	14·8	12·8	16·6	19·6	17·0	16·6	176·4
3 Betsom's Hill	15·2	16·6	11·6	11·8	12·8	11·2	14·6	13·6	18·2	18·8	17·6	18·2	180·2
5 Reigate Hill	16·0	15·4	9·8	12·4	11·6	11·4	14·8	12·6	15·2	17·2	16·8	16·6	169·8
8 Chelsham	16·8	17·0	9·8	12·0	12·8	13·2	16·6	14·6	19·2	18·4	18·8	18·8	188·0
12 Chipstead	13·8	14·2	8·8	10·6	10·4	10·4	11·6	9·8	14·0	14·6	15·4	14·2	147·8
13 Kenley	14·8	17·0	11·0	11·0	11·4	11·2	13·6	12·8	15·8	17·8	17·8	15·2	169·4
18 Titsey	17·6	18·0	15·0	14·0	16·0	14·4	17·2	14·6	19·8	19·6	18·2	19·6	204·0
32 Park Hill	14·8	14·8	10·4	12·0	11·4	12·2	14·8	11·8	17·6	16·2	17·4	17·0	170·4
36 West Wickham	14·2	14·2	10·0	12·6	10·2	11·8	13·4	11·2	17·0	17·2	17·0	15·2	164·0
41 Addiscombe	14·2	14·4	10·0	12·2	11·4	12·0	14·4	12·2	17·0	17·2	17·4	16·4	168·8
44 West Norwood	15·0	15·8	10·6	12·0	11·6	11·4	14·6	13·4	17·2	17·4	17·4	17·4	173·8
49 Waddon	13·4	14·8	9·2	10·2	12·4	11·8	14·0	11·2	16·8	17·8	19·4	17·0	168·0
50 Greenwich	13·6	14·8	11·0	11·0	12·4	11·2	13·6	12·0	15·8	17·0	17·0	15·6	165·0
57 Brimstone Barn	12·4	14·2	9·4	10·4	10·8	11·4	14·2	11·2	16·0	15·6	15·6	14·6	155·8
58 Beddington	13·6	13·0	9·0	10·8	11·6	10·8	13·6	12·0	16·2	17·0	16·4	15·2	159·2
68 Kew	14·0	14·8	8·2	11·0	12·2	12·2	13·6	12·4	16·8	16·8	18·2	17·8	168·0
Average	14·7	15·3	10·3	11·6	11·9	11·9	14·3	12·4	16·8	17·4	17·3	16·6	170·5
Feet above Sea.													
Above 800 (Mean, 841)	15·4	16·2	11·2	11·7	12·3	12·3	14·7	13·2	17·4	19·2	17·3	17·4	178·3
Between 600—800 (Mean, 648)	16·4	16·2	9·8	12·2	12·2	12·3	15·7	13·6	17·2	17·8	17·8	17·7	178·9
Between 400—600 (Mean, 493)	15·4	16·4	11·6	11·9	12·6	12·0	14·1	12·4	16·6	17·3	17·1	16·3	173·7
Between 200—400 (Mean, 234)	14·4	14·5	10·1	12·3	11·0	12·0	14·2	11·7	17·2	16·9	17·3	16·2	167·8
Below 200 (Mean, 124)	13·7	14·6	9·6	10·9	11·8	11·5	13·9	12·0	16·5	16·9	17·3	16·3	165·0
Above 400 (Mean, 633)	15·7	16·3	11·0	12·2	12·4	12·2	14·7	12·9	17·0	18·0	17·4	17·0	176·5
Below 400 (Mean, 159)	13·9	14·5	9·8	11·1	11·6	11·6	14·0	11·9	16·7	16·9	17·3	16·2	165·9

TABLE XI.—RATIO OF THE MONTHLY TO THE ANNUAL RAINFALL FOR THE FIVE YEARS 1881–85.

STATION.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.
1 Botley Hill	75	99	56	58	60	58	68	69	121	126	122	88
3 Betsom's Hill	81	102	55	60	60	54	64	69	123	125	123	84
5 Reigate Hill	85	98	53	51	58	74	71	76	123	116	116	79
8 Chelsham	80	106	53	62	63	60	70	68	117	120	119	82
11 Leaves Green	76	114	53	66	61	62	65	65	122	114	120	82
12 Chipstead	81	107	58	56	56	72	70	75	119	113	114	79
13 Kenley	79	108	58	63	63	62	73	70	110	116	119	79
14 Layham's Farm..	76	101	57	69	63	65	58	73	124	122	116	76
16 Birchwood House.	76	101	60	62	59	65	64	70	124	125	116	78
18 Titsey	77	103	58	60	58	63	73	71	108	119	127	83
30 Addington	76	107	57	70	60	66	66	74	120	117	115	72
32 Park Hill........	74	112	55	68	61	68	68	69	118	120	113	74
36 West Wickham ..	71	108	53	74	62	68	66	75	125	116	110	72
39 Caterham Junc...	79	112	58	61	65	66	69	68	110	118	119	75
41 Addiscombe	77	111	53	68	60	67	68	68	118	120	115	75
44 West Norwood ..	72	97	55	69	63	77	83	65	117	128	101	73
49 Waddon	72	105	49	66	67	69	72	68	122	123	115	72
50 Greenwich	69	90	58	68	68	82	77	68	124	123	97	76
57 Brimstone Barn..	70	101	52	65	64	77	76	69	123	122	109	72
58 Beddington	75	104	52	68	62	74	76	66	125	123	104	71
68 Kew	71	99	56	68	65	74	75	75	117	126	102	72
Mean	76	104	55	64	62	68	70	70	119	121	114	77
Feet above Sea.												
Above 800 ...... (Mean, 841)	78	101	55	59	60	56	66	69	122	126	122	86
Between 600—800 (Mean, 648)	83	102	53	56	61	67	70	72	120	118	118	80
Between 400—600 (Mean, 493)	77	106	57	63	60	65	67	71	118	118	119	79
Between 200—400 (Mean, 234)	75	110	55	68	62	67	68	71	118	118	114	74
Below 200 ...... (Mean, 124)	72	99	54	67	65	75	76	69	121	124	105	73
Above 400 ...... (Mean, 594)	79	104	56	61	60	63	68	70	119	120	119	81
Below 400 ...... (Mean, 193)	73	104	54	68	63	72	72	70	120	122	109	73
Greenwich 1841—85	82	62	58	67	80	82	96	95	96	119	90	73

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Croydon Microscopical and Natural History Club.

OFFICERS FOR 1886.

President.—Henry T. Mennell, F.L.S.

Vice-Presidents.—John Berney, F.R.M.S.; Alfred Carpenter, M.D., &c.; Philip Crowley, F.Z.S., F.L.S.; H. Lee, F.L.S., &c.

Treasurer.—Kenneth McKean, F.L.S.

Committee.—J. G. B. Brewer; H. S. Cowdell; Thomas Cushing, F.R.A.S.; John Henry Drage; H. S. Eaton, M.A., F.R.Met.Soc.; Edward Lovett; E. Straker; E. B. Sturge; H. G. Thompson, M.D.

Hon. Secretary.—W. Low Sarjeant, 7, Belgrave Road, South Norwood, S.E., to whom all communications may be addressed.

PROCEEDINGS & TRANSACTIONS

OF THE

CROYDON

MICROSCOPICAL & NATURAL HISTORY

CLUB.

MARCH 10, 1886, TO JANUARY 2, 1887.

CROYDON:

PRINTED FOR THE CLUB, BY WEST, NEWMAN & CO., HATTON GARDEN, LONDON.

1887.

PROCEEDINGS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1886–87.

ORDINARY MEETING.—MARCH 10TH, 1886.

HENRY T. MENNELL, F.L.S., President, in the chair.

It was proposed by the President, and seconded by Mr. Philip Crowley:—

"That a vote of thanks be passed to Commander Lovett Cameron, R.N., C.B., for the very interesting Lecture on Africa he delivered before the Club in February, and also that he be elected an Honorary Member."

The vote was carried unanimously.

Seventeenth Annual Meeting,

Held at the Public Hall, Croydon, Wednesday, January 12th, 1887.

HENRY T. MENNELL, F.L.S., President, in the chair.

It was proposed by Mr. Henry T. Mennell, seconded by Mr. Philip Crowley, and carried unanimously:—

"That Henry S. Eaton, M.A., F.R. Met. Soc., be elected President for the ensuing year."

The respective offices of the Club being filled by the following gentlemen, no other nominations having been received:—

President.—HENRY S. EATON, M.A., F.R. Met. Soc.

Vice-Presidents.—JOHN BERNEY, F.R.M.S.; ALFRED CARPENTER, M.D., J.P., &c.; PHILIP CROWLEY, F.Z.S., F.L.S.; HENRY LEE, F.L.S., F.G.S., &c.; HENRY T. MENNELL, F.L.S.

Treasurer.—KENNETH MCKEAN, F.L.S.

Committee.—F. C. BAYARD, L.L.M.; J. G. B. BREWER; H. S. COWDELL; THOMAS CUSHING, F.R.A.S.; W. M. GIBSON; E. STRAKER; E. B. STURGE; H. G. THOMPSON, M.D.; W. TOPLEY, F.G.S.

Hon. Secretary.—WILLIAM LOW SARJEANT.

The Balance-sheet was taken as read, and after a few explanatory remarks by the President was passed, and a vote of thanks accorded to the Auditors.

It was then proposed by Dr. A. Carpenter, seconded by Mr. Berney, and carried unanimously:—

"That a hearty vote of thanks be passed to the President for his very valuable services during the past year."

A hearty vote of thanks was also passed to the other officers of the Club for their services during the year.

The President, Henry T. Mennell, F.L.S., then delivered his Address.

The President's Address.

GENTLEMEN,—At the close of my second year of office as its President it is my duty again to present to the Club a brief review of its proceedings in 1886.

To those present this evening, many if not most of whom have regularly attended our meetings and taken an active part in them, such a recital may perhaps appear superfluous, but when we consider, not without regret, how small a proportion of our members thus assist at our meetings, the use of such a summary which reaches them all through our printed Transactions will be apparent. I wish I could convey in this address such an impression of the interest of our meetings as should induce them in larger numbers to attend.

Number of Members. — During the past year 29 new members have joined the Club, and we have lost 14 by death and resignation; our numbers therefore stand at 256, as compared with 241 a year ago, being a gain of 15.

Obituary. — Of those of our members whose loss by death we have to deplore, the name of Mr. W. H. Rowlands will at once occur to us all. He was one of the original members of the Club, and frequently took part in its proceedings, more especially in its earlier years. His knowledge of and interest in Ornithology especially was extensive, and in our Transactions for May, 1871, will be found a paper by him on the Great Bustard.

Finance. — The financial statement presented this evening shows a balance in hand of £45 8s. 4d., but if we deduct on either side the items belonging to the "Special Fund," the balance is really £20 18s. 9d., compared with £49 1s. 11d. last year; but as it will be seen that we have paid about £50 for printing the Transactions, we need not be alarmed at this reduction in the balance. The Club's share in the proceeds of the Bazaar held in July, 1882, has, in accordance with the expression of opinion at the last Annual Meeting, been invested in the purchase of £210 11s. 8d. Consols, in the names of Messrs. P. Crowley, H. T. Mennell, Kenneth McKean, and Ed. B. Sturge. The accumulated interest, amounting to £29 19s. 7d., will, with the dividends as they become due, be available for the purposes for which the Bazaar was held, *viz.*, furnishing and fitting up the Club-rooms, and providing cabinets for its collections.

Herbarium.—It is to me one of the most gratifying facts of the past year that a commencement has been made in this direction by the purchase of a cabinet for a collection of Surrey plants. Steps have already been taken to get together such a collection; the response from all our local botanists has been so cordial that I have no doubt that a thoroughly satisfactory representative collection will speedily be got together. Messrs. Bennett, Beeby, Miller, Straker, Epps, and Dr. Franklin Parsons have all assured me of their co-operation. The small space at our disposal in our present club-room prevents us from attempting much more in this direction at present. There are, however, some other departments of Natural History (land and fresh-water shells, for example), collections of which occupy small space and might be undertaken in the near future.

Transactions. — The publication of the last part of our Transactions, to which I have incidentally alluded in speaking of the finances, calls for further reference in this review. I think it will be felt by all of us that this volume does credit to the Club, and is perhaps the most valuable it has issued. I would especially refer to the permanent interest and importance for future reference of the five years' Report on the Meteorology of the District, in continuation of a similar report previously published, which brought down the record to 1880. To Mr. H. S. Eaton the Club is greatly indebted for the admirable way in which this Report has been prepared and edited. Of similar permanent value is the elaborate paper on "Surrey Wells and their Teachings," by Mr. Whitaker. These careful records will be looked upon as essential data in all future well-sinking and water-searching operations undertaken in our county.

Evening Meetings. — Our Evening Meetings during the year have been of much interest, excellent papers (with only one exception by our own members) have been read at them all, and the discussions have often been lively. The Exhibition of objects of interest has also been well kept up.

Commander Cameron's Lecture.—In place of the Ordinary Meeting in February, a lecture was delivered in the Large Hall to the members and their friends by Commander V. Lovett Cameron, R.N., C.B., &c., "On the Countries and People of Central Africa visited by him on his Journey across the Continent." The lecturer first briefly stated the reasons which led to his taking part in an expedition in search of Livingstone; how he heard on his way of the death of the great traveller, and assisted the party bearing his body to the coast by sending back with it his only white companions. The first object of his journey being thus frustrated, he decided to push forward alone, and to trace the course of the mighty Congo across the continent. The main features of this marvellous journey from Zanzibar to Loando were graphically described, with many interesting details of the peoples and tribes met with in the course of it. The great charts borrowed from the Royal Geographical Society enabled the lecturer very clearly to indicate his route as he proceeded. Commander Cameron concluded by impressing upon his hearers the immense importance to this country of opening up the great trade routes from the north through the Soudan, and even more so those going northward from our own possessions in the South of Africa; the fact of the Germans getting a footing in Zanzibar and endeavouring to open up trade with the interior making those routes which are under our own control more than ever important to us. He believed that the murder of Bishop Hannington was mainly due to the recent German annexations, which had made the natives suspicious of every stranger. The Large Hall was well filled, and the vote of thanks moved by Dr. Carpenter and seconded by Dr. Thompson was most cordially supported by the audience.

Second Evening Meeting, March 10th, 1886. — At the Evening Meeting, held on March 10th, 1886, Commander Lovett Cameron was, with his cordial assent, elected an honorary member of the Club, to show its appreciation of his able and interesting lecture.

Mr. E. Lovett exhibited and described a rare Crustacean (*Alphæus ruber*), which has the power of producing a loud sharp noise like the cracking or fracture of glass.

Mr. A. Bennett exhibited specimens of an *Equisetum* (*E. littorale*), found in Surrey by Mr. Beeby, and new to the British Flora.

Mr. W. Topley, F.G.S., then read a paper, "On the Changes of the English Coast-line within Historic Times" (TRANS., art. 59).

In this able and interesting paper Mr. Topley referred to the more important changes, involving loss and gain of land, along our coasts, pointing out the great importance of the shingle beaches and their movements along our southern coasts, and the mischief done by artificial interference with them for supposed local advantages. His general conclusions were, that although the losses in certain localities had been very great, taking the whole coast-line together, the gains and losses had been fairly balanced, and that the land area of Great Britain has remained pretty nearly the same for many centuries.

An interesting discussion followed the reading of the paper, in which many members took part.

Third Evening Meeting, April 14th, 1886.—At the third Evening Meeting, held on April 14th, 1886, Mr. Philip Crowley made some remarks on the habits of the larvæ of some species of large African moths, which he had previously exhibited.

Mr. McKean also exhibited platinotypes of type-specimens from the Royal Herbarium of Brussels of *Arctium nemorosum*, a species of Burdock, and pointed out the value of such reproductions of rare and critical species, and how admirably adapted for the purpose the platinotype process is.

Dr. Alfred Carpenter then read a paper, "On Disease-Germs as at present Established" (Trans., art. 60), illustrated by numerous and admirable diagrams. Dr. Carpenter described the various forms of Bacteria and Bacillus which are known to be associated with specific diseases, and the present state of our knowledge respecting them. He described the methods of research and identification, and the bearing of the facts described upon the prevention and suppression of zymotic diseases.

A discussion followed, in which Dr. Keith Brebner and Dr. Perkins Case took part.

Microscopic preparations of Bacilli, &c., illustrating the lecture were exhibited by Dr. Carpenter and Mr. Low Sarjeant.

Fourth Evening Meeting, May 12th, 1886. — At the fourth Evening Meeting, held on May 12th, Mr. J. H. Drage exhibited and described some peculiarities in the structure of the bones of the Eared Grebe.

Mr. F. C. Bayard showed and described a series of self-registered curves from a *Ricard* Thermograph, a *Ricard* Barograph, and a *Jordan* Sunshine Recorder.

Dr. Carpenter mentioned an interesting fact, showing the severity of the weather in March. He stated that on March 3rd some branches were lopped off a large maple in his garden, and on the 13th he observed icicles hanging from the ends of the branches, which gradually increased until on the 17th they measured 18 in. in length by 1 in. in thickness. These icicles were due to the copious flow of sap from the cut surfaces of the branches, and indicated great activity in the tree, in spite of the severity of the weather.

The paper of the evening was by Mr. H. S. Eaton, "On the Meteorology of the Croydon District from 1881 to 1885 inclusive, the Air, Temperature, and the Rainfall." This valuable report was included in the last volume of Transactions, having been formally presented for that purpose at the Anniversary Meeting. Mr. Eaton's paper pointed out all the more important and interesting results of, and deductions from, the records of the five years.

An excellent discussion followed, the meeting having the advantage of the presence of Mr. Symons and Mr. Marriott, the eminent meteorologists. Several of our own members, including Mr. Baldwin Latham and Dr. Carpenter, also took part in the discussion. The relative value of the various recording stations and the defects of position, &c., especially of the Greenwich instruments, were pointed out.

Mr. Baldwin Latham exhibited a diagram showing the variations of the water-level in the Addington Valley, and remarked on the rainfall and water-temperature in the various wells in the district, the results of a carefully recorded series of observations maintained by him for a number of years, some of the results of which he promised to place at the service of the Club.

Fifth Evening Meeting, September 8th, 1886.—The first meeting after the recess, being the fifth of the session, was held on September 8th. Mr. Nation exhibited a very interesting specimen of the cells of a solitary bee, which had been built upon the edges of a book standing in a book-case.

I, also, exhibited specimens of the small orchid, the autumnal ladies' tresses, *Spiranthes autumnalis*, from Riddlesdown. This plant is very irregular and uncertain in its appearance, and was this year in most unusual abundance all along the ridge of Riddlesdown, especially in the neighbourhood of the rifle-butts.

Mr. Edward Lovett then read a paper, "On the Gun-flint Manufactory at Brandon, in Suffolk" (Trans., art. 61), illustrated by a large and most interesting series of specimens. The great interest which attaches to this manufactory is, in the first place, that it is almost, if not quite, the only manufactory of gun-flints still existing, and it continues to turn out these at the rate of three or four millions a year, chiefly for the African market; and secondly, that the manufacture of flint implements has gone on here continuously through the Palæolithic and Neolithic periods right down to our own times. The well-known Grimes' Graves in its neighbourhood are simply the pits by means of which the flint beds have been worked by our prehistoric ancestors, and the same rude means of obtaining them are used now as in that ancient period. The flint is of a remarkably fine compact quality, and found in large masses. Mr. Lovett showed, from specimens he had had worked for him, how far the present workers can go in imitating their ancient predecessors, pointing out that they altogether failed to produce the surface-chipping which is seen in the older work. He gave a most interesting description of the tools now used, and the method of working.

A short discussion followed, in which Mr. Bidwell and Dr. Thompson took part.

Sixth Evening Meeting. — *Mr. Seebohm's Lecture.* — On October 19th (in place of the sixth Ordinary Meeting) a Lecture was delivered in the Large Hall by Mr. Henry Seebohm, the distinguished traveller and ornithologist, "On the Migrations of Birds." It is a difficult task to summarise this most able and interesting lecture, which was listened to with the closest attention and delight by an audience of about 600 persons. The lecturer began by referring to the evident knowledge possessed by the ancients of the movements of birds, as shown in the books of Job and Jeremiah, and traced down the history of the subject to the present day, especially dwelling on the vast amount of close observation and study which has been given to it during the past few years in England by a number of observers under the direction of a committee of the British Association, and in Heligoland by Mr. Gätke, who during a long residence in the island has given it the closest attention. Mr. Seebohm then referred to the causes of migration, summing up this part of the subject by stating that search for food was in all cases the motive power. The following summary of this part of the paper is taken from an excellent report in the 'Croydon Chronicle':—

"Migration, it had been found, was not confined to one family of birds, nor was it confined to either hemisphere of the world, nor, indeed, to the whole of the individuals of a species; for there were many birds which were migratory in one part of their range, and residents in another. For instance, the robin, the blackbird, and the thrush, which remain with us during the whole of the winter, yet are migratory in many parts of North Germany, where the winters are too severe. There was one law respecting this migration that might be laid down as being without exception, and that was, that birds breeding in the tropics were always residents, or their migrations were simply confined within the country in which they lived. Thus they might breed upon the hills and winter in the valleys, but they never left the country. Migratory and non-migratory birds could be distinguished from each other by the shape of their wings. The wings of non-migratory birds were rounded, and the end or flight-feathers were almost all of the same length, and were small; whereas in migratory birds, like the swift, they were enormously developed, as if the whole vital energy had gone into the flight-feathers. It should be particularly noticed that birds never bred in the south and then migrated to the north. They always bred in the farthest north. Thus every bird that came to breed in this country went farther south for its winter quarters, and every bird that came here for its winter quarters bred farther north. Birds did not migrate simply from a whim, but because there was a reason for it, and the cause of the migration must be taken to be almost entirely want of food. It was very improbable indeed that birds migrated simply to avoid cold. They were able, in the course of ages at least, to provide themselves with fur coats, so closely packed to their bodies that they really rendered themselves impenetrable to cold. One of the causes for birds migrating originally was, probably, because every bird has to be constantly increasing its range or trying to do so. There was throughout the animal creation, as through the vegetable creation, an enormous struggle for existence constantly going on. It was difficult to realise the vastness and extent of that struggle. But he thought he would be able to make them realise to some extent to what an enormous degree it must operate upon the animal world by an example. Supposing they were to take a pair of partridges and put them in the fields outside Croydon, and supposing those partridges were to build a nest and lay eighteen eggs, as they frequently did, and hatched them all, and allowing that process to go on for sixteen years, each pair of young birds laying eighteen eggs and hatching them, then at the end of sixteen years there would not be room on the whole surface of the earth for those birds to stand, without standing on each other's backs. So they could see there must be annually an immense mortality among birds, and there was no doubt that a great deal of that mortality took place during the migration."

He then described the great lines of migration in Europe and Asia, pointing out that in some cases these routes follow the lines of ancient coast-lines long since submerged, showing the enormous antiquity and unchanging character of the instinct. He gave a most graphic and interesting account of his own observations in Heligoland. This island lies on the direct track of one of the greatest lines of migration between Arctic Europe and England, and South Germany; and the vast multitudes of birds which pass over it seem almost incredible.

Mr. Seebohm related how (quoting again from the 'Chronicle') "he had been round the island one day twice with his gun, but had not seen a bird, and he returned home to a friend's house, who was an old resident and well versed in bird-lore, and told him how disappointed he was that no birds had arrived. But his friend said, 'If I were you I should go to bed early, for to-morrow the island will be full of birds.' He asked, 'How do you know that?' His friend replied, 'Because the wind has changed. There is now a perfectly favourable wind, and there must be birds within twelve hours, or possibly within six.' He went to bed early, according to his friend's instruction, leaving word with his landlady if any migration of birds was to be seen that he was to be called. About midnight he was awoke and told that the island was full of birds, and that everybody was out trying to catch them. He went out and found it a pitchy dark night, without moon or stars to be seen. The whole of the inhabitants of Heligoland had turned out with lanterns attached to their waists and with nets, something like ordinary fishermen's nets, and were wandering over the potato-fields and over the grass, continually popping their nets upon the birds, which flew up at their feet, doubtless attracted by the light, but frightened by their tread. He made his way direct to the lighthouse, which was a favourite place, and as he went across the potato-fields almost at every step birds were getting up at his feet. On reaching the lighthouse he saw one of the most remarkable sights that it had ever been his good fortune to witness. The top of the lighthouse, as far as could be seen from the reflecting rays of the light, was one dense mass of birds. In fact the top of the lighthouse was a drifting sea of birds. He went up to the top, and there he found enormous clouds of birds were passing over the lighthouse, almost all of them being sky larks, but occasionally he heard the sound of other birds amongst them. Perhaps out of the thousands one here and there would be attracted by the light of the lighthouse, and would descend from the flock to see what was the matter. Most of them passed on again, but now and then one of them, which was perhaps rather tired, would rest upon the wire netting outside of the light, and in that way he and those with him were able to put their hands upon them and catch them; and in the course of some two hours and a half they caught about 240 birds. The birds were evidently crossing over from Denmark to England, and would alight, according to the wind, either on the coasts of Norfolk or Yorkshire, and would then scatter along the coast, gradually sending out little detachments, until by the time Cornwall was reached the whole flock would be dispersed. The height at which the birds fly varies very much. Sometimes at Heligoland, from early morning till late at night, one long straggling line of hooded crows would be seen flying so close to the sea that they had to rise to cross the island. At other times birds flew at such a height that they could not be seen, and their presence was only known by hearing their call-notes. There were many birds, too, which migrated so high that they were out of range either of sight or hearing. Astronomers, especially in America, had seen with their telescopes flocks of birds which must have been more than a mile above the surface of the ground." As to the power or faculty which enabled birds to steer their course at night, Mr. Seebohm said that "birds no doubt migrated by sight. They had landmarks with which they were familiar, and when they could see those landmarks they flew with great certainty; but when they did not, they flew with great hesitation and doubt. Carrier pigeons, which were taught to return home, had to be acquainted with the country around the spot they were brought up in. It was found by the Arctic explorers that when they let out some pigeons, which they had brought out in the hope of sending them home, that they fluttered about helplessly. They had no landmarks, and they had not the slightest idea what to do or where to go. There could be no doubt that birds had a very remarkable power of remembering localities. That, every-one would recognise in a moment if they thought how larks would build in the middle of a great field of long grass, and yet would have no difficulty in finding the place where they had deposited their nest and eggs."

In conclusion, the lecturer gave some interesting particulars of the order of the migrations, the young birds coming first, led by two or three old bachelors or spinsters, and taking about a week to pass; then in the second week come the male birds, followed in the third by the females, and in the fourth week by a strange company of cripples.

The meeting will long be remembered as one of the most successful ever held under the auspices of the Club.

Seventh Evening Meeting, November 10th, 1886. — The seventh Evening Meeting was held on November 10th. Mr. Crowley exhibited some cleverly coloured specimens of Lepidoptera, to show how spurious varieties are executed by unscrupulous dealers to deceive collectors.

Mr. W. H. Beeby then read a paper, "On the Additions to the Surrey Flora during 1886," which will be published in our Transactions (TRANS., art. 62). It was illustrated by excellent specimens of the species referred to.

Mr. W. H. Mordaunt, President of the Sidcup Club, followed with a paper, "On the Spider," illustrated by excellent diagrams of the spinning organs and structure of these animals. Mr. Mordaunt gave an interesting popular account of the spider, and a detailed description of their more important organs and structure, especially of the spinnerets. Microscopic preparations illustrating their anatomy were also shown.

Eighth Evening Meeting, December 8th, 1886. — The eighth Evening Meeting was held on December 8th. The first paper of the evening was by Dr. George J. Hinde, "On the Microscopic Structure of the 'Malm,' or Firestone Rock of Merstham and Godstone" (TRANS., art. 63). The discovery of the composition of this rock is due to Dr. Hinde's researches, and is of great geological interest. He finds that the stone is almost entirely made up of the spicules of fossil sponges. In his paper, which I need not refer to in much detail, as it will doubtless appear in our Transactions, he described the geological position of the rock, the geographical limits of its outcrop, and illustrated its composition by an admirable series of diagrams and of microscopic preparations.

An interesting discussion followed, in which the remarks of Mr. Topley, Mr. Stanley, and others were of much interest.

Mr. Topley then gave an account of the new well at Addington, which is being sunk by the Corporation, in which, after some disappointing delays, a copious supply of water amounting to about 1,200,000 gallons per day has recently been obtained. Mr. Topley gave interesting particulars of the nature of the chalk-fissures in which the water flows, and of the position and dip of the strata, illustrating his remarks by maps and diagrams.

The meeting had the advantage of the presence of Mr. Thomas Walker, the Engineer to the Corporation, under whose direction the works are being executed; of Mr. Morland, the Chairman of the Water Committee; and of Mr. Baldwin Latham, whose unequalled knowledge of the water-bearing strata of the district is so well known. The discussion therefore brought out a large amount of valuable information, and was extremely animated.

Mr. Topley spoke favourably of the prospects of obtaining water from the underlying Greensand, if the well should be sunk down to it. He pointed out that the water-supply from that formation would probably be much softer than that from the Chalk, thus rendering unnecessary the artificial softening of the Croydon water, which has recently been strongly advocated by some members of the Corporation.

The meeting was one of unusual interest, the practical importance of the subjects under discussion being appreciated by all present.

Conversational Meetings. — Conversational Meetings have been held during the year; those devoted to photographic topics have been very successful and well attended. At that held on October 27th Mr. Low Sarjeant demonstrated the Collodio-Bromide-Emulsion process through all its stages, from the coating of the plate to its development and finish as a lantern-slide. On November 24th Mr. James Epps, jun., kindly brought his lantern, and fifty photographic slides (all the work of our own members) were projected on the screen. The success of the photographic meetings, and the comparative failure of others, point, I think, to the true functions and uses of these meetings. It is, I think, not to be expected that our Honorary Secretary, willing and energetic as he is, should provide subject-matter for them; they ought rather to be arranged for by groups or sections of our members with common interests, and they would then afford excellent opportunities for these to meet together to exchange information and ideas. The success of our Photographic Section points also to the organisation of other subsections for the special prosecution of other branches of science.

Excursions or Field Meetings.—The Excursions or Field Meetings announced at the beginning of the season were eight in number; in two of them we were associated with the Holmesdale Club, in one with the Quekett, and in one with the Essex Field Club. I give the list as issued, but regret that I can only speak from personal knowledge of four of them in which I was able to take part.

Excursions.

May 15th.—To Merstham, for Chipstead and Upper Gatton. To join the Holmesdale Club at Merstham.
June 14th (Whit Monday).—Oxted and neighbourhood. *Whole day.*
July 3rd.—Frensham Ponds. *Whole day.* To join the Holmesdale Club.
July 17th.—Warlingham. *Half day.*
Aug. 7th.—Leatherhead. *Half day.*
Aug. 28th.—Caterham Junction, for Chaldon. *Half day.*
Sept. 18th.—Hayes and Keston. *Half day.* To join the Quekett Club.
Oct. 2nd.—Chingford. *Whole day.* To join the Essex Field Club.

On Whit Monday, June 14th, the excursion was to Oxted and neighbourhood. The party of about twenty, after leaving Oxted Station, followed the footpath from the church towards the chalk quarries. My friend Prof. John Macoun, of Ottawa, of the Canadian Government Geological and Natural History Survey, and one of its representatives at the recent Exhibition, was one of the party. He is known in Canada as the chief pioneer of the survey and settlement of the Great North-West Provinces of the Dominion. His delight and admiration at the sight of a field of crimson clover, *Trifolium incarnatum*, through which the path lay, was unbounded. "We have nothing in America to show you equal to this," were his first words. In the woods skirting the lane to the quarries, the great helleborine, *Cephalanthera* *grandiflora*, and the fly orchis were just coming into flower, and some magnificent plants of the deadly nightshade, *Atropa Belladonna*, were noticed on the chalk-banks. Mr. MacLachlan, who was with us, captured here a fine specimen of the wood tiger-moth. In and about the quarries many orchises were in full bloom; and the large butterfly, *Habenaria chlorantha*, the sweet-scented *Gymnadenia conopsea*, the bee, *Ophrys apifera*, and the fly, *Ophrys muscifera*, were all in plenty; I had also the pleasure of gathering fine specimens of the Adder's Tongue, *Ophioglossum vulgatum*, thus confirming an old record of John Stuart Mill's. In the woods above Titsey, *Myosotis sylvatica* was still in bloom, though past its best. Thence we followed the ridge to Botley Clump, whence a magnificent view was obtained across the rich and beautifully wooded country from Oxted to Westerham and thence to Sevenoaks, and southward to the South Downs, Chankenbury Ring above Worthing being distinctly visible. Our photographic members had some of them brought their cameras, and these were brought into requisition and a very good group of the party obtained. Looking northward, the Crystal Palace, St. Paul's, and the course of the Thames eastward could be seen. A pleasant walk over hill and dale brought us to Chelsham Common. Some of the chalky fields by the way so thickly strewn with flints that little or no soil was visible, provoked from our Canadian friend comparisons not flattering to them, with the rich deep black soil of the prairies. He told us he had been much impressed everywhere he had been in England, and here more than anywhere, with the immensely greater amount of labour and tillage needed to obtain a crop than in Canada, and the consequent crushing disadvantages under which our farmers labour. In the ponds on the Common the water purslane, *Peplis portula*, and *Chara flexilis* were abundant. Some refreshment was obtained at the well-known Inn, and the walk home by Selsdon, Croham, &c., brought a very pleasant day to a conclusion. About 200 species of flowering plants were noted, and the keen interest in our native flora shown by Prof. Macoun reminded me pleasantly of my own enthusiasm when exploring with him the swamps around Ottawa, the prairies of the North-West, a flora so new and strange to me, and when on the lofty Rocky Mountains we found the, to me, familiar and beautiful flora of our European Alps and Scottish Mountains.

On July 3rd a day's excursion to Frensham Ponds with the Holmesdale Club was announced. I regret to say that I and members of my family were the only representatives of Croydon present. The distance is almost too great, and the railway connection too circuitous and slow for us to undertake from Croydon. It is nevertheless a most interesting excursion. The vast sandy tract running from the neighbourhood of Farnham to the foot of the Hindhead range and the Devil's Jumps is a very remarkable one; a number of very shallow but extensive lakelets are found in its slight depressions. The day was intensely hot, which seemed appropriate to the character of the country. The botany of the district is rich and interesting, several plants seldom met with elsewhere in the county are abundant. Among the most interesting is *Carex arenaria*, a species of sedge everywhere else a distinctly seaside or sandhill plant. Others noteworthy are the sweet rush, *Acorus Calamus; Littorella lacustris, Anagallis tenella, Carex dioica, C. stellulata, C. pulicaris, Chara aspera*, and *C. fragilis*. The white water-lilies were in great beauty and profusion. Vipers were disporting themselves in the pools, an example which was soon followed by many of the party. I wish some of our entomological friends had been present, as I have no doubt they would have reaped a rich harvest.

On July 17th a half-day's excursion to Warlingham was on the programme. The morning was very threatening and showery, so that many doubtless were discouraged from joining us; but the afternoon turned out extremely fine and enjoyable. We met at Lower Warlingham Station, and ascending the hills above it, walked along them to the entrance of the Hallelu Valley, which we followed upwards to Sline's Oaks, and then mounted the steep slopes formed of Oldhaven pebble-beds like those of Addington to Worms Heath, from the top of which (about 800 ft. above the sea) a view of great extent and beauty was spread before us, Box Hill and Leith Hill being conspicuous objects. I happened to be staying with my family at Beech Farm, close by, and had the pleasure of entertaining the party there. Amongst the rarer plants noted were the grass-leafed vetch, *Lathyrus nissolia*, with its beautiful crimson blossoms; *Lathyrus hirsutus*, one of our greatest county rarities; *Phyteuma orbicularis*, &c.; and one of my boys had found in Tilsey Woods, close by, the small Wintergreen, *Pyrola minor*, a very interesting addition to the flora of this division of the county.

Mr. McKean, who very kindly conducted the party, has favoured me with the following notes of the half-day's excursion to Leatherhead on August 7th:—"At the Leatherhead excursion eight members turned up. Thinking that some photographers might be among the number, I had arranged to take them to the hunting ground by a roundabout way, *viz.*, through the village of Bookham, where there are some pretty cottages and rustic peeps. However, there were no cameras that day. On arriving at our destination, Great Bookham Common, we found the string of ponds were almost totally dry, so there was not much collecting to be done. Mr. Berney had come fully equipped for Entomology, Dr. Franklin Parsons and Mr. Holmes for

Botany, and two others for Molluscs. There was nothing of any importance taken, but all enjoyed the excursion, which was favoured by splendid weather. We had tea together at Leatherhead on returning, and reached Croydon about eight o'clock."

The half-day's excursion on August 28th to Merstham and Chaldon was a very pleasant and successful one. The day was beautifully fine, and on this, as on the Whit Monday excursion, we were greatly indebted to Mr. E. Straker for his guidance of the party. The now well-known wall-paintings in Chaldon Church were one of the main attractions of the day. Several cameras were brought by the members present and photographs of the church taken; but the light was very difficult to manage, coming in the wrong direction, and I doubt if the results were very satisfactory. From Chaldon we made for Farthing Down, a rather remarkable spur of the chalk range, covered with beautiful turf, and with the remains of many barrows upon it. A very beautiful walk thence brought us to Kenley, where we were most hospitably entertained by Mr. E. Straker at his father's residence there.

Of the remaining two excursions on our programme, that to Hayes and Keston on September 18th and to Chingford for a Fungus Foray with the Essex Club on October 2nd, I can unfortunately give no account. I believe none of our members participated in the latter.

Our Photographic Section has been most active during the past season, and several very agreeable and successful Saturday afternoon rambles with the camera have taken place. The results of their work showed to great advantage, as we shall all remember, at the Soirée, of which it now only remains for me to speak.

Soirée, November 17th, 1886.—Our Seventeenth Annual Soirée was held on November 17th, in the two halls in the building, and the improvement effected by the construction of a corridor or lobby between them was greatly appreciated by the company. The Large Hall was as usual devoted chiefly to the microscopes, of which 142 were exhibited, an increase of 5 over last year; they were contributed as to 92 by members of twelve Clubs besides our own, 39 were shown by our own members, and 11 by exhibitors unattached to any Club. The Small Hall was devoted to exhibits of interesting objects of Natural History, Ethnology, and the Arts. Of those that will occur first to the memory of those who were present, I may safely place the most interesting and instructive collection of light-producing apparatus of all ages and climes brought together by Mr. Edward Lovett and Mr. Bidwell. The lamps of antiquity, the flint-strikers, and the more modern but now obsolete rushlight, which I well remember in my childhood used to cast such weird and ghostly shadows and patterns on the walls as it slowly waned, were all well represented. Then I would place next the portfolio of beautiful water-colour sketches made by my friend Mr. John Dixon, C.E., in all parts of the world, but especially in the Colorado and Yellowstone Rocky Mountains; and the exceedingly choice and valuable case of Egyptian antiquities collected personally by the same gentleman. Another section of Mr. Philip Crowley's seemingly inexhaustible collection of Lepidoptera; and Commander Cameron's most valuable collection of African weapons, musical instruments, and ornaments, were also among the more important exhibits, but no less attractive were many of the single or less extensive exhibits, of which I can only glance at a very few, selecting them rather from my own recollections than from any wish to depreciate those which I may omit. Mrs. Miller's basket of flowers from Addiscombe, which has been a feature of the Soirée for so many years, this year numbered 133 distinct varieties. The live and lively Australian opossum of Mr. Frank Allen had a constant concourse of admirers. Mr. Warner, with Mr. Stanley's electrical machines, shocked the ladies to their hearts' content. Among the many valuable pictures exhibited, a fine winter landscape at Davos, in the Eastern Alps, by Mr. Harry Goodwin, and a beautiful copy of the Coronation of the Virgin, by Mrs. Goodwin, were much admired. But the new corridor hung with the productions of our Photographic Section was perhaps the most popular resort of the evening. I specially noted Mr. K. McKean's "Croydon Slums,"—Middle Row, Day's Lodging-house, &c.,—and his admirable groups of children. Messrs. Low Sarjeant, Collyer, Straker, Bishop, Gower, Howell, and Jacques, all contributed, and many of their landscapes were of great beauty. Mr. Crowley again most kindly decorated the stage with valuable flowers. The attendance of members and visitors was 820, and the general opinion, as far as I heard it expressed, was one of unqualified satisfaction.

Donations. — A list of the many valuable donations of books and periodicals which we have received during the year will be appended to this address, and to all the donors the hearty thanks of the Club are due.

Lectures. — In looking back at the Proceedings of the year I would single out, as one of its special features, the revival of the practice which had almost become obsolete, of offering to our members and a large circle of our friends, lectures by men eminent in their own departments of science and research, of which we have had two most admirable examples in the lectures of Commander Cameron and Mr. Seebohm. I think nothing can tend more to extend an appreciation of the Club and its work, and I trust that from time to time the practice will be continued.

Botanical.—Time runs on or I should have liked to have added to this review of our doings in a corporate capacity some notice of the scientific work in which our members have been engaged. Following, however, the advice to the cobbler to stick to his last, I can only refer to some of the botanical work which has been accomplished. To English botanists the issue of the eighth edition of the 'London Catalogue of British Plants,' so long desired, marks with a red letter the year 1886. My friend Mr. Frederick J. Hanbury has been the responsible and capable editor of this work, which involves an amount of labour, care, and responsibility as to nomenclature which can only be appreciated by botanists. In this work his most valued coadjutor has been Mr. Arthur Bennett, to whose knowledge and aid, as Mr. Hanbury says in his preface, every page bears witness. Another of our members, Mr. Beeby, has also given most valuable assistance. The general arrangement and typography of the work leave nothing to be desired. That so many and such great changes in nomenclature have been found necessary is a matter of perhaps vain regret to conservative minds like my own. Mr. Beeby has also continued his labours upon the Surrey Flora, labours which we may hope are about approaching their successful termination, and I trust that the current year will see the publication of the work.

Geological. — A paper very important and interesting to local geologists, and closely connected with the work of our Club, has appeared in the 'Transactions of the Zoological Society of London' (vol. xii., Part 5, 1886), "On the Remains of a Gigantic Species of Bird (*Gastornis Klaasseni*, n. sp.) from the Lower Eocene Beds at Croydon," by Mr. E. T. Newton, F.G.S. This paper describes some of the bones found by our former member, Mr. H. M. Klaassen, in the lignite bed exposed during the construction of the railway at Park Hill. It will be remembered that bones of a large extinct mammal (*Coryphodon Croydonensis*) from precisely the same locality have already been described by Mr. Klaassen, and figured in our Transactions. The discovery of the remains of this gigantic ostrich is of even greater interest. The six bones found appear to have belonged to at least four individuals, and Mr. Newton hence argues that the birds must have been very numerous in our locality in Eocene times. The Croydon bird seems to come near to the *Gastornis Parisiensis*, the remains of which have been found at Meudon. Mr. Newton in his paper treats in great detail of the relations of the genus *Gastornis* and of its Croydon representative with other genera of fossil birds, especially with *Dinornis*, and also its relations with some recent genera, pointing out specially its points of resemblance with some aberrant forms of the goose tribe, notably the New Holland Goose, *Cereopsis*. Mr. Newton infers, from the bones which have hitherto been found, that this bird was at least as large and far heavier in build than any recent ostrich, that it equalled in this respect some of the more massive forms of New Zealand moas, but did not attain to the height of the larger species of *Dinornis*. The local interest of this discovery of Mr. Klaassen's justifies me in introducing a notice of it in this address.

Valedictory. — In conclusion, I desire most sincerely and cordially to thank all my colleagues in office for their kind support and assistance during my two years' presidency. I entered upon its duties, as my friends know, with great diffidence and hesitation. I hope that the interests of the Club have not suffered at my hands, and that from year to year my successors in this chair will be able to congratulate its members on continued and increasing prosperity, not only in numbers, but in good work accomplished, and added knowledge in the various departments of the extensive field of enquiry and observation which we profess to be ours.

Members elected, 1886.

Jan. 13*th.*—H. W. S. Worsley-Benison, F.L.S., Lulworth, Sutton. Thomas W. Binyon, Chichester Road. G. W. Beard, High Street, South Norwood. Thomas Ryder, 3, Tennison Road, South Norwood.

March 10*th.*—Robert Marshall, Broomfield, Duppas Hill. Francis Campbell Bayard, Warwick Villa, Springfield Road, Wallington. James Davies, 26, South End.

April 14*th.*—Edgar Skinner, Bramley Hill. Simpson Rostron, Beddington Lane. Reuben Vincent Barrow, Engadine, Park Hill Road. William Thomas Smith, Spring Lodge, Dean Road. John Cooper, Hooley House, Purley. Francis J. G. Linton, 18, Fairfield Road. Albert D. Howell, 9, Fairfield Road.

May 12*th.*—William H. Cullis, 7, Gresham Road, South Norwood. William Murton Holmes, Glenside, St. Peter's Road. Charles Clayton, Chatsworth Road.

Sept. 8*th.*—Thomas Walker, 32, Sumner Road.

Nov. 10*th.*—H. Weir Brown, Ferndale, Heathfield Road. Robert McLachlan, F.R.S., F.L.S., 23, Clarendon Road, Lewisham. Hon. Sidney Herbert, M.P., Manchester Square, W. A. W. Turner, Cambridge House, Canning Road. Arthur G. Carey, 9, Balfour Road, South Norwood. Frederick Alfred Barritt, Hazeleigh, Dean Road. Donald Shearer, Park Hill House. Stephenson R. Clarke, Croydon Lodge. M. E. Lownds, Stonehouse Lodge, Forest Hill.

Dec. 8*th.*—Martin W. Maylard, 86, Lower Addiscombe Road. J. C. Jolliffe, Shirley.

Presentations to the Club, 1886.

Journal of the Royal Microscopical Society. Science Gossip; from the Publishers. Across Canada to the Rocky Mountains, by H. T. Mennell, F.L.S.; presented by the Author. Notes on the Physical Geography and Geology of Western Canada, by W. Topley, F.G.S., and on the Flora and Vegetation of Western Canada, by H. T. Mennell, F.L.S.; presented by the Authors. On the Structure of *Naias graminea*, by C. Bailey, F.L.S. Report of the Botanical Exchange Club for 1884, by A. Bennett, F.L.S. Report of the Smithsonian Institute. Proceedings of the South London Entomological Society for 1885. Annual Report of the Brighton and Sussex Natural History Club. Twenty-eighth Report of the East Kent Natural History Society. Annual Report of the Sidcup Scientific Society. Report of the Belgium Microscopical Society. Le Naturaliste for April. Report of the British Association for 1884 (Montreal); presented by W. F. Stanley. Report of the Committee on the Erosion of the Sea Coasts of England and Wales; presented by W. Topley. Proces verbaux des Sciences de la Societé Royal Malacologique de Belgique for 1885. Annual Report of the Manchester Microscopical Society. Annual Report of the Hackney Microscopical Society. On the Occurrence of *Naias graminea* in Lancashire, by Charles Bailey; presented by the Author. Journals of the Quekett Microscopical Club; Northamptonshire Natural History Club; and the West Kent Natural History Society. Fifteenth Annual Report of the South London Microscopical and Natural History Club. Wood's Index Entomologicus, 1 vol.; Westwood's British Butterflies, 1 vol.; Westwood's British Moths, 2 vols.; presented by Mr. Basil Greenfield.

Exhibits, 1886.

Jan. 13*th*.—J. H. Drage, nest and eggs of the Dipper (*C. aquaticus*) taken from a hole in the rock by the side of a stream in Dumfriesshire. W. L. Sarjeant, microscope arranged to show how a good "black-ground illumination" could be obtained by means of the ordinary bull's-eye condenser, by using it as a spot-lens.

March 10*th*.—W. Topley, diagrams and maps illustrating alterations of coast-line, &c., in Great Britain. E. Lovett, the rare sound-producing Crustacean (*Alpheus ruber*) from the Channel Islands, and specimens of raised beaches from old coast-line of Jersey and Sark. Dr. Franklin Parsons, vegetable remains in peat from various localities. A. Bennett, a new Surrey plant (*Equisetum litorale*) found by Mr. Beeby.

April 14*th*.—Dr. A. Carpenter, diagrams and microscopic slides of disease-germs. Kenneth McKean, platinotypes of the type-specimen of *Arctium nemorosum* from the Royal Herbarium of Brussels, lent to Mr. Beeby for identification; also odontophore of *Haliotis tuberculata*. W. L. Sarjeant, slides of *Bacillus tuberculosus*, &c.

May 12*th*.—F. C. Bayard, curves from a Recard thermograph, a Recard barograph, and a Jordan sunshine recorder. J. H. Drage, the Grey Plover and the Eared Grebe, both shot in Norfolk in the spring of 1886. E. Straker and W. L. Sarjeant, platinotypes and photographs.

Sept. 8*th*.—E. Lovett, gun-flints and flakes from Brandon. W. Nation, cells of a solitary bee built on the edge of a book. H. C. Collyer, photographs. W. L. Sarjeant, photographs of Guernsey. H. T. Mennell, living plants of *Spiranthes autumnalis* from Kenley. E. B. Sturge, *Echinus sphæra* from Land's End. W. M. Holmes, fangs of viper, showing poison-duct.

Nov. 10*th*.—W. H. Beeby, new and rare Surrey plants; W. H. Mordaunt, series of slides to illustrate the anatomy of the spider. Philip Crowley, lepidoptera artificially coloured. Kenneth McKean, variety of *Helix caperata*.

Dec. 8*th*.—Dr. G. J. Hinde, a series of rocks and microscopical slides showing the structure of the Merstham and Godstone malm. E. Lovett, a series of flints. W. L. Sarjeant, jurassic rock from Wotton Bassett, Wilts.

Erratum. — Proc., page l, *Carex dioica* should not have been included among the plants found at Frensham Ponds.—H. T. M.

Croydon Microscopical and Natural History Club.—Balance Sheet for the Year ended 31st December, 1886.

Receipts.	£	s.	d.
Balance in hand	49	1	11
Subscriptions	116	1	6
Sale of Transactions	0	14	0
Sale of Soirée Tickets	30	10	0
Accumulated Interest on £210 11s. 8d.* at 3 per cent. from July, 1882, to Nov., 1886	29	19	7
	£226	7	0

Expenditure.	£	s.	d.
Rent of Club Room	10	0	0
Hire of Room for Meetings	5	0	0
Hire of Hall for Two Lectures	4	9	0
Royal Geographical Society, for Hire of Charts	3	3	0
Printing	5	3	0
Printing Transactions	49	1	1
Postages (including Transactions)	15	2	9
Books and Binding	3	3	0
Attendance and Collecting Subscriptions ...	6	16	0
Stationery	4	8	3
Refreshments at Annual Meeting	1	10	0
Soirée Expenses	62	12	2
Cabinet for Botanical Specimens	5	10	0
Sundries	5	0	5
Balance*	45	8	4
	£226	7	0

* This sum represents the Club's share of proceeds of the Bazaar held in July, 1882, and is now invested in Consols in the joint names of Philip Crowley, Henry Tuke Mennell, Kenneth McKean, and Edward Brockway Sturge.

* Not including postages in hand, £1 17s. 7d.

KENNETH McKEAN, *Treasurer.*

We, the undersigned, having examined the above Accounts and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and the Bankers' Pass Book.

WALTER M. GIBSON,
JAMES EPPS, jun. } *Auditors.*

January 4th, 1887.

TRANSACTIONS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1886–87.

60.—Disease Germs.

By Alfred Carpenter, M.D., F.R.M.S., &c.

(Read 14th April, 1886.)

Dr. Carpenter gave a demonstration of such disease germs as are thoroughly recognised in the medical world, and established upon a good foundation. He referred to his lecture upon Dry Rot in 1874, and to Dr. Philpot's paper on the same subject in April, 1876, and pointed out the great advance in microscopical research which has been made since that time. This advance has been wonderfully increased by the discovery of the method of staining living organisms by means of dyes, such as aniline gentian violet and freschine dye. These did not affect other organic matter, the organisms alone being stained by them. He then detailed the plan now adopted of cultivating different classes of disease-germ, and showed how cultivation in sterilised fluids and solids, such as gelatine, had shown the distinctive nature of the germ itself which had been thus cultivated. Tracing the history of infusorial discovery, he brought the subject down to Zopf's classification, and his order of Schizomycetes, into four groups, which he adopted, in the first two of which he (Dr. Carpenter) placed most of the established disease-germs. He showed how some organisms grow best in slightly acid solutions, whilst others can only increase and multiply in alkaline or neutral liquids, and gave credit to one of the genus of *Coccaceæ*, viz., to the *Ascococcus*, as a germ whereby a previously harmless solution may be made to produce a virulent germ, in consequence of the *Ascococcus* changing an acid solution, such as the acid ammonia tartrate, into an alkaline fluid; and then various cocci which develop enthetic disease may be rapidly produced, such production not taking place at all whilst the solution was distinctly acid in its reaction. This distinctive characteristic as to the effect of acid solutions had been dwelt upon in the author's paper upon Dry Rot, in which he showed that an atmosphere with excess of carbonic acid diffused through it assisted to develop dry rot in wood. In the group *Coccaceæ* he placed the coccus of pyæmia, of erysipelas, of fowl cholera, of blood rain, of gonorrhœa, of small-pox and cow-pox, the sarcina of dyspepsia, and some others which are now thoroughly recognised.

The second group, *viz.*, that of *Bacteriaceæ*, contained that form which produced alkaline fermentation in urine; that which gave rise to acid reactions, those which caused phosphorescence in some organic remains, that which sets up diphtheria in pigeons and men, as well as the pebrine or silk-worm disease. In this genus was also to be found the comma bacillus of Koch, as well as that of cholera nostras, and also the tubercle bacillus; the spirillum of relapsing fever, and the bacillus of anthrax, which also sets up wool-sorter's disease, malignant pustule, and splenic fever.

The attenuation of virus was explained, by means of which Pasteur hoped to do for cattle that which vaccination had done for men; and Dr. Carpenter explained the immunity of individuals from second attacks, on the theory that disease-germs required a certain kind of food to enable them to multiply, and that if there was no such food no such development took place; that the quantity available for such growths was minute, and that it was consumed by an attack of infectious disease, so that second attacks were rare in consequence of no food remaining. He pointed out the influence of the Ray fungus in setting up abscesses in various parts of the body, and gave it as his opinion that the treatment of disease would in the course of a few years be on very different lines to what it is at present; and that a very great number of those which now came under treatment would before very long become as much diseases of the past as dysentery, plague, and scurvy, because they would be treated upon a rational and scientific plan, instead of the empirical plan now frequently adopted.

Specimens of some of those referred to were exhibited, mounted and stained by Dr. Heron, among which were the "Comma Bacillus" of Koch, and the "Comma Bacillus" of Pfluger, the former believed by some to be the cause of Asiatic cholera, the latter established as the cause of English cholera. The "Tubercle Bacillus," "Spirillum of Relapsing Fever," and "Bacillus Anthracis" were also shown. The microscopic appearances of the disease-germs mentioned by Dr. Carpenter were well shown in some large diagrams which had been lent to him by Dr. Dreschfield, of Manchester.

61.—The Gun-flint Manufactory at Brandon, with reference to its Connection with the Stone Age.

By Edward Lovett.

(Read September 8th, 1886.)

In that vastly remote period in the history of man, known to us as the age of stone, we have every reason to believe that metals in any shape or form were entirely unknown. This age, of which the only trace whatever exists in the various implements of stone found in almost all parts of the world, together with a few mounds, cairns, &c., and still fewer human remains, has been divided into two periods, which are called the Palæolithic, or older stone period, and the Neolithic, or newer stone period. The chief material used for the manufacture of implements in these periods was flint (although silica in many other forms was extensively used in various parts of the world). But it was in the older stone period that flint was most general in use, igneous and other hard rocks coming into use in the later era. In our own country there are abundant traces of this age of flint occurring even in places where flint is not found *in situ*, as, for example, in some parts of Ireland and Scotland, and notably in the case of my cave discovery in the Island of Jersey. Where, however, flint does occur *in situ*, worked flints and traces of imperfect working and chipping are often common, and show by their position that they were obtained and worked up into weapons on the spot. Several of these old stone-age-men's workshops exist on our south coast, and on the Wolds of Yorkshire.

Perhaps, however, no one spot possesses more interest in this respect than the locality now occupied by the picturesque village of Brandon, on the borders of Suffolk and Norfolk, and near the town of Thetford. Near this village there still exist deep and curiously formed pits in the chalk, the origin and history of which were shrouded in mystery till their exploration and the excavating of fallen-in *débris* revealed their unwritten history. In and near these pits were discovered great numbers of the earliest type of flint implements, rudely shaped haches, pick-like instruments, calcined cooking-stones, bruisers, &c.; but by far the most wonderful discovery of all was a number of picks formed of the horns of the red deer, to which I shall again allude. These were found in the workings of the old flint pits. The country about this part bears strong evidence of having been a place of great importance in palæolithic times, and when the Neolithic age dawned its reputation had either not been lost or was discovered fresh by the men of the newer stone age, for flakes, knives, scrapers, &c., occur in greater abundance than in perhaps any other spot where such things are found. I consider it probable that, in the ages of bronze and early iron which followed, the chief business of great flint centres would shift to such places as iron and copper were to be found in, although it was undoubtedly the fact that flint was used long after the discovery of these metals. But Brandon being a place of great importance, was in all probability a busy centre all this time, for it is likely that upon the discovery of metals the old plan of producing fire by friction would be speedily followed by a primitive form of the flint and steel, which from that time has actually continued to the present day, for I was informed that the flint "diggers" still light their pipes in this way, and they are not the only ones who do so.

When the discovery of gunpowder revolutionised the fighting method of humanity, flint was again called into urgent request, and it is curious to consider that such an advance in the knowledge of the iron age and its science should have been accompanied by such a marked resuscitation of the use of stone as an implement. From that date to this Brandon has not ceased to be the leading centre of the gun-flint trade, though from all accounts it seems at last to be dying out. Few seem to be aware that gun-flints are still in use, and they would be still more astonished to know that they are exported annually to Central Africa to the extent of several millions. There must be some reason for the popularity of Brandon as a source of flint, and it probably exists in the fact that the quality of this material in that place surpasses what is found elsewhere.

Being desirous of examining for myself a manufacture so interesting, and so conconnected with a lost industry, I made a visit to the locality, and owing to the kindness of Mr. Snare, one of the leading manufacturers of Brandon, I was able in a very short time to examine the whole of the history of a gun-flint, from the digging of the rough material to the packing up of the finished gun-flints for export, together with several points connected with the business and financial side of the question. In the notes which I have drawn up I have embodied my own observations and ideas with all the information I was able to obtain from the workmen, but time prevents my entering very minutely into many interesting details connected with this curious manufacture.

We will first consider the source from whence the flint is derived for working into gun-flints. From time immemorial Brandon has been the chief seat of manufacture of flint weapons or implements of one sort or another, and the reason appears to be that flint of finer quality and size can be obtained there. Certain it is that in the locality are numerous pits excavated by prehistoric man for a similar purpose, *viz.*, to obtain flint for his weapons. These old pits are known as "Grimes' Graves," and they are of great interest to students of the early history of man. Their extreme age is undoubted, as the rude flint implements found in considerable numbers in and near the pits fix their age in the stone period with certainty. Besides this, a fact of great importance and interest came to light in the investigation of the pits, and this was the discovery of the picks used by these early diggers. These picks are made of the horns of the red deer, and all the tynes or branches of the horn are removed except the one at the base of the horn, and this one serves for the point of the pick. These remarkable pre-metallic tools were found in considerable numbers in the galleries of the pits, their points were bruised and worn, and the part held in the hand was smooth. In one case at least, the impression of a hand could be traced on the once wet chalky handle. Owing to their enormous age, these wonderful deer-horn picks were as fragile as dust, and in order to preserve them gelatine was poured over them as they lay on the ground.

It is astounding what results were obtained by prehistoric man, when we consider that metal was (in the stone age) absolutely unknown; when his pickaxe was a deer's horn, and when his axes and spades were of flint or igneous rock. It is also remarkable that the present flints are worked on almost exactly the same method and principle as the old ones, and that the iron pick of to-day is peculiar to these workmen, and strangely resembles in form and make the old deer-horn pick of an unrecorded age.

Before, however, we refer to the present flint pits, there are one or two points of a geological character which call for notice. As already stated, the chalk of Brandon yields very fine and large flints, and the chief pits are situated on a high and breezy common, about a mile out of the village. The ordinary soil or alluvium of the locality contains thousands of small broken flints, as well as implements of a prehistoric period. These are all highly glazed and stained, through long contact with various materials—vegetable, mineral, and meteorological; these are known to the flint-workers as china-faced flints, and are certainly the most highly glazed specimens I ever saw. Below this alluvial deposit occurs an impure chalky loam, locally known as "dead-lime." This material is charged with re-deposited flints much broken, which are there called "edgeways." Below this deposit comes the true chalk, in the upper part of which occur branched flints, called "horns flints"; below this comes the top stone, which is not very good in quality; below that the side stone, and at about forty-five or fifty feet from the surface they come to the "floor stone," or best quality flint. This occurs in very large solid blocks of about one hundredweight each, though pieces have been obtained of as much as three hundredweight.

The method by which the flint is obtained is one of the most remarkable features of the whole industry. One man and a boy is the usual staff to a pit. No rope, chain, ladder, basket, windlass, or plank is used, and yet masses of flint of the great weight already mentioned are raised to the surface from this depth of fifty feet. In short, the method pursued to-day is in all probability identical with that followed by palæolithic man, and I will now endeavour to describe it. First of all a pit is dug on the surface, about six feet long, by three feet wide, by three feet deep; then a second pit is sunk of the same length and width, but six feet in depth; this second sinking includes half the first area, but is excavated at right angles to obtain its full size; below this, again, a third is sunk at right angles to the second (still excavating), and so on, leaving a step or stage each time, so that when the floor stone is reached, about six or seven steps, of six to eight feet each, are formed, and the bottom of the shaft is some twelve feet from the perpendicular of the top opening, and at an angle of 45° to the angle of the mouth of the pit. When the bottom is reached tunnels are cut, and the good flint brought to the foot of the shaft and lifted on to the first step; to this step the man ascends by means of notches cut in the sides of the shaft. The blocks of flint are then lifted to the next step, the man following as before, until the top is reached, when the flint is stacked in one-horse loads, called "jags." These stacks of flint I observed were covered with branches of Scotch fir, which I was told was very necessary to protect the flint from the influence of sun, rain, &c., as the surface of the flint was much altered thereby, and the flint itself was not so good for use. This fact I consider of great interest, as much importance is always attached by collectors to the glassy and smooth or whitened surface of flint implements as a conclusive proof of their great age and genuineness. This test I consider much weakened by what I saw of the rapid alteration in exposed flints at Brandon Heath. When a pit has been worked a considerable length, the workman commences to fill in, working away the sides as he ascends, and otaining the wall and top stone, or inferior flints, which are used as building-flints. When the surface is reached the pit is filled up as far as possible with the top rubbish, but as flint has been taken out a hollow is left, and the heath is covered with the depression of these used-up workings. The flint being dug, it is carted down to workshops.

The places in which the gun-flints are made are small sheds situated at the back of a house or cottage, and the piece of ground adjoining is generally used to deposit the waste chippings upon. The shed we inspected accommodated three workmen, but as trade was dull only one was at work at the time. The three work-benches were really three stumps of trees, like butchers' blocks, and a small stump before each serves as a seat; another stump is used to sit upon when "flaking" is being done. Each block is nearly buried in flint *débris* and waste chips, and the whole flints for breaking up are stacked up on the opposite side of the shed. The process of reducing these natural masses of flint to marketable gun-flints is as follows:—The workman sits down upon the flaking block, and puts on a stout leathern apron; he then buckles on his left leg, above the knee, a thick pad faced with strong leather. Having finished these preliminaries, he takes up a flint, often one of forty or fifty pounds in weight, and placing it on this pad he breaks it into little pieces of about eight pounds weight with a short massive hammer, called a quartering hammer. This is apparently done with the greatest ease, the pieces coming off as if they were lumps of chocolate instead of flint. An idea, however, of the difficulty of the operation to anyone but a skilled workman may be formed from the fact that the quartering hammer, though of steel, becomes in a comparatively short time battered and turned as if it were lead. We also ascertained upon inquiry that the leg of the workman, though protected by the pad, becomes hard and insensible to delicate feeling.

The large blocks of flint being thus quartered, the same man takes up another hammer, called a flaking hammer, which is somewhat like a stone-breaker's hammer, bluntly pointed at either end, and it is also of steel. Selecting one of the pieces of flint, he places it on his pad, with a fractured black face uppermost, and with the side of the flaking hammer he breaks off all the outside crust or rough irregular flint. Having done this he strikes a sharp blow with the thin end of the hammer, about half an inch from the edge of the now clean black lump of flint, and this blow strikes off a long flake usually an inch in width, and from three to seven inches long, according to the thickness of the flint. These flakes are struck off in rapid succession, until nothing is left but the rough crust on the opposite side of the lump. When all the batch has been flaked up, the long knife-like pieces are turned out on to the big block before referred to. This block has a piece of steel, very much like a broad chisel fixed perpendicularly in it, and a hammer is used, called a knapping hammer, which is a flat piece of steel about six inches in length by one inch wide, and very thin; this is fixed horizontally into a handle. The flakes are held across the "stake," as the chisel-like arrangement is called, and struck with the knapping hammer; this flakes off pieces about the size and shape of a gun-flint, and a tap or two more completes the implement. The rapidity with which a skilled workman can produce gun-flints is remarkable, and the difficulty which a novice encounters on trying to fabricate a gun-flint is equally striking.

There are several recognised sizes of gun-flints, known chiefly as Carbines, Muskets, Single-barrels, and Horse-pistol; and as the flakes produce unequal sizes the workman is supplied with different receptacles, so that he has to discriminate as to which class the particular gun-flint he produces at each blow of the hammer belongs to, and deposits it accordingly. No gauge or measurement of any kind is used, and yet when the gun flints are turned out in the bulk according to pattern they run with remarkable uniformity in size and appearance. The present gun-flints are struck from long flakes several to a flake, and I was informed that they are called "Frenchmen," owing to the fact of their having been introduced to Brandon from France. The old gun-flints appear to me to have been rounded at the base, and were more like what the flint-makers call "Strike-a-lights," only smaller; these again resemble the so-called "scrapers" of the Neolithic age. Indeed I was much struck with the evolution of these recent flint implements from those of the older period. The "Strike-a-lights," already referred to, are generally known as "Englishmen"; they are used with flint and steel, and I was surprised at the demand for these things even now. Not only do they go abroad, but many are used in this country; and I understand that the flint-workers themselves never obtain fire but by the old flint and steel method.

As I was desirous of ascertaining to what extent the gun-flint workers were capable of producing other implements besides those of their regular trade, I took a man off his work, and gave him some ideas to work out. Beyond the chipping that could be produced by means of the knapping hammer on the "stake," I soon found that nothing could be reproduced at all like prehistoric implements, beyond the scrapers already referred to. The so-called secondary working, admired and valued as a proof of the genuineness of neolithic weapons, is produced on the gun-flint worker's block as a natural consequence of breaking off the the overlapping flint by the hammer when the flint is laid over the edge of the stake. Indeed I produced the same effect myself with the greatest ease, and I fabricated a "scraper" out of a piece of waste flint, which is certainly equal in finish to any I ever saw of Neolithic age. But when we come to face-flaking and chipping, the matter is a very different one. I did all I could to get the worker to do this, but all attempts broke the flake each time, and I was assured the thing was quite impossible. Here at any rate is a point in favour of the superior skill of prehistoric man, although I believe myself that, with different implements, &c., such work might be produced. At present the object of the gun-flint workers of Brandon is to make gun-flints, and to make them as fast as they can, as they are paid by the job; but I have no doubt that if they were called upon to fabricate a face-flaked weapon in like quantities they would in time be able to do so to perfection. As it is, their present occupation is by no means a simple one, and it takes a long time and much practice to attain to any proficiency in the art of making gun-flints. Quartering the big flints and striking off the long flakes is a very skilful operation, and I should say absolutely impossible to perform by an amateur. As for my own experience, I was able to make a respectable scraper and spear-head, but as for flaking and knapping gun-flints, I broke every one I tried.

There is of course a great deal of waste, not only chippings, but large pieces too, for it often happens that upon quartering a big flint it turns out too full of flaws and imperfections to be made into gun-flints, so it is put aside with any other pieces of a suitable size, and these are trimmed into blocks about six inches, by three inches, by four inches, and are called "builders." These are sold for facing houses, for ornamental work in building, and even for making walls. Many of the houses and garden-walls in Brandon are built of splendid dressed flints, and, though very old, seem as good and as sound as ever. The chippings, on the other hand, are almost useless, except for road-making; but the locality is well supplied with this material, and, as freight and cartage is an item of consideration, it does not pay to send it elsewhere for road-making, or even for pottery manufacture, in which silica is greatly used.

We now come to the final use of gun-flints. It is no doubt a matter of astonishment to many that such articles are made at all in these days of percussion caps, breechloaders, pinfires, central-fires, &c., yet so it is, and for these reasons. Our old flint-lock rifles and guns are not destroyed by any means; they are, or were, sold to merchants for purposes of barter with natives, chiefly of equatorial Africa. As, therefore, these guns still exist, and as they require gun-flints, flint being scarce or even unknown in Central Africa, it follows that a demand still exists in these regions for the article of commerce in question. Zanzibar and other points communicating with the interior are the chief points of consignment, and, as Mr. Snare was good enough to supply me with some of his business statistics, I am able to quote the annual output of gun-flints from one firm in six years:—1880, 4,500,000; 1881, 2,832,500; 1882, 3,115,000; 1883, 4,721,300; 1884, 4,793,150; 1885, 3,203,250. After the flints are made they are counted off into store casks, which are usually flour-barrels, and I saw thus stored several hundred thousands in one warehouse. For export they are packed into kegs or well-made small barrels, each holding as near as possible 29,800 gun-flints. In this condition they go out to the African ports for barter with the natives, to make fire for the old flint-lock muskets which did duty in this country before the days of the Enfield, the Snider, and the Martini-Henry.

In conclusion, there are one or two points of great interest which I wish to point out in reference to this gun-flint manufactory. We have seen how that in all probability Brandon has been a continuous source for flint implements from the very earliest times. We have also seen that in the methods of obtaining the flint the same primitive means, with a total absence of mechanical appliances, is now adopted, which we have every reason to believe men of the stone age employed. We also find the methods of working up the flint to be probably identical with that of primeval times. But there are two other points to which I would refer. First, I observed that the Brandon flints under certain conditions of exposure became much altered as to their freshly-broken surfaces, and were therefore protected by branches of trees, as I have already stated. Now, it is generally held that the glazed, stained, or polished surface of worked flints is a sure and certain proof of the great age and antiquity of the specimens; but I am certain, from what I saw at Brandon, that such surfaces, at least there, do most decidedly undergo such alteration and decomposition in a remarkably short space of time, so that I am inclined to attach but little importance to such an indication, *per se*, as a proof of genuineness. Secondly, I made a careful note of the fracture produced in flaking the flint, which, being naturally conchoidal, results in what is termed a bulb of percussion. Now, this bulb has been held most properly to be another sure indication of genuineness and human origin, although I believe some have argued to the contrary; but I do not see how it is possible for such a fracture to be produced by natural causes. To produce it, or indeed to produce a flake at all, the flint must be struck sharply by a hard body (iron, stone, or otherwise), having a point or striking-surface of a smaller area than the flint itself; the flint to be flaked must be held or fixed so as to ensure an elastic blow, for if a dead or solid blow be struck the flint is either crushed or, what is more likely, does not break at all.

It is obvious, therefore, that such a combination as the above does not occur in Nature, and the bulb of percussion must on that account be taken as a certain proof of the human origin of the implement or flake in question. One feature of implements of the stone age may be considered also as a conclusive proof of their genuine origin, and that is the face-flaking or chippings of the flat surface, This is, I believe, considered to be a lost art; and I think it must be so, for I was quite unable to get the flint-workers to do anything of the kind, although they did their best to produce some spear-heads. We see, therefore, that as most modern ideas help us to understand better the remains of ancient phenomena, so also, by a careful examination of the manufacture of gun-flints, considerable light may be thrown on the methods adopted by palæolithic man, whose sole object in life was to live, and whose sole means of supporting that life existed indirectly in the hard flint stone. The stone implements from "Grimes' Graves" were kindly sent me by Mr. F. Norgate, of Downham, near Brandon, whose collection is a remarkably fine one.

It should be mentioned that the paper was illustrated by a large number of specimens collected during a recent visit to the locality indicated, including a set of flint-worker's tools. The reading of the paper was followed by a brief discussion, in the course of which the hearty thanks of the members were conveyed to Mr. Lovett for his paper.

62.—On some Additions to the Flora of Surrey (1886).

By W. H. Beeby.

(Read November 10th, 1886.)

In my report on the work done in connection with our county Flora for 1885, read before you some time since, I was unable to record that any species new to the county had been discovered. During the past summer, however, several additions have been made, and this is due chiefly to the working of that portion of the Bourne Brook Basin which lies between Egham and Chertsey, and adjacent to the River Thames. The plants of this small tract of country are of particular interest to us, as they represent a flora which is gradually disappearing from our county, owing to drainage and other causes; for, besides the novelties, several plants which have become extinct, or nearly so, in their only other recorded stations in Surrey are found here in abundance. The small tract alluded to may, indeed, be called a fen district on a small scale, and it is here, if anywhere, that we should re-find such a plant as *Lathyrus palustris*, once a native of Surrey, but long since extinct. Drainage has, however, already advanced too far to make it very likely that the *Lathyrus* will be again found. This fen tract is certainly deserving of more attention than I have yet been able to give to it, and, if any of our members are anxious to add a new plant to our list, there is a fair prospect of the wish being gratified, if they will investigate the locality mentioned closely.

Of the two new species, the first I will call attention to is *Potamogeton zosterifolius*, one of the grass-leaved pondweeds. This species is, as you are aware, already credited with as many as three stations in Brewer's 'Flora.' The three records are all on the authority of John Stuart Mill, who certainly did not well understand these plants. None of his specimens representing it are known to me, and all his stations have been searched several times in vain; and accordingly his record is not accepted in Top. Bot. It was with much pleasure, therefore, that I found last spring a plant which I thought would prove to be this species. A later visit confirmed the opinion, and, although the plant has not been obtained in fruit, I have no doubt as to its name, as the only alternative is a species new to Britain, if not new altogether, as the plant in question is not *acutifolius*, the only other species we have in this country which resembles it at all in the structure of the leaves. The plant occurred very sparingly in but one slow-running ditch near Chertsey, and, as it has been looked for a great deal in Surrey for some years past, it is probably quite one of our rarest species.

I am indebted to my friend Mr. Arthur Bennett for the additional distribution of the plant beyond that given in Top. Bot., from which it appears that Berkshire is the only other county south of the Thames in which it is known to occur, while it extends north to Forfar. *P. acutifolius*, which is locally rather common in Surrey, has, on the other hand, a much more southern range, occurring in five counties south of the Thames, and not extending north of Yorkshire.

The next new species is one of the *Characeæ*, viz., *Tolypella intricata*, a plant often included in the genus *Nitella*, which it resembles in having the stems composed of a single pellucid tube, but now separated by most authors chiefly on the characters afforded by the position of the reproductive organs. These plants are of course well known as showing well the movements of the cell-contents. This is the only *Tolypella* yet found in Surrey; and it was not the one I had expected to get, as the Messrs. Groves found *Tolypella glomerata* some years since on the Middlesex side near Staines, and I had thought that it might turn up on our side of the river. The Surrey one is much the rarer species, and it is not at all impossible that we may eventually get the other as well.

Besides these new records, *Sium latifolium*, now all but extinct in its well-known Thames-side stations, occurs in several places, and in one is fairly abundant, and is likely to occur in many of the ditches hereabouts. *Utricularia vulgaris*, the common bladderwort, has not been found in Surrey for many years, and has apparently been extinct in the old locality, near Walton Bridge, for some years. It occurs in the greatest profusion in nearly every ditch in this fen-tract. Of other rarities found here, I may name *Rumex maximus*, only recorded elsewhere from Cut Mill-pond, where it is apparently very scarce; and *Carex intermedia*, also a very uncommon Surrey plant; *Hottonia*, *Hydrocharis*, *Œnanthe Phellandrium*, *Callitriche obtusangula*, and *Lemna gibba*.

Leaving this district, the Rev. E. S. Marshall has found

Orobanche Picridis in some plenty near Witley. Mr. Bennett, who has paid much attention to these plants, believed it to be the true *Picridis* on seeing a fresh specimen, and it appeared to me to be quite the same as the Kentish plant. The plant has been several times recorded, but I think Mr. Marshall's the only, at present, undoubted station, although one other may be right. Mr. H. T. Mennell has found *Pyrola minor*, the lesser winter green, and also *Carex strigosa*, in the neighbourhood of Oxted, and we now have both of these plants in three districts.

In the Aldershot district I found, last year, very poor and late examples of *Batrachium intermedium;* and this year, on going earlier, found it in great abundance. It is common in some parts of Hants, but has never been abundant in its old Surrey localities near Esher, where Messrs. Groves found it to be nearly extinct some years since. On gravelly places near the canal I gathered this spring *Cerastium tetrandum*, very rare as an inland plant, and previously perhaps scarcely a certain native of Surrey.

There is one plant I may briefly allude to, as we ought to find it in Surrey, viz., *Callitriche truncata.* This was until recently only known as British from old Sussex specimens in Borrer's herbarium. While going through this herbarium last spring, to extract Surrey records, I was surprised to see a specimen of the same plant, collected by the late Gerard Edward Smith "in the stream at Westerham." I found the plant at Westerham this summer, and feel little doubt that it is *truncata*, although it would be more satisfactory to get the plant in fruit, which has not yet been done. The only other plant resembling it is *C. autumnalis;* but this is a northern form, not known south of Cheshire, and all the probabilities are in favour of the Kent plant being the same as the Sussex one. As the bulk of Surrey lies practically between the two stations, there is a very fair chance of the plant turning up in our county. It is easily distinguished at a glance from the common species of our ponds and ditches by the leaves being dark-green and pellucid, instead of pale green and opaque. Occasionally the common species become dark green or even black through incrustation, but, under those circumstances, instead of being pellucid, they are more opaque than in the normal state.

In conclusion, I will record the result of a few additional investigations respecting the bur-reeds, *Sparganium ramosum* and *S. neglectum.* I have now succeeded in raising several plants of typical *S. neglectum* from seed, thus showing that it is not merely a sterile state of *ramosum*, which had seemed to me possible, though not very probable. The seeds which germinated were collected in a ditch last April, where they had therefore been lying since the previous autumn. It is therefore probable that the seeds of these plants always lie dormant throughout the winter, and do not germinate much before the following June. I was able to observe that the beak of the fruit splits up into several strips, and it is at this point that the young plant emerges. The diagrams represent the early state of the two plants as grown together in the same tub. I was much pleased, on first seeing these plants this spring, to see the marked difference in habit, which I venture to think more marked than is frequently found to be the case in two allied Monocotyledons. The difference in habit demonstrated through cultivating these plants, confirmed as it has been by observations on the two forms in the wild state in various localities, has quite removed the lingering doubt which I had felt as to the propriety of according specific rank to *S. neglectum*. The difference is not always quite so strongly marked, or at all events is not so easily observable, as in the examples represented; and it is essential that the plants be examined in the early state, as later in the season the leaves get trodden down by cattle, blown about, and generally disarranged, so that by the time they are in full flower it is no easy matter to detect this difference in habit. The difference of the tapering of the apex of the leaves, of their colour, texture, &c., some of which characters I have previously spoken of, seem to be very generally characteristic of the two plants; at the same time ripe fruit is essential to enable the botanist to separate them with certainty; but this is also the case with not a few other plants, and especially so in the genus *Sparganium*.

63.—The Microscopic Structure of the so-called Malm or Firestone Rock of Merstham and Godstone, Surrey.

By George J. Hinde, Ph.D., F.G.S.

(Read December 8th, 1886.)

On the southern slope of the well-known escarpment of White Chalk which runs in a generally W.N.W. direction from the coast near Folkestone, through the counties of Kent, Surrey, and Hampshire, there is shown in places a second escarpment, lower than that of the Chalk, and extending a short distance in advance of it. This second escarpment is well exposed between Godstone and Merstham. The rocks of its upper portion belong to the Upper Greensand, and these are underlaid by the Clay of the Gault, which forms the valley between the Chalk and Upper Greensand escarpment, and that of the Lower Greensand on the opposite or Redhill side of the valley.

It is my purpose in this paper to describe the microscopic characters of the Upper Greensand Rock of this secondary escarpment. Locally it is known under the name of *Malm*, apparently an old Anglo-Saxon word signifying a soft sand or building stone; or *firestone*, because of its employment for furnaces, and its capacity of not being affected by heat; or *hearthstone*, because of its use for giving a white appearance to hearths and flagstones.

Near Merstham and Godstone the rock has been largely quarried for building and other purposes, and good sections of it are exposed. Seen from a short distance it might readily be mistaken for chalk, as it is of a white or greyish white tint. When newly quarried, it has a light brown appearance, which gradually gives place to white in the process of drying. The rock is soft and earthy when moist, but becomes considerably harder by drying on exposure. When thoroughly dry it is relatively light, owing to a minutely porous structure, and from the same cause it is largely absorbent of water.

In some places the whity-brown rock gradually passes into rock which is considerably harder, and of a bluish tint; and in places these bluish portions become irregularly nodular in form, and are disposed horizontally in distinct beds, like the flints in chalk, and thus add to the illusory resemblance between the Malm and Chalk. These blue nodules are locally termed "flints"; but they are quite distinct in appearance from genuine chalk-flints, and, unlike these latter, they are not clearly delimited from the white matrix in which they are enclosed.

When tested by dilute sulphuric or nitric acid, the nature of the Malm is at once seen to be different from that of genuine Chalk. In some cases no action whatever results, thus showing the absence of carbonate of lime, of which real chalk is nearly entirely composed; in other instances a slight ebullition takes place, indicating the presence of a small proportion of lime.

Examining a freshly fractured surface of the rock, first by means of a good hand-lens, we can readily discover the presence of silvery-white scales of mica, powdery granules of milky-white silica, and minute threads or rods of a greenish or translucent appearance. In places also the rock seems filled with minute empty tubes of capillary dimensions. When a thin transparent section of the harder and more compact portions of the rock is viewed under the microscope, it is seen mainly to consist of numerous minute straight or curved rods with definite walls, and with a central axial portion usually of a different tint to the exterior. These rods are in close contact with each other, but not otherwise attached than by the cementing matrix of the rock; and there is no regularity in their disposition, so that in the section some are cut through nearly in the direction of their length, whilst others are cut obliquely, and others directly transverse; these latter appearing as two concentric circles, an outer light and an inner of a dark appearance.

Some of the rods are of a green colour, and nearly opaque to transmitted light; and many of these greenish rods occupy the axial spaces of others, and are enclosed by a coating of a lighter mineral. In the interspaces between the rods, and sometimes also apparently in-filling cavities where the rods have been, there are numerous nearly transparent minute discs or small spherular bodies. Many of the transparent rods and most of the small spherular bodies are negative to polarised light, but in others the tints of chalcedony are indicated between crossed Nicols. A section of the bluish nodules, or so-called flints, exhibits substantially a similar structure to the harder portions of the white rock, but there seems to be in the nodules a greater quantity of chalcedonic silica and also of the greenish rods.

The main interest of this Malm rock is in the nature of these rods, and there is no doubt whatever that they are the spicules of siliceous sponges; and consequently that the rock itself is mainly of organic origin, and due to the living action of sponges in separating the silica in solution in the sea-water to form their skeletons.

The proof of these rods being the spicules of sponges rests on the similarity of their structure and form to the spicules of existing sponges. Of course in considering their present chemical nature we must take into account the changes which the original silica may have undergone during the process of fossilization. In the spicular skeletons of existing sponges the siliceous material is, as all are aware who have seen these objects under the microscope, of a brilliant transparent aspect; it is also negative to polarised light, thus indicating that the silica is in a colloid condition, as in opal, and readily soluble in heated caustic potash. In this condition, however, it is unstable, and, under the influences to which it is exposed in the rock, liable to change to the more stable chalcedony or quartz. As a rule, most of the silica in fossil sponges is now either chalcedonic or crystalline; but the spicules in this Malm are still for the most part in the condition of opal, though they have lost that brilliant appearance so characteristic of recent sponge-spicules, and, instead of being homogeneous throughout, the silica appears to be separating into minute granules and spherules.

It is somewhat difficult to ascertain the complete forms of these minute spicules when, as in the Malm rock, they are irregularly mingled together in a hard matrix, and can only be studied in thin sections in which fragments merely are shown. It fortunately happens, however, that under certain conditions the rock in places loses its cementing materials, and becomes powdery and incoherent, so that by a little careful manipulation the spicules can be isolated, retaining their forms fairly complete. From some of this decayed rock or rotten stone I obtained a variety of different forms of spicules.

The simplest forms are straight or slightly curved rods, thickest in the centre, and gradually tapering to both ends. Throughout the length of each spicule and opening at either end is a slender axial canal, now filled with solid material, but of a different aspect to that of the enclosing walls; not infrequently this in-filling is of a greenish tint, and has been recognised as glauconite, *i.e.*, a silicate of iron and potash. These spicules, with a simple unbranched axial canal, are termed monactinellids.

In another form the spicules have each four pointed rays springing from a common centre in different planes; each ray has its axial canal, which connects in the centre of the spicule with those of adjoining rays. In some instances the rays are subequal, but in others one of the rays is considerably elongated, so as to form a shaft, from the distal ends of which the other smaller rays diverge. These four-rayed spicules belong to the group of tetractinellid sponges.

In other spicules the form is very irregular; the rays curve and give off slight branches, which expand at the ends, and are thus adapted for clasping each other. These spicules belong to the group of lithistid sponges.

And in yet another distinctive form each spicule has six rays disposed at right angles to each other; these are characteristic of the group of hexactinellid sponges.

Thus in this Malm rock are found detached skeletal spicules representing each of the four principal groups into which existing and fossil sponges are divided.

It is somewhat remarkable, however, that though, as we have seen, this rock is literally composed of the spicules of siliceous sponges, there is not a single entire example of a fossil sponge to be met with in it; only the detached, isolated spicules. This arises from the fact that in nearly all the sponges to which these spicules belong the individual elements of the skeleton are not organically united together in the living sponge, but are merely held in their natural positions by the soft fleshy or merely horny tissues of the animal; and these, after the death of the organism, rapidly decay, and the mineral particles or spicules, losing their attachments, fall apart, and are scattered and indiscriminately mingled together over the sea-bottom. In all probability, generation after generation of sponges flourished in the same area of the sea-bottom; the scattered spicules of each generation serving as a floor to support that immediately following, until by the gradual accumulation of millions of these microscopic particles solid masses of rock have been formed; portions of which are now used for building houses and walls, and for other purposes.

Very few other organic remains than those of sponges can be recognised in the Malm rock of the district under consideration.

Here and there a few Foraminifera can be distinguished, and the calcareous ingredients of the rock may probably be derived from these organisms. As already mentioned, some of the harder portions of the rock give no indications of calcite, and appear to consist nearly entirely of the siliceous spicules, together with some thin scales of mica; and from the absence of heavier mechanical materials it may be assumed that this rock was formed in a sea sufficiently deep to allow of the deposits at the bottom to remain undisturbed. In the beds now worked for hearthstones there is a certain amount of calcite and a greater proportion of mica, together with some quartz-grains and granules of glauconite; but the minute spherules or discs of transparent silica derived from the solutions of the sponge-spicules are abundantly present.

Under certain conditions the Malm rock occurs as a cream-coloured, soft, powdery material, very light, and throughout filled with minute tubes. This kind is more particularly shown at Farnham, and the nearest equivalent to it at Merstham is the yellowish decayed rotten-stone. The cavities in it are really the negative casts of spicules, that is, the spicules in it have been dissolved, and only their minute impressions in the soft matrix remain. This matrix is nearly entirely composed of minute discs and spherules of soluble silica, and seems therefore to have been derived from the solutions of the spicules.

Beds of Malm rock more or less closely resembling those of Godstone and Merstham can be traced westwards, round the northern margin of the Wealden area to Selborne, in Hampshire, and they also occur at Wallingford and other places in Berkshire. At Merstham the beds have a total thickness of nearly 16 ft.; near Reigate and Betchworth Station the harder firestone beds are about 10 ft. in thickness, whilst at Farnham they are reported to have a total thickness of 60 ft. At Selborne, in Hampshire, the classical home of the Rev. Gilbert White, sections of the Malm rock are exposed having a thickness of 15 ft., and fragments of the harder beds are abundantly shown on the surface of those fields beneath which the rock crops out. The peculiar *mineral* nature of the rock did not escape the notice of the genial author of the 'Natural History of Selborne,'[1] who writes of it that it is but little removed from chalk in appearance, but seems so far from being calcareous that it endures extreme heat. It was known in his day as the white malm, in contradistinction to the chloritic marl, which was called the black malm. Gilbert White lived before the days of platyscopic lenses and transparent microscopic rock-sections, and it is no blame to him therefore that he failed to note the minute organic contents of the rock.

[1] 'Natural History of Selborne.' Bell's edition, p. 3.

The rock indeed appears to have been uniformly regarded as a siliceous or siliceo-calcareous rock of inorganic origin until about two years since, when the writer, suspecting from the descriptions given of it that the silica in it might have been due to sponges, visited the quarries at Merstham, and there met with abundant evidence of the fact.

Beds of rock largely formed of the *débris* of the skeletons of siliceous sponges also occur in Upper Greensand strata in other areas, but in none of these does the rock assume the peculiar greyish appearance and comparatively soft and porous structure which characterise the malm and firestone of the northern margin of the Wealden area. This distinctive appearance and structure seem, to a certain extent at least, to be due to the fact that the silica of these sponge-spicules and of the rock-matrix derived from them, is principally in the colloid or non-crystalline state, and has assumed the form of minute translucent discs or spherules which appear to be only lightly cemented together. The reasons why the silica should have been preserved in this form instead of the more usual crypto-crystalline condition of chert are not very clear, since to all appearance nearly similar conditions of deposition appear to have prevailed in both areas.

In the hard beds of rock forming the summit of the Undercliff at Ventnor and to the west of it, in the Isle of Wight,—which, like the Malm at Merstham, are due to the remains of sponges,—the silica has passed into a semi-translucent chert, which, as shown by its tints between crossed Nicols, is either in the state of chalcedony or has even passed into the crystalline condition of quartz. In this chert the sponge-spicules can as a rule only be distinguished by mere shadowy outlines, or merely by the infilled casts of their axial canals in glauconite or chalcedony which have remained after the outer walls of the spicules have been dissolved. These semi-translucent chert-bands have generally an outer crust of white porous rock, harsh to the feel, which gradually shades off into the solid chert. The porosity is due to the empty casts of spicules and the silica derived from their solution has gone to form the solid chert.

The contrast between this hard chert and the Malm rock of Merstham is strikingly apparent, but there is no doubt of the fact that both kinds of rock originate from similar materials. The proof of this has been afforded by the occurrence of cavities or pockets in the chert, which are filled with the spicules of sponges quite loose from each other, and in some instances nearly as perfect as if they had been obtained from living sponges. Some of the spicules in this chert of the Isle of Wight, and at Warminster, in Wiltshire, belong to the same genera, if not to the same species, as those in the malm rock, but as a rule the spicules of the Malm are of smaller proportions than those of other greensand areas in which true chert prevails.

It is only within a very recent period that the part played by sponges as rock-formers has been recognised. The organic nature of *limestone* rocks has long been known; indeed, solid beds filled with the *débris* of molluscan shells, corals, crinoids, and crustaceans could not fail to be observed, and closer investigation also recorded the fact that soft earthy limestones like our Upper Chalk are largely composed of minute Foraminifera. On the other hand, the organic nature of flint, chert, and other siliceous rocks does not seem to have been suspected till very recently. It has generally been supposed that these siliceous rocks of sedimentary strata were due to the *direct* deposition of silex from waters charged with this mineral in solution, and the recurrence of the siliceous beds was supposed to arise from the prevalence at intervals of currents of warmer water holding an abundance of silex. This theory was even put forward so late as 1878 by Prof. Hull, F.R.S.,[2] the Director of the Geological Survey of Ireland; and this in face of the fact—subsequently ascertained by Prof. Sollas[3]—that some of the microscopic sections studied by the author were filled with sponge-spicules.

The smaller proportion which organic *siliceous* rocks bear to organic *calcareous* rocks in the geological series may be due to the fact that the organisms in nature secreting silica as the material for their skeletons are few in comparison with those whose skeletons are built up of carbonate of lime, and this in its turn may arise from the lesser amount of silica in sea- or fresh-water in comparison with lime. Thus the silica-secreting organisms are limited to the three groups of Diatoms, Radiolarians, and Sponges. All microscopists are aware of the deposits due to accumulations of Diatoms; that at Richmond, in Virginia, for example, being 30 ft. in thickness; but rocks formed by these organisms have not been recognised earlier than the Tertiary Epoch. Strata in which *Radiolarians* constitute the principal constituents were, until within this last three years, unknown, but rocks largely made up of these organisms have been dis-

[2] "On the Nature and Origin of the Beds of Chert in the Upper Carboniferous Limestone of Ireland," 'Scientific Transactions of the Royal Dublin Society,' vol. i. (N. S.), 1878, part 1, p. 71. Since the reading of this paper, Prof. Hull has communicated to the Royal Society a note on my paper, "On Beds of Sponge-remains in the Lower and Upper Greensand of the South of England," 'Philosophical Transactions,' 1885, p. 403. In this note, which has not yet been published, Prof. Hull still advocates the theory put forward by him in 1878, that, as regards the chert of the Carboniferous rocks, the silica is derived *directly* from the sea-water, and further that there is no foundation for my suggestion that it has been derived from sponge-spicules (G. J. H., May, 1887).

[3] 'Annals and Mag. Nat. Hist.,' vol. vii., 1881, p. 141.

covered by Dr. Rüst[4] as low down as Jurassic strata in Germany; lastly, it may now be fairly considered as certain that the flints in the Chalk, the cherts, and siliceous rocks of the Upper and Lower Greensands (including the malm and firestones), are due to the siliceous skeletons of sponges. It is probable also that the cherty rocks of still earlier geological periods are mainly derived from these organisms; this has been proved as regards Liassic strata in Germany,[5] and I have also been able to determine, from a recent examination, that the massive beds of chert (in some cases nearly 20 ft. in thickness) in the Carboniferous strata of Yorkshire are as distinctly derived from sponge-spicules as the Malm rock referred to in this paper.

This Malm rock is certainly not at all attractive in outward appearance, and even by many geologists would be passed by as a very uninviting material for study; but the facts shown by a microscopic investigation of its structure render it of some interest, and they certainly furnish another exemplification of the truth of the poet's remark,

"The dust we tread upon was once alive."

[Appendix.—May, 1887.— The derivation of the *Carboniferous* chert from the spicular remains of siliceous sponges has been further confirmed by an examination which I have lately made of the series of chert beds exposed in and near Holywell and other places in Flintshire. These beds, which reach the unusual thickness of over 300 ft., are in places filled with spicules, and there can be no doubt that the silica of the chert, like that in the Cretaceous strata, is derived from these organisms. This series of beds has hitherto been regarded by Mr. A. Strahan, F.G.S., and Mr. G. H. Morton, who have specially described them, as of sedimentary (*i. e.*, inorganic) origin.]

4 "Beiträge zur Kenntniss der fossilen Radiolarien aus Gesteinen des Jura," 'Palæontographica,' vol. xxxi. (1885).

5 Dunikowski, 'Die Spongien, Radiolarien, und Foraminiferen der Unterliassischen Schichten vom Schafberg, bei Salzburg.' Bd. xlv. Denkschriften Kais. Akad. Wiss. Wien. 1882.

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Croydon Microscopical and Natural History Club.

OFFICERS FOR 1887.

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Vice-Presidents.—John Berney, F.R.M.S.; Alfred Carpenter, M.D., J.P., &c.; Philip Crowley, F.Z.S., F.L.S.; Henry Lee, F.L.S., F.G.S., &c.; Henry T. Mennell, F.L.S.

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Hon. Secretary.—W. Low Sarjeant, 7, Belgrave Road, South Norwood, S.E., to whom all communications may be addressed.

PROCEEDINGS & TRANSACTIONS

OF THE

CROYDON

MICROSCOPICAL & NATURAL HISTORY

CLUB.

FEBRUARY 9, 1887, TO JANUARY 11, 1888.

CROYDON:

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1888.

PROCEEDINGS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1887–88.

ORDINARY MEETING.—FEBRUARY 9TH, 1887.

HENRY S. EATON, M.A., &c., President, in the chair.

Due notice having been given at the preceding Meeting, it was proposed by Mr. Edward Lovett, seconded by Mr. W. M. Holmes, and carried, that Rule I. (Management of the Club) be altered as follows:—

"That the business of the Club shall be conducted by a Committee (four to form a quorum), consisting of a President, Vice-Presidents (consisting of all Past Presidents), a Treasurer, an Honorary Secretary, and nine other members."

[Under the Rule as it stood previously the Vice-Presidents were limited to four.]

It was proposed by the President, seconded by Mr. K. McKean, and carried unanimously:—

"That a cordial vote of thanks be accorded to the Water Committee of the Corporation for inviting the Club to inspect the new well at Addington, and to Messrs. Morland, Topley, and Walker, for receiving the members and describing the characteristics of the well."

Eighteenth Annual Meeting,

Held at the Public Hall, Croydon, Wednesday, January 11th, 1888.

HENRY STORKS EATON, M.A., &c., President, in the chair.

It was proposed by Mr. Henry T. Mennell, and seconded by Dr. Carpenter:—

"That Henry Storks Eaton, Esq., M.A., &c., be re-elected President for the ensuing year."

It was proposed by the President, and seconded by Mr. Philip Crowley, that Mr. Kenneth McKean be re-elected Treasurer for the ensuing year.

It was proposed by Mr. John Berney, and seconded by Mr. H. S. Cowdell, that Mr. W. Low Sarjeant be re-elected Hon. Secretary for the ensuing year; and they were all unanimously elected to the respective offices.

Mr. Edward Lovett and Mr. James Epps, jun., were duly elected to fill the vacancies on the Committee.

The following is the complete list of officers for the year 1888:—

President.—HENRY STORKS EATON, M.A., F.R. Met. Soc.

Vice-Presidents.—JOHN BERNEY, F.R.M.S.; ALFRED CARPENTER, M.D., J.P., &c.; PHILIP CROWLEY, F.L.S., F.Z.S.; HENRY LEE, F.L.S., F.G.S., &c.; HENRY T. MENNELL, F.L.S.

Treasurer.—KENNETH MCKEAN, F.L.S.

Committee.—F. C. BAYARD, L.L.M.; HENRY S. COWDELL; THOMAS CUSHING, F.R.A.S.; JAMES EPPS, JUN., F.L.S.; WALTER M. GIBSON; EDWARD LOVETT; ED. B. STURGE; H. G. THOMPSON, M.D.; WM. TOPLEY, F.G.S., &c.

Hon. Secretary.—WM. LOW SARJEANT.

The Balance-sheet was taken as read, and after some remarks was passed, and a vote of thanks accorded to the Auditors.

It was proposed by the President, and unanimously carried, that George James Symons, Esq., F.R.S., F.R. Met. Soc., be elected an Honorary Member of the Club.

A hearty vote of thanks was accorded to the President and to the other officers of the Club for their services during the past year.

The President (H. S. Eaton, Esq., M.A., &c.) then delivered his Address.

The President's Address.

GENTLEMEN,—The hope expressed at the last Anniversary Meeting by my esteemed predecessor in this chair, that the Club might continue to grow both in usefulness and in numbers, has, I am glad to say, been fulfilled. And there is every prospect of its being able to extend its sphere of usefulness in the present year by collecting further information of scientific interest to the public. At the end of the year 266 members were on the register, of whom 26 had been elected in the course of the year. On the other hand the resignations have been 15, and the Club has to deplore the loss of 2 of its members by death, namely, Mr. B. Jenkins and Mr. W. Field. The total shows an increase of 10, compared with the corresponding date in 1886. Including the candidates elected this evening, the total is 280.

Financial Statement.—In the annual statement of accounts submitted this evening a slight modification has been introduced from the form adopted in previous years, with the object of keeping the Special Fund distinct from the ordinary accounts of the Club. The ordinary balance (not including postages) on the 31st ult. was £34 2s., as compared with £20 18s. 9d. last year; and the Special Fund has increased in the twelve months from £24 9s. 7d. to £30 12s., the sum of £6 2s. 5d. having been received as dividend on £210 11s. 8d. Consols, and no expenditure having been incurred in connection with the Natural History collections. Disregarding balances, the net income and the net expenditure for the two years 1886 and 1887 compare thus:—

	1886.			1887.		
	£	s.	d.	£	s.	d.
Net Income	147	5	6	138	14	6
Net Expenditure	175	8	8	125	11	3
	– 28	3	2	+ 13	3	3

There is one particularly gratifying feature in the accounts, which is, that notwithstanding the extremely unfavourable weather on the night of the Annual Conversazione,—intense frost and a fog so dense that not a few visitors were obliged to turn back after starting without having reached the Hall,—the cost to the Club was, with the exception of 1885, less than in any year since 1876. This reflects great credit on Messrs. Crowley, Berney, Cowdell, Sturge, and Sarjeant, on whom lay the chief burden of the preparation for the entertainment. The average annual cost of the Conversazione for the eighteen years since its establishment has amounted to £52 9s. 4d., and the sale of tickets has realized £26 7s. 7d., thus leaving £26 1s. 9d. to be borne by the general funds of the Club. The expense to the Club of the last Conversazione was £29 3s. 2d., against £32 2s. 2d. in the previous year, although there were 230 more members and visitors present in 1886. It will also be noticed that the cost of printing the Transactions in the year just terminated has been only £12 17s., as compared with £49 1s. 1d. in 1886.

Publications.—We are indebted to Mr. Mennell for again kindly editing the Proceedings and Transactions of the Club, including the period March, 1886, to January, 1887. The printed matter has been considerably less than last year, which to some extent is due to the resolution of the Club at the Annual Meeting in January, 1882, "That in future the Transactions of the Club contain only papers on local subjects, or such as are the result of original observation and research."

The Microscopical Sub-Committee.—Although the Club was founded mainly, as its original name implied, for the pursuit of Microscopy, this has for several years fallen somewhat into abeyance. It is true that at our Annual Soirée, the display of microscopes forms one of the most prominent features of the evening. But it was thought by some of our members that the Annual Soirée, thoroughly successful as it is as a popular evening, and leaving little to be desired in point of the attendance of members and their friends, did not afford sufficient leisure and opportunity for the critical study of the instruments and objects under examination; and that many of the exhibitors did not pay sufficient attention to the manipulation of their microscopes for instructional purposes. It was also found that at the Monthly Meetings, when papers are read, with the exception of two or three members, few persons brought their microscopes with them, the limited time available on those evenings not affording enough inducement to do so. Although this had been to some extent met by the admirable demonstrations given by our Honorary Secretary, Mr. Low Sarjeant, at the Conversational Meetings, the accommodation was limited, as I can personally testify, which rendered it possible for only a very few persons to take advantage of the instruction afforded. The Committee therefore felt that it would be reverting to the primary object of the Club, and be of great advantage and interest, to devote one of the Monthly Meetings in the course of the year to the exhibition and study of microscopical apparatus. Action in the matter was taken at the Committee Meeting on the 9th of March, when a motion by Mr. W. M. Gibson on the subject was discussed, and it was resolved that such a meeting should be "arranged to be held in the Small Public Hall for the purpose of stimulating interest in the study of the microscope and its appliances, and affording members a more convenient opportunity of exhibiting microscopic objects of interest than can at present be afforded at the Annual Soirée." The following members were then appointed as a Sub Committee to carry out the necessary arrangements:—Messrs. J. Berney, T. Cushing, H. Greenway, W. M. Gibson (Hon. Sec.), W. Low Sarjeant, E. Lovett, T. Loftus, K. McKean, and E. B. Sturge.

The Sub-Committee regrets that it so happened that the evening, 11th of May, on which this meeting was held was the same as that on which the Croydon Football Club gave an attractive entertainment in the Large Public Hall, and that many members were in consequence unable to attend the meeting. Those present, however, had every reason to be satisfied with the exhibition, which completely fulfilled their expectation of a pleasant and instructive evening. The fifteen exhibitors, and the objects shown, were:—J. H. Baldock, Pollens and starches. F. C. Bayard, Portable microscope and lens for field-work. R. J.

Backwell, Red water-mite, &c. T. Cushing, Trichinous human muscle. W. M. Gibson, Head of plumed gnat and *Volvox Globator*. H. D. Gower, Photographs. W. M. Holmes, Fibrous alabaster, pitch-stone, basalts, and other mineralogical specimens. C. Lanfear, Marine hydrozoa and polyzoa. T. M. Loftus, *Melicerta ringens.* E. Lovett, Foraminifera from the South Pacific; young fresh-water shrimp; young of the common prawn. K. McKean, *Planorbis albus*, mounted in March, 1882, in a medium containing too much glycerine, whereby the greater part of the shell had been dissolved; ova of *Limnea peregra* just hatching out. W. L. Sarjeant, *Dinobryon sertularia*, *Melicerta ringens* and various other rotifers and infusoria from the ponds in the Morland Road, and *Fredericella Sultana.* E. B. Sturge, Various. J. E. Syms, Blood corpuscles, &c.

The Meteorological Sub-Committee.—In the course of the summer Mr. F. C. Bayard, of Wallington, suggested the expediency of the Club undertaking the systematic reduction of the meteorological observations recorded in Surrey, which he offered to superintend on behalf of the Meteorological Sub-Committee, who thereupon drew up a report on Mr. Bayard's proposition, which was unanimously adopted by the Committee. The co-operation of Mr. G. J. Symons was secured and a formal application from the Honorary Secretary of the Club, with the copy of a letter from Mr. Symons, was forwarded to all observers of rainfall in the Club District and to local authorities likely to be able to promote the inquiry. Up to the 31st of December Mr. Bayard received thirty-four favourable replies, and it is hoped that by the end of February the register of the daily fall of rain for January, 1888, at these stations will be in the hands of the members. It is intended to issue a copy of the record of the January rainfall to every member of the Club, and of the rainfall of subsequent months to such members as may express in writing their desire to have them. The thanks of the Club are specially due to Mr. Bayard for undertaking this labour of love, for it is of no light character, but involves much correspondence and hard work; and to Mr. Symons, the chief authority on rainfall in the United Kingdom, for his kindness in so readily acceding to our request and in helping us in other ways, and for which his election as an Honorary Member of the Club this evening is but a fitting acknowledgment. I have no doubt that the results of this investigation will redound to the credit of the Club.

Report of the Meteorological Sub-Committee.

In accordance with a resolution adopted by the Committee on the 11th ult. on the proposal by Mr. Bayard, "That the Croydon

Microscopical and Natural History Club should collect and publish meteorological observations in the County of Surrey," the Meteorological Sub-Committee has to report that it has held a meeting, and has agreed to submit for approval the following recommendations:—

1. That in the first instance the Club should undertake the management, collection, and publication of rainfall observations only, and in the Club District as defined in the first report of the Botanical Sub-Committee. This at present includes 30 rainfall stations in Surrey and 20 in Kent.
2. That in order to obtain the concurrence of rainfall observers a letter, covering a request from Mr. G. J. Symons, F.R.S., to the observers to report to the Club, be sent to each observer, who shall be asked to communicate with Mr. Bayard, the Honorary Secretary of the Meteorological Sub-Committee.
3. That the rules for the guidance of observers be those issued by Mr. Symons to his correspondents.
4. That a sum not exceeding £10 be granted to the Sub-Committee for preliminary expenses, including the purchase of a cyclostyle, the printing of circulars, forms for recording observations, postage, &c.
5. The Sub-Committee proposes to issue forms for recording the daily rainfall, and to request each observer to return to Mr. Bayard within a week of the commencement of each month the rainfall as observed by him in the preceding month.
6. The results of all satisfactory observations to be tabulated and issued to every observer, to each member of the Committee, and to such members of the Club as may express their desire in writing to receive copies.
7. Also to prepare as early as possible in each year a general report of the previous year's rainfall, that the same may be printed in the Transactions of the Club.

In making the above recommendations the Sub-Committee has not taken into consideration the expenses of inspection of stations or of the testing of rain-gauges, as it considers that both the inspection and testing can be done by its members without expense to the Club.

F. C. Bayard.
7th October, 1887. Thos. Cushing.
Henry Storks Eaton.
Baldwin Latham.

Report of Sub-Committee adopted by Committee on 12th October.

62, Camden Square, London, N.W.,
November 2nd, 1887.

Dear Mr. BAYARD,

I am delighted to hear of the proposed action of your Society, for everything that tends to the more thorough organization of rainfall work is naturally gratifying to one who has spent the best years of his life with that object. I hope that all the friends who have helped me for so many years will co-operate with you, as they will thereby assist the local work as well as that general organization which has so long been indebted to their assistance.

Yours very truly,
G. J. SYMONS.

The Geological Sub-Committee.—This Committee has undertaken to prepare a report upon the geological features of the well belonging to the Croydon Corporation at Addington, sunk for the purpose of supplementing the supply of water to Croydon, and which it is hoped may be submitted to the Club at an early date. Meanwhile one of its members, Mr. Walker, the Borough Engineer, at the suggestion of Dr. H. G. Thompson, of the Water Committee, and Mr. Topley, their geological adviser, has kindly communicated to the Club an interesting and valuable record of well-gaugings, including two in the Parish of Addington, six in Wickham, one in Selsdon, three in Warlingham, five in the Kenley Valley, and three in the Brighton Road Valley. The measurements, all taken on the same day at intervals of a few weeks, comprise the height in feet above Ordnance datum of the mouth of the wells, of the bottom of the wells, and of the level of the surface of the water in the wells. They extend over a period of four years, namely, from October, 1883, to the end of 1887, and when they have been compared with the rainfall of the district for the corresponding period will also form the subject of a communication to the Club. It will, I think, be advisable in future years to publish the results of these well-gaugings in connection with the meteorological statistics.

Photography.—Considering the small number of members—not more than about fifteen—who are interested in this branch of the Club's work, the meetings which have been devoted to Photography were so well attended that a special evening was set apart for the purpose, *viz.*, the first Friday in each month, commencing with last July. The following is a list of Photo. meetings for the past year:—

Annual Meeting.—Exhibition of lantern-slides, the work of members.

Jan. 26th.—Photomicrography, by Mr. W. Low Sarjeant.

Feb. 23rd.—Photomicrography (continued), by Mr. Sarjeant. These two lectures were well illustrated, in fact the entire process was demonstrated in the most complete manner.

July 1st.—Discussion, "On Exposure," opened by Mr. Hussey.

Aug. 9th.—Exhibition of negatives and prints taken on the summer excursions.

Sept. 2nd.—Informal discussion.

Oct. 7th.—Lantern exhibition.

Nov. 4th.—Lantern exhibition.

Dec. 2nd.—Experiments in Instantaneous Photography by artificial light; gun-cotton and magnesium powder, by Mr. C. Hussey; Brock's pyrotechnic mixture, by Mr. Meyer.

The following is a list of Excursions:—

April 23rd.—To Hayes and Keston Common.

May 14th.—To Ockley, conducted by Mr. C. Hussey.

June 11th.—To Penshurst, conducted by Mr. H. C. Collyer.

July 9th.—To Godstone, Crowhurst, and Lingfield.

Aug. 13th.—To Reigate, conducted by Mr. W. Brooks.

The Excursions were very well attended.—K. McKean.

Excursions.—The first excursion of the season was to the Croydon Corporation well at Addington, and took place at an earlier period of the year than usual. It arose in this way: Mr. Walker, the borough engineer, having some time before very kindly offered to show me over the works then in progress, it occurred to me that the members of the Club might like to join in a visit to a work of considerable importance to the town. But time was pressing, as the adits were nearly completed, and the workmen on the point of being withdrawn; besides, the volume of water was rapidly increasing and likely to overpower the pumps. Accordingly, Mr. Councillor Morland, the chairman of the Water Committee, on being consulted, undertook to receive the members of the Club as soon as the necessary arrangements could be made. The visit came off on Saturday, the 5th of February, between 3 and 5.30, p.m. The afternoon was very fine, and the party, numbering some seventy or eighty persons, was met on the spot by Mr. Morland, Mr. Walker, Mr. Topley and several workmen. The former gentleman then proceeded to give the assembly an account of the general undertaking, while Mr. Walker exhibited a plan and section of the adits and headings with the springs, and explained the pumping arrangements, those for ventilating the headings, and the methods of raising the chalk. Mr. Topley gave an open-air lecture on the geological features of the strata pierced by the well. At the time of the visit the pumps were raising 2,500,000 gallons of water daily, which flowed on the surface to Addington village. Having observed all that there was to be seen on the surface, some twenty of the party armed with candles, and dressed in flannel suits and india-rubber boots, or else workmen's jackets, were lowered two at a time in the tub used for conveying the excavated chalk to the surface, to a depth of 148 feet, the well itself being several feet deeper, and from thence, under the guidance of Mr. Walker, explored the adits, the longest of which was 889 feet. These galleries were not quite horizontal, but all rose slightly proceeding from the well, so that the water readily found its way along the bottom to the well from which they radiated. The fissures in the chalk bearing the water presented some very interesting features. From one of them three or four inches in width and extending across the entire breadth and height of the adit, I extracted from one side of the fissure a fragment of grooved and striated chalk, which had evidently been in rubbing contact with the opposite face of the fissure, the whole fissure being similarly marked. The fissure contained some extremely finely-pulverized mould, which possibly had in some way got down there from the surface. Notwithstanding nearly all those who ventured below got a good wetting, everyone, I believe, was quite satisfied and thoroughly enjoyed the expedition.

Other excursions were announced as follows, not including the expeditions of the Photographic Section:—

May 21st. To Red Hill and Reigate, in conjunction with the Geologists' Association. Mr. Topley was the conductor. The weather was cold and rainy, and only one other member of the Club was present. The programme of the excursion was only partly carried out.

May 30th. Godstone to Oxted. There was a good attendance, the day being fine though hazy. The party, under the leadership of Mr. E. B. Sturge, walked from Godstone Station, by the East Grinstead Road, over Tilburstow Hill and Common, the quarries being visited by the way, on to Godstone, thence by Godstone Ponds and Church to Tandridge Church, and from thence to Oxted.

June 25th. Our Club was invited to join an excursion of the Geologists' Association to Gomshall, Netley Heath, and Clandon. The excursion was for the whole day; the weather was very fine; but I have no particulars of the attendance.

August 6th. Kew Gardens.

September 17th. To Hayes and Keston with the Quekett Club. On this occasion the weather was very unpropitious.

At the first Ordinary Meeting, on the 9th of February, an alteration was made in the rule relating to the management of the Club. Due notice having been given, it was proposed by Mr. E. Lovett, seconded by Mr. W. Murton Holmes, and resolved, "That the business of the Club shall be conducted by a Committee (four to form a quorum) consisting of a President, Vice-Presidents (consisting of all past Presidents), a Treasurer, an Honorary Secretary, and nine other members." The alteration was in the clause concerning the Vice-Presidents, which had previously been "four Vice-Presidents to be elected from Past Presidents."

A cordial vote of thanks was then unanimously accorded to the Water Committee of the Corporation, for inviting the Club to inspect the new well at Addington, and to Messrs. Morland, Walker, and Topley, for receiving the members and describing the characteristics of the well.

Previous to the reading of the paper of the evening, Mr. J. H. Drage exhibited several barnacle geese which had been shot at Rowcliffe, about five miles north of Carlisle. He stated that the barnacle goose frequented that neighbourhood in the winter, and it was believed had done so for nearly 300 years, to the almost total exclusion of other localities in England.

The paper on this occasion was on "Domestic Birds, and the Probable Causes of their Domestication," by Mr. J. Jenner Weir, F.L.S., F.Z.S. The author stated that of the ten or eleven thousand species of birds known only eleven were domestic, or twelve if the ostrich were included. These were the canary, pigeon, dove, peacock, turkey, fowl, guinea-fowl, swan, goose, duck, musk-duck, and ostrich. The conditions of domesticity in a bird were defined to be:—unimpaired fertility in captivity; plasticity of constitution, enabling it to live under widely different conditions of environment; attachment to locality; attachment to persons, or tameness; and finally, usefulness. Mr. Weir showed that their migratory habits were a bar to the domestication of many species of birds. The eider duck was a bird on the verge of domestication, being comparatively tame during the breeding-season, but at other times it was a rover. The author then referred to the habits of the various birds specified in his list, dwelling particularly on the swan and the goose. On the question of birds as food Mr. Weir expressed his personal aversion to pigeons, which he considered no better than swallows, wrens and robins. Finally, he gave it as his belief that no truly domestic birds other than he had specified would ever be obtained.

On the 9th March Mr. W. August Carter, of the National Fish Culture Association, and of the Icthyological Section of the late Exhibitions at South Kensington, read a paper upon "Marine and Freshwater Fishes." At the outset Mr. Carter referred to the paucity of available data concerning the fauna of the Aqueous Kingdom. This he considered partly due to the great difficulty and expense involved in striving to "pluck out the heart" of the ocean's mysteries. He considered that one of the most effective aids to the study of Icthyology was the aquarium, which enabled the naturalist to study at leisure the proclivities of the finny tribes. He then proceeded to compare the natures and habits of fishes with those of terrestrial animals, and considered the former were not so bereft of the characteristics of the latter as was supposed. According to experiments which he had made at South Kensington and elsewhere, he found that fish possessed the power of communicating with each other in a marked manner. He had on several occasions witnessed a shoal of carp approached by a solitary congener, which ultimately conducted the entire body to the spot whence it emerged. This migration was occasioned by the appearance of food. It was in consequence of this communicative capacity that the hours of many a patient disciple of Izaak Walton were rendered wretched and barren of piscatorial events. Nature had not denied entirely to fish that which she had freely lavished upon higher animals; and, therefore, he thought that the more the subject was studied, the more we should realise that the gift of communication had been implanted in the nature of every creature in a more or less degree. In regard to their habits, Mr. Carter said fish were endowed with somnolent desires, although it might reasonably be thought that the sphere of existence which they occupied was scarcely in *bon accord* with repose; but, on the other hand, it was difficult to credit the assumption that fish were excluded from the potency of sleep, which came upon all periodically, "as the death of each day's life."

Mr. Carter next referred to deformities in fishes, which seemed more common amongst them than any of the three classes of vertebrata. He had kept a careful record of the number of deformed specimens of young trout and salmon at South Kensington, and found two cases in every thousand, and one case of monstrosity in every four thousand. The deformities consisted chiefly of crooked forms and protruding underjaws. Monstrosities, such as dual-headed or twin fish, did not live long, but deformed fish existed for a considerable period. He had noticed that deformed fish, at their birth, issued from the egg head foremost; as a rule, fry ruptured the capsule with their tail and so escaped.

Mr. Carter then proceeded to speak of the natural misarrangement of parts, and instanced the *Pleuronectidæ* family, as coming under this category. The flounder, for instance, whose contortions were more pronounced than the rest of the same family, was a monstrosity throughout, and was one of the most degraded of fish, its unsymmetrical appearance being noticed in the earliest ages. The study of the progress of development from their birth was exceedingly mysterious and interesting, when it was considered that on issuing from the ova they possessed an eye on both sides of the head and swam on edge like round fish. Later on their visual organs became contiguous to each other, one eye shifting its position. By the time this change had taken place, the creature's body became twisted half round, and laid upon its side. The consequence was, this transformation occasioned the misplacement of all the parts; and yet, notwithstanding this, the balance of deformity was marvellously maintained, insomuch that the ordinary observer might fail to notice the peculiarities referred to.

In America very few soles were found, and the Government of that country were striving to propagate them. The National Fish Culture Association had forwarded several consignments for this purpose, but the difficulty was to secure male soles, there being only one to about five hundred females.

Mr. Carter then referred to fish autocrats or sovereigns of clans, and stated that he had found, by repeated experiment, that trout were subservient to leaders, and that when a sovereign succumbed to the wiles of the genus *homo*, another fish occupied his throne.

In conclusion, Mr. Carter referred to the destruction of spawn and immature fish, detailing the various kinds of depredators. He said that if all the eggs of fishes became incubated the waters would be choked with life. The number of ova shed by a single cod equalled the number of cod-fish brought annually to the London Market, *viz.*, 9,000,000. But many of the ova failed to come to life, whilst a large proportion was devoured by fishes. All this was provided against by nature, who gives to all members of the finny tribes extraordinary power of re-production, but at the same time she employed destructive agents to keep down superabundance of fish life. Although Nature provided for her own losses, she did not undertake to repair the wanton injury perpetrated by man, who devastated the nurseries where the parents so carefully laid their offspring, and caught and destroyed many thousand tons of immature fish weekly. A great deal was being done towards culturing fish by the National Fish Culture Association; but in order to carry out this important work on an extensive and systematic scale, it behoved the Government to assist in the same way as was done by the American Commissioners.

The paper on the evening of the 13th of April was by Mr. W. Topley, F.G.S., the subject being "Recent Earthquakes." Mr. Topley observed that although no general explanation of earthquakes could be given, it was well known that certain regions were more liable to them than others, and that there seemed to be a close connection between earthquakes and volcanic eruptions. The eruption of Vesuvius, that destroyed Herculaneum and Pompeii, had been preceded by a great earthquake. But the occurrence of earthquakes could never be foretold. They were, however, by no means exceptional phenomena; in fact they were very common, and during the last twenty years there had been no fewer than 8000, of which Great Britain had experienced 75. In Japan there was an average of one earthquake a day, but many of them were only perceptible by delicate instruments. Mr. Topley then proceeded to observe that earthquakes were preceded by slight tremors, which were generally considered to be the origin of the noise which accompanied them; then followed the shock. Accounts of earthquakes were often greatly exaggerated. A friend of his in the Riviera described the hotel in which he was staying at Nice at the time of the recent earthquake, on the 22nd of February, as having been lifted two feet vertically, whereas if it had been raised a single inch probably the entire building would have been overthrown, and a lift of 0·1 inch would have upset all the chimney-pots. It was believed that the majority of earthquakes originated at no great depth below the surface, probably some seven or eight miles, The region of greatest damage to buildings was not immediately over the focus, when the shock was vertical, but at some distance from it, when the emergent shock struck their foundations at an angle. Mr. Topley then remarked that some earthquakes might perhaps be attributed to the falling in of large blocks of limestone in caverns hollowed out in limestone strata by the action of water, producing a disturbance on the surface of the earth. Earthquakes having their origin under the ocean gave rise to enormous sea-waves. The disastrous effects of the earthquake at Lisbon in May, 1755, had been greatly aggravated from this cause; and on the 13th of August, 1868, the whole Pacific coast of South America was subjected to a succession of vast ocean rollers from the same cause. Mr. Topley then considered the most suitable kind of foundations for buildings to resist earthquake shocks, and pointed out that by far the largest amount of damage done was due to the bad construction of buildings. Round stones built into the walls of houses were especially objectionable. With respect to the East Anglian earthquake on the 22nd of April, 1884, Mr. Topley observed that only six of greater violence had been recorded in the British Isles, the last severe one having occurred during the trial of Wycliffe at Westminster Hall in 1480, which led to the trial being abandoned. One of the effects of the East Anglian earthquake was temporarily to raise the level of the water in wells 400 feet deep to the extent of 7 feet. The water had been previously sinking, and was now reverting to its former level.

"Notes on the *Foraminifera*, with especial reference to the Varieties in the Tests of this class of Animals," was the title of an excellently illustrated paper by Mr. C. Davies Sherborn, F.G.S., on the evening of the 14th of September. The author referred to the various groups into which *Foraminifera* were divisible, and dwelt at considerable length on their methods of re-production (TRANS., art. 64).

On the 12th of October the paper was "On the Power of Movement in Plants," by Mr. H. W. Worsley-Benison, F.L.S. The lecturer observed that the power of movement in some form or other was an essential condition of life, and that the motion to which he would refer was the result of life and its processes, admitting only the mention of such external forces as light and heat, to which an organism responded in virtue of the life which it possessed (TRANS., art. 65).

On the 9th of November Mr. Albert J. Crosfield read a paper entitled "Notes on Birds seen in Bombay and the Central Provinces of India during December, 1886, and January, 1887," when he noticed over seventy species of birds, all of which occur in considerable abundance in these parts of India during the cold season. The paper was illustrated by specimens of most of the species referred to.

On the 14th of December, Mr. W. Murton Holmes read a paper on "The Epidermic Growths of Vertebrate Animals." In this communication attention was drawn to the fact that a great number of useful and ornamental articles derived from the animal world are modified epidermic formations, as are also the horny scales of the armadillo and pangolin, and the spines of the porcupine and hedgehog, which serve as a means of defence to these animals. The structure of the epidermis was then described as showing a gradual transition from a series of rounded nucleated cells at the surface of the true skin into flattened horny scales at the outer surface, identical in composition with hair, horns, nails and hoofs, and increasing in thickness where-ever there is pressure or friction. The cast skin of a snake was an illustration of the continuity of the epidermis over the exterior of the body.

The scales of fishes were stated not to be analogous to the scales of reptiles and other vertebrates, but are developed in the substance of the true skin, resembling cartilage and bone in their texture and composition.

Artificial pearls are made from the scales of the bleak—*cyprinus alburnus*—by washing them in water and collecting the pearly powder deposited on standing. This powder is then mixed with solution of isinglass and introduced into small globules of glass, which, when dry, are filled up with wax.

The carapace of the hawk's-bill turtle is covered with a series of horny plates, which constitute the tortoiseshell of commerce.

All birds are provided with a modified epidermic covering constituting feathers.

A typical feather consists of three parts: the quill or barrel, by which it is inserted in the skin; the shaft or scape, which bears on each side a series of flattened plates, the vane or web.

These plates or barbs are placed obliquely on the shaft by their bases. Their edges bear numerous smaller processes called barbules, and these in their turn, in the most perfect feathers, are fringed with still smaller barbicels or hooklets, by which the barbs are held together, so as to present a resisting surface to the air.

The accessory plume or plumule, formed at the junction of the shaft, was then described. This attains its greatest development in the feathers of the emu and cassowary, being in these birds almost as large as the main feather. It is never developed on the large wing and tail feathers, and is entirely wanting in all feathers in some groups.

The forms of feathers vary with their position on the body of the bird and the purposes to which they are adapted. In the down-feathers the stem is not much developed, and the soft barbs have long slender barbules with knotty dilatations in place of barbicels. In the thread-feathers the barbs are rudimentary or altogether wanting. The ends of the shafts in some abnormal cases are developed into horny expansions, as in the secondary feathers of the waxwing, &c.

The author remarked that the great beauty of the plumage of birds led in many instances to their wholesale and wanton destruction, and expressed a hope that the provisions of the Wild Birds' Protection Act would be rigidly enforced, and, if need be, extended. He regretted also that so many birds were annually sacrificed at the dictates of fashion, for the purpose of adorning hats and bonnets, a most unnecessary proceeding in the presence of more attractive charms. He considered that birds mounted in cases and surroundings which closely imitate their natural haunts gave delight and instruction to many who would otherwise have no opportunity of seeing them.

In the Mammalia, the highest division of Vertebrates, some part or other of the integument is always provided with hairs at some period of life.

Hairs are modified epidermic formations. Each is embedded in a hair-follicle, formed by an inversion of the skin. The portion at the bottom of the follicle is dilated into the bulb, which encloses a softer vascular body, the papilla or pulp; and it is by the continual augmentation of this pulp and its gradual conversion into horny matter that the growth of the hair is due.

The portion projecting beyond the skin is the shaft or scape, that below, the root. Two elementary parts are visible in the shaft: the medulla or pith, consisting of a number of large cells of various shapes, generally containing air; and an outer fibrous-looking portion, more or less coloured from pigment-cells—the cortical portion. It is upon this that the colour, firmness, and elasticity of the hair depend.

By prolonged soaking in caustic potash hair becomes separated into nucleated cells.

The hair of the ornithorhynchus or duck-mole, is of peculiar construction. The lower portion of the shaft is very long and narrow, with a flattened expansion at the apex containing air and pigment-cells. The author considered this structure somewhat analagous to the expansion of the shaft in the feathers of the wax-wing, &c.

The hairs of animals belonging to the different natural orders were then described, attention being directed to the great development of the medulla in the deer family, and to the composite nature of the hairs of some of the Ungulates. A porcupine's quill was shown to be nothing more than a greatly developed hair, and this is the character of other spines. The scales of the scaly ant-eater were described as being formed on triangular projections of the skin.

Nails and hoofs were shown to be similar in their nature.

True horns are of two kinds: those with and those without a bony core. The horns of oxen, sheep, goats and antelopes are examples of the former, and the horn of the rhinoceros comes under the latter category. This latter consists of a solid mass of hardened epidermic cells, growing from a cluster of free papillæ, and only differs from a mass of agglutinated hairs in not growing from follicles.

Whalebone is essentially of similar structure.

The tongues of the various members of the cat family are covered with numerous recurved horny teeth, developed upon the conical papillæ with which the tongue is furnished. These teeth are useful to the animals for rasping off the flesh from the bones of their prey.

A few remarks were then made on the adaptation of markings on feathers and fur of animals to their environment.

The paper was illustrated with diagrams drawn from nature.

The Eighteenth Annual Soirée was held in the Large and Small Public Halls, on the 16th of November, between 7.30 and 10 p.m. I have already referred to the prejudicial effect the weather had upon the attendance, which was only 590 members and visitors as compared with 820 last year, being a falling off of 230. The number of microscopes displayed was 83, being less by 59 than in 1886. The persons, however, who ventured to come had ample room to move about in, and expressed themselves as thoroughly satisfied with the arrangements. The following is a complete list of the societies or clubs, and the names of the 75 exhibitors :—

Croydon (31).—W. Aldridge, E. H. Baldock, J. H. Baldock, J. Berney, R. F. Backwall, R. J. Backwall, J. A. Carter, H. C. Collyer, P. Crowley, H. Cullis, H. Drummond, J. Epps, W. M. Gibson, W. M. Holmes, R. G. Hovenden, M. Hughes, J. W. Justican, C. Lanfear, H. Lee, T. M. Loftus, H. Long, M. E. Lownds, C. M. Major, K. McKean, P. W. Perkins-Case, W. L. Sarjeant, J. Stanley, W. F. Stanley, E. B. Sturge, J. E. Syms, and F. West.

Forest Hill (4).—H. H. Cowley, C. Drury, M. E. Lownds, and J. H. Worters.

Greenwich (2).—W. Crush and W. S. Scarr.

New Cross (8). — G. P. Berry, E. Carlile, C. Hart, H. T. T. Hart, H. Hills, A. J. Jenkins, A. J. Mitchell, and T. D. Whittington.

Quekett (11). — F. W. Andrew, J. W. Bailey, W. J. Brown, H. A. Crowhurst, J. J. Hunter, C. J. W. Jakeman, J. P. Kern, J. H. Oliver, F. D. Rudkin, A. F. Tait, and W. Watson.

Royal (3).— F. Bossey, M.D., G. J. Smith (How and Co.), and W. Watson.

South London (3).—T. D. Ersser, C. W. Stidstone, and D. Ward.

Sutton (2).—A. W. Bawtree and W. J. Fuller.

Tower Hill (4).—B. S. Grubb, R. Sedgwick, J. Thompson, and G. T. White.

Unattached (7).— L. Atkinson, G. Berry, F. Enoch, F. Pert, G. Rodman, C. D. Sherborn, and S. N. Sherborn.

Amongst the more important and interesting exhibits other than microscopes, mention may be made of the admirable series of photographs in the gallery between the two halls, all by members of the Club; a number of Moorish curios recently brought home by Mr. E. Straker; the very interesting series of tobacco-pipes, of all countries and dates, exhibited by Mr. Lovett; another section of Mr. Philip Crowley's magnificent collection of Diurnal Lepidoptera, this year those chiefly of Central and South America; the basket of flowers from gardens at Addiscombe, which has now become a regular feature of the exhibition, — this year Mr. Miller was only able to count up sixty-seven varieties, the early and severe frosts having cut off nearly all the late autumn flowers; a much appreciated exhibit of "Saccharin," by Mr. F. A. Barritt; and a number of most interesting and delicate meteorological instruments, self-recording, &c., exhibited by the President.

Mr. W. Brooks held possession of the Old School of Art Room, and had a large attendance throughout the evening to witness his dissolving views, chiefly from photographic slides of his own taking, of Windsor Castle and its neighbourhood.

The stage was decorated, by the kindness of Mr. Philip Crowley, with many beautiful and valuable plants from his conservatories.

Our Hon. Secretary has kindly furnished me with the following particulars of the objects exhibited at the various meetings of the session, and the new members elected at them.

Exhibits, 1887.

Feb. 9*th.* — J. Jenner Weir, diagrams illustrative of his paper, "Domestic Birds and possible causes of their Domestication." H. S. Eaton, fragment of chalk from a water-bearing fissure in one of the galleries of the new well at Addington, shewing grooves and striæ produced by faulting. B. Latham, shells of *Anodon cygneus.* D. Johnson, feathers of several species of birds. E. Lovett, native stone axe from New Guinea, and English stone implements restored on the same principle. J. H. Drage, specimens of barnacle geese. W. Murton Holmes (under microscope), spicules of *Geodia Barretii.* M. E. Lownds (under microscope), section of toe of white mouse.

March 9*th.*—W. August Carter, drawings illustrative of his paper on marine and freshwater fishes. E. Straker, photographic enlargements on Eastman paper. E. Lovett, microscopic slides illustrating the embryology of fishes. J. H. Drage, drawing of a rare blenny from the Scotch coast.

April 13*th.*—W. F. Stanley, photographic slides illustrating the Essex earthquake of April, 1884. K. McKean, normal specimen of *Helix ericetorum*, and a sub-scalariform variety of the same from Marden Park. E. Lovett, dwarf form of the tortoiseshell butterfly (*Vanessa urticæ*). M. E. Lownds (under microscope), spore-cases of ferns.

Sept. 14*th.*—J. H. D. Fox, foraminifera from the Chalk, Margate. E. Lovett, seventy-two slides of foraminifera, and carnelian containing fossils. K. McKean (under microscope), *Globigerinæ* dredged from 2435 fathoms. Dr. A. Carpenter, iron arrowheads found near South Croydon; also arrowheads from North America. J. Epps, new Surrey plant, *Euphorbia esula.* G. Corden, photographs of lightning taken by him during the storm of August 17th in Croydon. P. Crowley, series of sixty-four photographs of storks taken from nature.

Oct. 12*th.*—W. H. S. Worsley-Benison, diagrams and drawings illustrative of his paper, "The Power of Movement in Plants." K. McKean (under microscope), *Acme lineata.* E. Lovett, fish-hooks. E. B. Sturge (under microscope), *Œcidium compositum.* W. M. Holmes (under microscope), chert from Godstone, with spicules. C. D. Goodman, seed-pods of yellow iris.

Nov. 9*th.* — A. J. Crosfield, bird-skins from India. E. Lovett, Kaffir stone-weights and digging-sticks. K. McKean (under microscope), glands in leaf of *Eucalyptus globulus.* W. Low Sarjeant, bromide enlargements from ¼-plate negatives. M. E. Lownds (under microscope), *Echinus* spines. P. Crowley, Gould's 'Birds of Asia.'

Dec. 14*th.*—W. Murton Holmes, diagrams and microscopic slides to illustrate his paper "On the Epidermic Growth of Vertebrate Animals." E. Lovett, fig., description, and specimen of the large earwig (*Labidura gigantea*). E. Straker, skin of a rattlesnake from Texas. H. T. Mennell, custard apple.

Members elected, 1887.

Feb. 9th.—W. Brooks, Laurel Villa, Wray Park, Reigate. C. H. Goodman, Dorlcote Road, Wandsworth Common. Charles Hussey, Brae Side, Waddon. George Maw, F.R.S., F.L.S., Benthall, Kenley. Carl Waydelin, jun., Bensham Villas, Broad Green.

March 9th.—Joshua Allder, Chatsworth Road. William Foot, 32, Wellesley Road. Bruce McKay Johnson, Katharine Street. Martin Taylor, Southbridge Road.

May 11th.—William Viney Austen, 18, Belgrave Road, South Norwood. Henry W. Down, London and South Western Bank, North End.

Sept. 14th.—Frederick W. East, Tamworth Lodge, Mitcham Common. D. Mackenzie, Beulah Road, Thornton Heath. Archibald H. Perry, 6, Friend's Road East. Frederick Webster Prince, Brickwood House. James Webster Prince, Brickwood House. C. F. W. Sage, The Cedars, Cargreen Road, South Norwood.

Oct. 12th.—Walter Adams, Trevenna House, Chepstow Road. Bryce Collyer, Woodlands, Hayling Park Road. Fred. C. L. Wratten, 43, Canterbury Road. Sidney Herbert Wratten, 43, Canterbury Road.

Nov. 9th.—John T. Glazier, Mavis Bank, Park Hill Rise. J. Purser, 37, Clyde Road. Aubrey Scott Wild, Canning Road.

Dec. 14th.—Frederick George Clarke, The Cedars, Addiscombe Road. Alfred Couchman, Houghton, Birdhurst Rise.

Library and Collection.

We are indebted to Mr. McKean for looking after the Library, and I am glad to be able to announce, on his authority, that more use is now made of the books than formerly, both for study and for reference. The additions to the Library and Collection, acquired since the last Anniversary, include the following presentations:—

From Individuals.—J. H. Baldock: Microscopical slides of various starches. F. C. Bayard: Hints to Meteorological Observers. W. H. Beeby: The Flora of Shetland. T. Cushing: Foundation and Work of Ben Nevis Observatory. W. L. Sarjeant: Cantor Lecture on the Microscope. W. F. Stanley: Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland for 1886; B. A. Report of Corresponding Societies. E. B. Sturge: Our Sea-marks. W. Topley: East Anglian Earthquake, 1884; Gold and Silver, their Geological Distribution.

From Societies.—Belgium: Bulletin de la Société Belge de Microscopie; Proces verbaux des Séances de la Société Royale Malacologique de Belgique. Essex Field Club: Transactions, 1886. East Kent Natural History Society: Twenty-ninth Annual Report. Manchester Natural History Society: Annual Report. National Foot-path Preservation Society: Second Annual Report. Northamptonshire Natural History Society: Journal. Quekett Microscopical Society: Journal. Royal Microscopical Society: Journal. From *Proprietors:* Essex Naturalist; Le Moniteur de Practicien; Science Gossip.

Croydon Microscopical and Natural History Club.—Statement of Accounts for the Year ending 31st December, 1887.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance, 1st January, 1887	20	18	9	Rent of Club Room	10	0	0
Subscriptions	115	0	0	Hire of Room for Meetings	6	14	0
Sale of Transactions	0	12	0	Printing	7	7	6
Sale of Soirée Tickets	23	2	6	Books and Bookbinding	5	11	0
				Stationery	3	7	9
				Printing Transactions	12	17	0
				Postages, including Transactions	11	15	0
				Soirée Expenses	52	3	8
				Attendance and collecting Subscriptions ...	7	2	6
				Sundries	8	10	10
				Balance (not including 18/11 postages in hand)	34	2	0
	£159	13	3		£159	13	3

SPECIAL FUND.

	£	s.	d.		£	s.	d.
Balance, 1st January, 1887	24	9	7	Invested in Consols	£213	0	0
Dividend on Consols	6	2	5				
	£30	12	0	Balance at Banker's, 31st December, 1887 ...	£64	10	0
Balance, 31st December, 1887							

KENNETH McKEAN, *Treasurer.*

We, the undersigned, having examined the above Accounts and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and the Bankers' Pass Book.

MARTIN WM. MAYLARD, } *Auditors.*
CECIL H. LANFEAR, }

January 3rd, 1888.

THE CROYDON

MICROSCOPICAL AND NATURAL HISTORY CLUB.

(Established March, 1870, as "The Croydon Microscopical Club.")

The Club has for its objects the mutual help of its Members in the study of Microscopy, Natural History, and Photography, the investigation of Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon and the County of Surrey, and the dissemination amongst its members of information on the subjects of Microscopy and Natural History.

The Ordinary Meetings of the Club are held on the second Wednesday in the months of February, March, April, May, September, October, November, and December. The Annual Meeting of the Club is held on the second Wednesday in January.

The Rooms are open for the reception of Microscopes and objects of interest at 7 p.m. The Chair is taken at 8 p.m.

A Soirée is held in the month of November, to which Ladies are admitted.

Field Excursions are occasionally arranged during the summer months.

In order to organise and develop the work of the Club in Meteorology, Geology, Zoology, and Photography, a Sub-Committee is appointed for each of these branches of Science; and the Members of these Sub-Committees will at all times be glad to receive notice of, and to investigate, any facts of interest connected with the Natural History of the District, and to give to any Members of the Club any advice and assistance in their power.

RULES.

TITLE AND OBJECTS OF THE CLUB.

The Club shall be called "The Croydon Microscopical and Natural History Club," and shall have for its objects the mutual help of its Members in the study of Microscopy, Natural History, and Photography, the investigation of the Meteorology, Geology, Botany, and Zoology of the neighbourhood of Croydon, in the County of Surrey, and the dissemination amongst its Members of information on the subjects of Microscopy and Natural History.

MANAGEMENT OF THE CLUB.

1.—The business of the Club shall be conducted by a Committee (four to form a quorum), consisting of a President, Vice-Presidents (to consist of all past Presidents), a Treasurer, an Honorary Secretary, and nine other members.

2.—The officers of the Club shall be elected at the General Annual Meeting. The President shall not hold office more than two years in succession. Of the nine members of the Committee two shall retire each year, and shall not be eligible for re-election that year. The retiring members shall be (*a*), the one who has attended the smallest number of Committee Meetings during the past year; (*b*), the one who has served upon the Committee the longest. The remaining seven shall retain office without re-election. If two or more members have attended an equal number of Committee Meetings, that member shall retire who has served the longest. If two or more members have served an equal length of time, that member shall retire who has attended the Committee least often during the past year.

At a Committee Meeting held on March 14th, 1888, the following Resolutions were passed:—

I.—"That Lady Visitors introduced by Members be cordially welcome to join all the Excursions or Field Meetings of the Club.

II.—"That when in his judgment the Paper of the evening is likely to be of sufficient general interest, the President be empowered, with the consent of the reader of the Paper, to invite the attendance of Lady Visitors introduced by Members. Such invitation to be conveyed on the Notice convening the Meeting."

III.—"That the various sectional Sub-committees be also empowered, when they think it desirable, to invite the attendance of Ladies as Visitors at any Meetings, whether out or indoor, held under their auspices."

MEMBERSHIP.

1.—Every candidate for Membership shall be proposed by two or more Members, one of whom at least shall have a personal knowledge of him, and who shall sign a certificate in recommendation of him, according to the form appended. The certificate shall be read from the chair, and the candidate therein recommended balloted for at the following meeting. One black ball in five to exclude.

2.—The Annual Subscription shall be 10s., payable in advance on the 1st of January (or on election, if previous to November), and no person shall be entitled to the privileges of the Club until his Subscription shall have been paid.

3.—Distinguished men may be elected Honorary Members of the Club; such Honorary Members shall not be subject to any of the expenses of the Club, and shall have no vote in its affairs.

4.—In order to encourage the study of Microscopy and Natural History amongst mechanics, &c., residing in the district, individuals of that class may be admitted as Associates, provided they shall first communicate some original information or observation on Microscopy or Natural History, or exhibit such specimens as shall, by their merit, satisfy the Committee. Such Associates shall enjoy the privileges of Honorary Members.

5.—No Member shall be considered to have withdrawn from the Club until he shall have paid his arrears, and given a written notice to the Secretary of his intention to resign.

6.—If it shall be thought desirable to expel any Member from the Club, the same shall be done by a resolution of the Committee, which shall be read at the next ordinary meeting; and at the following meeting a ballot shall take place with respect to the proposition, and if two-thirds of the Members present shall vote for such Member's expulsion, he shall no longer be considered a Member.

7.—Any Member may introduce a visitor at an ordinary meeting, who shall enter his name, with that of the Member by whom he is introduced, in a book kept for that purpose.

ORDINARY MEETINGS.

1.—The ordinary meetings of the Club shall be held on the second Wednesday in every month (excepting the months of June, July, and August), at seven o'clock in the evening; the chair to be taken at eight precisely, or at such other time as the Committee may appoint.

2.—The ordinary course of proceedings shall be as follows:—

I.—The minutes of the previous meeting shall be read and submitted for approval as being correct.

II.—The names of candidates for Membership shall be read, and the ballot for election of Members shall take place.

III.—Scientific communications shall be read and discussed; after which the chair shall be vacated, and the meeting shall resolve itself into a conversazione, to terminate at ten o'clock.

3.—In the absence of the President, the Members present at any ordinary meeting shall elect a Chairman for that evening.

4.—No paper shall be read which has not received the sanction of the Committee; and, whenever it is possible, early notice of the subject of the papers to be read shall be given by the Secretary to the Members. No paper shall exceed twenty minutes in the actual reading, unless by the special permission of the Chairman.

5.—In addition to the above ordinary meetings, others, for conversation and the exhibition of Microscopical objects and Natural History specimens, and for the borrowing and exchanging of books, shall be held on the fourth Wednesday in each month throughout the year, at eight o'clock in the evening.

6.—Photographic Meetings shall be held on the first Friday in each month throughout the year, at eight o'clock in the evening.

BUSINESS MEETINGS AND ELECTION OF OFFICERS.

1.—The accounts of the Club shall be audited by two Members appointed at the ordinary meeting in December. No Member of the Committee shall be eligible as an Auditor.

2.—At the same meeting, notice of the Annual Meeting in January shall be given from the chair.

3.—An Annual Meeting of the Club shall be held, in the place of the ordinary meeting, on the second Wednesday evening in January, at eight o'clock, when the election of officers for the year ensuing shall take place; and the report of the Committee on the affairs of the Club, and the balance sheet, duly signed by the Auditors, shall be read.

4.—The Officers of the Club shall be nominated in writing, and such nominations shall be sent to the Secretary seven clear days before the Annual Meeting. In the event of the number of nominations exceeding the number of Officers to be elected, a printed list of the nominations shall be circulated at the Annual Meeting, and the Members present shall vote by ballot by striking out the names of those for whom they do not desire to vote, and placing the lists in an urn upon the table. Scrutineers shall be appointed at the meeting, and the votes shall be counted during the course of the meeting.

5.—No permanent alteration in the Rules shall be made, except at one of the monthly meetings of the Club, and notice of any proposed alteration or addition must be given at or before the preceding ordinary meeting.

LIBRARY.

1.—Application for the loan of books or microscopical slides to be made to the Hon. Librarian at any "Ordinary" or "Conversational" meeting of the Club, the borrower to sign a receipt, which will be cancelled on the return of the work borrowed.

2.—No member may have more than one work at a time.

3.—No work may be retained longer than one month, but the same work may be again borrowed provided there be no other applicant for it. Any Member not complying with this rule will incur a fine of 1s. for each month after the first that the work is retained.

4.—The borrower shall make good all damage which any book, &c., may receive while under his charge; such damage to be assessed by the General Committee.

5.—Books marked "R" (reference) and unbound pamphlets are not to be removed from the reading-room.

6.—No member will be entitled to the privileges of the Library who has not paid such fines as he may have incurred.

CATALOGUE OF BOOKS

BELONGING TO THE

CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

Achromatic Microscope. *Beck.*
Algæ, Seaweeds, &c. *Neave & Spicer.*
American Insects. 3 vols. *Say.*
Archæologia. 23 vols.
Archæologia, Catalogue of Broadsides.
Austen, N.L., Memoirs of. *Buckland.*
Barometer, Average height of. *Eaton.*
Beale. (See Microscope).
Berwickshire Naturalists' Club, Transactions.
Birds of Middlesex. *Harting.*
Birds' Eggs, Catalogue of, in Collection of P. Crowley.
Botany, a Text-book of. *Sachs.*
British Birds' Eggs and Nests, 3 vols. *Morris.*
British Birds' Eggs and Nests. *Atkinson.*
British Birds, List of. *Brit. Ornith. Union.*
British Diatomacæa. 2 vols. *Smith.*
British Association Reports. 5 vols.
British Butterflies. *Westwood.*
British Moths. 2 vols. *Westwood.*
British Fishes, Natural History of. *Buckland.*
British Flora. 2 vols. *Bentham.*
British Journal of Photography. Almanack 1887—8.
British Land and Freshwater Shells. *Adams.*
British Land and Freshwater Shells. *Turton.*
British Rainfall. 12 vols. *Symons.*
British Ornithological Union, List of Birds.
Brighton and Sussex Nat. Hist. Society. Transactions.
Bromley and Keston, Walks round.
Buckland, Frank. Nat. History of British Fishes.
Buckland, Frank. Memoirs of N. L. Austen.
Buckland, Frank. Crab and Lobster Fisheries.
Burton's Modern Photography.
Carpenter, Dr. W. B. Foraminifera.
Carpenter, Dr. W. B. The Microscope.
Chronicles of Croydon.
Cole. Studies in Micro. Science. 3 vols.
Crab and Lobster Fisheries. *Buckland.*
Crowley Philip. Catalogue of his Eggs.
Croydon Micro. and Nat. Hist. Club. Reports and Transactions.
Croydon to the North Downs.
Cryptogamic Botany. *Berkeley.*
Darwin. Nature Series.
Davies. On preparation of Micro. Objects.
Davis. Practical Microscopy.
Diatomacæa, British. 2 vols. *Smith.*
Dictionary of Scientific terms. *Buchanan.*
East-Anglian Earthquake of 1884. *Meldola & White.*
Eastbourne Natural History Society. Transactions.
Eaton on the average height of the Barometer.
Edward, Life of. *Smiles.*
Edwards. Our Sea Marks.
Fishes, Natural History of British. *Buckland.*
Fluids. *W. F. Stanley.*
Foraminifera. *W. B. Carpenter.*
Fungi, Manual of Preservation of. *English.*

Geology, Manual of. *Houghton.*
Histology, Lectures on. *Quekett.*
Hudson and Gosse. The Rotifera. 2 vols.
Human Microscopic Anatomy. *Kölliker.*
Index Entomologicus. *W. Wood.*
Keston and Bromley, Walks round.
Land and Freshwater Shells. *Adams.*

Land and Freshwater Shells. *Turton.*
Manual of Geology. *Houghton.*
Manual of Preservation of Fungi, &c. *English,*
Marvels of Pond Life. *Slack.*
Memoirs of N. L. Austen. *Frank Buckland.*
Micrographic Dictionary. *Griffith & Henfrey.*
Microscope, The Achromatic. *Beck.*
Microscope, The. *Carpenter.*
Microscope, The (Ed. 1875). *Carpenter.*
Microscope, The. *Clarke.*
Microscope, The. *George Adams.*
Microscope, Treatise on the use of the. *Quekett.*
Microscope, Treatise on the. *Naegeli.*
Microscope, How to work with the. *Beale.*
Microscope, How to work with the (ed. 1880). *Beale.*
Microscopic Anatomy, Human. *Kölliker.*
Microscopical Manipulation. *Suffolk.*
Microscopical Science, 3 vols. *Cole.*
Middlesex, Birds of. *Harting.*
Modern Photography. *Burton.*
Moths, British. 2 vols. *Westwood.*
Mounting and Preparation of Micro. Objects. *Davies.*
Natural History of Selborne. *White.*
Natural History of Birds. *Rymer Jones.*
Notes on Collecting and Preserving Nat. Hist. Specimens. *Taylor.*
Our Sea Marks. *Edwards.*
Philosophical Transactions of Royal Society. 17 vols..
Photography, British Journal of. Almanacks. 2 vols.
Photography, Modern. *Burton.*
Photography, Practical Portrait. *Heighway.*
Photography, Year Book of. 2 vols.
Polarized Light. *Woodward.*
Pond Life. *Slack.*
Practical Microscopy. *Davis.*
Preservation of Natural History Specimens. *Taylor.*
Preservation of Fungi and Wild Flowers. *English.*
Pamphlets. Vols. 1 and 2. [Contents are detailed below].
Quekett Microscopical Club Journal. 3 vols.
Rainfall, British. 12 vols. *Symons.*
Recent and Fossil Shells. 2 vols. *Woodward.*
Rosarian's Year Book. 8 vols.
Rotifera, The. 2 vols. *Hudson & Gosse.*
Royal Microscopical Society Journal. Complete set.
Royal Society, Philosophical Trans. 17 vols.
Science Gossip. 1881—1887.
Seaweeds, Algæ, &c. Collectors' Handbook. *Neave & Spicer.*
Selborne, Natural History of. *White.*
Smithsonian Institute. Reports. 6 vols.
Spectrum Analysis. *Suffolk.*
Students' Natural History. *Baird.*
Studies in Microscopical Science. 3 vols. *Cole.*
Watford Natural History Society. 3 vols.
Wild Flowers, Preservation of. *English.*
Year Book of Learned and Scientific Societies. 1887—1888.
Year Book of Photography. 1887—1888.
Zoology, Text Book of. *Nicholson.*
Zoologist, The, 1883, 1884, 1885.

Pamphlets.—Volume I.

The Subsidences on Blackheath. *Report of Committee.*
On Portions of a Cranium and Jaw of Archæopterix. *John Evans, F.R.S.*
On Systematic Observation and Record of Rainfall. *Symons.*
Note of Fall of Meteorite near Middlesborough. *A. S. Herschel.*
Catalogue of Meteorites in British Museum. *Brit. Mus.*
Recent Foraminifera in Down and Antrim. *J. Wright.*
Notes on the Flora of Surrey. *A. Bennett.*
Deep Sea Exploration.
Subjects recommended for investigation by local Scientific Societies. *Brit. Association.*
Embryology of the Podophthalma. *Ed. Lovett.*

Excursion to Camberley described. *Geol. Association.*
On the Microscopical Structure of Amber. *Sorby & Butler.*
New Method of measuring and recording Bands in the Spectrum. *Thos. Palmer.*
Application of Microspectroscope to the Study of Evergreens. *Thos. Palmer.*
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[*The paging of the last Part of the* TRANS. *should have been 111 to 132, instead of 1—22. Members should correct this before binding, as in the Index the corrected paging will be referred to*].

TRANSACTIONS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1887–88.

64.—NOTES ON THE FORAMINIFERA, WITH ESPECIAL REFERENCE TO VARIATION IN THE TEST, TOGETHER WITH COLLECTED INFORMATION AS TO THEIR SEX AND REPRODUCTION.

BY C. DAVIES SHERBORN, F.G.S.

(Read September 14th, 1887.)

THE Foraminifera, notably the Nummulites, by reason of their peculiar shape, size, and abundance, became objects of curiosity at an early period of geological research, the older authors dealing chiefly with these lentil-shaped Tertiary fossils under various names. Conrad Gesner seems to have been the first to describe and figure any of these Protozoa, and in his 'De omni rerum fossilium genere,' amongst several doubtful forms, he figures what may be a *Vaginulina*. This book was published at Zürich in 1565. The earliest paper of real importance was one by Janus Plancus (Bianchi), entitled 'De Conchis minus notis,' and published in 1739. Plancus described some thirty forms, many of which were identified by Linné in the 12th edition of his 'Systema Naturæ.' The striking figures of what we now know as *Rotalia Beccarii*, *Cristellaria Calcar*, *C. cultrata*, &c., by Gaultieri, were published in 1742, and in 1758 came the 10th edition of Linné's 'Systema,' in which for the first time the Foraminifera received specific names. Very many more or less interesting papers followed rapidly, and in 1781 Lorenz Spengler published in the 'Danske Skrifter' his beautiful plates of *Peneroplis* and *Calcarina*, along with other forms. Geo. Walker, in 1784, described some rare shells from the sand near Sandwich, Kent. This work is of great interest, as Walker was the first English author to describe the Foraminifera in any detail. About this time, too, a master-mind was at work at Sienna, and in 1789 the first part of the 'Testaceographia,' of Ambrogio Soldani appeared. This work, completed in 1798, consists of 228 quarto plates, with hundreds of figures, and it was upon these figures that d'Orbigny founded many of his species.

The rarest of all the books upon the Foraminifera appeared in 1791; it consists of six plates and a coloured wrapper, on which are printed the descriptions, and is entitled, 'Sechs Kupfertafeln mit Conchylien des Seesandes,' by J. G. A. Batsch. This work is remarkable for the accuracy of the figures, and for the zoological arrangement of the individuals, which arrangement is practically the same as that at present adopted. Only two copies of this rare book are known to exist—one in Mr. H. B. Brady's library, and one in Vienna. Thanks to Mr. Brady, I am able to-night to show you tracings of the figures in the Vienna copy which is uncoloured.

It is impossible here to mention the important writers of the next thirty years, but they include Lamarck, Fichtel and Moll, Denys de Montfort, Defrance, Montagu, and others well known to workers in this subject. Until the publication of Lamarck's papers (1800–1804), the genus *Nautilus* had been used for all the forms, and the animal was considered to belong to the Cephalopoda amongst molluscs. It was reserved for Alcide d'Orbigny to first separate the Foraminifera as a *special* order of Cephalopoda, and to reduce them to definite genera and species. His 'Tableau Méthodique de la Classe des Céphalopodes,' published in 1826,* laid the foundation for the scientific study of these beings. But even d'Orbigny, with all his acuteness, did not understand the animal, and it was not until 1835, when Félix Dujardin published his paper, "Observation sur les prétendus Céphalopodes microscopiques,"† that the true and definite nature of the Foraminifera was established. Since 1826 the literature has increased with extraordinary rapidity, about 2000 papers having been written on the subject. The labours of Reuss, Parker, Rupert Jones, Carpenter, Williamson, Brady and others are too well known to need repeating here, and their publications are easily accessible in our great public libraries.

We are still very imperfectly acquainted with the animal of the Foraminifera, and the general description "a particle of sarcode, with doubtful differentiation into ectosarc and endosarc, occasionally presenting a nucleus and contractile vesicle, and possessing the power of extension of the mass into pseudopodia, which inosculate to form a network," still holds good for most of the Rhizopoda.

In some Rhizopods, Amœba, Actinosphærium, &c., the differ-

* 'Annales des Sciences Naturelles,' vol. vii. 1826.
† Idem, 'Zoologie,' ser. 2, vol. iii.

entiation of the animal is much more distinct, and from a study of these, and kindred forms, we can judge somewhat of the nature of the animal living in these calcareous and sandy tests. Schultze, Schulze, Gruber and others have thrown much light upon the biology of the Protozoa, and there have been recently published by Miss Greenwood, of Cambridge, some interesting and careful papers on "Digestive process in some Rhizopoda."*

The simple nature of these organisms (Protozoa) makes us despair of getting exact particulars as to their economy, but on one point, and that perhaps the most important of all—the sex and reproduction—we have, if not very definite information, at least some very important details. Amœba and Actinophrys are believed to be asexual, and to reproduce themselves solely by fission or gemmation. Amongst the Foraminifera it is extremely likely that both these methods obtain; and we have evidence of a third method, that of viviparous reproduction, and this may possibly indicate sex. In 1854, Max Schultze published his remarkable work, 'Der Organismus der Polythalamien,' and he figured therein a *Miliola* and a *Rotalia*, in both of which numerous young shells are shown. Ehrenberg and Strethill Wright also noticed this in *Spirillina*. In 1883 Shacko published in the 'Archiv der Naturgeschichte,' a paper in which he describes and figures a *Peneroplis proteus*, d'Orb., showing the last fourteen chambers of the shell crowded with embryos; and to be more exact he figures another specimen, to show that the shape of the embryo corresponds exactly with the original chamber of the parent shell. Again, in 1884, Brady figured in the 'Challenger' Report a specimen of *Cristellaria crepidula*, in which young shells are seen occupying some of the chambers. As there is no orifice in these shells (with the exception of *Spirillina*) sufficiently large to admit of the passage of the young to the exterior, it seems highly probable that the birth of the young means the death of the parent, unless indeed an actual segmentation of the parent takes place to produce the young. This, however, is merely suggestive; but we have the same thing taking place when Amœba divides into two; the parent ends independent life, and becomes two immature individuals. In *Cymbalopora*, one of the *Rotalinæ*, the last or youngest chamber of the mature shell is much inflated, and young shells are found therein, and Mr. Brady has noticed the presence of the rotaline portion of the shell, showing traces of the fractured balloon-shaped chamber amongst mature and young individuals.

De la Harpe, when studying the Nummulites, observed that there are two recognisable forms of each species, the individuals

* 'Journal of Physiology,' 1886 and 1887.

being divisible by size; and further, that the smaller shells invariably begin with a large chamber, while the larger shells either have no recognisable central chamber, or one of very small size.* De la Harpe considered these two forms as distinct species. MM. Munier-Chalmas and Schlumberger took up this question, and came to the conclusion that the difference was one of development only, and that the "pairs" were two forms of the same species. De la Harpe, in a later paper, suggests that, had it been a fact that sex existed amongst the Foraminifera, he would have been inclined to regard this difference as of a sexual nature. Mr. Patrick Geddes is inclined to agree with this later suggestion of De la Harpe. Similar large and small initial-chambered forms amongst the *Miliolinæ* have been described by MM. Munier-Chalmas and Schlumberger.

So little being known of the animal, the only classification possible was that of shell-structure. Many schemes have been proposed, the most simple being that of Rupert Jones, based on previous observations by himself and others. Prof. Jones divides the Foraminifera into Porcellana or Imperforata (thick and imperforate shell-wall), *Cornuspira*, *Miliolina*, &c.; Arenacea (sandy tests), *Lituola*, *Textularia*, &c.; Hyalina or Perforata (thin, vitreous, and perforate shell-wall), *Lagena*, *Nodosaria*, *Rotalia*, &c.,—by far the largest number. Roughly speaking, all the Foraminifera can be relegated to one or other of these three sections. Those interested in the further discussion of classification will find the best-known schemes criticised and explained in the opening pages of Brady's 'Challenger' Report, 1884.

The further classification of the Foraminifera into genera and species has also been carried out on external features, and it is often difficult to understand how certain forms can possibly hold good as genera or even species, but, although they pass in many instances so completely from one into another, we know they do not differ in form and ornament alone, but in habit, occurrence, depths at which they live, modes of life, &c. "Whether species or not," says Mr. Brady, "they have distinctive characters, and it is necessary they should receive distinctive names."

It has been the custom of some authors to name every variety as a species; with others to group many varieties around one marked form. It is hard to say which is the more correct method; as often, in geological research, a particular variety of a so-called species is characteristic of a stratum. The work of elucidating and explaining the meanings of older authors has been carefully and elaborately done by Parker and Rupert Jones, and later on by Brady, in a series of articles contributed to the 'Annals and Magazine of Natural History' between 1859 and

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* A fact previously observed by Parker and Jones.

1872; and when I tell you that one of these old authors, thus treated, was Ehrenberg, you will be impressed with the patience and labour of this work.

It is incumbent on all who attempt to determine new species to refer most carefully to previously published papers, and this, formidable task as it is, has been rendered comparatively easy by the bibliography appended to Brady's 'Challenger' Report. In the course of the past three years I have made it my business to refer to and index every figure in the known papers, and have acquired the painful knowledge that over 50,000 forms have already been figured and described.

The great majority of the Foraminifera live at the sea-bottom, at moderate depths; those living at the surface are nearly, if not quite, confined to one family, the *Globigerinidæ*, and occur in relative abundance as follows:—*Globigerina*, *Orbulina*, *Hasterigerina*, *Pullenia*, *Sphæroidina*, and *Pulvinulina*, the few other genera being of rare occurrence. Nearly all Foraminifera have a wide geographical range, and seem to thrive at varying depths, though depth usually makes a difference in shell-thickness. According to the 'Challenger' Report, by far the richest gathering was obtained from a depth of 390 fathoms. The richest locality of the 'Challenger' was Torres Strait, the warm shallow waters of coral seas being especially rich and varied in their minute fauna.

The geological range is remarkably persistent. *Lagena* occurs apparently the same as those of to-day, in Silurian Shales. The Foraminiferal fauna of carboniferous times was probably peculiar, though some well-known recent forms occur; in Permian and Triassic times the family of *Nodosarinæ*, amongst others, existed much the same as they do to-day. The Jurassic period was extremely rich; thousands of "species" have been described from European deposits. The Cretaceous forms are well known to you through the labours of your member, the Rev. George Bailey, and at the word *nummulite* everyone remembers the vast importance of the Foraminifera in Tertiary times.

With regard to the variation of the test, in the diagrams on the wall I have endeavoured to trace the variations of form and ornament in a simple *Nodosaria*. In a large collection of specimens we can see the most perfect gradation from a smooth, unornamented, single-chambered shell (*Lagena*), through all the vagaries of dots, spines, ribs (either broken or continuous), and other far more complex ornaments; and from a single-chambered shell through the nodosarian (straight), dentaline (curved), cristellarian (partly or wholly coiled), to the most perfect spiral form, either compressed or globulous; and we cannot say this or that is even a permanent variety. Taken separately, and for purposes of classification, it is, as was said before, extremely useful to have a definite double name for these variations, but when using this it is necessary not to forget that it is merely for classificatory and useful purposes.

65.—On the Power of Movement in Plants. [Abstract.]

By H. W. S. Worsley-Benison, F.L.S.

(Read October 12th, 1887.)

Speaking first of the movements depending upon the protoplasm contained in plant-cells, or upon the presence of cilia, or small hair-like processes on their surfaces, the lecturer remarked that the motion of the contents of cells was of two kinds. In rotation the current coursed only along the walls either spirally or reticulately, the protoplasm making paths for itself in the cell-sap, as in the stone-worts, *Nitella* and *Chara*. In *Chara* the inner layer of protoplasm rotated, carrying the nucleus with it; while the outer layer, or primordial utricle, immediately within the cell-wall remained motionless, as did also the chlorophyll grains. The motion in *Chara* was at an angle with the wall, while in *Vallisneria* it was parallel to and all round the wall, carrying the chlorophyll grains with it. Cold retarded, heat accelerated, but electrical currents stopped it. Jolting or pricking the cell stopped it. The speed varied; in the bristles on the ovary of *Circæa* it completed the round in about one minute.

In circulation, the protoplasm was hollowed out, and the motion was in *net-like* currents, radiating from and returning to the nucleus, passing in threads and bands through the cell-sap. This was seen in the cells of the purple hairs of spiderwort, in the cells of celandine, in nettle-hairs, and particularly in the hairs of the buds of the marsh-mallow. Among the causes of movement inside the cells of plants were constant chemical changes, such as the formation and evolution of carbonic acid, and the formation of starch and the albuminoids; these disturbed the equilibrium of forces, and produced heat, and probably electrical currents, which in turn gave rise to forces of astonishing magnitude, setting atoms and molecules in motion, and representing an enormous amount of work. The absorption of water alone developed an enormous force. The tension of tissues or cells, due to unequal growth of layers; turgidity, or the pressure of cell-sap on the cell-wall, caused by attraction of water by the substances dissolved in the cell-sap; the diffusion of gases; and light and heat (as was well seen in the action of these agents causing chlorophyll grains and *Algæ* spores visibly to shift their positions), all brought about motion.

In naked or primordial cells, the protoplasm not being confined by a cell-wall, was able to move of its own accord from one place to another. This occurred in the group of *Fungi* called *Myxomycetes*. The author cited as an example *Æthalium* or "flowers of tan," an orange-coloured organism, growing in and around tan-pits. It existed as a mass of protoplasm with no cellulose wall, slimy or creamy in appearance, and made up of a number of anastomosing net-like channels, along which a nearly constant current of protoplasm slowly passed, carrying all kinds of foreign bodies with it. Motion from place to place was effected by the protoplasm projecting at its edge a number of arm-like processes, into which the current flowed, thus increasing their size, and in time the whole mass shifted its position. Before fructification it had a tendency to climb erect objects like trees or stumps, where at rest it formed capsules containing spores, which later were set free as naked masses of protoplasm; these subsequently coalesced, three or four of them making a fresh *plasmodium*. They also were endowed with the power of motion, using this power in order to coalesce. The protoplasm or *plasmodium* of *Didymium* could travel nearly 0·4 inch in a minute. A similar power existed in the protoplasmic filaments ejected from the glandular hairs on the leaves of the common teasel, which absorbed nutriment from the bodies of insects drowned in the water contained in the cups formed by the connate leaves. It was also seen in the leaves of the compass-plant of the prairies.

The motion of embryonic cells, or zoospores, and of antherozoids, was accomplished by vibratile cilia, with which the organisms were provided, and which occurred in two chief varieties. In the first variety the zoospores of certain *Algæ*, like the red-snow plant, and of some *Fungi*, such as the potato fungus, they consisted of embryonic cells, set free by rupture of the parent cell, and were naked masses of protoplasm provided with cilia, but destitute of any cell-wall during their motile period. They moved with great rapidity, sometimes rotating on their own axis, sometimes with a rolling motion, lashing the water with one cilium, while the other trailed behind; sometimes fixing themselves by one cilium, and spinning round on it by means of the other; after a time they lost their cilia, developed a cellulose coat, and gradually grew up to adult forms. The second variety comprised the Antherozoids, or male elements of reproduction formed within, and set free from the *antheridia* of some *Algæ*, and also of *Characeæ*, ferns, and other higher Cryptogams; they resembled zoospores in appearance and in motile power. In both these cases the cilia were the agents of motion, of which the causes were surmised to be analogous to those of the rotation of protoplasm.

There were numerous instances of motion of entire and adult plants. In the adult *Protococcus*, and in cell families, such as *Volvox globator*, where several unicellular *Algæ* united to form a colony, motion was effected by cilia. In the *Oscillatoriæ*, a filamentous group of *Algæ*, and the *Schizomycetes*, *Algæ* containing *Bacterium*, *Vibrio*, *Spirillum*, and *Leptothrix*, there were no cilia, and yet their vibratile, oscillating, and creeping movements were well known, although the causes of such movements were involved in obscurity. No cilia had been discovered in the brisk, active diatoms, and it was supposed that they moved either by minute projections of protoplasm through spots in their shells, or that their motion depended on osmotic currents, set up by interchange of matter between their cell-contents and the water in which they lived.

Movements purely mechanical and due to physical causes included the bursting of spore-cases in Cryptogams, such as the rupture of *sporangia* in ferns, the breaking-away of the *opercula* in mosses, and the unwinding of the elastic elaters on the spores of Equisetums ; also the dehiscence of anther-cells for the escape of pollen, and of the fruit of flowering-plants. All these were the destruction of parts resulting from structural conditions acted on by external physical phenomena. In anthers, dehiscence was produced partly by pressure of the pollen-grains on the coats of the anther-lobes, causing partial absorption of the latter, partly by action of the fibrous cells lining the anther. The two main causes of this class of movements were varying power of inbibition of moisture, and varying degree of elasticity in the tissues. These in turn were affected by the hygroscopic condition of the atmosphere, as seen in the elaters of Equisetum. The degree of expansion of cells due to moisture varied from one-thousandth to one-half of the cell-diameter. Expansion brought about by turgidity had a smaller range, being only from one-eightieth to one-fifth of the diameter of any cell. Curvature was caused by unequal absorption of moisture, and if different degrees of elasticity ensued, the equilibrium of turgidity was still more displaced. The dehiscence of seed-capsules, whether valvular, or by pores as in the poppy, or by a circular slit as in the pimpernel, or by uplifting flaps, was always governed by the same physical forces, where also the varying anatomical structure of the several layers bore a part. As examples Mr. Worsley-Benison cited the twisting of the awns of oat and of other grasses, the separation of the fruit-valves of wallflower, geranium, and spurge. The balsam took its name, *Impatiens noli-me-tangere*, from the fact that when ripe the capsules, if gently pressed in the middle, would suddenly coil up from each end, the middle would rise into a hump, and the seeds be shot out to a distance of six or seven yards.

The author then proceeded to discuss the movements occurring in living parts of plants during active growth, which he characterised as the most interesting, though difficult of classification. These he grouped under two heads :—Periodic, which occurred at regular times and under constantly similar circumstances; and Induced, which were mainly brought about by mechanical stimuli, such as touch, concussion, &c., and not simply by heat or light.

With regard to Periodic movements, the morphology both of these and of the Induced kind consisted mostly of a folding-up, or curvature of some sort. Usually, too, there was either some peculiarity in tissue-construction, or in the union of the moving organ to some other organ, such as the stem. Heat and light greatly influenced Periodic movements; for example, in the *Mimosa*, or sensitive plant, there was no movement at a temperature under 59° Fahr., while death occurred above 125°. Prolonged darkness caused rigidity, and therefore loss of motile power. The so-called sleep of plants, or of plant-organs, was a notable kind of Periodic movement, which the author illustrated by the case of the leaves of *Mimosa*. These were bi-pinnate; the compound leaf was divided into four leaflets, arranged like the sprays of a feather on the main axis; and again, each pinna was divided into a series of pinnules similarly situated. At night the pinnules folded upwards on one another, all along the axis, like butterfly-wings; the four leaflets moved up and laterally towards the apex of the leaf, closing over one another like the flaps of a fan; then the whole leaf-stalk bent downwards, getting closer to the stem, and a general collapse took place. These movements, as had been explained by Darwin, were effected either by alternately increased growth on the opposite sides of the leaf, leaflet, or leaf-stalk, or by means of an aggregated mass of cells called a *pulvinus*, which formed a little swelling at the articulation of the leaf-stalk with the parent stem, and consisted of a vascular bundle, wrapped round with soft parenchymatous tissue; they existed also at the articulations of the leaflets with the common leaf-stalk, and there was a separate one for each pinnule, the swellings here being called *strumæ*. The parenchymatous cells, which were the irritable ones, filled with water drawn from the plant; their cell-walls were not irritable but elastic. If the cells were irritated by a touch, or by concussion, or by light or heat, their contained water passed out from them, their turgescence was lessened, and their elastic cell-walls contracted, the contraction affecting the side of the whole mass on the touched side of the *pulvinus;* the result was that the contraction of the touched side was communicated to the stalk, which moved up or down. In *Mimosa* the under surface of the *pulvinus* was irritable, but the *strumæ* were irritable only at the upper part. If a *struma* at the tip of a leaflet was touched, the folding of the leaflets went from tip to stalk-joint, the closing of one pair being sufficient to communicate the disposition to close to the neighbouring pair. If the lowermost pair was made to close, the impulse travelled from joint to tip by the same sympathetic influence. After depression had ensued, a fresh flow of water into the emptied cells raised the leaf, and the leaflets opened again. This "water-theory" was affected by Gardiner's researches on 'Continuity of Protoplasm.' He found this continuity in the *pulvinus*, a discovery which would probably lead to the conclusion that the movements had close relation to the continuity of protoplasm. All this was effected periodically in *Mimosa* by the light and heat of the atmosphere, which were the stimuli; sleep commenced just before sunset, waking preceded the sunrise. Thus *Mimosa* closed its leaflets and drooped its leaves gradually during the day, and during the night gradually raised the leaves and opened the leaflets, which was the reverse to the general habit of sensitive plants.

The *Mimosa* had a tendency, on a succession of mechanical shakings, of getting used to it. Desfontaines proved this by carrying a *Mimosa* on a stage-coach journey, when, although at first affected by the jolting, after a time the plant kept its leaves extended. Another instance of this movement was afforded by the telegraph-plant, *Desmodium gyrans*, so-called from its motion resembling that of the two arms of the old-fashioned Semaphore signal. The leaf was trifoliate, the terminal leaflet being very large, the lateral leaflets very small. During the day the end leaflet gradually followed the sun, sinking slowly until its under surface lay quite back against its own stalk or petiole. The pair of side leaflets, on the other hand, moved up and down with a jerky motion, from about 8.30 a.m. until between 3 and 4 a.m. of the next day. Both the end and lateral leaflets moved in virtue of *pulvini* at the base of their petioles. The end one seemed to be influenced by the sun, but the lateral leaflets were apparently independent of external influences. Their movements were spasmodic, stopping occasionally as if to overcome some unseen obstacle, and seemed to result from the alternate lengthening and shortening of one side of the petiole. Their motion was on their own axis, being circular as well as up and down, and each moved alternately with the other, the down stroke being rapid, the up stroke more steady. As the terminal leaflet fell, its petiole rose, so that at night the leaves were all drooping, and the petioles upright, thus greatly reducing the diameter of the plant. There could be no doubt that the object of the sleep of leaves was, that they might expose less of their surfaces to the effect of chill by radiation from those surfaces at night.

Hence they crowded together as closely as possible. Nowhere was this better seen than in *Desmodium*, where the rising of the petioles, and the vertical position of the leaves, acted in the same direction. Without this provision many plants exposed to a clear sky on a frosty night would perish. As a rule, plants that slept did not get a good night's rest unless they had been exposed to an adequate temperature the day before, the degree varying in nearly every case. The leaves of the French bean slept better at midsummer than earlier. A violent wind would sometimes keep species of arrow-root awake for two nights in succession. Among the many plants whose leaves slept, he mentioned the stitchwort, mallow, flax, wood-sorrel, balsam, *Tropæolum*, lupine, clovers, *Lotus*, acacias, *Wistaria*, milk-vetch, and many other *Leguminosæ*; evening primrose, passion-flower, tobacco-plant, *Polygonum*, goosefoot, spurge, and only one Cryptogam, the pepperwort. With respect to the sleep of flowers, Mr. Worsley-Benison remarked that the "floral clock' of Linnæus must not be taken literally, because a dull day or a bright one, a dry morning or a moist one, would often modify the accuracy of the statements. Still, certain flowers had in many cases a pronounced tendency to open and close at specific times, or within a few minutes of those times. He then referred to the list made out by Linnæus, which had been abbreviated by De Candolle, and confirmed as follows in each instance:—Time of opening—2 a.m., purple convolvulus; 3 to 4 a.m., great bindweed; 5 a.m., chicory; 5 to 6 a.m., dandelion, nipple-wort, and blue convolvulus; 7 a.m., water lilies; 8 a.m., scarlet pimpernel; 9 a.m., marigold; 9 to 10 a.m., red sand-wort; 11 a.m., star of bethlehem; noon, blue passion flower; 2 p.m., *Pyrethrum*; 5 to 6 p.m., night-flowering catch-fly; 6 p.m., evening primrose; 7 p.m., evening campion; 7 to 8 p.m., night-flowering *Cereus*. Some flowers closed at certain hours; goatsbeard closed at noon, hence the name given to it of "John Go-to-bed-at-noon." He had watched these plants on the banks of the Wye, and had never seen a greater variation in the time than between 11.45 a.m. and 12.15 p.m. The pimpernel closed at 3 p.m., marigold between 4 and 5 p.m., yellow-wort at 5 p.m., and the daisy towards sunset. Those flowers opening after 6 p.m. were night-flowering plants, and were all fragrant, to attract the night-flying moths as their fertilisers. Some flowers, such as the red sandwort, closed instantly on being plucked; others, once opened remained so till they withered, as did most orchids; others, like the commercial flax, closed a few hours after expanding, never to open again. The water-lily remained open for twelve hours; purslane closed after an hour's expansion at noon. All these movements depended on the intensity of light. The mechanism of the movements was not so well known as that of the movements of leaves; but it was probably connected with the contractile power of protoplasm in the attached parts of their organs, and with variation in turgescence. Moisture governed some of the floral movements of hygroscopic plants, and thus meteorological changes might often be predicted with tolerable accuracy. The Siberian sow-thistle closed at night if the following day was going to be fine, and the reverse; bindweed, marigold, and pimpernel, if open, closed on the approach of rain. Many leaves were hygrometric, as were also some larger *Algæ*. Of flowers, the pimpernel, or "poor man's weather-glass," was most reliable, keeping its petals closed if clouds were coming, open if a fine day was at hand. If pimpernel was wide open at 9 a.m., the day was almost sure to be fine. The time of year at which flowers opened was, Mr. Worsley-Benison said, governed by the *intensity* of the light.

Plants forming their floral buds in the autumn, and opening in the spring, were usually short-flowered; those budding and expanding in the same year mostly remained open longer. So with geographical differences, a plant opening at 6 a.m. in Senegal, did not open in England until 8 or 9 a.m., and in Sweden not until 10 a.m. One opening in Senegal at 10 a.m., opened in England at noon, and not at all in Sweden; and one opening at noon in Senegal, would not bloom either in England or in Sweden. Forced plants, acted on by artificially increased light and heat, as hot-house and stove plants, and those grown in electric light, were similarly affected.

Heliotropism was the turning either towards or away from the light. Positive heliotropism, or turning towards the sun, a common occurrence, was seen in the internodes of growing stems, in petioles, and in flower-stalks. This was caused by the part turned to the light, the concave side, being retarded in growth; the convex side, or part turned away from the light, growing more rapidly. Among flowers, the *Compositæ* furnished many examples. In particular, the peduncle of the sunflower twisted in a circle during the day, bringing its flower constantly towards the sun. The flower usually faced south-east, and when the petioles became etiolated, the twisting came into action. Ripening corn inclined to the south, not to the north. Negative heliotropism, the turning away from the light, was a rarer phenomenon, and was the reverse of the above. The part exposed to the sun grew more rapidly, and being convex, the concave side was turned away from the sun. Examples were afforded by the older branches of the ivy and the tendrils of vines, also in the tendrils of *Bignonia*, and the moving masses of *Æthalium*. In the cyclamen it enabled the plant to scoop a hole with its peduncle in the earth or sand, and bury its own seed-pods. An allied phenomenon was seen in the compass-plant of the Texan prairies, which invariably grew with the edges of its leaves north and south, the faces or surfaces being east and west. This was to expose both surfaces to an equal amount of light, there being in this plant an equal number of *stomata* on both surfaces. Trappers used this plant as a compass on dark nights to find their way by, and even in the daytime it was a guide to those who might be lost on the prairies. The sleep of flowers was, like that of leaves, a provision against the ill effects of too great radiation. The direction, not the intensity, of light was that which governed both positive and negative heliotropism.

Mr. Worsley-Benison then referred to induced movements in leaves, such as might be seen in *Mimosa* and *Desmodium*, and in sundew and Venus's fly-trap, where insects were the agents, sacrificing their lives in the process; also to such cases as the leaves of *Schinus* and *Rhus*, which could be made to execute a dance by throwing them into water. In *Utricularia*, or bladder-wort, the fine hair-like leaves were furnished with floating bladders. These possessed valves which closed with a fatal snap, when the wanderings of aquatic insects or young fishes led them to examine the bladders. In illustration Mr. Worsley-Benison stated that Mr. G. R. Sims, of Oxford, recently noticed that some 200 or 300 young perch in his aquarium had unaccountably disappeared. The aquarium had large quantities of bladder-wort growing in it, and on investigation it was found that many of the small fry had been entrapped by the bladders, some by the head, and others by the tail.

Finally, Mr. Worsley-Benison brought his address to a conclusion by referring to the induced movements in floral-organs, seen in the irritability of stamens in the barberry, pellitory, nettle, saxifrage, rue, grass of Parnassus, and periwinkle; in the movements of the styles of the passion-flower, cactuses, and others; in the mutual approach of stamens and styles in the fuchsia and the mallows; and in the raising and lowering of the *labellum* of many orchids, and the central parts of the same flowers. All these cases, he said, except the last, and those of the leaves, had to do with fertilizing processes; those of the leaves of *Drosera* and *Dionæa*, and of the bladders of *Utricularia*, with the actual nutrition of the plant.

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Croydon Microscopical and Natural History Club.

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PROCEEDINGS & TRANSACTIONS

OF THE

CROYDON

MICROSCOPICAL & NATURAL HISTORY

CLUB.

FEBRUARY 8, 1888, TO JANUARY 9, 1889.

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PROCEEDINGS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1888–89.

Nineteenth Annual Meeting.

Held at the Public Hall, Croydon, Wednesday, January 9th, 1889.

HENRY STORKS EATON, M.A., &c., President, in the chair.

The Balance-sheet of the accounts for the year 1888 was taken as read (page cviii) and passed, and a vote of thanks accorded to the Auditors.

It was proposed by the President, seconded by Mr. F. C. Bayard, and carried unanimously:—

"That Henry George Thompson, Esq., M.D., be elected President for the ensuing year."

It was proposed by Mr. J. Berney, and seconded by Mr. E. F. Jones, that Mr. Kenneth McKean be re-elected Treasurer.

It was proposed by Mr. H. T. Mennell, and seconded by Mr. W. Murton Holmes, that Mr. W. Low Sarjeant be re-elected Honorary Secretary.

The above propositions were carried unanimously.

Dr. George J. Hinde, F.G.S., and Mr. Edward Straker were elected to fill the vacancies on the Committee caused by the retirement of Dr. Thompson and Mr. Topley.

The following is the list of officers for the year 1889:—

President.—HENRY G. THOMPSON, M.D.

Vice-Presidents.—JOHN BERNEY, F.R.M.S.; ALFRED CARPENTER, M.D., J.P., &c.; PHILIP CROWLEY, F.L.S., F.Z.S.; HENRY STORKS EATON, M.A., &c.; HENRY T. MENNELL, F.L.S.

Treasurer.—KENNETH MCKEAN, F.L.S.

Committee.—F. C. Bayard, L.L.M.; Henry S. Cowdell; Thomas Cushing, F.R.A.S.; James Epps, jun., F.L.S.; Walter M. Gibson; George J. Hinde, Ph.D., F.G.S.; Edward Lovett; Edward Straker; Edward B. Sturge.

Hon. Secretary.—William Low Sarjeant.

The retiring President, Mr. Eaton, delivered an Address, at the conclusion of which a hearty vote of thanks was accorded to him and to the other officers of the Club for their services during the past year.

Mr. Eaton then vacated the chair in favour of Dr. Thompson.

The President's Address.

Gentlemen,—It is with much satisfaction that I am able to announce that the Club has increased in numbers since the last anniversary, and has maintained its influence and position as one of the chief local natural history societies of the day. The roll of the Club on the 31st of December included 269 members, 7 honorary members, and 2 associates; altogether 278. The elections in the twelve months comprised 30 ordinary members and 1 honorary member. Our losses from all causes have reached 27 members, of whom 3 have been removed by the hand of death, namely, Mr. J. S. Crowley, Mr. H. Lee, and Mr. I. J. Witt, jun. Chief among these was Mr. Henry Lee, the founder of the Club, and its first President, who died on the 31st of October, at Brixton, after a brief illness. Mr. Lee was well known to the zoological world as the successor of Mr. J. K. Lord, in 1872, to the position of naturalist to the Brighton Aquarium. In this capacity he carried out several investigations into the habits of marine animals, experimenting on whitebait, smelts, and herrings. He was a close friend of the late Mr. Frank Buckland, whose methods and views he adopted, and was a frequent contributor to 'Land and Water.' It has been observed by a member of this Club, who knew him well, that it was entirely owing to the unflagging zeal and the tact displayed by him, as well as to his widespread influence in the scientific world, that the Club secured a solid foundation; that few except his most intimate friends ever knew the amount of labour he undertook when the Club was originated; and that he entered into the scheme with his whole heart from the very first, and for months worked almost incessantly for its furtherance. Mr. Lee had not resided in Croydon for several years, so that to many of the members he could only have been known by name, and as one of the Vice-Presidents. To perpetuate his memory it has been resolved by the Committee to suspend an enlarged photographic likeness of him on the wall of this room, and his portrait will also appear as a frontispiece to the next number of our Proceedings. Mr. Lee contributed seven original papers to the Club, namely (1), "On Siliceous Anchoring Sponges," October 19th, 1870; (2), "On a new locality for *Trocheta subviridis*, a rare land-leech," November 16th, 1870; (3), "The microscopy of a fishmonger's shop," May 15th, 1872; (4), "Some notes of observations of animal life in the Brighton Aquarium" and (5), "Development of *Hydra tuba*," February 19th, 1873; (6), "On some of the developments that have taken place in the Brighton Aquarium, February 18th, 1874; and (7), "The history and teaching of a copper-plate," October 17th, 1877.

Finances.—On the general account the net income and the net expenditure for the last two years compare thus :—

	1887.			1888.		
	£	s.	d.	£	s.	d.
Net Income	138	14	6	149	13	6
Net Expenditure	125	11	3	151	4	11
	+13	3	3	− 1	11	5

There has therefore been a slight excess of expenditure over income.

Beyond the practically compulsory conversion of the 3 per cent. Consols into 2¾ per cents., no change has been made in the Special Fund. No expenditure has been incurred, and the balance available for the purchase of apparatus is now £38 16s. 2d.

During the past year the progress of the Club has been manifested in the activity displayed by some of the sections. This has been pre-eminently so in the case of the Meteorological Subsection, under the active supervision of its Honorary Secretary, Mr. Bayard. The programme laid down twelve months ago has been closely followed, and the expectations then held out have been fully realised. At the comparatively small cost of a little over £20 the daily rainfall from 34 stations in the Club district has been tabulated every month, examined and corrected, and the results printed and issued to the observers and all members of the Club interested in the question, before the end of the month succeeding that to which the statistics refer. The quality of the results is enhanced by the close scrutiny to which they are subjected by Mr. Bayard, who immediately directs the attention of observers to any apparent discrepancy in their returns, and asks for an explanation. The Royal Observatory at Greenwich and the Kew Observatory are both represented, and the applications for co-operation have generally met with a cordial and ready response. There are still, however, portions of our district where a few more rain-gauges would be acceptable; for instance, the crest of the North Downs and the vicinity of Erith. Nevertheless, having some acquaintance with the statistics of rainfall, I have no hesitation in expressing my belief that there is no area of equal extent to the Croydon district in any other part of the country over which the rainfall is better observed. At the end of the year the number of stations had reached 48, being at the rate of one gauge to about every ten square miles. This is probably sufficient. The efforts of the Club may now, I think, be directed to the more uniform distribution of the gauges. The Club is much indebted to the Photographic Subsection for photographs of several of the stations, which will be preserved as permanent records of the surroundings of the gauges. The Report of the Meteorological Sub-Committee for the year 1888 will be found in the Transactions (Trans., Art. 73).

While the depth of rain falling on the surface of the earth is thus noted, the movements of the water below, being that portion of the rain which escapes evaporation, has not been neglected. This subject of research has been termed "hydro-geology," and is pursued mainly by observing the height of the water in wells. Before now considerable misconception has arisen concerning the hydrogeology of this district, through the levels of the water not having been referred to the same epoch. But the inquiry has been pursued with success for several years by our member, Mr. Latham, who has been thereby able to predict some time in advance, in rainy seasons, the outburst of the bourns in the Caterham Valley. Last year I referred to the well-gaugings undertaken by the Croydon Corporation. It has been thought advisable to defer their publication till they could appear in conjunction with the rainfall tables. They are now, thanks to the kindness of our member, Mr. Walker, the Borough Engineer, completed to the end of the year 1888. They do not, it is true, exhibit continuous records of the height of the water in the wells, as would be shown by self-recording gauges; but they do show the connection between the rainfall and the movements of the subterranean water. From these gaugings it is manifest that the rainfall in autumn and in winter is more efficacious in replenishing the wells than an equal amount of rain in a similar interval of time in the spring or summer, when a larger proportion of the rain is withdrawn from the soil and restored to the atmosphere by evaporation. But these great operations of Nature are slow in their processes, and the effects are not immediately manifest. As a consequence, on the average of years, it is not till November that the water in the wells in the higher part of the district begins to rise from its lowest level, attaining a maximum height between February and June. In the lower ground, nearer Croydon, the epochs of minimum and of maximum water-level are respectively about a month later. This may be seen by comparing the observations at Slynes Oaks with those at Addington Village, although the comparison is somewhat vitiated from the two stations not being in the same drainage area. I am informed by Mr. Latham that the rate of propagation, of what may be termed a wave of water downwards from the hills, is less speedy in some valleys than in others, and that it is retarded in the valley leading from Farley towards Addington. This is probably to be attributed to the greater or less obstruction to the flow of the water through strata of varying density, or to the chalk being more or less fissured, and to the comparative length and steepness of the gradient of the impermeable floor of the individual valley. There are, however, many subsidiary points bearing upon the question which need investigation. To conclude my remarks on this subject, the variation in the level of the water is much greater in the deep wells among the hills than in the shallow wells sunk in the lower ground. It amounted to 95 ft. at Crewe's Farm and 66 ft. at Slynes Oaks, as compared with 27 ft. at Addington Village and 17 ft. at Sparrows Den, West Wickham. But the twenty wells observed by the Corporation of Croydon are not altogether best calculated to exhibit these phenomena in the clearest light, being for the most part situated in a band from east to west transversely to the flow of the water. A detailed statement of the well-measurements is given in the Transactions (Trans., Art. 74).

I am indebted to Mr. Mennell and to Mr. McKean for the following Reports relating to the Botanical and Photographic Sections respectively. It will be noticed that the Botanical Sub-Committee, for weighty reasons, has substituted the county of Surrey as its special field of operations for the natural district adopted by the other sections of the Club.

Report of the Botanical Sub-Committee, January, 1889.

The Botanical Sub-Committee has now thoroughly taken in hand the formation of the Club Herbarium, for which an excellent cabinet has been purchased and placed in the Committee-room.

The collection will be strictly limited to plants gathered in the county of Surrey, but will not be restricted to the plants of the special district to which it was at one time proposed to limit the operations of the Club.

The late Mr. Flower very carefully mapped out such a district for the Club, based upon the limits of the river-basins, and these doubtless form the most truly natural areas for the study of the distribution of the fauna and flora. In the district thus mapped out certain portions of the county of Kent forming part of the drainage area of the

Ravensbourn were included, and on the other hand portions of Surrey were excluded. The Sub-Committee has decided to reject these natural boundaries in favour of the purely artificial limits of the county, because the former are extremely difficult to indicate correctly on a map, or to follow when out collecting; whereas a good county map is readily obtained, and the county boundaries are easily ascertained. The literature and study of English geographical or topographical Botany also strictly follows the limits of the counties. The standard authority is Baker's edition of Watson's 'Topographical Botany.' In this work the larger counties are divided into two or more convenient divisions; 112 county areas are thus formed, of which the county of Surrey is No. 17. All modern local floras also follow the boundaries of the counties, and the flora which it is hoped will ere long be published by Mr. Beeby will deal with the whole county of Surrey. It was manifestly desirable that the herbarium of the Club should correspond with and illustrate this work.

The desire of the Sub-Committee is to make the collection a thoroughly representative one, and especially that the specimens contained in it should be good, complete, and typical exemplars of the species. Valuable contributions have already been received from Mr. Bennett, Mr. Beeby, Mr. Straker, Mr. Miller, Mr. Epps, Dr. Franklin-Parsons, and Mr. Mennell. These have been roughly arranged in the order of the London Catalogue, and during the winter the Sub-Committee hopes to have them all mounted and fit for reference and exhibition.

It is hoped that further contributions will be received from other members, and during the next season it is intended to invite all local botanists to collect and dry good specimens of any plants they may come across which are not already well represented in the collection.

The Sub-Committee desires to invite the co-operation and assistance of the members in this work, as well as in the mounting and arrangement of the collection.

Passing to other matters of local botanical interest, the most important addition to the county flora during the past year has been that of *Polygala austriaca* (Crantz), found by Mr. William Whitwell on a roadside bank near Caterham on the 2nd of June last. This is a most interesting find, as this form of the plant has hitherto only been known in one English locality near Wye, Kent. A very distinct form or variety, *P. uliginosa*, is found on Cronkley Fell, Teesdale, on the Yorkshire side of the river. Mr. Whitwell states that in the Kent locality the flowers are usually blue, but those found at Caterham were a delicate white. It is somewhat remarkable that a stranger to the district should have had the good fortune to make this interesting addition to our flora.

Amongst many valuable papers contributed by Mr. Beeby to the 'Journal of Botany,' one of special local interest calls for remark; this is "On the Two Valerians," and appears in the November number. In this paper Mr. Beeby exhaustively describes the two forms (or species) which have sometimes been combined under the name of *V. officinalis*. These are *V. mikanii* and *V. sambucifolia*; the former is *par excellence* a Surrey plant, growing in woods and copses on the chalk, and, speaking generally, is much the rarer plant. *V. sambucifolia* is a lover of marshy or moist places. Mr. Beeby unravels the literature and nomenclature of the two species, and, amongst other interesting facts, he states that cats, to whom the valerian is a "planta grata," readily discriminate between the two forms or species, about which botanists differ, devoting their attention almost exclusively to the chalk plant, *V. mikanii*, which is no doubt the true *V. officinalis* of the Pharmacopœia.

Phenological Botany has received considerable attention, and Mr. Miller has placed the results of many years' patient observations before the Club (Trans., Art. 69).

On behalf of the Sub-Committee,
Henry T. Mennell, *Hon. Sec.*

Report of the Photographic Sub-Committee, January, 1889.

The Photographic Section has now a muster-roll of 31 members, and is probably the strongest section of the Club, for all the members are workers. The meetings, which are held on the first Friday in each month throughout the year, have generally been instructive, and have been very well attended, the Club-room having been on several occasions inconveniently crowded. Four evenings were devoted to lantern exhibitions, and some excellent work was shown. Valuable assistance could doubtless be given by the members of this section to anyone wishing to deliver a well-illustrated lecture or paper before the Club.

The summer of the present year was a bad one for out-door work, and though the usual excursions have been undertaken, few good pictures resulted. Early in the summer the Photo Section received an invitation from Mr. F. W. East, of Lowfield Heath, to spend a day with him. The invitation was cordially accepted, and on Saturday, the 30th of June, 12 members armed with cameras proceeded to Horley, and were met by Mr. East, who drove them to many pretty spots in the neighbourhood, and afterwards entertained them most hospitably in his own house. The weather, though bright, was unfortunately very windy, and notwithstanding a large number of exposures, the results were indifferent.

Excursions were held on the 28th of April (Leatherhead), the 2nd of June (Reigate Park), the 28th of July (Oxted), and the 11th of August (Betchworth and Brockham), when Mr. Purser was conductor. The weather on the last occasion, though dull, was very still, and some excellent pictures were obtained.

Two very useful papers have been contributed by Mr. Chas. Hussey, namely: on the 6th of April, "Stereoscopic Photos and how to take them" (Trans., Art. 67); and on the 7th of September, "Pizzighelli's Platinum printing-out process." He also showed, at the December meeting, his method of making lantern-slides by reduction from large negatives, and the printing in of clouds. At the same meeting Mr. Low Sarjeant gave an excellent demonstration on contact printing, and the development of gelatino-bromide lantern-slides.

K. McKean, *Hon. Sec.*

Mr. John Berney, the Honorary Secretary of the Zoological Sub-Committee, has drawn up the following entomological lists, namely:—

		Genera.	Species.
Rhopalocera, or British butterflies	...	28	66
Sphingina	... ...	11	101
Bombycina	... ...	60	36
Noctuina ...	... ...	93	294
Geometrina	... ...	85	272
	Totals ...	277	769

He has had these several families lightly bound in four parts, and has prepared a list of notes, replies to which, if carefully made, will form a valuable collection of information. Mr. Berney, whose labours for the good of the Club deserve our hearty recognition, has not touched the Micro-Lepidoptera, leaving them to be dealt with by those members who collect them.

Six excursions were planned for the summer months, and each was conducted by one of the members of the Committee in turn, to whom the arrangement for the excursion was left.

The first, on Whit Monday, the 21st of May, was the best attended of the season, the day being bright and breezy, a perfect one for a long country walk. Having left East Croydon Station by train for Oxted at 10.35 a.m., the party of 30 proceeded over Limpsfield Common to Kent Hatch, then across country by Crockham Hill Common and through the woods beyond to Brasted Chart, from whence a magnificent view was obtained of the Weald of Kent through openings in the beech-woods, which were in their full glory of light delicate green foliage of early summer. On commencing the descent from the Chart to Toy's Hill several specimens of the azure or holly-blue butterfly (*Lycæna argiolus*) were captured. By this time the party had somewhat diminished, several having returned to Westerham or Oxted. The high road was now followed to Four Elms, and 18 succeeded in accomplishing the 11-mile walk to the South-Eastern Railway Station near Edenbridge, which was left for Croydon shortly before 5 o'clock.

The second was a botanical excursion under the guidance of Mr. A. J. Crosfield, of the Holmesdale Club, acting for Mr. Mennell, on the afternoon of Saturday, the 16th of June, to Reigate. The weather was somewhat showery, with bright intervals. The route lay to Wray Common, up Wray Lane to the Suspension Bridge, then westward along the path through the beech-woods and the hill over the rifle-butts; some distance beyond a descent was made from the hills by a lane passing under the railway to Reigate Heath.

The third excursion was on the afternoon of Saturday, the 14th of July, under the guidance of Mr. K. McKean, along the well-wooded banks of the Basingstoke Canal from Woking to Byfleet. It was a grey, still afternoon, one of the very few fine days of that exceedingly rainy month. The attendance was only 5 persons.

The fourth field day, a whole day's outing, was arranged by Mr. E. B. Sturge. The route followed was from Edenbridge to Hever Church and Castle, thence across the fields to Chiddingstone, and from there to Penshurst; a total distance of about 7 miles. Permission to visit Hever Castle had been kindly granted by the occupier, Mr. E. Heard. It may well be believed, from the quaint aspect of the precincts, that there has been little alteration from the time when Henry VIII. saw and courted the ill-fated Anne Bulleyn in the garden of her father, Sir Thomas Bulleyn, the owner of the castle. Immediately on leaving Edenbridge Station, and elsewhere in the neighbourhood, *Erysimum Cheiranthoides*, a plant not met with in the immediate neighbourhood of Croydon, was found in abundance by Mr. Mennell, to whom I am indebted for the following botanical notes. In the hedgerows beyond Edenbridge, on the road to Hever, the rarer form of the hawthorn (*Cratægus Oxyacanthoides*, Thuill.), with two or three carpels instead of the solitary undivided "stone" of the commoner form, was as plentiful as the other. Farther on towards Hever, the deep wet ditches bordering the road were full of one of the water dropworts (*Œnanthe crocata*), a highly poisonous umbelliferous plant, not found near Croydon. In some oat-fields between Hever and Chiddingstone it was noticed that the oats were overrun to an injurious extent by the handsome grass, *Bromus secalinus;* and the walls of the churchyard at Chiddingstone were plentifully studded with the little wall-spleenwort, *Asplenium Ruta-muraria*. Drizzling rain fell in the afternoon. The attendance was 20.

The leadership on the afternoon of Saturday, the 25th of August, was entrusted to Mr. Topley. Proceeding to Oxted our party of 16 was met at the railway-station by Mr. Leveson Gower, of Titsey Park, and Mr. F. C. J. Spurrel, of the West Kent Natural History Club, and taken by them to a building in the grounds of the Manor House, Limpsfield, where, in the absence of Mr. A. M. Bell, the owner, Mr. Gower showed and explained the very fine collection of Palæolithic implements, chiefly flint, consisting of celts, stone hammers, trimmed flakes, skinning knives, awls, scrapers, flint arrow-heads of various forms, and other articles. These had been collected within a mile or two of Limpsfield. Our kind entertainers then accompanied us to the gravel-pits and deposits of brick-earth, near which many of the Palæolithic implements had been found, and of interest as lying on the watershed of the Darenth and Medway. The walk was subsequently prolonged over the high land of Chart Common by Moor House to Westerham, and the majority of the members returned to Oxted in time to catch the last train to Croydon. The weather was exceedingly fine. Mr. Topley supplied the members with a sketch map and geological section of the district.

The last excursion of the season was on Saturday afternoon, the 15th of September, from Epsom along the east side of Durdans and Woodcote Parks, thence through Ashtead Park to Ashtead Church. The day was fine, but only 5 members joined in the excursion.

Meetings.

The following Papers have been read at the Monthly Meetings:

February 8th.—"Foraminifera and other Micro-organisms in Flint," by the Rev. George Bailey, F.R.M.S. (Trans., Art. 66). In this communication Mr. Bailey gave the results of an examination of a series of preparations from some hollow flints collected on the 11th of April, 1884, during an excursion of the Club to Down and Cudham. In the discussion which followed questions were raised as to the presence of organisms on the outside of flint nodules as well as inside. How was the mealy powder in the hollow flint formed? What are Xanthidia, and where are they formed? And what are the processes of treatment most suitable for the treatment of flint organisms? In replying Mr. Bailey described the process of treatment adopted by himself in the preparation of slides. The mealy powder was carefully separated from fragments of flint, put into a beaker-glass containing clean water, and well shaken; the sediment was allowed to settle and the water gently poured off. This simple washing was repeated until all milkiness disappeared from the water. The washed residue was then dried in a shallow vessel, the organisms picked out with a fine sable-brush, and mounted in the usual way. Turpentine or carbolic acid was often useful in rendering chalk forams transparent, when they were to be mounted in Canada balsam; but these silicious specimens would be spoilt if either turpentine or balsam were used.

March 14th.—"*Helix aspersa*, considered as a type of the Land Gasteropods," by Mr. Kenneth McKean, F.L.S.

April 11th.—The evening was devoted to an exhibition of microscopes, and other scientific apparatus and objects, in the Small Public Hall, by the Microscopical Sub-Committee, after the transaction of the ordinary business. There were 19 exhibitors. No paper was read.

May 9th.—"Report on the New Well at Addington," by Mr.

Edward Lovett, Secretary of the Geological Sub-Committee (Trans., Art. 68).

September 12*th.*—"Dates of the First Flowering of some Plants near Croydon, 1880 to 1887," by Mr. W. F. Miller (Trans., Art. 69). In this most interesting record of Mr. Miller's personal observations it is shown that there is a wide difference, from year to year, in the dates of the flowering of plants which come into blossom in winter and in spring, being 93 days in the case of dog's mercury, which on the average first flowers on the 31st of January, and of the lesser celandine, which comes into flower on the 24th of February. In summer-flowering plants the range is small. It is restricted to 6 days in the tufted vetch, which flowers on the 17th of June, and to 5 days in the spear plume-thistle, of which the normal date of flowering is the 9th of July.

October 10*th.*—"The Evolution of the art of making Fire," by Mr. Edward Lovett (Trans., Art. 70).

November 14*th.*—"Notes on Fossil Ostracoda," by Mr. C. Davies Sherborn, F.G.S. (Trans., Art. 71).

December 12*th.* — "The Anatomy of Spiders," by Mr. W. J. Fuller, F.I.C. (Trans., Art. 72). At this meeting Messrs. W. Murton Holmes and Charles Oakley were appointed auditors of the accounts for the year 1888.

The Conversational Meetings, which are held on the Wednesday fortnight after every Ordinary Meeting except in the month of December, have been vigorously supported by the Honorary Secretaries of the Sub-Committees. Two evenings have been occupied by the Botanical Sub-Committee, the first in exhibiting rare plants, and the second in making arrangements for the herbarium for the Club, which has been undertaken by Mr. Mennell. On another evening Mr. Lovett described and illustrated the geology of the Rock of Gibraltar. And at the meeting of the 23rd of May, Mr. Frederick Gaster, who is in charge of the Storm Warning Department of the Meteorological Office in Westminster, described and illustrated the "Weather Systems of the British Isles," the meeting being held in the Old School of Art Room.

One special lecture was given under the auspices of the Club, on the 16th of May, in the Large Hall of the Institution. The subject was "A Naturalist's Experiences in the Solomon Islands,"* in which group the lecturer, Mr. C. M. Woodford, had spent many months, and whither he was about to return. The locality of the islands was illustrated by some large maps,

* See 'Proceedings of the Royal Geographical Society,' vol. x., 1888, p. 351. "Exploration of the Solomon Islands," by C. M. Woodford.

and the scenery by dissolving views. Admission was by ticket to members and their friends, of whom 350 were present. Mr. John Berney presided.

Soirée.

The Nineteenth Annual Soirée, held in the Large and Small Public Halls on the 21st of November, was as successful as any of its predecessors. On two previous occasions, in 1885 and 1886, when the numbers present reached respectively 893 and 820, the rooms were somewhat overcrowded. At the late gathering, an assembly of 690, or exactly 100 more than in 1887, did not occasion any inconvenience on this head. The smaller number compared with 1885 and 1886 was probably attributable to the price of admission to the public having been raised from 2*s*. 6*d*. to 5*s*. a head. The financial results to the Club remain pretty constant. The net cost has been in 1886, £32 2*s*. 2*d*.; 1887, £34 0*s*. 2*d*.; and 1888, £36 18*s*. 2*d*. Of the 690 persons present, 154 were members and 536 visitors. Twelve societies and clubs, besides persons unattached to any club, joined in the exhibition of microscopes; and of the 135 exhibitors, 102 brought 117 microscopes. A very fine effect was produced in the Large Hall by the collection of flowering and foliage plants with which Mr. P. Crowley decorated the stage.

The principal objects of interest in the Small Hall were a splendid series of tropical Lepidoptera from the collection of Mr. Crowley; Roman antiquities, and a large number of Palæolithic and Neolithic flint implements, from the collection of Mr. R. Elliott; a small but nearly perfect series of British land and fresh-water molluscs, by Mr. A. J. Jenkins; African weapons, by G. Lovell; botanical specimens, by Mr. Henry T. Mennell; old Egyptian bronzes, by Mr. John Dixon.

A feature of these annual gatherings has been for many years the basket of flowers culled in the open air on the day of the Soirée by Mrs. W. F. Miller. On this occasion the number of species was 139 against 67 last year.

The corridor between the two halls was occupied by the exhibits of members of the Photographic Section, who made a very creditable illustration of the year's work. The Royal Meteorological Society contributed a small series of photographs of lightning. Special mention must be made of the screen of transparencies, the work of our Honorary Secretary, Mr. W. Low Sarjeant, which was shown in the Small Hall.

Members elected, 1888.

January 11*th.*—William Cash, jun., Scarcroft, Chichester Road. Edmund Gill, Linn Villa, Sutton Hill, Sutton. Edward O. Newman, Purleyville, Grant Road. Charles F. Oakley, Abbotsford, Sudbury Road, Thornton Heath. Alford Roods, 35, Derby Road. J. S. Streeter, High Street. Alfred Waters, Oakfield Road. *Honorary Member.*—George James Symons, F.R.S., F. R. Met. Soc., 62, Camden Square, London, N.W.

Feb. 8*th.*—Edward Roger Bastard, Highbury House, South Norwood. Frederick Gaster, F. R. Met. Soc., 137, Acre Lane, Brixton. Charles King, 42, Portland Road, South Norwood. Harold Smith, F. R. Met. Soc., Ingleside, Kenley.

March 14*th.* — Dr. J. Beard, Westwood, Brighton Road. F. Burrough, Trellis Cottage, Collier's Water Lane, Thornton Heath. James William Helps, Waddon Marsh Lane.

April 11*th.*—Arthur Brock, Stafford Villa, South Norwood Hill. George Chatterton, M.A., M. Inst. C.E., F. R. Met. Soc., Linton, Grosvenor Hill, Wimbledon. Arthur Cecil Hovenden, Arbor End, Selhurst Road, South Norwood. Ernest Churcher Hovenden, Arbor End, Selhurst Road, South Norwood. Gerald Stanley Hovenden, Arbor End, Selhurst Road, South Norwood. George Mayer, 1, Lancaster Villas, Albert Road, South Norwood. Councillor J. H. Schmitz, J.P., Lansdowne Road.

May 9*th.*—William Morris, M. Inst. C.E., The Kent Waterworks, Deptford.

Sept. 12*th.*—Claude E. Crowley, 3, Park Hill Rise. John T. Sandell, Abbotsford, Sudbury Road, Thornton Heath.

Oct. 10*th.*—Henry Danvers Crossman, Shirley.

Nov. 14*th.*—James William Claridge, 22, The Waldrons. H. N. Klaassen, Aberfeldy, Campden Road.

Dec. 12*th.*—Louis Courlander, 42, North End. G. N. Stunt, Kenley, Surrey. Robert Sutcliffe, 6, Bramley Hill.

Library and Collection.

The additions to the Library during the year 1888 include the following presentations :—

From Individuals.—Rev. C. L. Ackland: The most remote Church in the British Isles; Some Stone Circles in Shetland. F. C. Bayard: Miscellaneous Meteorological Pamphlets. W. H. Beeby: On Nomenclature. P. Crowley: International Scientists' Directory for 1885. J. C. Goodchild: 4 vols. of Transactions of the Cumberland Association. H. Lee: Sea Fables explained; Sea Monsters unmasked; the Octopus; the Vegetable Lamb of Tartary. W. F. Stanley: B. A. Reports, 1885 (Aberdeen), 1886 (Birmingham), 1887 (Manchester); Journal of the Royal Microscopical Society, vols. 1 to 15 inclusive. W. Topley: Miscellaneous Geological Pamphlets.

From Societies.—Belgium: Bulletin de la Société Belge de Microscopie; Procès verbaux des Séances de la Société Royale Malacologique de Belgique. British Association for the Advancement of Science: Report, 1887; Report of the Conference of the Delegates at Bath.

City of London Science Society, 2nd and 3rd reports. East Kent Natural History Society: Thirtieth Annual Report. Manchester Microscopical Society: Report for 1887. Middlesex Natural History Club: Transactions. Northamptonshire Natural History Society: Journal. Royal Microscopical Society: Journal.

From Proprietors.—Essex Naturalist; Le Moniteur de Practicien; Science Gossip.

Exhibits, 1888.

Feb. 8th.—Rev. George Bailey, Series of 70 mounted specimens of organisms from hollow flints, collected near Down. J. Epps, A "Walnut-bug." E. Gill, Xanthidia in flint, under microscope. W. Goodman, Flints containing organic remains. W. Murton Holmes, Fossil teeth of extinct shark. Seed-vessels of Star Anise. E. Lovett, Radiolaria taken in the 'Challenger' Expedition. 70 slides of various Foraminifera. Series of hollow flints. Nodule of iron pyrites in flint. K. McKean, Sponge spicules from hollow flints.

March 14th.—Dr. Alfred Carpenter, Natural cheese from the stomach of a calf. Curious growth of potato. J. Goodman, Series of British land-shells. E. Lovett, Series of *Helix aspersa* and *Helix pomatia*. *Triton polyphemus* from South Pacific. K. McKean, Diagrams and shells to illustrate his paper "*Helix aspersa*, considered as a type of the land Gasteropods." *Bulimus Goodallii.* Branchial sac and pulmonary vein of *Helix aspersa* (under microscope). H. T. Mennell, Series of shells of *Helix aspersa.* Palate of *Dentalium* (under microscope).

April 11th.—Special exhibition of microscopic objects under the auspices of the Microscopical Sub-Committee, namely:— By John Berney, Section of root of screw pine. P. Crowley, Type-slides of the Diatomaceæ. J. Epps, Leaf-scales. W. M. Gibson, Vorticellæ. E. Gill, Fungi. C. H. Goodman, Entomological micro-forms. H. Greenway, Various botanical slides. J. Gregory, Petals and pollen of *Correa cardinalis.* W. M. Holmes, Sections of animal tissues, &c. C. H. Lanfear, Hair of pupa of the Goat Moth. T. M. Loftus, Filamentous Algæ. E. Lovett, Slides illustrative of the embryology of Fishes, Crustaceans, Echinoderms, and Mollusca. M. E. Lownds, Diatomaceæ. K. McKean, Sections of the shells of Mollusca. H. T. Mennell, Diatomaceæ and deep-sea organisms. C. H. Oakley, Parasite of Seal. W. Low Sarjeant, Circulation in *Vallisneria spiralis.* J. E. Syms, Blood corpuscles of various animals. H. Turner, Section of hair from tail of Elephant.

May 9th.—P. Crowley, Specimen of granite containing a fine cross-turn of felspar. German work on British Lepidoptera. E. Lovett, Specimens of Chalk, &c., to illustrate his report on the well sunk by the Corporation of Croydon at Hares Bank, Addington. H. T. Mennell, Fossils from the Park Hill cutting. E. Straker, Morell fungus (probably edible).

Sept. 12th.—E. Lovett, The rare crustacean, *Dromia vulgaris.* Spider-crab (*Maia squinado*) with abnormal growth of primary feet. K. McKean, *Pupa marginata*, a dentate form of the variety *Albina* from Cleeve, Somersetshire. H. T. Mennell, Paraguayan Tea, or Yerba Maté (*Ilex Paraguanensis*), and gourd from which it is drunk.

Oct. 10th.—J. Epps, Nests of the tree-wasp. H. Greenway, Homecured tobacco grown in his garden at Addiscombe. E. Lovett, in illustration of his paper, "The Evolution of the art of making Fire," Fire-drills of the Eskimoes, Sioux and Zuni Indians. Seven forms of European tinder-boxes. Zulu flint and steel. Old Yorkshire flints and steels. Iron pyrites and flints of the Stone Age from a Jersey cave floor.

Dec. 12*th*.—P. Crowley, Two specimens of very rare Lepidoptera. J. Epps, Novel method of illuminating microscopic objects by means of light passing through a bent glass rod. W. T. Fuller, in illustration of his paper, "On the anatomy of the Spider," slides under the microscopes of several of the members. E. Lovett, *Dermestes vulpinus*, and rafter of a bone-manure warehouse at Bow honeycombed by its ravages. B. A. Williams, Photographs coloured by a mechanical process.

List of Exhibitors of Microscopes at the Nineteenth Annual Soirée, November 21*st*, 1888.

Croydon (30).—W. Aldridge, W. J. Allbright, R. J. Backwell, J. H. Baldock, E. R. Bastard, J. Berney, J. A. Carter, H. C. Collyer, P. Crowley, W. H. Cullis, A. W. B. Drummond, H. Drummond, J. Epps, W. M. Gibson, W. M. Holmes, J. W. Justican, C. Lanfear, H. Long, M. E. Lownds, K. McKean, H. T. Mennell, C. F. Oakley, P. W. Perkins-Case, W. Pool, W. L. Sarjeant, E. L. Shore, W. F. Stanley, J. S. Streeter, J. E. Syms, and H. Turner.

Brockley and St. John's, late New Cross (7).—G. P. Berry, W. Gregory, H. T. Hart, H. Hills, J. T. Holder, A. J. Mitchell, and G. J. Wightman.

Conchological Society of Great Britain and Ireland (1).—A. J. Jenkins.

Forest Hill (11).—O. Boyes, H. Cowley, C. D. Drury, T. D. Fenner, E. George, E. E. Jones, E. Perrins, Miss R. F. Perrins, J. H. Stanley, C. F. Worters, and J. H. Worters.

Greenwich (3).—J. Beale, W. B. Bradford, and H. Scarr.

Holmesdale (5).—F. Bossey, J. B. Crosfield, A. B. Gough, E. Salmon, and F. Tindal.

Metropolitan Scientific Association (1).—C. West.

Quekett (16).—F. W. Andrew, J. W. Bailey, E. Bartlett, W. J. Brown, H. P. Hind, J. J. Hunter, J. T. Kern, J. H. Oliver, G. D. Plomer, C. Rousselet, F. D. Rudkin, A. Smith, A. T. Spriggs, A. F. Tait, W. M. Taylor, and W. Watson.

Royal (5).—F. W. Hembry, G. J. Smith, T. P. Watson, A. Williams, and J. A. Williams.

South London (10).—H. G. Coomb, A. L. Corbett, T. D. Ersser, R. Macer, C. Oakden, R. Reeve, W. Short, C. W. Stidstone, D. Ward, and W. West.

Sutton (1).—W. J. Fuller.

Tower Hill (2).—J. Alston and R. Sedgwick.

Unattached (10).—L. Atkinson, G. Berry, E. Collingwood, H. Cooper, F. Enoch, J. Gregory, F. W. Peet, H. Rodman, C. D. Sherborn, and A. L. Woodward.

Croydon Microscopical and Natural History Club.—Balance Sheet for the Year ending 31st December, 1888.

Receipts.	£	s.	d.	£	s.	d.
Balance, 1st January, 1888				34	2	0
Subscriptions for the year 1886 ...	4	0	0			
,, ,, ,, 1887 ...	12	0	0			
,, ,, ,, 1888 ...	107	10	0			
,, ,, ,, 1889 ...	4	10	0			
				128	0	0
Sale of Transactions...				0	6	0
Sale of Soirée Tickets				21	7	6
				£183	15	6

Expenditure.	£	s.	d.
Rent of Club Room	10	0	0
Hire of Room for Meetings	8	18	6
Printing	9	17	6
Bookbinding	1	7	0
Stationery	1	1	10
Printing Transactions	14	4	6
Postages, including Transactions	13	3	1
Soirée Expenses	58	5	8
Meteorological Sub-Committee	20	10	4
Attendance and Collecting Subscriptions ...	7	18	6
Sundries	5	18	0
Balance, 31st December, 1888	32	10	7
	£183	15	6

SPECIAL FUND.

	£	s.	d.
Balance, 1st January, 1888	30	12	0
Dividends, and Bonus on Converted Stock... ...	8	4	2
	£38	16	2

	£	s.	d.
Invested in £2 15s. per cent. Consolidated Stock	£210	11	8
Balance at Bankers, 31st December, 1888 ...	£71	6	9

KENNETH McKEAN, *Treasurer.*

We, the undersigned, having examined the above Accounts and the Vouchers relating thereto, hereby certify that they are correct, according to the Vouchers and the Banker's Pass Book.

January 3rd, 1889.

CHAS. F. OAKLEY,
W. MURTON HOLMES, } *Auditors.*

TRANSACTIONS

OF

THE CROYDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

1888–89.

66.—Foraminifera and other Micro-organisms in Flint.

By the Rev. George Bailey, F.R.M.S.

(Read February 8th, 1888.)

Perhaps too large a subject has been chosen for this short paper, a subject that might reasonably lead those who have looked at it to expect much fuller treatment. It is not intended to discuss the still vexed, though interesting, question respecting the mode of flint-formation. Nor is it proposed to furnish anything like a complete list of organic remains that have been detected in flint by numerous careful observers. The object is briefly to draw attention to a series of microscopic preparations made from some hollow flints collected on April 11th, 1884, during an excursion to Downe and Cudham in connection with this Club. And this is done in the hope that other members will endeavour not only to collect objects of interest, but to bring their work forward for the purpose of showing what practical use may be made of the facilities which the Club provides.

On the day named I was unwise enough to go unarmed with hammer or other appliances for field geology, except a few leaves from an old railway time-table. In company with another member of the Club, I lagged somewhat behind the excursionists during part of the journey, certain heaps of flint having attracted us by the way. A solid stone served us for a hammer, and with its aid we were able to crack a few selected hollow flints, the most promising of which were carefully put in paper and taken home.

These hollow flints contain a white silicious meal, which when washed, dried, and sifted, yielded all the micro-organisms now on the table. The material has, however, been very far from exhausted in the preparation of these slides, and I hope to extend my series from the remainder of the rich material this excursion yielded.

So far, I have not mounted many of these organisms as transparent objects, because most of those mounted in balsam become so transparent as to be almost invisible. Nor have I determined all the species that comprise this series, not being able to name them all. Some differ from anything that I have seen described or figured in such works as are accessible to me.

There are seventy slides on the table. These slides contain fifteen species of Foraminifera, six of Polyzoa, five of Sponge-remains, three of Entomostraca, one small Brachiopod, and six species that I have not classed in any of the foregoing groups.

The largest group consists of well-preserved Foraminifera. The genera represented are *Globigerina*, *Truncatulina*, *Cristellaria*, *Marginulina*, *Nodosaria*, *Dentalina*, *Textularia*, *Frondicularia*, *Gaudryina*, and *Haplophragmium*, and doubtless many other genera can be included. There is a *Nodosarian* in this series well-marked, and unlike any I have met with previously. But the most curious and interesting form, which I take to be a Foraminifer, is a somewhat irregular lobed tube, covered with small yet distinct spines. At first I had only two examples of this organism. Further examination yielded seven more; and yet another specimen has since been derived from the interior of an *Echinus* obtained in a chalk-pit at Farningham Road, Kent, making ten specimens in my collection for comparison and determination.

Another group consists of Polyzoa. I have not made this class a study, and do not even attempt to indicate the genera which are represented. The specimens will speak for themselves with more eloquence than I could command.

Then there is a group of spicules and skeleton-fragments of Sponges. Dr. Hinde has been singularly fortunate in this department, as will be found on reference to his memoir on 'Fossil Sponge-spicules from a Hollow Flint in the Upper Chalk at Horsted, in Norfolk.' Dr. Hinde described and illustrated 160 forms of spicules, referring them to thirty-eight species of thirty-two genera of Sponges. The series which I have is small compared with that, but some of the examples are of great beauty.

Although the Entomostraca occur so abundantly in the Chalk generally, they were not present in noticeable quantities in the material now under consideration. Only three slides represent this group.

For the rest, that are unclassed, I may say, one slide seems to exhibit a piece of mammilated chalcedony; another, three ossicles of a crinoid; another, a fragment of coral; two more contain organisms that may be Forams, which have been encrusted or altered; and the three which remain may be parts of the spines of an Echinoderm.

67.—Stereoscopic Photographs, and how to take them.

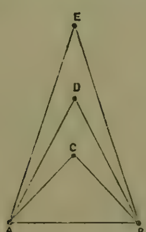
By Charles Hussey.

(Read at a Meeting of the Photographic Section, April 6th, 1888.)

Twenty-five years ago a stereoscope was found in every drawing-room; now such an instrument is hardly ever seen. The very success of the instrument caused its downfall, as the large demand for stereoscopic photographs induced the production of views which were either not stereoscopic, being prints from the same negative mounted side by side, or else prints which, being stereoscopic, were wrongly or imperfectly mounted. With the faulty views were found badly-constructed instruments, and the public soon lost confidence in the stereoscopic system.

No one who has ever perfectly realised stereoscopic effect will forget his first delight at the marvellous sensation of relief revealed to him; and now that stereoscopic photography is showing signs of revival, it may interest beginners to know how stereoscopic photographs are produced. The present paper is written in the hope that some members of the Croydon Club may be tempted to take up this fascinating branch of our art-science.

Briefly stated, stereoscopic effect is due to parallax; that is, the same object is seen by the two eyes from different points of view, the "sensation of relief" or appearance of solidity being produced by the varying convergences of the axes of the eyes in looking at an object.



Suppose the line A, B, to represent the distance of the eyes apart, or, in other words, the parallactic base of the triangle, the eyes themselves being directed to the points C, D, E, at different distances, it is obvious that the convergence of the optic axes must be greater in the case of A, C, B than A, D, B, and so on, and it is this greater or less convergence which gives the sensation of distance. Nature has provided man with muscles to alter the curvature of the lens of the eye; and by this means, and by habit and use, we may fancy we can see relief with one eye only; but it is not so, as the area of the pupil of the eye, even if distended to its utmost, as by the application of belladonna, is altogether inadequate to produce parallax.

Again, if we are looking at very distant objects, such as mountains, the distance of the eyes apart, that is, the parallactic base of the triangle, is so small, and the angle at the apex of the triangle so acute, that the sensation of relief is lost; it is therefore necessary for some subjects to take the two pictures at a considerable distance apart, so that the base of the triangle may be lengthened. Some successful stereos of the moon have been obtained by photographing one picture in England and the other in the Antipodes. This, of course, is an extreme case; but the same result is observable in, say, a rocky coast-line taken at a considerable distance out at sea. If one picture be exposed, and the vessel allowed to travel some yards before the other is uncapped, a sensation of relief will be obtained in the resulting prints, which is not visible in nature. In this case it is needless to point out that foreground is sacrificed.

That the two eyes do see differently may be easily proved. If one eye be closed, and any near object, say, a window-frame in the room, be covered with a finger at arm's length, and then the other eye be opened and the first one closed, it will be seen at once that the finger occupies quite a different position in the field of vision of the second eye; this effect is due to the convergence of the optical axes to a near point, or, in other words, to parallax.

Now in order to apply this principle to photography it is only necessary to take pictures from two different standpoints, corresponding more or less approximately to the relative positions of the eyes, and then by means of a stereoscope to cause these two pictures to blend in the brain to produce stereoscopic effect.

Special cameras are provided for this work, fitted with twin lenses, that is, two lenses of identical foci, but any camera and lens which will take a photograph may be employed with success, the possessor of the humble quarter-plate being as well equipped as the owner of the lordly twelve-by-ten.

For sizes below half-plate it is necessary to take one photograph, and then, by moving the camera bodily a few inches, to expose another plate for the same time, taking care that the object in both cases occupies the same position on the plate. This may be done by moving the camera with its stand; but a better way is to fit the camera on a board with guides, so that it may be moved into its second position by pushing along the guides, without the trouble of a second arrangement of the composition. With a camera of half-plate size, or larger, the same result may be obtained by having a sliding front which will permit the lateral movement of the lens for the required distance, the interior of the camera being divided by an opaque partition, so as to prevent the light striking both sides of the plate at once.

These systems of course are only applicable to still-life subjects; where movement is likely, or when instantaneous effects are desired, twin lenses are essential. The lenses are mounted side by side at a distance of about $2\frac{1}{4}$ to $2\frac{3}{4}$ in. apart, and the two pictures exposed simultaneously by hand or shutter, as may be convenient.

The most suitable lenses to employ are single landscape lenses of from $4\frac{1}{2}$ to 6 inches focus; as although, owing to spherical aberration, the image of straight lines is sometimes distorted by these instruments, this distortion is corrected by the stereoscope, and true rectilinearity obtained. Any lenses are suitable, however, provided their focal length does not exceed six inches; but it should be remembered that an absolutely rectilinear photograph may be distorted by the prismatic lenses of the stereoscope. For those who are purchasing new lenses for stereoscopic work, single landscape lenses offer every advantage, as they are considerably cheaper than rectilinear lenses of the same class.

The exposure, especially if twin lenses are employed, is most conveniently made by means of a shutter, which will give a shorter or longer exposure at will. The drop-and-flap pattern is very suitable for this work, and has been used for some time by me with success. It is not my intention to give directions for developing the negative. I presume everyone to be acquainted with ordinary photographic manipulation; but it may be necessary to say that a very full exposure should be given, so as to get a soft, thin negative, full of detail; under-exposure, dense, or hard negatives should be avoided, as the resulting picture will suffer from what is known as the "snowy" appearance so common in stereographs.

Paper prints may be made by any convenient process—silver, gelatino-bromide, or platinotype. If the high lights are chalky, it is a good plan to "sun them down," that is, by exposure to light to tint or degrade the highest lights. As the right-hand side of the negative comes out on the left-hand side of the print, it is necessary to reverse these in mounting on card, so as to preserve a true stereoscopic effect, and avoid a pseudoscopic or hollowed-out appearance.

The success of the stereograph depends so much on accurate mounting, that a few remarks on that point may be useful:—

(1.) As soon as the print is ready, a straight cut should be made right along the top and bottom of both pictures, so that they both correspond as to amount of foreground and sky.

(2.) It must be remembered that in printing, the picture taken by the right-hand lens comes on to the left-hand side of the print, and *vice versâ;* it is therefore necessary to mount them on the reverse sides to that in which they are printed, so that the true relative positions may be retained. This is done by cutting the print, and mounting the pictures taken by the right and left lenses on the right and left sides of the card respectively.

(3.) The two should then be divided, and the sides trimmed to the proper width, so that the centres shall be about 2¾ inches apart when mounted, bearing in mind that the picture on the right-hand side should show more of the right side, and that on the left-hand side more of the left of the object.

The author has been accustomed to try the positions in the stereoscope before mounting permanently; by this means subsequent vexation and disappointment is often avoided. The best class of stereographs are printed as transparencies on glass; but for this purpose it is necessary, unless special appliances are used, to cut the negative so as to reverse the pictures, but the superiority of the result well repays for the extra trouble involved.

Should any member of the Club want further information, I shall be pleased if he will write to or call upon me, and I will help him to the best of my ability.

68.—Report on the New Well at Addington.

By Edward Lovett.

(Read May 9th, 1888.)

The site of this well is in a valley about three-quarters of a mile south-by-west of Addington Church, near Hares Bank. In sinking the well the Corporation of Croydon sought to obtain a supply of water from the Chalk in a drainage area outside that containing the old wells. The well was commenced on the 29th of January, 1885. The surface of the ground at its mouth is 318 ft. above mean sea-level; and the area of the gathering ground of the water supplying the well has been estimated at about eleven square miles. In the Chalk formation subterranean water generally travels along fissures which are often found under the valleys, although instances occur in which this does not happen; for example, water from Merstham Valley flows under high ground towards the Carshalton Springs. The well is circular, 10 ft. in diameter, and 200 ft. deep. It is lined with brickwork to a depth of 51½ ft. from the top, but below there is no lining. Several tunnels 6 ft. high by 4½ ft. wide have been driven from the well, the longest, at a depth of 142 ft. from the surface, 291 yards in a south-easterly direction. From this a branch heading at a distance of ten yards from the well has been excavated for a length of 156 yards to the north-east, and from this again two other branches extend in a south-easterly direction parallel with the long main heading. The lowest heading is 153 ft. from the surface, and is 62 yards long.

A guide-pipe for future boring is sunk in the bottom of the well. Bore-holes have been pierced at certain places at the sides of the headings, some of which yielded water. The well is sunk entirely in the Chalk, there being no newer deposits overlying it at this spot. Nearly a mile northwards the Chalk dips under the Tertiary Beds (Thanet Sand, Woolwich Beds, and Oldhaven Beds), and these again dip under the London Clay about three miles further north. Southwards the Chalk rises gradually, almost following the inclination of its dip, and about 5½ miles somewhat east of south the Upper Greensand crops out at a higher level above the sea than the mouth of the well; but it is about 340 ft. below sea-level at the site of the well. The Chalk excavated from the well contained few fossils, and varied much in density and character. The upper portion was divided by bands of flint, which in some cases assumed the tabular form so well shown in the cliffs at St. Margaret's, near Dover, and resembling the Chert bands in the Portland Beds of the Oolite. The last bed of flints was met with at 152 ft. from the surface, at which depth the Chalk was without fissures, dense, and dry. In excavating the headings numerous water-bearing fissures were cut; and at 230 ft. from the main shaft, in an easterly direction, a fault was encountered, of which the faces of the Chalk exhibited in a marked degree the striated and grooved appearance known as slikensides. The fissures in several instances contained brown argillaceous matter, probably introduced in part by percolation from the surface of the ground, and in part due to the dissolving action of water on the Chalk leaving the insoluble clayey matter behind. Below the Chalk at this spot comes the Upper Greensand, essentially a sandstone in this district, of limited thickness.

As regards the thickness of the Cretaceous strata, probably not less than 50 ft. of higher beds have been removed by denudation. There is some uncertainty as to the total thickness of the Chalk near Croydon. Under London it is about 650 ft., there being but little variation in the sections of deep-well borings. Therefore it is believed that there exists another 400 or 450 ft. of Chalk below the present bottom of the well. As regards the Upper Greensand, 50 ft. would be a liberal allowance, that formation thinning northwards from its outcrop. The Gault varies in thickness near London; it is 147 ft. in the Streatham Well, 340 ft. in the Caterham Well; but 250 ft. would probably be a fair estimate for the thickness at Addington, so that the probable depth to the Lower Greensand would be some 750 ft.

To revert to the well; water was first found at a depth of 87 ft. from the surface, or 231 ft. above sea-level, and at 101 ft. pumps had to be started to keep the well sufficiently free for carrying on the work. The greatest yield of water during the progress of sinking the well was 196,000 gallons daily. On the 10th of April, 1887, after the galleries had been pierced, the yield was 2,491,000 gallons, and as the available pumping capacity was overpowered, work in the well ceased. Meanwhile the water as it was raised was conveyed through pipes to the road through Addington, by the side of which it flowed to a gravel-pit at Kent Gate, where it soaked away in the porous ground. After pumping had been discontinued for a year, measurements of the water in the well gave the following results:—1888, April 4th, depth from the surface, 92 ft.; April 25th, 87·4 ft., the heights above O.D. being respectively 226 ft. and 230·6 ft.

69.—Dates of the First Flowering of some Plants near Croydon, 1880 to 1887.

By William F. Miller.

(Read September 12th, 1888.)

Most of the members of the Club are, I expect, aware of the good work done for many years by the Rev. T. A. Preston, formerly of Marlborough College, in the way of tabulating and arranging, for the Royal Meteorological Society, phenological observations relating to the dates of the first flowering of plants, the first appearance of migratory birds, and other allied phenomena. These dates vary very much from year to year, and Mr. Preston and those observers with whom he is associated have felt that by the accumulation of carefully noted facts of this description, considerable progress would be made in our acquaintance with the annually recurring features of Nature.

My own observations have been confined almost exclusively to plants. They were commenced before I knew of Mr. Preston's labours, but the results have been of late years embodied in his reports, our Croydon district being one of the nineteen stations included in his survey. It is only right, by the way, to note that the observations of most, if not all, of the observers do not profess to be more than approximately correct. A perfect observer would be one who, having first carefully mapped out a plan of walks, which should include localities for all the plants to be noted, should make his rounds of observation every day, wet or dry, unhindered by any cause whatever. Unfortunately there are few such observers, and I am certainly not one of them, even though I have been aided by more than one kind and competent helper. We can therefore only hope for an approximation to the date when the first celandine expanded its petals in early spring on some sunny bank near Croydon; or when, in May or June, the first wild rose was noticed in the old Chalk quarry on Park Hill, or other sheltered spot.

As regards the range of dates between early and late years, members will notice that, as might be expected, it is considerably greater in early spring than in summer or autumn. Thus, there is a difference of more than two months between the earliest recorded flowering of the hazel, in December, 1881, and the latest in February, 1880. So, too, in regard to the dog's mercury, coltsfoot, and other plants. In the case of the lesser celandine, the difference is even greater. In 1881 it was observed in flower on December 31st, and in 1887, not until April 2nd. The average date of the first flowering of this plant, reckoning for the eight years over which the observations extend, is February 24th. As the year advances the flowers become more constant in their times of opening. For instance, there is little more than a month between the first recorded flowering of the hawthorn, on April 15th, 1882, a very forward year, and that in 1887, a typically backward year, when it was not gathered till May 19th; whilst in the case of the wild rose the difference is barely three weeks, between May 29th, in 1882, and June 18th, in 1887. The variation will be found to be even less in the flowers expanding at the end of June, or in July: though there are a few marked exceptions, an explanation to which will no doubt be found by continuing the records for a longer period. So far as my experience goes, the common field thistle seems to be one of the most constant plants amongst those noticed. Its first flowering has not varied more than a day in three of the recorded years, nor more than two days in the other five. July 1st is its average date of flowering.

I may add that the flowers noticed are seventy-seven in number, namely, sixty-six wild flowers, and eleven cultivated shrubs and other plants; and that they are arranged in the chronological order of their earliest average coming into flower, from the hazel on January 21st to the ivy on September 19th.

Most of the plants are those selected by the Royal Meteorological Society as most likely to afford useful results, a few not common near Croydon having been omitted. The first two columns in the list give the Latin and English names of the several plants. Then follow the recorded dates of first flowering from 1880 to 1887 inclusive, reckoning from the first day of each year, the negative sign in the few instances where it occurs showing the number of days to the end of the year; whilst in the last four columns the earliest and latest and the average dates of each flower are given, and also, in accordance with a suggestion of our President's, the number of days between the earliest and latest recorded dates of first flowering. For convenience of reference, the following data may be of service:—

Date.	Day of Year.	Date.	Day of Year.
Jan. 1st	1	June 1st	152
Feb. 1st	32	July 1st	182
March 1st	60	Aug. 1st	213
April 1st	91	Sept. 1st	244
May 1st	121	Oct. 1st	274

In the leap years 1880 and 1884, after February, 1 must be added to the number of the day of the year; for example, March 1st is the 61st day of the year.

Botanical Name.	English Name.	Recorded Dates of First Flowering.											
		1880	1881	1882	1883	1884	1885	1886	1887	Earliest.	Latest.	Interval in Days.	Average Date.
1 Corylus Avellana (m)	Hazel	53	37	113	11	18	30	38	30	18 Dec. 1881	22 Feb. 1880	66	21 Jan.
2 Mercurialis perennis	Dog's Mercury	73	58	113	11	115	2	(66)	78	16 Dec. 1883	19 Mar. 1887	93	31 ,,
3 Tussilago Farfara	Coltsfoot	59	64	42	28	12	52	73	56	12 Jan. 1884	13 Mar. 1886	60	17 Feb.
4 Ranunculus Ficaria	Lesser Celandine	71	58	11	28	41	74	80	92	31 Dec. 1881	2 Apr. 1887	93	24 ,,
5 Draba verna	Spring Whitlow-grass	86	71	(29)	56	34	74	80	85	By 29 Jan. 1882	26 Mar. 1880	56	5 Mar.
6 Viola odorata	Sweet Violet	..	72	57	34	48	..	(90)	90	3 Feb. 1883	31 Mar. 1886	56	6 ,,
7 Ulmus montana	Wych Elm	..	79	50	63	41	76	(90)	..	10 Feb. 1884	Abt. 31 Mar. 1886	49	7 ,,
8 Salix Caprea (m)	Common Sallow	..	72	57	53	52	60	88	92	21 Feb. 1884	2 Apr. 1887	40	9 ,,
9 Anemone nemorosa	Wood Anemone	80	79	59	62	76	88	93	96	28 Feb. 1882	6 Apr. 1887	38	19 ,,
10 Caltha palustris	Marsh Marigold	..	68	69	98	84	(100)	105	114	9 Mar. 1881	24 Apr. 1887	46	1 Apr.
11 Nepeta Glechoma	Ground Ivy	87	99	78	82	76	93	114	114	16 Mar. 1884	24 Apr. 1887	39	3 ,,
12 Prunus spinosa	Blackthorn	101	99	64	111	76	93	(116)	120	5 Mar. 1882	30 Apr. 1887	56	7 ,,
13 Primula veris	Cowslip	..	99	70	108	82	..	(114)	117	11 Mar. 1882	27 Apr. 1887	47	8 ,,
14 Stellaria Holostea	Greater Stitchwort	108	107	64	105	82	108	(111)	121	5 Mar. 1882	1 May, 1887	57	11 ,,
15 Fraxinus excelsior	Ash	116	100	92	(105)	(97)	102	(122)	128	2 Apr. 1882	8 May, 1887	36	18 ,,
16 Cardamine pratensis	Cuckoo Flower	..	113	91	104	95	114	(116)	121	1 Apr. 1882	1 May, 1887	30	18 ,,
17 Scilla nutans	Wild Hyacinth	..	120	89	108	..	105	(119)	117	30 Mar. 1882	29 Apr. 1886	30	20 ,,
18 Sisymbrium Alliaria	Jack-by-the-Hedge	108	(112)	(104)	112	96	(120)	(111)	121	5 Apr. 1884	1 May, 1887	26	20 ,,
19 Veronica Chamædrys	Germander Speedwell	112	118	92	108	96	(123)	121	127	2 Apr. 1882	7 May, 1887	35	22 ,,
20 Plantago lanceolata	Ribwort Plantain	115	114	105	110	97	(122)	122	125	6 Apr. 1884	5 May, 1887	29	24 ,,
21 Ajuga reptans	Bugle	108	120	106	111	110	..	128	127	17 Apr. 1880	8 May, 1886	21	26 ,,
22 Vicia sepium	Bush Vetch	122	127	106	111	96	..	(128)	135	5 Apr. 1884	15 May, 1887	40	28 ,,
23 Acer pseudoplatanus	Sycamore	116	114	(104)	137	105	(130)	122	130	By 14 Apr. 1882	17 May, 1883	33	30 ,,
24 Geranium Robertianum	Herb-Robert	116	128	113	132	101	(128)	128	142	10 Apr. 1884	22 May, 1887	42	3 May
25 Cratægus Oxyacantha	Hawthorn	129	132	105	131	111	120	129	139	15 Apr. 1882	19 May, 1887	34	4 ,,
26 Ranunculus acris	Meadow Crowfoot	109	114	113	138	105	136	141	142	14 Apr. 1884	22 May, 1887	38	5 ,,

Botanical Name.	English Name.	Recorded Dates of First Flowering.											
		1880	1881	1882	1883	1884	1885	1886	1887	Earlies	Latest.	Interval in Days.	Average Date.
27 Polygala vulgaris	Common Milkwort	130	135	106	125	132	130	129	135	16 Apr. 1882	15 May, 1881, 8	29	8 May
28 Pedicularis sylvatica	Heath Lousewort	130	148	113	145	(130)	130	129	142	23 Apr. 1882	25 May, 1883	32	13 ,,
29 Lotus corniculatus	Bird's-foot Trefoil	143	124	120	125	(150)	129	(136)	142	30 Apr. 1882	Abt. 29 May, 1888	30	14 ,,
30 Quercus Robur	Oak	144	138	127	139	132	144	129	..	7 May, 1882	24 May, 1885	17	16 ,,
31 Galium Aparine	Cleavers	143	143	127	140	139	144	129	(149)	7 May, 1882	Abt. 29 May, 1887	22	19 ,,
32 Hieracium Pilosella	Mouse-ear Hawkweed	130	145	127	145	139	136	143	151	7 May, 1882	31 May, 1887	24	19 ,,
33 Trifolium repens	White Clover	..	148	130	147	139	129	(136)	142	10 May, 1882	28 May, 1881	18	19 ,,
34 Chrysanthemum Leu.	Ox-eye Daisy	141	134	130	143	135	143	145	150	10 May, 1882	30 May, 1887	20	20 ,,
35 Potentilla anserina	Silver Weed	143	134	130	160	(150)	150	(150)	150	10 May, 1882	9 June 1883	30	25 ,,
36 Symphytum officinale	Comfrey	149	145	112	144	(159)	(150)	(164)	(162)	22 Apr. 1882	Abt. 13 June 1886	42	28 ,,
37 Lychnis Flos-cuculi	Ragged Robin	151	(150)	141	146	145	157	(148)	(162)	21 May, 1882	Abt. 11 June 1887	21	30 ,,
38 Iris Pseud-acorus	Yellow Flag	..	139	134	148	153	(171)	161	171	14 May, 1882	20 June 1887	37	3 June
39 Euonymus europæus	Spindle-tree	150	..	141	174	(150)	151	157	163	21 May, 1882	23 June 1883	33	4 ,,
40 Papaver Rhœas	Common Red Poppy	..	161	134	154	146	158	(164)	169	14 May, 1882	18 June 1887	35	4 ,,
41 Orchis maculata	Spotted Orchis	143	162	133	160	..	(171)	165	169	13 May, 1882	Abt. 20 June 1887	38	7 ,,
42 Rosa canina	Wild Rose	..	162	149	160	154	161	164	169	29 May, 1882	18 June 1887	20	9 ,,
43 Lathyrus pratensis	Meadow Vetchling	164	162	154	158	..	164	165	165	3 June 1882	14 June 1887	11	11 ,,
44 Stachys sylvatica	Hedge Woundwort	164	162	147	167	152	(171)	165	177	27 May, 1882	26 June 1887	30	12 ,,
45 Malva sylvestris	Common Mallow	165	162	150	161	166	164	170	176	30 May, 1882	25 June 1887	26	13 ,,
46 Centaurea nigra	Knapweed	170	168	152	167	166	169	170	176	1 June 1882	25 June 1887	24	16 ,,
47 Vicia Cracca	Tufted Vetch [herb	171	168	166	167	170	167	168	164	13 June 1881, 7	19 June 1880	6	17 ,,
48 Epilobium montanum	Broad-leaved Willow-	172	170	168	167	166	164	165	170	13 June 1885	20 June 1880	7	17 ,,
49 Ligustrum vulgare	Privet	172	176	149	161	160	171	(175)	177	29 May, 1882	Abt. 24 June 1886	26	17 ,,
50 Cornus sanguinea	Dogwood	172	162	..	167	166	(171)	(175)	177	11 June 1881	Abt. 24 June 1886	13	19 ,,
51 Thymus serpyllum	Thyme	..	155	149	154	188	164	192	(198)	29 May, 1882	Abt. 18 July, 1887	20	20 ,,
52 Achillea Millefolium	Yarrow	168	171	176	177	181	161	170	182	10 June 1882	1 July, 1887	21	21 ,,

Botanical Name.	English Name.	Recorded Dates of First Flowering. 1880	1881	1882	1883	1884	1885	1886	1887	Earliest.	Latest.	Interval in Days.	Average Date.
53 Daucus Carota	Wild Carrot	151	..	161	177	(185)	173	(190)	183	30 May, 1880	Abt. 9 July, 1886	10	23 June
54 Prunella vulgaris	Self-heal	178	171	148	174	174	192	183	177	28 May, 1882	11 July, 1885	44	24 ,,
55 Spiræa Ulmaria	Meadow-sweet	174	176	168	180	180	171	(180)	183	20 June 1885	2 July, 1887	12	26 ,,
56 Hypericum pulchrum	Heath St. John's-wort	..	..	182	181	173	..	185	(183)	23 June 1884	Abt. 4 July, 1886	11	30 ,,
57 Carduus arvensis	Creepg. Plume-thistle	178	177	183	177	186	185	185	184	26 June 1881, 3	4 July, 1884, 5	8	1 July
58 Senecio Jacobæa	Ragwort	..	176	190	187	181	189	192	177	25 June 1881	11 July, 1886	16	4 ,,
59 Galium verum	Lady's Bedstraw	..	181	190	197	181	..	185	191	1 July, 1881	16 July, 1883	15	6 ,,
60 Convolvulus sepium	Great Bindweed	176	198	194	185	189	186	(192)	187	26 June 1880	17 July, 1881	21	7 ,,
61 Carduus lanceolatus	Spear Plume-thistle	..	190	193	188	..	..	(202)	191	7 July, 1883	12 July, 1884	5	9 ,,
62 Epilobium hirsutum	Gt. Hairy Willow-hb.	..	..	191	206	196	..	196	189	8 July, 1887	25 July, 1883	17	15 ,,
63 Campanula rotundifolia	Harebell	..	198	193	208	193	..	198	198	12 July, 1882	27 July, 1883	15	17 ,,
64 Sonchus arvensis	Corn Sow-thistle	..	203	203	204	(195)	(195)	(190)	198	9 July, 1886	23 July, 1883	14	17 ,,
65 Angelica sylvestris	Wild Angelica	..	207	213	216	(221)	(220)	..	..	26 July, 1881	Abt. 8 Aug. 1884	13	3 Aug.
66 Hedera Helix	Ivy	270	264	252	252	(257)	269	262	268	9 Sept. 1882, 3	26 Sept. 1880	17	19 Sept.
Galanthus nivalis	Snowdrop	..	..	..	..	32	52	(51)	23	23 Jan. 1887	21 Feb. 1885	29	8 Feb.
Amygdalus communis	Almond	..	..	49	57	51	76	93	100	18 Feb. 1882	10 Apr. 1887	51	12 Mar.
Ribes sanguineum	Flowering Currant	..	..	..	56	48	78	92	94	25 Feb. 1883	4 Apr. 1887	38	15 ,,
Populus balsamifera	Balsam Poplar	..	..	70	..	76	..	95	111	11 Mar. 1882	21 Apr. 1887	41	24 ,,
Ribes Grossularia	Gooseberry	..	..	71	97	83	96	(101)	107	10 Mar. 1882	17 Apr. 1887	38	2 Apr.
Abies Larix	Larch	..	..	..	104	90	94	(101)	..	30 Mar. 1884	14 Apr. 1883	15	7 ,,
Cerasus lusitanica	Laurel	..	..	91	..	96	130	128	135	1 Apr. 1882	15 May, 1887	44	26 ,,
Æsculus hippocastanum	Horse Chestnut	..		102	135	97	128	125	133	6 Apr. 1884	15 May, 1883	39	30 ,,
Syringa vulgaris	Lilac	..	..	106	126	(110)	121	129	136	16 Apr. 1882	16 May, 1887	30	1 May
Cytisus Laburnum	Laburnum	..	..	113	137	134	134	134	150	23 Apr. 1882	30 May, 1887	37	5 ,,
Secale cereale	Rye	..	..	141	124	128	..	126	..	4 May, 1883	21 May, 1882	17	10 ,,

70.—The Evolution of the Art of making Fire.

By Edward Lovett.

(Read October 10th, 1888.)

Mr. Lovett, who illustrated his remarks by a large number of valuable and interesting specimens, observed that wherever modern tribes have been visited, or the works of prehistoric races investigated, abundant proof exists of a knowledge of fire either in the presence of charred remains of bones, wood, stones, or pottery; and it is difficult to imagine the survival of man in his present form if, in addition to his many other difficulties, he was ever ignorant of the means of obtaining fire. The calcined cooking-stoves of the older stone age in Britain; the great conflagrations which destroyed settlement after settlement of the Swiss Lake dwellings, the numerous burnt objects in the great earth mounds of North America, the charred remains of objects found in the kitchen middens of Scandinavia, and the shell mounds of New Zealand, all prove the universal knowledge of fire possessed by prehistoric man of every age.

Selecting the friction method of obtaining fire first, Mr. Lovett indicated the "stick and groove" as the most simple. It consists of a flat soft piece of wood, into which a pointed stick of hard wood is run up and down. This form is still in use in many of the South Sea Islands. In some islands fire has been produced by the rapid drawing of a piece of rough bamboo over the edge of another piece; this, however, approaches the flint and steel method, the silica in the bamboo acting as the flint in striking off particles of the struck cane, the heat so generated being sufficient to ignite the particle. An advance on the groove plan was the "fire-drill," consisting of the same kind of flat soft wood, but with a hard pointed piece revolved in holes in the lower piece. In its simplest form the fire-drill revolved between the hands of the operator. Of course so simple a form of fire-drill as this was soon improved upon by the ingenuity of primitive man, and the next step forward was the "bow-drill" and the "pump-drill," each form varying slightly in different localities, but the main principle being strictly observed. In the Eskimo bow-drill the twirling-stick, instead of being revolved by the hands, was worked by a bow like an archer's bow, the string taking a turn round the fire-stick: by working the bow rapidly backwards and forwards with one hand, while the other held the stick down by means of a guard, a powerful friction was produced. The bow-drill was also used for fire-making by the Sioux or Dacotah Indians. The pump-drill consists of the usual stick and flat soft piece of wood; upon the former is fixed a wooden disc to give impetus, a cross-piece of wood carrying a thong from its ends over a notch in the top of the fire-stick produces, when worked up and down pump-fashion, an alternate rotary motion similar to that produced by the simple hand-twirled stick, but much more effective. This form of drill is an exceedingly interesting one; it is found in some of the islands of the South Pacific, as well as in North America, where it was in use by the Iroquois Indians. It is also one of the oldest types of tool (as a drill) to be found in the workshops of European carpenters, where it was possibly introduced from Asia in early times. According to Professor Kuhn, the early European fire-making instrument was the drill and not the groove, as the operation is described as boring or drilling. The usual European method, and indeed a very widespread method of producing fire, is by the percussion of flint and steel in some form or another. This method is of great antiquity, and paradoxical as it may seem, dates back to the stone age, when metals were unknown,—that is, as workable substances.

The lecturer then referred to the cliff cavern discovered by him in Jersey, the floor of which had yielded a large quantity of worked flint-knives, spear-heads, charred shells, remains of teeth and bones, and most important of all, a calcined nodule of iron pyrites. Chalk flints and iron pyrites are unknown *in situ* in the Channel Islands, the rocks of which are chiefly syenites, basalts, traps, rhyolites, and some altered clay-slates; so that the flint and iron pyrites must have been brought to the cave by prehistoric man for a purpose, the former to make implements, and the latter no doubt to make fire. Indications of the use of flint and pyrites in prehistoric times are recorded from many sources; the most remarkable are those in which these objects were deposited in the graves of the dead.

In the earliest historical times it is difficult to obtain any trustworthy account as to the means adopted in this country of obtaining fire, but there is no reason to think that any other but the flint and steel method was in general use from that time down to the introduction of matches in 1834. Before the perfection of the tinder-box it must always have been a matter of considerable difficulty to get the desired spark; consequently the utmost precautions were taken to preserve fire from year's end to year's end. Even within the last eighty years a Yorkshire Dale village actually lost fire, and was some time in getting it again, as it was during a severe winter, and none of the tinder-boxes were of any use, showing conclusively that where possible the flint and steel were quite neglected, and the perpetuity of live fire relied upon.

71.—Notes on the Fossil Ostracoda.

By C. Davies Sherborn, F.G.S.

(Read November 14th, 1888.)

To the working microscopist the common *Cypris* of our ponds and ditches is a well-known object, and it is the ancestors and relations of *Cypris*, in the past geological times, that I propose to bring to your notice to-night.

The literature of the subject is very extensive, the principal contributors being Rupert Jones, Kirkby, and G. S. Brady in England, Reuss, Bosquet, Terquem, Schmidt, Claus, and Sars in Europe.

The Ostracoda form one of the lowest groups of the great class Crustacea, and are mostly under 2 mm. in length.* An ostracod may be defined as a crustacean, having the body enclosed in a bivalved shell or carapace, of which the valves may or may not be furnished with hinge-teeth, and are united along the dorsal line by an elastic ligament.

It is desirable, when studying any group of animals, to classify them according to the structure of the softer parts primarily, and it will therefore be advisable to consider first the structure of one of the most familiar forms, the common *Cypris*.

In the genus *Cypris* the animal is contained entirely within the bivalved shell. The mouth leads, through a narrow œsophagus, to a small "crop," and from thence to a stomach and short intestine. There are seven pairs of appendages. Two pairs of antennæ are present; the second of these in *Cypris* and *Cythere* end with strong curved bristles, by means of which the animal can drag itself up or along and fix itself as with an anchor. In the exclusively marine forms this second pair of antennæ serves also for swimming. To the second pair of maxillæ is attached a fan-like organ, by which the animal produces the necessary circulation of water for respiratory purposes. Near the posterior end of the body is seen the creeping-foot with its strong terminal hooklet, and above and behind it the so-called cleaning-foot, *furca*. The Ostracoda possess single and paired eyes, an auditory organ, and, in the genera *Cypridina* and *Halocypris*, another sense-organ situated in front of the single eye. The liver is in the form of two long sacs, one on each side, and over these, in the female, are seen the ovaries. A heart is present in the dorsal region, of *Cypridina* and *Halocypris*, but absent in *Cypris*, *Cythere*, and others. The nervous system consists of a chain of double ganglia in the abdominal region. The whole surface of the body serves for respiration, an unbroken stream

* *Leperditia Balthica*, of which some specimens were exhibited by Dr. G. J. Hinde, F.G.S., reaches 15 mm.

of water being driven over it by the movement of the fan-shaped organ spoken of above. The genital organs of the male are of a very complicated structure. *Cypris* is remarkably prolific, a single congress with the male being apparently sufficient in some species to render the females fertile for life. There is also strong reason to believe that parthenogenesis exists for several generations in some members of the group.

The majority of the Ostracoda produce eggs, some carrying them about within the shell, others (the minority, *Cypris*, &c.), fixing them to water-plants. Claus, to whom we are indebted for much recent knowledge of the structure of *Cypris*, tells us that the young of this genus pass through a most complicated metamorphosis. In the first or "nauplius" stage [name given by F. O. Müller to unsegmented ovate larva of lower Crustacea, with median frontal eye, but without a true carapace] *Cypris* possesses only three pairs of limbs and a bivalved shell. It passes through several later stages, with complete moults, before arriving at maturity. The *Cytheridæ* (marine) are much more fully developed at birth.

Unfortunately, in dealing with fossil Ostracoda, we are, except in the rarest cases, quite unable to learn anything about the animal itself, and when studying the numerous and peculiar extinct genera of palæozoic times, we are forced, if we attempt to classify and arrange them, to content ourselves with the external evidence afforded by the shell. This is often very puzzling and unsatisfactory, as certain structures and peculiarities of the shells are difficult to understand by analogy. It is also extremely difficult in a few cases to definitely decide upon the anterior and posterior ends of the shell in some of the extinct genera. Professor Rupert Jones has found it a fairly safe guide to take the narrow and compressed end as the anterior, in that it offers the least resistance to the medium in which the animal lived. But in many of the silurian *Beyrichiæ* the front end is swollen by the addition of a great lobe, on each side, to twice the size of the posterior, and therefore we have at once an exception to a possible rule.

The difficulty in the way of our obtaining knowledge of the softer parts of the fossil Ostracoda will make it necessary for me to describe in some detail the structure and peculiarities of the carapace. The carapace of the Ostracoda is composed of two valves, one usually larger than the other, which are joined dorsally and kept apart ventrally by an elastic ligament. The closing of the shell is effected by an adductor muscle, so that in this respect the Ostracoda resemble the bivalved Mollusca. The adductor muscle is placed towards the anterior end of the carapace, and is inserted in a series of sunken pits in the median line of each valve. These spots, "muscle-pits" or "lucid-spots," as they are called, often take in particular genera a definite and recognisable grouping; and, as they are remarkably persistent in the different species, form a not unimportant consideration in the determination of the genus.

In addition to the elastic ligament, which serves to bind together the two valves, many of the Ostracoda are provided with hinge-teeth. In the genus *Cythere* there is usually a strong tooth at each dorsal angle in the one valve; these teeth are joined by a groove, and fit into corresponding hollows in the other valve; these hollows are connected by a bar or ridge, which in its turn fits into the groove of the toothed valve. The large angle teeth of *Cythere* frequently consist of three or more denticles, and this seems to be a characteristic feature of the Jurassic members of the group. In the genus *Cytheridea* there is a series of denticles or crenulations along the whole of the dorsal margin in one valve, with a corresponding series of small pits in the other valve, the bar and furrow being, of course, absent. In *Bythocythere* the hingement consists of a simple bar and furrow. In *Cypris* the hingement is more simple, an overlapping flange. *Candona*, *Aglaia*, *Argillœcia*, and other *Cyprididæ* have simple contact margins; while in the genus *Cytherella* one valve is larger as a rule than the other, the smaller of the two fitting inside the larger with a rabbet edge, similar to a shouldered pill-box. In *Bairdia* the hingement is flexed but simple, the left valve being much larger than the right, and overlapping all round the margins. In *Cythere* and some other genera the hinges can be seen at the angles outside the shell.

The ventral margin is usually unbroken, except in rare cases by a few serrations; but in the genera *Cypridina*, *Cypridea*, *Asterope*, &c., a distinct and sometimes deeply cut notch is seen in the antero-ventral margin.

The junction of the ventral margins of the valves in the Ostracoda also shows a variety of conditions, though usually more regular than those of the dorsal. They may be flush as in many *Cytheræ*, but it is more usual to find one of the valves overlapping the other slightly in the middle of the margin. This overlap sometimes becomes very strong, and in such genera as *Bairdia* and *Pontocypris* forms a well-developed roll. Usually the valves close anteriorly and posteriorly, but in some species, *Asterope teres* for example, there is a slight gape at the anterior end.

With regard to the external ornament of the valves, some of the Ostracoda, notably the *Cytheridæ*, are very richly sculptured and decorated with fringes, spines, ridges, or tubercles; and amongst the fossil forms specific determinations are based very largely upon this external sculpturing. Shell surface-marking is well known to be a very variable character, and we find in many so-called species the ornament passing from one to the other in a very perfect series. Still, this character, considered with the ventral and end aspects of fossil forms, affords a safe basis on which to classify and keep within bounds the species of the fossil Ostracoda.

Hence it is very important that the student of fossil Ostracoda, not being able to examine the animal as a guide to his researches, shall, before determining species, make definite and exact drawings of the side, ventral, and end views of the carapaces he is examining; and not only this, but these drawings should be all made from one individual, so as to ensure correct and faithful observation and outlines. Further, it is necessary to note the relative size of the right and left valves, the position and form of the teeth, and, if possible, to determine the shape and characters of the muscle-spot. Then. and only then, can the identification of species become possible. It is easy enough for any one to become acquainted with the characters of the genera of any particular group of organisms; but it requires long study and very careful observation to enable the student to have a definite understanding of the differences which combine together to form a so-called species, especially amongst fossil forms.

Now, with regard to the importance of the Ostracoda in the geological series: palæontologists cannot fail to be impressed with the enormous abundance of the remains of the smaller organisms in the sedimentary rocks, as compared with those of the larger organisms. The Foraminifera, with the genera *Nummulites*, *Fusulina*, &c., have, with a little cementing material, formed hundreds of feet of strata. The Sponges, as lately shown by Dr. Hinde, have largely composed many, if not all, of the thick deposits of chert in the carboniferous period; and the Ostracoda, although we do not see such stupendous thicknesses of rock-masses formed of their remains as we do with the Foraminifera and the Spongida, still we owe considerable thicknesses of rock at different periods of our geological history to the reproductive energies and cast carapaces of these minute Crustacea.

In early Silurian times the genera *Beyrichia*, *Thlipsura*, &c., left very considerable quantities of their remains in the Wenlock and other shales. In the Devonian rocks Ostracoda are rare; but the Rev. G. F. Whidborne has recently discovered some Beyrichian forms near Torquay, one of which has been described by Professor Rupert Jones under the new generic name of *Kyamodes*. *Entomis serrato-striata* of the Continent is the best known Devonian form. In Carboniferous times the Ostracoda seem to have reached the period of their greatest abundance, beds of shaly limestone and carbonaceous shale being in some places crowded with their remains. In a small piece of shale weighing less than one ounce, which I lately examined, I obtained over

150 individuals, belonging to six or seven species. In the coal-measures whole beds of hard shale may be split into thick laminæ along the surface formed by the crustacean valves.

In Jurassic times the Ostracoda have, till quite recently, only been known from a few scattered finds; but a splendid series of specimens from the fuller's-earth clay has lately been obtained, and these have been described by Professor Rupert Jones and by myself, and fill up an important gap in the geological history of the Ostracoda.

The immense masses of *Cypris* limestone and shales of the Purbeck and Wealden formations must be well known to all geologists present. Some of these beds are entirely composed of ostracodal valves, and in the case of at least one form fix the age of the bed with great exactness. In the Wealden area, the paper shales of Shepherd's Chine, Isle of Wight, cannot fail to be noticed by the most casual observer. Here, for foot after foot, the clay-beds may be split up into laminæ as thin as paper, the lamination being almost entirely due to the smooth valves of *Cypridea valdensis.* At Brook Point, in the hard reddish-brown clays, thousands of specimens can be obtained from a few square inches; indeed, the whole of the coast section between Brook and Atherfield, and again at Sandown, offers abundant points where these Ostracoda may be seen as rock formers, and where specimens may be collected without trouble.

From the Gault and Chalk a large and beautiful series has been described, and before long a revised list, including the new species collected since the first descriptions were published forty years ago, will soon be ready.

Nearly every Tertiary clay yields a harvest of Ostracoda, and very considerable thicknesses of the Hempstead beds of the Isle of Wight are thickly crowded with valves of *Cytheridea Mülleri.*

72.—The Anatomy of Spiders.

By William J. Fuller, F.I.C.

(Read December 12th, 1888.)

The spinning spiders (*Araneina*) are commonly supposed to be insects, but in every important characteristic they differ from the Insecta, and are really much more nearly allied to the Crustacea. The eyes, when present, are two, four, six, or eight, generally eight, and are simple lenses, sometimes very large and bright, and very different from the complex facetted eyes of insects. They are variously situated on the anterior portion of the cephalo-thorax in a manner excellently adapted to the habits of the various genera. The falces (mandibles) consists of two strong joints attached to the fore part of the cephalo-thorax, each armed with a formidable fang folding into a groove on the inner side, the whole somewhat resembling a pruning-knife. A poison-gland is present in the cephalic region, and connects with an orifice in the fang by a straight tube. Two maxillæ on the under surface assist mastication, and the palpi, proceeding from the outer edge, are long, five-jointed, antenna-like organs, and are used as antennæ normally; but in the male, on arriving at maturity, the two end joints are developed into complex organs, which defy description, but will well repay investigation. These are in all probability used by the male in the process of conjugation. They differ in every species, and in some instances are extremely beautiful objects. The labrum is a very simple organ, which completes the oral apparatus.

The legs are arranged round a large oval sternite, which forms the under side of the cephalo-thorax, and none of their coxæ are in contact. They are seven-jointed and variously furnished with hairs and spines all over their surface; but on the treading surface a collection of hairs is frequently found, which are of service for travelling over smooth surfaces. There are also, at the tip of the tarsus, two or more pectinated claws, which in some cases are curiously shaped. The hairs of the leg are varied in shape, being sometimes club-shaped, frond-like, toothed, &c. In the *Ciniflonidæ* the last joint but one is furnished with a double row of spines, arranged so that the points of one row may approximate to the points of the other. This apparatus, called the "calamistrum," is used by the spider for carding the web as it is spun, and so producing a beautiful flossy web. The spinning apparatus consists of six or eight mammillæ, fixed at the extremity of the abdomen, on the summit or interior surface of which are numerous spinnerets or jets, supplied with a quickly-drying fluid by numerous glands, situated in the lower posterior part of the abdomen. When the spider wishes to make a web, it applies the mammillæ spread out like the fingers of a hand to the surface of some convenient body; filaments from hundreds of spinnerets are attached to the body, and elongated as the spider proceeds; in some cases these filaments are combined into one thread, or they may be woven into a complex mass of floss web by the calamistrum. The *Epeiridæ* and others bead their web by causing large masses of web to agglomerate at certain points. At the anterior extremity of the abdomen, on the under surface, are found one or two pairs of transverse slits on either side the median line, and on either side of the opening of the generative organs. These slits are the stigma or openings of the *Branchiæ*, which consist of book-like foldings of an excessively delicate membrane, between which air permeates on the outer side, and the blood is brought into efficient communication with the air on the other (as in the mammalian lungs). The long heart, which is found in the upper median line of the abdomen by four sets of veins, draws the blood from the abdominal cavity, and propels a part through the cephalo-thoracic artery to the head and legs (the artery separating into two branches on meeting the exuvial stomach, and embracing it in its forward progress); the rest is passed through the lung-cavity by means of side branches arising from the base of the heart.

The alimentary canal is commenced by a long sucking tongue, along the centre of which is a furrow leading into a fine chitinous œsophagus, which ends in a chitinous stomach or gizzard. The interior coat of the whole of this is shed at every moult, and so must be looked upon as being a modification of the mouth. The true stomach is met with beyond the exuvial stomach, and generally consists of a sac furnished with eight or ten cœca, which correspond with and approach the legs and palpi; subsequently the intestine takes a course down the median line, rising more or less in the abdominal region as the underlying ovaries are more or less distended with eggs; on the far side of the ovary the intestine meets and discharges into a large sac situated in the extreme rear of the spider, and which empties itself by an opening immediately above the spinnerets.

The nervous system is contracted in spiders to a large thoracic infra-œsophageal ganglion, which supplies the limbs and abdominal organs with nerves, and a supra-œsophageal ganglion, which supplies the eyes and head generally. In this respect spiders are far superior to insects, and again are very nearly allied to crabs.

The near allies of each, the scorpions and lobsters, are perhaps still more similar in their construction.

73.—Report of the Meteorological Sub-Committee for 1888.

(Read February 13th, 1889.)

The programme of arrangements for observing the daily rainfall round Croydon, as announced at the Anniversary Meeting last year, has been fully accomplished, the whole organisation being under the immediate charge of Mr. F. C. Bayard, the Honorary Secretary of the Committee. The year commenced with a staff numbering 31 observers, superintending 34 stations. Of these, two stations have been discontinued. Captain Sherrard, R.E., left Hillside House, Woolwich, for Malta in October, but observations have since been carried on in the adjoining garden by Captain Cleeve, R.E. Mr. Porter left Border Lodge, Forest Hill, at the end of September, and the gauge with which it had been intended to continue observations monthly was stolen in November. And Mr. Rostron moved on the 10th of October from Woodlands, Beddington Lane, into the village of Beddington. The two last-mentioned observers, however, will be on the staff for the present year.

Appendix I. to this Report contains a list of the observers, with particulars relating to the stations and gauges. The seven stations with an asterisk prefixed were admitted after the commencement of the year.

Appendix II. contains the Tables of daily rainfall issued monthly, and subsequently stereotyped.

Appendix III. gives the monthly rainfall of the six other stations.

Appendix IV. contains 5-year means of monthly rainfall, so far back as they extend, of the Observatories of Greenwich and Kew, arranged in lustra, as recommended by the International Meteorological Congress of Vienna, 1873.

Finally, Appendix V. gives a record of all falls of rain of 1 in. and upwards in the twenty-four hours, extracted from Appendices II. and III.

For this year the stations have been arranged according to their height above sea-level, from the highest to the lowest, for Kent and Surrey separately. But it has been suggested by some of the observers that the distribution of rain in heavy local falls would be better followed if the stations were grouped according to their proximity to one another, irrespective of height above sea-level and of county. This method of local grouping will be adopted for the year 1889, proceeding from south to north, from west to east, and back again from east to west, as far as possible in regular sequence.

The chief characteristics of the rainfall for the year 1888 may be gathered from a comparison of the figures at the foot of the tables in Appendix II. and from Appendix III. It will be seen that the summer was a very wet one. The rainfall in the months of June and July was everywhere in excess, and in many places in August, and raised the total for the year to above the average. At the Royal Observatory, Greenwich, the fall in these three months was 13·84 in., being 0·64 in. more than in the corresponding months of 1879, the wettest summer before the present of which trustworthy records exist. This great excess of rain was brought about by thunderstorms, which in July were especially severe, on two occasions passing centrally over Croydon from the south-west, and extending north-east to

Greenwich. On and near a continuous but somewhat irregular line drawn between Leatherhead and Greenwich the rainfall for the month exceeded 7 in.; being at D'Abernon Chase, 7·22 in.; Kenley, 9 in.; Purley, 7·82 in.; Beddington, 7·15 in.; Park Hill Rise, Croydon, 7·36 in.; Dingwall Road, Croydon, 7·73 in.; Addiscombe, 7·39 in.; Bickley, 7·12 in.; and Greenwich, 7·04 in. North-west and south-east of the narrow band in which these large falls were measured the amount diminished to 5·24 in. at Surbiton in a westerly direction, and 4·42, 4·54, and 4·61 in. on the western boundary of the district at Esher, Richmond, and Kew respectively. A deficiency of stations, which will be remedied this year, does not enable similar definite information to be given of the rainfall on the eastern boundary. The smallest depth recorded on that side of the band was 5·70 in. at Woolwich. The copious rainfall on the 26th of June was the product of two distinct thunderstorms, the first of which spread over the extreme south of the district, about Caterham; the other, which occurred between 6 and 8 p.m., passed over the south of London, and was felt most severely in the north-east. The large rainfall on the 1st of August was also associated with a thunderstorm, the brunt of which was experienced at Upminster, in Essex, some five miles outside our area, where the fall of rain was more than 4½ in. Besides June and July the rainfall of March and November was considerably in excess. That of the other months was deficient, being less than half the average in January, May, September, and October.

Satisfactory progress has been made in the last twelve months in the more even distribution of the stations, but much remains to be done. The Committee trusts that any person willing to aid in the work will communicate with Mr. Bayard, and endeavour to establish rain-gauges at places unrepresented at present. The following may be specified:—Box Hill, Walton-on-the-Hill, Woldingham, Botley Hill, Tatsfield, Cudham, Shoreham, Chelsfield, Swanley, Bexley Heath, Erith, Battersea, and Barnes.

APPENDIX I.

Stations.	Observers.	Size of Gauge.	Height of Gauge above Ground.		Height of Station above Sea-level.
SURREY.		IN.	FT.	IN.	FT.
Caterham (Metropolitan Asylum)	G. S. Elliott, M.D.	5	1	0	610
Reigate Hill (Lovelands)	R. Binns	5	1	3	600
Caterham Valley (Birchwood House	C. & F. Rutley	5	1	0	471
Kenley (Ingleside)	Harold Smith	8	1	0	375
*Ashtead (D'Abernon Chase)	Sir Wm. Vincent, Bart.	5	1	0	300
Addington (Park Farm)	W. Whalley	5	1	0	268
Forest Hill (Honor Oak Road)	M. J. Porter	8	0	11	260
Croydon (Park Hill Rise)	Baldwin Latham	8	1	0	253
Sutton (Mulgrave Road)	W. Goode	5	5	6	230
*Sutton (Grange Road)	W. Thurtell	5	1	6	230
Purley (Tudor Cottage)	J. Bonwick	5	1	0	216
Addiscombe (Outram Road)	E. Mawley	8	0	9	202
Croydon (Dingwall Road)	Croydon Corporation	5	1	0	195
West Norwood (Chapel Road)	W. Marriott	8	1	0	185
*Wimbledon (Mount Ararat)	T. Devas	12	3	0	157
Wallington (Springfield Road)	F. C. Bayard	5	4	1	157
Waddon (Waddon House)	P. Crowley	5	1	0	156
Croydon (Brimstone Barn)	Baldwin Latham	5	1	0	130
Carshalton (The Wrythe)	J. W. Manley	5	4	10	107
Beddington (Beddington Lane)	S. Rostron	5	1	0	102
Brixton (Acre Lane)	F. Gaster	8	1	0	77
Wimbledon (Sewerage Works)	W. S. Crimp	5	1	0	58
Richmond (Ormond Lodge)	J. T. Billett	5	0	9	51
*Esher (West End)	W. H. Dines	5	1	0	51
Raynes Park (Pumping Station)	W. S. Crimp	5	1	0	47
Esher (Sewerage Works)	Baldwin Latham	5	1	0	40
Surbiton (Seething Wells)	R. Hack	10	0	6	25
Kew Observatory	Kew Committee	11	1	9	19
KENT.					
West Wickham (Layham's Farm)	W. Ashcroft	5	1	0	500
Keston (Heathfield)	Miss M. Holland	5	0	6	420
Woolwich (Shooter's Hill)	Capt. C. W. Sherrard Capt. S. D. Cleeve	5	1	0	352
Keston (Keston Tower)	G. Buchanan	8	0	9	351
Keston (Bradfield)	A. Hill	5	1	0	350
*Chislehurst (The Chestnuts)	J. B. Snell	5	1	0	325
Hayes Common (The Warren)	Miss Akers	5	1	0	296
Bickley (Highfield)	J. Batten	5	1	2	295
Forest Hill (Dartmouth Road)	Mrs. Behrens	5	1	0	220
*Eltham (Victoria Road)	Capt. M. S. Richardson.	5	1	0	205
Greenwich Observatory	Astronomer Royal	8	0	5	155
Beckenham (Foxgrove)	P. Bicknell	5	0	6	142
*Deptford (Kent Waterworks Co.)	W. Morris	5	1	0	20

APPENDIX II.

Daily Rainfall. **SURREY.** January, 1888.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·07	·03	·04	·02	..	·01	..	..	·01	·01	..
2	·50	·32	·28	·32	·35	·29	·32	·33	·32	·31	·32	·31
3	..	·01	·01	·01	..	·02	·01	..	·02	·01	·01	·02
4	·03	·04	·04	..	·02	..	·01	..	·03	·01	·01	..
5	·03	·01	·03	·01	..	·01	..	·02	..	..	..	·02
6	·17	·18	·14	·13	·07	·10	·07	·10	·12	·03	·06	·11
7	..	·01	·01	·01	..	..	..	..	..	..	·01	..
8	..	..	..	·01	..	..	..	..	..	..	..	..
9	..	..	..	·01	..	·01	..	..	..	..	..	..
10	..	..	..	·01	..	·02	·01	..	..	·01	·01	·02
11	..	..	..	·02	..	·02	·02	..	..	·01	·01	·03
12	..	·03	..	·02	·02	·01	·01	..	·04	·01	·01	·01
13	..	..	..	..	..	..	..	..	..	·01	..	..
14	..	..	..	·01	..	..	..	·04	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..
20	·10	·11	·12	·13	..	·10	·06	·16	·04	·09	·23	·10
21	·30	·27	·23	·25	·25	·13	·18	·16	·30	·15	·03	·18
22	..	·01	·01	·01	..	..	..	..	·02	..	..	..
23	..	..	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..	..	..
25	..	·02	·02	·01	..	..	..	..	..	·01	..	..
26	..	..	..	..	..	..	..	..	..	..	..	..
27	..	·04	·02	·05	·02	·01	·04	·08	·07	·03	·04	·03
28	..	..	·01	·01	..	·03	..	..	..	·01	·01	..
29	..	..	..	..	..	..	..	..	..	..	..	..
30	..	·01	·01	·02	..	..	·01	·02	..	·01	·04	·02
31	·22	..	·13	·12	·15	·23	·11	·10	·15	·14	·08	·15
Total	1·35	1·13	1·09	1·20	·90	·98	·86	1·01	1·11	·85	·88	1·00
From Jan. 1st	1·35	1·13	1·09	1·20	·90	·98	·86	1·01	1·11	·85	·88	1·00

Day of Month	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·02	·02	..	..	·01	..	..	·02	..	..	·02	·01
2	·32	·31	·40	·32	·34	·30	·30	·21	·32	·26	·22	·21
3	..	·01	..	..	·01	..	·01	·01	·02	..	..	·01
4	·02	·01	·01	·01	·01	..	..	·02	·01	·02	·02	·01
5	..	..	..	..	..	..	..	..	·02	..	..	..
6	·09	·07	·06	·07	·07	·12	·11	·09	·09	·06	·05	·07
7	..	·01	..	..	..	..	..	..	..	·01	..	..
8	..	..	..	..	..	..	·01	..	·01	..	..	..
9	·01	..	..	·01	..	..	..	..	·02	..	..	·01
10	·01	..	..	·01	..	..	..	..	·02	..	..	·01
11	·02	·01	..	·01	·02	..	..	..	·04	..	..	·02
12	·01	..	..	·01	..	..	..	..	·01	·03	..	·01
13	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..
20	·06	·09	..	·23	·08	·06	·12	·31	·11	·22	·05	·27
21	·23	·14	·30	·03	·18	·22	·21	..	·16	·07	·20	·04
22	..	·01	..	..	·01	..	..	·04	·01	..	..	..
23	..	..	..	..	..	..	..	..	·01	..	..	·01
24	..	..	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	·01	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..	..	..
27	·07	·03	·05	·07	·04	·02	·04	·06	·05	·07	·03	·05
28	..	..	..	..	..	..	..	..	·02	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..
30	·01	·01	..	·01	·02	·03	·03	·10	·04	..	·02	·10
31	·11	·09	·11	·07	·12	·20	·11	·05	·15	·13	·10	·03
Total	·98	·81	·93	·85	·91	·95	·94	·92	1·11	·87	·71	·86
From Jan. 1st	·98	·81	·93	·85	·91	·95	·94	·92	1·11	·87	·71	·86

Daily Rainfall. KENT. January, 1888.

Day of Month	Beckenham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·02	·03	·01	·01	·03	·01	..	..	·01	·01
2	·30	·32	·29	·31	·30	·34	·41	·20	·30	·34
3	·01	·03	·01	·02	·02	..	..	..	·01	·01
4	·02	..	..	·01	·01	·01	..	..	..	·01
5	·01	..	..	..	..	..	..	..	..	..
6	·07	·07	·07	·07	·05	·06	·09	..	·09	·09
7	..	..	·01	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..
9	..	..	·01	..	..	..	..	..	..	..
10	..	..	·01	..	·01	·01	·03	·04	..	·01
11	·03	·04	·01	..	·02	·01	·02	..	·02	·01
12	·01	·02	·01	..	·01	..	·01	..	..	..
13	..	·01	..	..	..	..	..	..	..	..
14	..	·01	·01	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	·09	..	..
17	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..
20	·04	·04	·04	·07	·03	·10	·07	..	·08	·08
21	·23	·22	·17	·21	·17	·13	·20	..	·13	·18
22	·01	·01	..	..	..	·01	..	..	..	..
23	..	..	..	..	..	..	..	·30	..	..
24	..	..	..	..	..	..	..	..	..	..
25	..	·02	·01	..	·01	..	·02	..	·01	·01
26	..	..	..	·02	..	..	..	..	..	..
27	·02	·03	·09	..	·02	·02	..	·06	·09	·02
28	..	..	..	..	..	..	·06	..	..	·01
29	..	..	..	..	..	..	..	..	..	..
30	..	·02	..	·01	·01	·01	..	·20	·02	·02
31	·17	·16	·17	·12	·10	·15	·20	·09	·13	·18
Total	·94	1·03	·92	·85	·79	·86	1·11	·98	·89	·98
From Jan. 1st	·94	1·03	·92	·85	·79	·86	1·11	·98	·89	·98

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(January, 1888.)

Anticyclonic conditions very prevalent throughout the month; weather nevertheless mild and damp as a rule, with much fog between the 9th and 12th; even the easterly winds were much less cold than usual in January. On the 26th a change occurred; the air became drier, the range of temperature larger, and depressions began to move over Great Britain from N.W. & N.

The rainfall is very deficient, being at Greenwich 1·25 in. and at Kew 1·14 in. below the January average for the ten years, 1871–1880.

Daily Rainfall. SURREY. February, 1888.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	·18	..	·03	..	..	·02	·03	..	·02	·02	·03	·03	·03	·01	·02	·02	·04	·04	·04	·05	·04	·03	·03
3	..	..	·02	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	·10	·10	·03	·06	·05	·04	·05	·07	·07	·05	·04	·05	·05	·04	·04	·06	·05	·05	·05	·07	·08	·06	·03	·07
8	..	·06	·03	·05	·05	·04	·05	·05	·05	·04	·04	·04	·03	·03	·03	·03	·03	·04	·04	·04	·05	·02	1	·03
9	..	·01	·04	..	..	·01	..	..	..	..	..	..	..	·01	..	..	..	..	..	..	·01	..	..	·01
10	..	.07	·01	·09	·08	..	·08	·09	·09	·10	·09	·10	·07	·11	·08	·08	·09	·06	·07	·07	·10	·06	·08	·05
11	·10	·15	·17	·20	·09	·26	·18	·19	·17	·18	·16	·21	·19	·17	·17	·20	·19	·18	·23	·13	·21	·22	·18	·09
12	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	..	..	·01	..	..	..	..	..	..	..
13	..	·36	·38	·23	·26	·26	·25	·16	·20	·15	·21	·24	·21	·20	·20	·20	·20	·24	·29	·50	·21	·29	·20	·50
14	..	·06	·11	·11	·05	·02	·03	·15	·14	·03	·03	·11	·12	·08	·04	·10	·07	·02	·04	·04	·08	·10	·17	·01
15	..	·12	·16	·16	·15	·13	·11	·12	·15	·11	·10	·12	·11	·07	·07	·11	·12	·05	·03	·05	·05	·04	·03	·06
16	..	..	..	..	·03	..	..	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	·05	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	·01	·01	..	..
18	·20	·19	·21	·20	·06	·08	·14	·07	·14	·12	·11	·04	·07	·07	·06	·09	·08	·09	·02	·01	·04	..	..	..
19	..	·14	·09	·08	·14	·03	·06	·01	·12	·06	·04	·08	·07	·03	·05	·05	·06	·05	·02	·05	·03	·01	·02	·02
20	..	..	..	..	..	..	..	·04	..	..	..	..	·01	..	..	·05	..	·01	..	..	..	..	..	..
21	·10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	·20	..	..	·03	..	..	·01	..	..	·01	..	·01	·01	..	..	·02	·01	·01	..	·01	·04	..	..	..
23	..	·02	·04	·01	..	·01	·01	..	..	·01	·02	·02	·01	..	·02	..	·01	·03	·02	..	·02	..	·01	·01
24	·06	·04	·03	·06	..	·03	·04	·05	·08	·03	·03	·04	·03	·02	·01	·09	·03	·04	·03	·03	·04	..	·02	·01
25	·07	..	..	·01	..	·01	·01	..	..	..	·01	·02	·01	..	..	..	·01	..	..	..	·01	..	..	..
26	·04	..	..	..	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	..	..
28	..	..	..	..	..	..	..	..	·03	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	·10	·05	·04	·05	.07	·01	·04	·08	·05	·04	·02	·03	·04	..	·03	·04	·02	·04	·01	·02	·02	·02	·02	·01
Total	·97	1·55	1·36	1·38	1·08	·93	1·08	1·11	1·29	·96	·92	1·14	1·07	·87	·81	1·14	1·00	·97	·89	1·07	1·05	·88	·80	·90
From Jan. 1st	2·32	2·68	2·45	2·58	1·98	1·91	1·94	2·12	2·40	1·81	1·80	2·14	2·05	1·68	1·74	1·99	1·91	1·92	1·83	1·99	2·16	1·75	1·51	1·76

Daily Rainfall. KENT. February, 1888.

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·03	..	·03	·04	..	..	·08	..	..
2	·02	..	·02	..	·01	·01	·02	·15	·01	·02
3	..	..	..	..	..	..	..	..	..	..
4	..	·01	·01	..	..	..	..	..	..	..
5	..	·01	..	..	..	..	..	·06	..	..
6	..	..	..	..	..	..	..	·10	..	..
7	·03	·04	·03	·03	·03	·03	·04	·09	·03	·04
8	·03	·05	·02	·04	·03	·04	·05	..	·02	·03
9	..	..	..	..	..	..	..	..	..	..
10	·08	·07	·05	·08	·07	·11	·11	·05	·04	·12
11	·20	·17	·19	·16	·15	·18	·20	..	·17	·20
12	..	..	..	..	..	..	..	..	..	..
13	·25	·35	·29	·30	·31	·41	·31	·06	·21	·20
14	·10	·14	..	..	·12	·06	·04	..	·01	·04
15	..	·07	·08	·28	·20	·13	·17	..	·15	·10
16	..	..	..	..	·01	..	..	·10	..	..
17	..	..	..	..	..	..	..	..	..	..
18	·07	·08	..	·12	·12	·12	·23	..	·12	·10
19	·20	·13	·10	·12	·14	·09	..	·07	·06	·04
20	..	·01	·05	..	..	..	..	..	..	·01
21	..	..	..	..	..	..	..	..	..	..
22	..	·01	..	..	·01	·01	..	..	·01	·01
23	·04	·02	..	·04	·04	·01	..	·06	·01	·02
24	·02	·02	..	·02	·03	·01	..	..	·03	·02
25	..	..	·02	·01	·01	..	..	..	..	..
26	..	·01	·01	..	·01	..	·07	..	..	..
27	..	..	..	..	..	..	..	..	..	..
28	..	..	·01	..	..	..	·02	·04	..	..
29	·06	·05	·01	·05	·05	·06	·03	..	·02	·01
Total	1·10	1·27	·89	1·28	1·38	1·27	1·29	·86	·89	·96
From Jan. 1st	2·04	2·30	1·81	2·13	2·17	2·18	2·40	1·84	1·78	1·94

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(February, 1888.)

The month commenced with rough cold weather, much snow in the western parts of the United Kingdom, and northerly gales. The Croydon district was, however, little affected till later on. After the 3rd a mild period set in with damp air, which continued throughout England till about the middle of the month. Then came a change, and the rest of the month was very cold; snow fell frequently and strong north-easterly winds were prevalent.

The rainfall is again very deficient, being ·92 in. below the February average in twenty years, 1866–1885, at Brixton; ·68 in. below the February average of the last thirty years at Kew, and ·72 in. below the February average of ten years, 1871–1880, at Greenwich.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	·05	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	·01	..	·01	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	·01	·04	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	..	..	..
5	·10	·04	..	·02	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	·02	·02	·02	·02	..	·02
6	..	..	..	..	..	..	..	..	·02	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	..
7	·03	·02	..	·03	..	..	..	..	·01	·01	..	..	..	..	..	..	..	..	..	..	·01	·01	..	·01
8	·20	·47	·35	·28	·20	·11	·17	·17	·23	·18	·16	·17	·18	·14	·14	·13	·15	·22	·18	·22	·18	·16	·19	·21
9	·30	·05	·05	·04	·03	·01	·02	·03	·05	·02	·02	·02	·02	·02	·02	·01	·02	·02	·03	·04	·03	·02	·02	·03
10	·55	·51	·51	·64	·59	·27	·47	·54	·59	·47	·47	·27	·53	·44	·28	·48	·41	·27	·23	·27	·26	·29	·31	·28
11	·25	·15	·18	·21	·12	·28	·11	·10	·14	·13	·09	·11	·14	·11	·08	·10	·09	·09	·09	·08	·08	·07	·07	·10
12	..	..	·01	·01	..	..	·01	..	·01	·01	..	..	·01	·02	..	..	·01	..	..	..	·01	..	..	..
13	·50	·54	·54	·44	·44	·35	·34	·29	·43	·34	·32	·30	·36	·33	·24	·26	·24	·34	·37	·32	·32	·29	·29	·37
14	·05	·06	·06	·12	·13	..	·10	·15	·14	·09	·09	·12	·17	·09	·10	·23	·27	·20	·16	·42	·17	·29	·18	·34
15	·05	·36	·20	·18	·12	·10	·13	·15	·16	·15	·12	·12	·15	·14	·14	·15	·13	·06	·08	·05	·10	·20	·12	·04
16	..	·02	·05	·02	·05	..	·01	..	·01	·01	·02	·01	..	·01	·01	..	·01	·02	·01	·01	·01	..	..	..
17	..	..	..	·01	·03	·01	·01	..	·02	·01	·01	·01	·01	..	..	..	·01	..	·01	..	·01	..	..	..
18	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	·14	·16	·25	·15	·39	·16	·24	·17	·19	·23	·20	·20	·24	·12	·16	·23	·19	·20	·18	·20	·16	·09	·30	·15
20	·10	..	·01	·02	..	..	..	..	·09	..	..	..	·01	..	..	..	..	..	..	..	..	..	·01	..
21	..	..	..	..	..	..	..	..	·02	..	..	..	·01	..	..	..	..	..	..	..	·01	..	..	·02
22	·50	·29	·19	·18	·11	·25	·11	·14	·13	·11	·13	·24	·14	·12	·11	·14	·13	·23	·19	·29	·15	·12	·14	·26
23	..	·08	·04	·06	·05	·08	·04	·06	·09	·03	·02	·07	·05	·04	·03	·04	·05	·08	·09	·05	·07	·04	·02	·06
24	·15	·20	·25	·23	·17	·25	·20	·17	·23	·20	·22	·21	·19	·21	·21	·11	·19	·16	·14	·18	·12	·12	·08	·21
25	·50	·37	·41	·45	·34	·19	·26	·28	·31	·28	·28	·14	·31	·31	·22	·27	·20	·15	·14	·17	·16	·15	·10	·17
26	·50	·35	·33	·24	·32	·10	·14	·13	·26	·12	·13	·12	·21	·15	·17	·11	·13	·23	·15	·29	·13	·14	·11	·42
27	·02	·24	·13	·21	·06	·18	·21	·17	·20	·18	·31	·16	·19	·20	·15	·37	·13	·08	·16	·30	·17	·13	·04	·21
28	·20	·17	·23	·30	·46	·14	·28	·28	·29	·29	·14	·15	·29	·22	·21	·05	·29	·23	·16	·02	·16	·14	·08	·06
29	·32	·27	·12	·16	·10	·07	·12	·12	·15	·15	·14	·09	·17	·14	·11	·16	·16	·08	·06	·04	·08	·02	·05	·03
30	·09	·09	·08	·07	·11	·08	·06	·12	·11	·06	·07	·07	·09	·09	·08	·09	·10	·08	·07	·06	·10	·06	·05	·06
31	·01	·01	..	·02	..	·02	·01	·03	·03	..	·01	·02	·06	·05	·03	·07	·07	..	..	..	·01	..	·01	..
Total	4·56	4·45	3·99	4·11	3·86	2·65	3·04	3·10	3·96	3·07	2·96	2·60	3·54	2·95	2·49	3·00	2·98	2·75	2·52	3·03	2·53	2·36	2·18	3·05
From Jan. 1st	6·88	7·13	6·44	6·69	5·84	4·56	4·98	5·22	6·36	4·88	4·76	4·74	5·59	4·63	4·23	4·99	4·89	4·67	4·35	5·02	4·69	4·11	3·69	4·81

Daily Rainfall. KENT. March, 1888.

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (Tower Fields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..
4	·01	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..
7	..	·01	..	..	..	..	..	..	..	..
8	·25	·20	·19	·20	·12	·17	·14	·15	·16	·16
9	·03	·04	·03	·03	·02	·02	..	·02	·02	·02
10	·55	·58	·43	·56	·56	·52	·43	·08	·37	·33
11	·16	·17	·10	·17	·09	·14	·10	·32	·07	·13
12	·02	·02	·09	..	·01	..	..	..	..	..
13	·33	·33	·34	·35	·35	·35	·30	·21	·35	·27
14	·06	·06	·15	·04	·04	·04	·05	..	·15	·09
15	·15	·19	·09	·20	·19	·14	·15	·07	·10	·16
16	·02	·03	·03	·03	·03	·01	..	..	·01	·01
17	..	·01	..	·01	·01	·01	..	..	·01	·01
18	..	..	..	..	·01	·01	·03	..	..	..
19	·05	·18	·15	·30	·27	·30	·23	·15	·19	·16
20	·01	..	·01	..	·01	·01	..	..	·01	·01
21	..	..	..	..	..	..	..	..	..	..
22	·11	·12	·16	·12	·09	·11	·17	·07	·19	·16
23	·05	·06	·06	·05	·06	·05	·02	·19	·07	·04
24	·26	·29	·24	·27	·29	·24	·29	·25	·28	·23
25	·30	·34	·16	·30	·25	·32	·25	·19	·16	·21
26	·27	·25	·18	·25	·20	·19	·13	·11	·13	·16
27	·19	·18	·05	·14	·11	·25	·17	·07	·13	·15
28	·22	·28	·24	·29	·30	·22	·21	·25	·22	·25
29	·11	·10	·05	·10	·10	·11	·10	·07	·04	·06
30	·08	·06	·08	·06	·06	·07	·05	·08	·12	·05
31	·01	·01	..	..	..	·01	..	..	..	..
Total	3·24	3·51	2·83	3·47	3·17	3·29	2·82	2·28	2·78	2·66
From Jan. 1st	5·28	5·81	4·64	5·60	5·34	5·42	5·22	4·12	4·56	4·60

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(March, 1888.)

The month commenced with high pressures, cold N.W. to N.E. winds, and dry weather. A mild time with S.W. winds commenced on the 5th, and lasted till the 11th–12th, when a deep depression advanced slowly over the southern districts of England from the W. Then came a spell of N.E. winds, followed by rough unsettled weather.

The most marked features of the month were the deficiency of bright sunshine and the heavy rainfall. At Kew Observatory the percentage of sunshine recorded was only 16, being 15 below the March average of the past ten years. The rainfall at Kew Observatory was the largest total since 1862, and is 1·50 in. above the March average for the past thirty years. At the Royal Observatory, Greenwich, the rainfall is 1·54 in. above the March average of the ten years, 1871–1880, and at Sutton it is 1·85 in. above the March average of the ten years, 1877–1886. Coltsfoot, *Veronica*, and *Potentilla* were seen in flower, and the Wryneck was heard, at Gatton, Surrey, on the 30th.

Daily Rainfall. SURREY. April, 1888.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	·05	·04	·04	·04	·04	·03	·05	·04	·03	·03	·01	·04	·05	·04	·05	·05	·03	·05	·04	·05	·04	·02	·04
3	..	..	..	·01	..	..	..	..	..	..	..	..	..	·01	..	..	..	..	..	·01	·01	..	..	·01
4	·02	..	..	·01	..	..	..	..	..	..	..	·01	..	..	..	..	·01	..	·01	..	·01	..	..	..
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	·01	..	..	·01	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	·01
7	·07	·08	·01	·07	·05	·05	·07	·07	·05	·07	·14	·06	·07	·06	·05	·05	·07	·08	·08	·06	·09	·01	·06	·06
8	·12	·02	·19	·05	·06	..	·06	·03	·10	·06	·01	..	·05	·06	·05	·05	·02	..	..	..	·01	·02	..	..
9	·04	..	..	·02	·05	·05	·02	·02	..	·03	·03	·03	·02	·03	..	·02	·03	·03	·03	·03	·02	·01	..	·02
10	·05	·08	·03	·04	·03	·04	·03	·04	·04	·03	·03	·04	·03	·03	·05	·03	·03	·04	·04	·03	·04	·03	·02	·02
11	·01	·01	..	·01	..	..	..	·01	·01	..	..	..	..	..	..	..	..	..	·01	..	·01	..	·02	..
12	·02	·03	·02	·02	·03	·02	·01	..	..	·01	·01	·02	·01	·01	·01	..	·01	·02	·02	·02	·02	·02	·01	·02
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	·10	·17	·10	·12	·11	·12	·13	·13	·11	·12	·12	·12	·13	·12	·12	·13	·12	·14	·15	·19	·15	·16	·13	·20
16	·20	·20	·19	·15	·08	·05	·06	·09	·12	·05	·04	·05	·08	·06	·05	·06	·05	·04	·07	·09	·07	·11	·07	·09
17	·07	·05	·08	·04	..	·04	·02	·03	·03	·02	·02	·03	·03	·03	·03	·03	·03	·02	·03	·07	·03	·11	·07	·02
18	·02	·01	·04	..	..	·06	..	..	·01	..	..	·05	..	..	..	·01	·02	·08	·09	·27	·08	·14	·05	·48
19	·48	·36	·61	·52	·57	·36	·59	·53	·60	·52	·56	·51	·60	·57	·59	·57	·50	·62	·65	·62	·65	·37	·45	·68
20	·02	.09	·04	·01	..	..	·01	..	·04	·01	..	..	·01	·03	·01	..	..	·02	·03	·01	·02	·03	..	·01
21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	·07	·17	·27	·12	·04	·12	·12	·07	·12	·12	·12	·09	·10	·11	·07	·07	·08	·10	·09	·09	·05	·03	·03	·09
23	·72	·63	·54	·59	·75	·70	·75	·63	·65	·75	·75	·74	·67	·69	·65	·65	·64	·64	·73	·50	·62	·48	·47	·46
24	·03	·02	·01	·02	·02	·02	·01	..	·03	·01	·01	·01	·01	..	..	·01	..	..	·01	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30	..	·02	..	·02	..	..	..	·01	·02	·01	..	..	·01	..	..	..	..	..	..	..	..	..	..	..
Total	2·05	1·99	2·17	1·87	1·83	1·67	1·91	1·71	1·97	1·85	1·87	1·77	1·86	1·86	1·72	1·73	1·66	1·86	2·09	2·03	1·93	1·56	1·40	2·21
From Jan. 1st	8·93	9·12	8·61	8·56	7·67	6·23	6·89	6·93	8·33	6·73	6·63	6·51	7·45	6·49	5·95	6·72	6·55	6·53	6·44	7·05	6·62	5·67	5·09	7·02

Daily Rainfall. **KENT.** April, 1888.

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..
2	·02	·04	·04	·05	·04	·03	·04	·07	·04	·05
3	..	..	..	..	..	..	..	..	..	..
4	·01	·02	..	..	·01	·01	..	..	..	..
5	..	·01	..	·01	·01	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..
7	·06	·06	·02	·05	·06	·07	·07	..	·04	·06
8	·10	·09	·01	·07	·10	·03	·02	·02	..	·06
9	·03	·05	·03	·05	·05	·04	·05	·08	·05	·04
10	·03	·03	·02	·02	·02	·02	·03	·03	·03	·03
11	..	·01	·01	..	..	·01	·04	..	..	..
12	·02	·03	·05	·02	·02	·02	..	·01	·03	·03
13	..	..	·01	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..
15	·10	·10	·12	·10	·09	·11	·10	·11	·11	·12
16	·05	·09	·04	·07	·07	·07	·04	..	·04	·03
17	·03	·04	·01	·03	·02	·03	·02	·03	·01	·02
18	..	·02	·05	·01	·01	..	..	·02	·08	·02
19	·62	·55	·38	·57	·46	·57	·59	·47	·39	·43
20	·01	·02	·08	..	·01	..	·02	·02	·01	..
21	..	..	..	..	..	..	..	..	..	..
22	·16	·14	·15	·16	·15	·14	·17	..	·18	·12
23	·73	·69	·50	·75	·70	·73	·82	·49	·50	·73
24	·02	·02	..	·02	·03	·02	·03	·28	..	..
25	..	·01	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..
30	..	·01	..	..	..	..	..	..	..	·01
Total	1·99	2·03	1·52	1·98	1·85	1·90	2·04	1·63	1·51	1·75
From Jan. 1st	7·27	7·84	6·16	7·58	7·19	7·32	7·26	5·75	6·07	6·35

Note.—The observations are taken at 9 a.m., except at Brixton and Woolwich (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(April, 1888.)

The month commenced with high pressure in the west, and low pressure in the east and south; cold northerly and north-easterly winds, and slight showers of sleet. On the 10th, the high pressure to the west moved towards the south, the barometer fell in the north, and a milder period set in, with winds gradually backing to S.W. and S., and showers of rain. On the 20th, the easterly winds returned, accompanied by thunder and heavy rains, followed by drier air. On the 26th, milder weather ensued, with south-westerly winds backing to the S. on the 30th.

The rainfall is above the April average of the ten years, 1871–80, at Kew by ·08 in., but is below the same ten years' average at Greenwich by ·61 in.; and is also below the Sutton average for April for the ten years, 1877–86, by ·54 in. The redstart was heard on the 20th, and willow-wrens, swallow, and cuckoo on the 30th at Reigate Hill; and the cuckoo was heard on the 24th, and the nightingale on the 25th at Beddington. Lesser celandine flowered at Bats Hill, near Redhill, on the 13th.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·01	·01	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	·24	·27	·26	·33	·29	·15	·21	·18	·25	·23	·20	·18	·22	·18	·11	·17	·18	·18	·16	·24	·18	·16	·12	·24
3	..	..	..	..	..	..	..	..	·04	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	·35	·38	·34	·37	·27	·23	·31	·40	·34	·31	·36	·30	·37	·28	·16	·32	·29	·26	·33	·40	·32	·34	·22	·38
17	·18	·30	·19	·23	·17	·19	·19	·20	·21	·20	·14	·18	·23	·16	·15	·17	·17	·16	·16	·31	·15	·28	·31	·30
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	·27	·23	·27	·27	·20	·15	·17	·23	·25	·17	·18	·17	·22	·19	·17	·20	·17	·20	·18	·21	·19	·18	·18	·21
30	..	·02	·02	·01	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	1·04	1·21	1·09	1·22	·93	·73	·88	1·01	1·10	·91	·88	·83	1·04	·81	·59	·86	·81	·80	·83	1·16	·84	·96	·83	1·13
From Jan. 1st	9·97	10·33	9·70	9·78	8·60	6·96	7·77	7·94	9·43	7·64	7·51	7·34	8·49	7·30	6·54	7·58	7·36	7·33	7·27	8·21	7·46	6·63	5·92	8·15

Daily Rainfall. KENT. May, 1888.

Day of Month	W. Wickham (Layham'sF.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..
2	·31	·25	·14	·25	·19	·24	·18	·12	·15	·15
3	..	·01	·01	..	..	..	..	·02	·01	..
4	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..
16	·29	·33	·26	·24	·29	·28	·22	·21	·24	·24
17	·17	·19	·09	·26	·14	·14	·13	·16	·08	·16
18	..	·01	..	..	..	..	..	..	..	..
19	·01	·01	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..
21	..	·01	..	..	..	..	·02	..	..	..
22	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..
29	·23	·22	·16	·21	·20	·20	·16	·14	·16	·14
30	·01	·01	..	..	..	..	..	..	..	..
31	..	..	..	..	..	..	..	..	..	..
Total	1·02	1·04	·66	·96	·82	·86	·71	·65	·64	·69
From Jan. 1st	8·29	8·88	6·82	8·54	8·01	8·18	7·97	6·40	6·71	7·04

Note.—The observations are taken at 9 a.m., except at Brixton and Woolwich (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(May, 1888.)

The distribution of pressure was such as to give rise to cyclonic winds till the 5th, and between the 14th and 18th, and after the 28th; at other times anticyclonic conditions were prevalent.

The most marked feature of the month is the deficient rainfall, and the two long dry intervals from the 2nd to the 15th and the 19th to the 29th. The rainfall is below the May average of 1871–1880 at Kew by ·49 in., and at Greenwich by 1·14 in.; and below the May average of 1877-1886 at Sutton by 1·81 in.

A brimstone-butterfly was seen at Beddington on the 4th, and a fine lunar-halo at Kenley on the 19th.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	·01	..	·01	·01
5	·02	·04	..	·02	..	·03	·02	·01	·04	·02	·01	·01	·02	·02	·01	·01	..	·01	·04	·14	·03	·11	·08	·12
6	·01	·02	·02	·02	..	·03	..	·03	·01	·01	..	·06	·04	·02	·02	·07	·04	·03	·01	..	·01	..	..	..
7	·05	·08	·03	·04	·04	·15	·04	·03	·05	·04	·03	·05	·05	·04	·03	·03	·04	·03	·04	·04	·04	·04	·03	·04
8	·09	·43	·24	·33	·13	·10	·15	·25	·26	·15	·18	·08	·22	·17	..	·19	·14	·05	·18	·25	·19	·28	·21	·24
9	·30	·03	·12	·10	·21	·15	·17	·03	·11	·11	·13	·19	·03	·13	·15	·02	·13	·24	·11	·08	·06	·01	·04	·10
10	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	..	·01	..	..	..	·03	..	·01	·01	..	..	·01	..	..	..	·01	..	·01	..	·01	..	·01	..	·01
13	·10	·08	·12	·11	·16	·20	·11	·05	·10	·12	·09	·13	·07	·09	·09	·04	·11	·15	·06	·12	·03	·02	·02	·06
14	·18	·25	·26	·15	·22	·24	·08	·07	·13	·14	·14	·05	·04	·04	·06	·04	·01	·06	..	·02	·05	·09	..	·02
15	·23	·22	·17	·13	·10	·20	·13	·14	·14	·13	·13	·20	·12	·10	·10	·12	·13	·27	·23	·22	·20	·16	·16	·21
16	·08	·01	·07	·03	·03	·07	·02	·03	·06	·02	·08	·02	..	·04	..	·01	..	·02	..	·02	..	..	..	·01
17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	·01	..	·01	..	·03	·01	·02	..	..	·01	·02	·01	·01	..	·02	..	·03	·02	·03	·03	..	·02	·01
19	..	·01	..	·01	..	·01	..	·01	..	..	..	·01	·01	..	..	..	..	..	·01	·02	·01	·01	·01	·02
20	·30	·24	·23	·23	·25	·28	·30	·21	·25	·29	·26	·23	·26	·26	·28	·20	·22	·17	·17	·08	·12	·11	·09	·04
21	·21	·32	·23	·18	·11	·18	·13	·22	·21	·13	·14	·12	·17	·13	·13	·15	·14	·23	·13	·14	·16	·35	·23	·19
22	..	..	..	·01	..	·01	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	·32	·53	·26	·32	·25	·08	·21	·25	·24	·17	·19	·10	·25	·26	·23	·27	·18	·08	·11	·11	·12	·21	·31	·12
24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	·10	·41	·07	·05	..	·17	·07	·02	·05	·08	·11	·13	·01	·04	..	·02	·01	..	·05	..	·02	·06	..	·03
26	1·16	·76	1·54	·45	·58	1·60	·59	·42	·47	·72	·55	1·09	·40	·41	·55	·45	·65	·93	·63	·50	·64	·33	·65	·52
27	·35	·32	·30	·23	·14	·20	·11	·14	·19	·11	·11	·17	·13	·10	·09	·09	·11	·24	·21	·32	·20	·23	·21	·32
28	·26	·56	·21	·12	·15	·15	·27	·20	·11	·16	·15	·47	·23	·22	·13	·25	·11	·20	·33	·32	·22	·37	·40	·19
29	·12	·16	·13	·22	·31	·14	·27	·21	·30	·23	·21	·08	·23	·18	·19	·19	·16	·10	·12	·14	·16	·09	·17	·09
30	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	3·88	4·49	4·00	2·78	2·68	4·05	2·68	2·35	2·74	2·63	2·52	3·23	2·29	2·26	2·06	2·18	2·18	2·85	2·45	2·56	2·30	2·48	2·64	2·35
From Jan. 1st	13·85	14·82	13·70	12·56	11·28	11·01	10·45	10·29	12·17	10·27	10·03	10·57	10·78	9·56	8·60	9·76	9·54	10·18	9·72	10·77	9·76	9·11	8·56	10·50

Daily Rainfall. KENT. June, 1888.

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..
4	..	·01	..	..	·01	·01	..	..	..	·01
5	·02	·03	·01	·02	·02	·02	·03	..	·02	·01
6	..	·01	..	..	..	..	..	..	..	..
7	·03	·03	·04	..	·02	·03	·04	·02	·03	·05
8	·24	·23	·01	·22	·15	·17	·10	·05	·05	·11
9	·24	·15	·11	·12	·17	·10	·29	·38	·06	·37
10	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..
12	..	·02	..	..	·01	·01	..	..	..	..
13	·47	·34	·26	·31	·31	·24	·30	·09	·27	·17
14	·22	·16	·10	·16	·18	·23	·38	·49	·15	·38
15	·13	·11	·14	·11	·09	·10	·14	·08	·13	·16
16	·05	·05	·04	·05	·04	·05	·09	·02	·01	·01
17	..	·01	..	..	..	..	..	..	..	..
18	..	·01	..	..	·01	..	·01	..	·01	·01
19	..	·01	..	·01	·01	·01	..	..	..	..
20	·33	·26	·17	·26	·26	·26	·24	·27	·19	·21
21	·11	·11	·07	·14	·11	·15	·14	·15	·06	·13
22	..	·01	..	..	..	..	..	..	..	..
23	·33	·22	·04	·19	·23	·17	·10	..	·07	·11
24	..	·01	..	..	..	..	..	..	..	..
25	..	·13	·14	..	·11	·16	·21	·05	·09	·20
26	·96	1·05	1·63	1·18	·94	·76	1·48	1·70	1·77	1·29
27	·25	·18	·16	·15	·15	·14	·15	·20	·18	·16
28	·31	·16	·06	·24	·16	·30	·44	·28	·08	·27
29	·36	·26	·12	·22	·28	·11	·12	·10	·19	·09
30	..	..	..	..	..	..	..	..	..	..
Total	4·05	3·56	3·10	3·38	3·26	3·02	4·26	3·88	3·36	3·74
From Jan. 1st	12·34	12·44	9·92	11·92	11·27	11·20	12·23	10·28	10·07	10·78

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(June, 1888.)

The most marked features of the month are the comparatively heavy rainfall, the number of thunder-storms, and the small amount of bright sunshine. The rainfall is above the June average of 1871-1880 at Greenwich by ·88 in., but below it at Kew by ·10 in.; above the June average of 1877–1886 at Sutton by ·38 in.; and of 1878–1887 at Croydon (Nantwich House) by ·60 in., at Addiscombe by ·57 in., at West Norwood by 1·31 in., and at Waddon by ·17 in. The rainfall during the thunder-storm of the 26th was highest at Greenwich (1·77 in.), and lowest at Esher (·33 in.).

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	·01	·01	..	·01	·01	..	..	·01	·01	..	..	·01	..	..	..	..	·01	·01	·01	..	·01	·03
2	·42	·46	·36	·43	·33	·40	·33	·37	·38	·33	·35	·45	·37	·32	·25	·34	·35	·49	·42	·54	·45	·41	·41	·52
3	·47	·25	·36	·23	·46	·18	·67	·39	·12	·64	·77	·25	·47	·59	·71	·64	·43	·21	·27	·09	·36	·25	·36	·09
4	·12	·15	·10	·53	·23	·20	·14	·28	·42	·15	·19	·25	·23	·18	·11	·29	·28	·15	·17	·08	·21	·20	·19	·09
5	·17	·15	·20	·14	·12	·10	·28	·17	·24	·26	·26	·06	·09	·21	·19	·14	·13	·21	·28	·37	·29	·06	·15	·50
6	·53	·91	·80	1·25	·85	1·00	1·28	·92	1·17	1·21	1·30	1·03	·97	1·10	1·10	·87	1·12	1·05	·79	·22	·75	·72	·61	·21
7	..	..	·01	..	·02	·01	..	..	..	..	·01	..	..	..	..	..	..	..	·01	·04	·02	..	..	·04
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	·08	·03	·01	·02	..	·03	·01	·02	·02	·02	·01	·01	·02	·01	·01	·03	·01	·03	·03	·03	·03	·01	..	·01
10	·20	·40	·32	·39	·42	·39	·49	·56	·43	·46	·48	·42	·57	·50	·45	·47	·50	·40	·44	·34	·46	·40	·44	·34
11	·20	·07	·02	·03	·05	·04	·04	·05	·04	·03	·09	·03	·03	·02	·02	·05	·03	·03	·03	·05	·04	·03	·02	·05
12	·08	·04	·07	·06	·08	·04	·06	·08	·08	·08	·02	·04	·07	·12	·13	·03	·10	·06	·08	·05	·07	..	·02	·04
13	..	..	..	..	..	..	..	..	..	..	..	..	..	·06	..	..	..	..	..	..	..	..	..	..
14	..	..	..	·02	..	..	..	..	..	·01	..	·01	·01	·01	..	..	·01	..	..	·04	·01	..	·02	·04
15	·67	·57	·93	·62	·56	·63	·68	·48	·61	·64	·71	·59	·52	·56	·63	·54	·47	·32	·30	·43	·45	·29	·52	·42
16	·02	·02	·05	·02	·03	·02	·01	..	·02	·01	·01	..	..	..	..	..	..	..	..	..	..	..	..	..
17	·24	·12	·12	·92	·17	·15	·14	·21	·45	·10	·07	·09	·08	·09	·06	·08	·08	·12	·13	·05	·11	·08	·16	·05
18	·07	·10	·05	·41	·19	·33	·11	·02	·42	·10	·12	·16	·13	·46	·29	·12	·34	·36	·04	·33	·13	·06	·06	·19
19	·01	·04	·01	..	..	·13	·07	·01	·02	·05	·05	·04	·08	·01	..	·10	..	·04	·02	..	·01	..	·01	·01
20	..	·04	..	·04	·03	·03	·03	·04	·05	·03	·02	·02	·04	·03	·03	..	·04	·05	·02	·04	·03	·05	·03	..
21	·03	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	·40	·47	·40	·38	·34	·43	·42	·44	·44	·38	·43	·44	·38	·40	·44	·43	·44	·42	·39	·33	·44	·31	·42	·40
23	·04	..	·01	..	..	·04	..	..	..	..	..	·03	..	..	..	..	..	..	·02	..	·03	..	·01	·01
24	·03	..	·01	·02	..	..	..	..	·03	..	·01	..	..	·01	..	..	·01	·01	·01	·02	·01	..	..	·01
25	·35	·40	·33	·36	·28	·31	·20	·27	·28	·20	·18	·24	·28	·14	·22	·23	·19	·31	·31	·31	·24	·21	·21	·38
26	·01	·01	·01	·03	..	·02	·01	..	·04	..	..	·01	·02	·02	·01	..	..	·02	·02	·04	·04	..	..	·12
27	·61	·77	·56	·56	·51	·35	·45	·42	·51	·46	·65	·39	·46	·50	·46	·46	·51	·33	·26	·32	·35	·23	·26	·29
28	·10	·20	·12	·15	·12	·03	·12	·11	·16	·09	·04	·06	·10	·08	·10	·08	·09	·03	·07	·03	·05	·16	·13	·02
29	·20	·23	·16	·16	·11	·16	·10	·13	·23	·10	·09	·17	·12	·11	·10	·12	·10	·22	·23	·22	·22	·07	·18	·20
30	·55	·81	·28	1·60	1·32	1·59	1·09	·98	1·10	1·42	1·23	1·61	·97	·90	·95	·84	1·48	·74	·69	·24	·92	·38	·55	·28
31	·61	·56	·40	·62	·63	·33	·62	·53	·56	·61	·63	·38	·47	·53	·45	·47	·44	·34	·46	·32	·50	·50	·47	·27
Total	6·21	6·80	5·70	9·00	6·85	6·95	7·36	6·48	7·82	7·39	7·73	6·78	6·48	6·97	6·71	6·33	7·15	5·94	5·50	4·54	6·23	4·42	5·24	4·61
From Jan. 1st	20·06	21·62	19·40	21·56	18·13	17·96	17·81	16·77	19·99	17·66	17·76	17·35	17·26	16·53	15·31	16·09	16·69	16·12	15·22	15·31	15·99	13·53	13·80	15·11

Daily Rainfall. **KENT.** **July, 1888.**

Day of Month	W. Wickham (Layham'sF.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·01	..	..	..	·01	..	..	·01	..	..
2	·30	·28	·44	·28	·24	·29	·33	·40	·39	·36	·36
3	·18	·39	·21	·52	·37	·49	·26	·20	·15	·30	·16
4	·17	·14	·13	·15	·13	·15	·20	·21	·18	·25	·17
5	·27	·22	·15	·18	·16	·15	·15	·08	·08	·25	·06
6	·50	·46	·52	·50	·44	·73	·58	1·02	·10	·86	·11
7	·01	·01	·02	..	..	·01	·02	..	..	·01	..
8	..	..	..	..	..	..	..	..	..	..	..
9	·01	·04	·03	·04	·03	·05	·03	·03	·03	·02	·01
10	·46	·42	·39	·41	·40	·51	·42	·43	·36	·45	·35
11	·05	·05	·04	·03	·04	·05	·07	·05	·01	·05	..
12	·08	·03	·03	·04	·04	·04	·02	..	·03	·03	·01
13	..	..	..	..	..	·01	..	·02	..	..	..
14	..	·01	..	..	·01	..	..	..	·02	..	..
15	·72	·54	·42	·49	·58	·78	·47	·60	·69	·71	·84
16	·03	·02	..	..	·01	·02	..	·01	..	..	..
17	·13	·44	·13	·35	·58	·40	·15	..	·10	·06	·10
18	·26	·53	·01	·21	·51	·22	·84	·60	·76	·15	·49
19	·01	·03	·11	·04	·02	·01	·11	·30	..	..	..
20	·02	·04	·03	·03	·02	·03	·03	..	·03	·01	·02
21	..	..	..	..	..	..	..	..	..	..	..
22	·39	40	·39	·40	·39	·35	·35	·40	·28	·34	·33
23	·02	·02	·02	..	·01	..	..	·03	·03	..	·02
24	·02	·03	..	·02	·01	·02	..	..	·01	..	·01
25	·30	25	·22	·26	·22	·19	·18	·20	·40	·17	·34
26	..	·01	·01	..	..	·02	·01	·03	·01	..	..
27	·56	·49	·37	·52	·51	·54	·42	·33	·37	·38	·34
28	·10	·09	·08	·12	·07	·08	·03	·05	·01	·04	..
29	·13	·12	·15	·12	·11	·11	·12	·08	·17	·11	·16
30	·75	·84	1·28	·95	·93	·90	1·63	1·18	2·49	1·05	2·54
31	·69	·76	·52	·87	·72	·71	·70	·35	·33	·45	·29
Total	6·16	6·69	5·70	6·53	6·55	6·87	7·12	6·60	7·04	6·05	6·71
From Jan. 1st	18·50	19·13	15·62	18·45	17·82	18·07	19·35	16·88	17·11	16·83	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

NOTES.

(July, 1888.)

The month is marked by an almost unbroken succession of thunder-storms and heavy showers, the falls on the 6th and 30th being particularly so. The fall on the 6th was heaviest at Croydon (Dingwall Road), and least at Greenwich, whilst that on the 30th was greatest (2·54 in.) at Deptford, and smallest (·24 in.) at Richmond; on this latter day 2 in. fell at Greenwich in 3 hours. Wednesday, the 11th, was exceedingly cold, with showers of snow in many places. Bright sunshine was very deficient, the percentage of actual duration at Kew being only 21, whilst the average of the past ten years is 40. The rainfall is above the July average of 1871–1880 at Greenwich by 4·41 in., at Kew by 1·78 in., and at Beckenham by 3·82 in.; of 1877–1886, at Sutton by 3·30 in.; and of 1878–1887, at Croydon (Nantwich House) by 5·41 in., at Addiscombe by 5·46 in., at West Norwood by 4·88 in., and at Waddon by 5·14 in.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·10	·26	·04	·39	·35	1·17	·63	1·19	·66	·66	·64	1·43	·85	·63	·60	1·13	·97	1·26	1·15	·93	1·16	·71	·87	·88
2	..	·01	..	..	..	·01	..	·02	..	..	..	..	·01	·02	..	..	·02	..	..	..	..	..	..	·01
3	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	·01	..	..	..
4	·12	·13	·08	·08	·08	·08	·07	·07	·07	·07	·06	·10	·06	·05	·05	·05	·06	·10	·10	·09	·10	·04	·04	·08
5	..	..	·01	·01	..	·01	·01	·01	·02	·01	·01	·02	·01	·01	·01	..	..	·01	·01	..	..	..	..	..
6	·04	·04	·04	·04	·03	·04	·02	·03	·05	·02	·03	·03	·03	·04	·03	·03	·04	·03	·03	·04	·03	·04	·02	·03
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	·02	·03	..	..	..	..	·02	·01	..	..	·01	·01	..	..	..	..	..	..	..	..	..	..
18	..	·03	..	·01	·02	..	..	..	..	..	..	..	..	·03	..	..	..	..	..	..	..	..	..	·01
19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	·22	·22	·19	·19	·20	·25	·24	·18	·19	·25	·23	·25	·19	·20	·20	·19	·22	·22	·19	·15	·19	·11	·14	·14
21	..	·01	..	..	·01	·02	·01	·02	·06	·01	·01	·02	·01	·01	..	..	·01	·02	·03	·02	·03	·03	·03	·02
22	·20	·01	·01	·02	..	·03	..	·02	..	·01	..	..	·01	..	..	..	..	..	..	..	..	·01	..	..
23	·12	·06	·06	·09	·03	..	·03	·01	..	·02	·02	·02	·02	·03	..	..	·01	..	·01	..	·02	..	..	..
24	..	·20	·35	·23	·35	·43	·35	·16	·28	·37	·31	·28	·22	·23	·24	·20	·19	·20	·16	·28	·18	·23	·23	·29
25	..	·01	..	..	..	..	..	..	·01	..	·01	..	..	·03	..	..	·02	..	·01	..	·01	·01	..	·03
26	..	·01	·01	..	..	..	..	..	·01	..	..	·01	..	..	..	..	..	..	·01	·01	·01	..	..	·01
27	·08	·06	·05	·05	·01	·15	·04	·04	·02	·03	·05	·13	·02	·04	·04	·04	·03	·04	·10	·11	·11	·05	·07	·10
28	·80	1·06	·69	1·05	·85	·65	·83	·67	·97	·81	·69	·73	·71	·60	·62	·65	·63	·87	·74	·74	·71	·75	·72	·68
29	..	·07	·02	·03	·03	·04	..	..	·06	..	..	·02	..	·01	·01	..	·02	..	·04	·09	·03	·04	·04	·12
30	..	·03	..	·04	·14	·23	·05	·17	·12	·08	·10	·26	·08	·02	·06	·13	·31	·30	·27	·47	·49	·29	·47	·41
31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·01	..	..	..	..	..	..	..	..	..
Total	1·68	2·21	1·57	2·26	2·10	3·13	2·28	2·59	2·54	2·35	2·16	3·30	2·23	1·96	1·87	2·42	2·53	3·05	2·85	2·94	3·08	2·31	2·63	2·81
From Jan. 1st	21·74	23·83	20·97	23·82	20·23	21·09	20·09	19·36	22·53	20·01	19·92	20·65	19·49	18·49	17·18	18·51	19·22	19·17	18·07	18·25	19·07	15·84	16·43	17·92

Daily Rainfall. **KENT.** August, 1888.

Day of Month	W. Wickham (Layham'sF.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·21	1·25	1·25	1·51	1·27	·54	1·12	·73	1·29	·50	1·27
2	·01	·01	..	..	..	..	·01	·03	..	..	..
3	..	·01	..	..	·01	..	..	..	..	..	..
4	·10	·08	·09	·08	·06	·08	·10	·04	·08	·10	·06
5	..	·03	·01	·02	·01	..	·02	..	·01	·01	..
6	·04	·04	·02	·03	·02	·02	·04	·14	·02	·02	·02
7	..	·01	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..
16	..	·01	..	..	..	..	..	..	..	..	..
17	..	·02	..	..	·01	..	..	..	..	..	..
18	·03	·03	..	·03	·02	·02	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..
20	·18	·22	·31	·23	·20	·24	·33	·06	·31	·33	·25
21	..	·01	·01	..	..	·02	·03	·23	·01	·01	·01
22	..	·02	·05	·01	·01	..	..	..	·16	..	·06
23	·03	·03	·02	..	·01	·01	·02	..	·02	·01	..
24	·27	·28	·32	·31	·27	·26	·34	·48	·32	·37	·32
25	..	·01	·02	..	..	..	..	..	..	..	·01
26	..	..	..	..	..	·01	·02	..	..	..	..
27	..	·05	·10	..	·01	·04	·03	..	·09	·04	·07
28	·88	·83	·73	·83	·68	·80	·72	·80	·75	·74	·73
29	·04	·07	·05	·08	·05	·02	·04	..	·08	·02	·08
30	·19	·10	·19	·07	·08	·06	·15	·23	·30	·36	·21
31	..	·01	..	..	..	..	..	..	..	..	..
Total	1·98	3·12	3·17	3·20	2·71	2·12	2·97	2·74	3·44	2·51	3·09
From Jan. 1st	20·48	22·25	18·79	21·65	20·53	20·19	22·32	19·62	20·55	19·34	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

Returns have been received this month from New Malden (Gosforth Lodge) and New Malden Sewerage Works (height respectively about 230 ft.), in Surrey; and Knockholt (785 ft.), Chislehurst (The Chesnuts), (325 ft.), Orpington (220 ft.), Eltham (Victoria Road), (205 ft.), and Wilmington (25 ft.), in Kent.

NOTES.

(August, 1888.)

The depression systems were of a comparatively simple character, excepting those at the beginning and close of the month. The sunshine at Kew is again below the average, being only 35 per cent. against 40 for the past eleven years. The rainfall on the 1st was highest at Wilmington (1·58 in.), and lowest at Knockholt (·02 in.); and on the 28th was highest at Reigate Hill (1·06 in.), and lowest at Wilmington (·52 in). The rainfall is above the August average of 1871–80 at Greenwich by ·75 in., at Kew by ·88 in., but below it at Beckenham by ·18 in.; above the August average of 1877–86 at Sutton by ·36 in., of 1878–87 at West Norwood by 1·06 in., and at Addiscombe by ·10 in., the average at Nantwich House, Croydon, and below it at Waddon by ·13 in.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·04	·02	..	..	..	·02	..	..	·02	·01	..	·01
2	·20	·21	·21	·11	·08	·14	·11	·12	·10	·11	·11	·17
3	·01	·01	..	·01	..	·01	..	..	..	..	..	..
4	·04	·01	..	·03	·08	·04	·05	·02	·12	·04	·03	·06
5	..	·01	·02	..	·03	..	..	..	..	..	..	..
6	..	·05	·05	·03	·02	·03	·04	·04	·04	·04	·04	·02
7	·12	·02	·03	·03	·05	·03	·07	·04	·03	·06	·06	·03
8	..	..	..	..	..	..	..	..	..	..	..	..
9	·02	·23	·03	·18	·08	·02	·02	·10	·05	·02	·02	·03
10	·04	·21	·02	·04	..	·03	·05	·10	·06	·02	·05	·02
11	..	..	..	..	..	..	..	..	..	..	..	..
12	..	·01	..	..	..	..	..	..	·02	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..	..
14	..	·01	·01	·01	..	..	..	..	..	..	..	·01
15	..	..	·01	·02	..	·04	·01	·02	·02	·01	·01	..
16	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..
19	..	·01	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..	·01	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..
23	..	·05	..	·01	..	·05	·01	·04	·02	..	..	·02
24	·05	·03	·02	·03	·02	·03	·03	·08	·03	·04	·04	·28
25	·17	·10	·12	·10	·15	·10	·10	·08	·12	·06	·07	·05
26	..	..	..	..	..	·01	..	..	·02	..	..	..
27	..	·01	·01	·01	..	..	·01	..	..	·01	..	..
28	·09	·11	·14	·08	·04	·08	·07	·07	·07	·07	·06	·10
29	·35	·38	·31	·37	·40	·27	·31	·32	·34	·30	·32	·27
30	..	..	..	..	..	..	..	..	..	..	..	..
Total	1·13	1·48	·98	1·05	·95	·90	·88	1·03	1·06	·80	·81	1·07
From Jan. 1st	22·87	25·31	21·95	24·87	21·18	21·99	20·97	20·39	23·59	20·81	20·73	21·72

Day of Month	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·02	·01	..	·01	·02	·02	·03	·04	·01	·01	·02
2	·11	·08	·10	·06	·08	·13	·14	·19	·10	·14	·10	·21
3	..	..	..	·03	..	..	..	..	..	·01	..	..
4	·03	·03	·02	·02	·04	·04	·05	·04	·05	·04	·03	·03
5	..	..	..	..	..	..	..	..	..	..	..	..
6	·04	·03	·04	·04	·03	·01	·07	·05	·03	..	·06	·03
7	·03	·07	·06	·03	·10	·06	..	·05	·06	..	·03	·06
8	..	..	..	..	..	·01	..	..	..	..	..	..
9	·06	·02	·06	·05	·05	·02	·01	·05	·03	·04	·03	·07
10	·03	·04	·03	·05	·04	·14	·07	·08	·08	·11	·11	·11
11	..	..	..	..	..	..	..	..	·01	..	..	..
12	..	..	..	..	..	..	..	..	·01	..	..	·01
13	..	..	..	..	..	..	..	..	·01	..	..	..
14	·01	..	..	..	..	..	..	..	..	..	..	·01
15	·02	·02	..	·01	..	·02	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	·01	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	·01
21	..	..	..	..	..	..	..	..	·01	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	·01
23	·02	·01	..	..	..	·01	..	·05	·05	·04	·05	·06
24	·05	·03	..	·01	·05	·03	·17	·16	·35	·20	·23	·20
25	·08	·06	·12	·09	·06	·18	·12	·21	·07	·11	·11	·22
26	..	..	..	·03	..	..	..	..	..	..	..	..
27	·01	·01	..	·04	·01	..	..	..	·01	..	·01	·05
28	·05	·06	·06	·04	·06	·08	·11	·14	·08	·15	·09	·08
29	·31	·30	·30	·31	·28	·28	·20	·23	·26	·31	·30	·25
30	..	..	..	..	..	..	..	..	..	..	..	..
Total	·85	·78	·80	·81	·81	1·03	·96	1·28	1·26	1·16	1·16	1·43
From Jan. 1st	20·34	19·27	17·98	19·32	20·03	20·20	19·13	19·53	20·33	17·00	17·59	19·35

Daily Rainfall. KENT. September, 1888.

Day of Month	W. Wickham (Layham'sF.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·01	..	..	..	..	·01	..	·01	..	..
2	·09	·07	·10	·05	·04	·07	·11	·15	·08	·11	·08
3	·01	·01	..	..	..	..	..	..	..	..	..
4	·03	·04	·05	·04	·03	·07	·06	·04	·04	·06	·04
5	..	..	..	..	..	..	..	..	..	..	..
6	·02	·03	·05	·03	·02	·03	·03	..	·01	·03	..
7	·06	·07	·05	·04	·06	·04	..	·07	·01	·02	..
8	..	..	·04	..	..	..	..	..	..	..	..
9	·01	·01	..	..	·01	·10	·05	..	·03	·01	·03
10	·01	·01	..	·02	·01	..	..	·04	·03	..	..
11	..	·01	..	..	..	..	..	..	..	..	..
12	..	·01	..	..	..	..	·02	..	..	..	..
13	..	·01	..	..	..	..	..	..	..	..	..
14	..	·02	..	..	..	..	·01	..	..	..	..
15	·02	·01	..	·01	..	..	..	..	..	·01	..
16	..	..	..	..	·01	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..
19	..	·01	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..
21	..	·01	..	..	·01	·01	·02	..	..	..	..
22	·01	·01	·01	..	..	·01	·01	..	..	..	..
23	..	·01	..	..	..	·01	·01	..	·01	..	..
24	·20	·05	·02	·04	·03	·04	·03	..	·02	·02	..
25	..	·17	·12	·16	·14	·09	·05	·13	·14	·01	·12
26	..	..	..	..	..	..	..	..	..	..	..
27	·01	·01	..	..	..	..	..	..	..	..	..
28	·05	·06	·02	·06	·04	·03	·04	·10	·09	·11	..
29	·40	·34	·28	·40	·32	·34	·33	·28	·26	·30	·23
30	..	·01	·01	..	..	..	..	..	..	..	..
Total	·92	·99	·75	·85	·72	·84	·78	·81	·73	·68	·50
From Jan. 1st	21·40	23·24	19·54	22·50	21·25	21·03	23·10	20·43	21·28	20·02	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

Returns have been received this month from Purley (Reedham Asylum) (height 375 ft.), New Malden (Gosforth Lodge) (48 ft.), and New Malden (Sewerage Works) (46 ft.), in Surrey; and from Knockholt (785 ft.), Chislehurst (The Chesnuts), (325 ft.), Orpington (220 ft.), Eltham (Victoria Road), (205 ft.), and Wilmington (25 ft.), in Kent.

NOTES.

(September, 1888.)

The month has been bright though rather cool, with a large amount of sunshine and small rainfall, which is below the September average of 1871–80 at Greenwich by 1·70 in., at Kew by 1·00 in., and at Beckenham by 1·80 in.; of 1877–86 at Sutton by 1·73 in.; and of 1878–87 at West Norwood by 1·52 in., at Croydon (Nantwich House) by 1·88 in., at Addiscombe by 1·93 in., and at Waddon by 1·91 in.

Daily Rainfall. **SURREY.** October, 1888.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·04	·03	·04	·03	·02		·04	·03	·04	·04
2	..	·06	·10	·08	·10		·05	·08	·06	..
3	·05	·03	·07	·04	..		·03	..	·01	·08
4	·20	·08	·05	·07	·10		·02	·05	·06	·03
5	..	·01	·01	·01	·02		·01	·04	·03	·01
6	..	..	..	..	..		..	..	..	..
7	..	..	..	..	..		..	..	..	..
8	..	..	..	..	..		..	..	..	..
9	..	..	..	..	..		..	..	..	..
10	..	..	..	..	..		..	..	..	..
11	..	..	..	..	..		..	..	..	..
12	·13	·14	·09	·11	·08		·07	·11	·13	·07
13	..	..	..	..	..		..	..	..	..
14	..	..	..	..	..		..	..	..	..
15	..	..	..	..	..	Now Taken Monthly.	..	..	..	..
16	..	..	..	..	..		..	..	..	..
17	..	·01	..	..	..		·01	..	..	..
18	..	..	..	..	..		..	..	·01	..
19	..	..	..	..	..		..	..	..	..
20	..	..	..	..	..		..	..	..	..
21	..	..	..	..	..		·01	..	..	..
22	..	..	..	·01	..		..	..	..	..
23	..	..	..	·01	..		..	..	..	..
24	..	·01	·01	..	..		..	..	..	..
25	·06	·04	·05	·04	·04		·01	·02	·03	·01
26	..	·01	·01	·01	..		..	..	..	..
27	·01	..	..	..	..		..	..	..	..
28	·25	·24	·24	·33	·22		·21	·18	·26	·20
29	·60	·68	·76	·90	·43		·55	·59	·58	·55
30	·36	·34	·38	·36	·50		·38	·39	·38	·40
31	..	..	·58	..	..		..	..	..	..
Total	1·70	1·68	2·39	2·00	1·51	1·14	1·39	1·49	1·59	1·39
From Jan. 1st	24·57	26·99	24·34	26·87	22·69	23·13	22·36	21·88	25·18	22·20

Day of Month	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·05	·02	·05	·06	·05	·04		·01	..	·01	·03	..	..	·01
2	·05	·06	·05	·05	·05	·06		·16	·18	·01	·17	·08	·10	·07
3	·02	..	·01	·01	..	..		..	..	..	..	..	..	..
4	·03	·05	·05	·03	·04	·05		·01	·07	·06	·09	·09	·06	·07
5	·01	..	·02	·02	..	·02		..	·01	·02	·02	·04	..	·01
6	..	..	..	..	..	..		..	..	..	..	..	..	..
7	..	..	..	..	..	..		..	..	..	..	..	..	..
8	..	..	..	..	..	..		..	..	..	..	..	..	..
9	..	..	..	..	..	..		..	..	..	..	..	..	..
10	..	..	..	..	..	..		..	..	..	..	..	..	..
11	..	..	..	..	..	..		..	..	..	..	..	..	..
12	·06	·05	·11	·07	·07	·10		·04	·06	·06	·08	·06	·08	·05
13	..	..	..	..	..	..		..	..	..	..	..	..	..
14	..	..	..	..	..	..		..	..	..	·01	..	..	..
15	..	..	..	..	..	..		..	..	..	·01	..	..	·01
16	..	..	..	..	..	..	See Note.	..	..	..	..	..	..	..
17	..	..	..	..	..	..		..	..	..	·02	..	..	..
18	..	..	..	..	..	..		..	..	..	..	..	..	..
19	..	..	·01	..	..	..		..	..	..	·01	..	..	·01
20	..	..	..	..	..	..		..	..	..	..	..	..	..
21	..	..	·01	..	..	..		..	..	..	·02	..	..	..
22	..	..	·01	..	..	..		..	..	..	..	..	..	..
23	..	..	..	..	..	..		..	..	..	·02	..	..	·01
24	..	..	·01	..	..	..		..	..	..	..	..	..	..
25	·01	..	·01	·01	..	·01		·01	..	·01	..	·03	..	·01
26	..	..	..	..	..	..		·01	..	..	..	..	..	..
27	..	..	..	..	..	..		..	..	..	..	..	..	..
28	·19	·28	·18	·19	·20	·18		·25	·22	·23	·22	·17	·20	·26
29	·72	·56	·55	·56	·50	·67		·43	·29	·59	·53	·52	·42	·57
30	·24	·38	·41	·35	·36	·30		·40	·39	·26	·38	·34	·43	·25
31	..	..	..	..	..	..		..	..	..	..	..	..	..
Total	1·38	1·40	1·48	1·35	1·27	1·43		1·32	1·22	1·25	1·61	1·33	1·29	1·33
From Jan. 1st	22·11	23·12	21·82	20·62	19·25	20·75		21·52	20·35	20·78	21·94	18·33	18·88	20·68

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (Tower Fields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·01	·02	..	..	·02	·02	·04	·02	·04	..
2	·17	·14	·11	·14	·15	·15	·15	..	·06	·08	·08
3	·10	·08	..	·07	·07	·07	·07	·07	..	·03	..
4	·05	·05	·03	·03	·03	·03	·04	·06	·03	·04	·02
5	·01	·01	..	·02	..	..	..	·04	..	..	..
6	..	·01	..	..	..	..	..	..	..	..	..
7	..	·01	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	·01	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	·02	..	..	..	..
12	·06	·07	·03	·06	·07	·07	·07	..	·03	·05	·01
13	..	..	..	..	..	..	..	..	..	..	..
14	..	·01	..	..	..	..	..	..	..	..	..
15	..	·01	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	·02	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	·01	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..
21	..	·02	..	..	..	..	·02	..	..	..	..
22	..	·01	..	..	..	..	..	..	..	..	..
23	..	·01	..	..	..	·01	·02	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..	..
25	·06	·03	..	·03	·02	·03	·01	..	..	..	..
26	..	·02	..	..	..	..	..	..	..	·01	..
27	..	..	..	..	..	..	..	..	..	..	..
28	·23	·20	·25	·20	·16	20	·22	·18	·24	·24	·24
29	·48	·55	·46	·52	·59	·59	·57	·34	·50	·48	·45
30	·47	·38	·54	·44	·40	·36	·40	·49	·41	·42	·41
31	·01	·01	..	..	..	..	..	·16	..	..	..
Total	1·64	1·63	1·44	1·51	1·49	1·55	1·63	1·38	1·29	1·39	1·21
From Jan. 1st	23·04	24·87	20·98	24·01	22·74	22·58	24·73	21·81	22·57	21·41	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

Returns have been received this month from Purley (Reedham Asylum) (375 ft.), Ashtead (D'Abernon Chase) (300 ft.), New Malden (Gosforth Lodge) (48 ft.), and New Malden (Sewerage Works) (45 ft.), in Surrey; and from Knockholt (785 ft.), Chislehurst (The Chesnuts), (325 ft.), Orpington (220 ft.), Eltham (Victoria Road), (205 ft.), and Wilmington (25 ft.), in Kent.

The gauge at Beddington was on October 10th removed to another situation, and the return for the remainder of the year will not be printed in full. The total rain was 1·32 in.

NOTES.

(October, 1888.)

The weather was generally cold till the 25th, and very warm and close from the 25th to the 28th. The mean percentage of bright sunshine at Kew was 33, the average for the past ten years being 28. The rainfall is below the October average of 1871–80 at Greenwich by 1·65 in., at Kew by 1·44 in., and at Beckenham by 1·58 in.; of 1877–86 at Sutton by 1·49 in; and of 1878–87 at West Norwood by 1·34 in., at Croydon (Nantwich House) by 1·53 in., at Addiscombe by 1·53 in., and at Waddon by 1·44 in.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·64	·78	·49	·69	·73	Gauge Stolen.	·72	·65	·76	·72
2	·60	·57	..	·75	·76		·72	·75	·75	·71
3	·04	·03	..	·02	·06		·01	·02	·04	·01
4	·17	·14	·11	·14	·08		·10	·11	·11	·10
5	..	..	..	..	..		·01	..	..	..
6	..	..	..	..	..		..	..	..	..
7	..	..	..	..	..		..	..	..	..
8	·16	..	·12	·13	·10		·12	·22	·14	·14
9	..	..	..	·01	·02		·01	·02	·05	..
10	·28	·32	·27	·28	·18		·19	·12	·25	·19
11	·01	..	..	..	..		..	·05	·02	..
12	·44	·46	·41	·43	·30		·31	·38	·40	·30
13	·05	·01	·06	·02	..		·01	..	..	·01
14	·01	..	·05	·02	..		..	..	·02	·01
15	·19	·19	·11	·13	·07		·04	·03	·10	·03
16	·05	·03	·03	·02	·01		..	..	·03	..
17	·03	·06	·09	·10	..		·04	·06	·10	·05
18	..	·11	·04	·05	·08		·04	·06	·05	·03
19	·39	·22	·13	·25	·16		·17	·21	·23	·16
20	..	..	..	..	·04		..	..	·03	·01
21	..	..	..	..	..		..	..	..	..
22	..	..	..	..	..		..	..	..	..
23	..	..	..	·01	..		..	..	..	..
24	..	..	..	..	..		..	..	..	..
25	·66	·53	·67	·63	·29		·43	·41	·50	·44
26	·20	·16	·19	·12	·02		·09	·15	·11	·08
27	·19	·30	·23	·25	·38		·23	·32	·25	·23
28	·19	·23	·24	·23	·29		·22	·35	·23	·22
29	·20	·26	·19	·15	·15		·21	·16	·18	·21
30	·15	·16	·15	·23	·23		·22	·24	·23	·21
Total	4·65	4·56	3·58	4·66	3·95		3·89	4·31	4·58	3·86
From Jan. 1st	29·22	31·55	27·92	31·53	26·64		26·25	26·19	29·76	26·06

Day of Month	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·78	·67	·67	·73	·56	·64	See Note.	·66	·62	·68	·62	·63	·66	·64
2	·74	·71	·73	·71	·64	·73		·75	·69	·66	·66	·67	·69	·68
3	·01	·03	·01	·01	·01	·01		·03	·03	·02	·04	..	·02	·01
4	·10	·08	·09	·08	·06	·07		·07	·07	·09	·07	·06	·05	·08
5	·01	·01	..	·01	..	..		..	..	·01	·01	..	..	..
6	..	..	..	..	..	..		..	..	..	..	..	..	..
7	..	..	..	..	..	..		..	..	..	..	·03	..	..
8	·13	·21	·18	·13	·12	·22		·23	·30	·29	·25	·20	·23	·30
9	..	·01	·01	·01	..	..		·02	·01	..	·02	..	..	..
10	·19	·18	·20	·18	·17	·17		·20	·16	·16	·16	·10	·10	·15
11	..	..	..	..	..	..		..	·01	..	..	..	..	..
12	·29	·22	·39	·29	·25	·36		·18	·25	·22	·26	·26	·25	·22
13	..	..	..	·01	..	·01		..	..	..	·02	·01	..	·01
14	·02	·01	..	..	·01	·02		·01	·02	·02	·02	..	·01	·02
15	·02	·04	·04	·02	·02	..		·04	·04	·05	..	·03	..	·02
16	..	..	..	..	..	..		..	..	..	..	..	..	·01
17	·08	·03	·06	·05	·04	·10		·02	·04	·04	·06	·09	·05	·05
18	..	·02	·05	·06	·04	..		·01	·03	·02	·04	..	..	·01
19	·16	·10	·17	·15	·15	·16		·10	·12	·11	·19	·21	·25	·11
20	·01	..	..	·01	..	..		..	..	..	·02	..	..	..
21	..	..	..	..	..	·01		..	..	..	..	..	..	..
22	..	..	..	..	..	..		..	..	..	..	..	..	..
23	..	..	..	..	..	..		..	..	..	..	..	..	..
24	..	..	..	..	..	..		..	..	..	..	..	..	..
25	·42	·42	·44	·41	·40	·41		·44	·37	·53	·38	·39	·37	·54
26	·10	·08	·11	·08	·06	·12		·10	·07	·12	·08	·07	·10	·13
27	·19	·31	·53	·30	·47	·34		·23	·17	·14	·15	·22	·14	·13
28	·20	·29	·23	·21	·14	·27		·34	·27	·28	·27	·27	·25	·27
29	·30	·14	·20	·26	·18	·25		·11	·19	·22	·27	·13	·16	·20
30	·16	·40	·25	·23	·21	·21		·50	·32	·31	·33	·18	·15	·31
Total	3·91	3·96	4·36	3·94	3·53	4·10		4·04	3·78	3·97	3·92	3·55	3·48	3·89
From Jan. 1st	26·02	27·08	26·18	24·56	22·78	24·85		25·56	24·13	24·75	25·86	21·88	22·36	24·57

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	·73	·68	·66	·70	·66	·66	·70	1·02	·65	·70	·64
2	·87	·77	·96	·77	·75	·76	·80	·51	·84	·75	·77
3	·03	·03	·04	·03	·03	·02	·05	..	·03	·04	·03
4	·13	·11	·07	·11	·12	·11	·09	·09	·10	·08	..
5	·01	·01	·01	..	..	..	·03	·03	..	·01	..
6	..	·01	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..
8	·10	·14	·08	·14	·14	·13	·11	·15	·09	·14	·11
9	·01	·02	·03	..	·01	..	·02	·03	·01	..	·01
10	·16	·18	·21	·18	·18	·17	·15	·21	·22	·17	·21
11	..	·01	..	..	..	..	..	..	..	..	..
12	·24	·22	·13	·22	·21	·20	·18	·15	·13	·17	·11
13	·05	·05	..	·04	·04	·03	·03	..	..	..	..
14	..	·01	..	..	·01	·01	·02	..	·01	·01	..
15	·10	·10	·05	·08	·05	·04	·02	·02	·03	·03	·03
16	·02	·03	·01	·02	·01	·01	..	·03	..	..	..
17	·04	·05	·05	·03	·03	·04	·03	·03	·04	·03	·03
18	·06	·04	·01	·04	·04	·03	·03	·02	..	·03	..
19	·17	·18	·01	·17	·15	·16	·12	·15	·08	·12	.10
20	..	·01	..	..	·01	·01	..	..	..	..	..
21	·02	·01	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..	..	..
24	..	·01	..	..	..	..	..	..	..	..	..
25	·62	·56	·41	·55	·41	·53	·41	·11	·41	·46	·40
26	·20	·20	·04	·18	·16	·12	·11	·08	·06	·01	·05
27	·21	·22	·16	·24	·19	·21	·16	·40	·39	·18	·37
28	·32	·31	·43	·32	·31	·28	·33	·25	·32	·29	·33
29	·24	·31	·22	·33	·28	·29	·26	·15	·20	·20	·18
30	·24	·22	·38	·25	·19	·22	·26	·28	·39	·30	·38
Total	4·57	4·49	3·96	4·40	3·98	4·03	3·91	3·71	4·00	3·72	3·75
From Jan. 1st	27·61	29·36	24·94	28·41	26·72	26·61	28·64	25·52	26·57	25·13	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

Returns have been received this month from Purley (Reedham Asylum) (height, 375 ft.), Ashtead (D'Abernon Chase) (300 ft.), Wimbledon (Mount Ararat) (157 feet), New Malden (Gosforth Lodge) (48 ft.), and New Malden (Sewerage Works) (45 ft.), in Surrey; and from Knockholt (785 ft.), Chislehurst (The Chesnuts) (325 ft.), Orpington (220 ft.), Eltham (Victoria Road) (205 ft.), and Wilmington (25 ft.), in Kent.

The gauge at Beddington was on October 10th removed to another situation, and the return for the remainder of the year will not be printed in full. The total rain was 4·11 ins.

NOTES.

(November, 1888.)

The month has been generally warm, wet, and sunless, more especially between the 1st and 4th, and between the 25th and 30th. The number of hours of bright sunshine at Kew was only 26, the percentage of possible duration being 10, the lowest November value. The rainfall is above the November average of 1871–80 at Greenwich by 1·62 in., at Kew by 1·69 in., and at Beckenham by 1·10 in.; of 1877–86 at Sutton by 1·48 in.; and of 1878–87 at West Norwood by 1·39 in., at Croydon (Nantwich House) by 0·98 in., at Addiscombe by 0·91 in., and at Waddon by 1·16 in.

Daily Rainfall. **SURREY.** December, 1888.

Day of Month	Caterham	Reigate Hill	Caterham Valley	Kenley	Addington	Forest Hill	Croydon (Nantw. H.)	Sutton	Purley	Addiscombe	Croydon (Dingw. Rd.)	West Norwood	Wallington	Waddon	Croydon (Brim. Barn.)	Carshalton	Beddington	Brixton	Wimbledon	Richmond	Raynes Park	Esher	Surbiton	Kew Observatory
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	..	·01	·01	·01		..	..	..	..	..	..	..	..	..	..		..	..	..	..	·01	..	..
2	·01	·02	..	·02	·01		·07	·08	·10	·07	·05	·06	·04	·05	·04	·06		·01	·01	·02	·01	·03	·01	·03
3	·16	·15	·12	·11	·04		·02	·03	·07	..	·01	·02	·02	·01	·01	·01		·02	·02	·02	·03	·02	..	·01
4	·09	·10	·06	·06	·04		·03	·01	·06	·03	·03	·01	·03	·03	·02	·02		·01	·02	·01	·03	..	..	·01
5	·04	·02	·04	·02	..		·01	·02	·02	·01	·01	..	·01	·01	·01	·01		·01	..	..	..	..	..	..
6	·02	..	..	..	..		..	..	·03	..	..	..	..	..	..	..		..	..	..	..	..	..	..
7	..	..	..	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	·01	..	..	·01
8	·17	·20	·17	·19	·15		·15	·17	·18	·15	·15	·16	·16	·16	·16	·16		·15	·15	·18	·16	·17	·18	·17
9	..	..	·01	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	..	..	..	..
10	..	..	..	..	..		..	..	..	..	..	..	·01	..	..	..		..	..	..	·02	..	..	..
11	..	..	..	·01	..		·01	..	..	..	..	..	·01	..	..	..		..	..	..	·02	..	..	·01
12	..	..	..	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	·01	..	..	..
13	..	..	..	·02	..	Record ceased.	..	..	..	..	·01	..	·01	..	..	..	See Note.	..	..	..	·01	..	..	·01
14	..	..	..	..	..		..	·04	..	..	..	..	..	..	..	·02		..	..	..	·02	..	·01	·01
15	·01	·04	·02	·02	..		·01	..	·02	·02	·01	·02	·02	..	..	·02		·01	..	..	·02	..	..	·01
16	..	..	..	·01	·01		·01	..	..	..	·01	..	·01	..	..	..		..	..	..	..	..	..	..
17	..	..	..	..	..		..	..	·03	..	..	..	..	..	·03	..		..	..	..	·01	..	..	..
18	..	·02	..	·01	·02		·01	·01	..	..	·01	..	·01	..	..	·01		·01	·02	..	·01	..	..	·01
19	..	..	..	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	..	..	..	..
20	..	·02	·03	·04	·03		·02	·02	·04	·03	·02	·03	·03	·03	·02	·02		·02	..	..	·02	..	·01	..
21	·38	·30	·40	·44	·42		·29	·40	·40	·31	·27	·16	·39	·30	·29	·30		·13	·19	·29	·22	·29	·27	·23
22	·01	..	·02	·02	..		..	..	·03	..	..	..	..	·01	..	·01		..	·01	..	·02	..	..	·01
23	..	·02	·04	·02	..		..	·03	·02	..	..	..	..	..	..	·02		..	·01	·02	·02	·04	·01	·01
24	·24	·24	·20	·26	·25		·20	·20	·31	·18	·18	·20	·23	·19	·17	·14		·22	·22	·30	·19	·16	·16	·34
25	·24	·20	·24	·21	·15		·13	·10	·13	·13	·12	·08	·13	·11	·09	·08		·12	·11	·18	·11	·08	·10	·19
26	·01	·02	·02	·04	·03		·02	·03	·04	·02	·02	·03	·02	·02	·02	·02		·03	·02	·01	·03	·02	·02	·01
27	·25	·27	·25	·28	·10		·26	·28	·32	·25	·29	·18	·30	·24	·13	·33		·06	·16	·18	·21	·18	·19	·18
28	·30	·18	·19	·26	·30		·16	·26	·19	·16	·10	·13	·28	·15	·13	·14		·21	·12	·13	·14	·15	·11	·16
29	·09	·08	·12	·08	·04		·09	·06	·12	·09	·08	·06	·07	·07	·07	·05		·03	·02	·01	·02	..	·01	..
30	..	..	·01	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	..	..	..	..
31	..	..	·01	..	..		..	..	..	..	..	..	..	..	..	..		..	..	..	..	..	..	..
Total	2·02	1·88	1·96	2·13	1·60		1·49	1·74	2·11	1·45	1·37	1·14	1·78	1·38	1·19	1·42		1·04	1·08	1·35	1·34	1·15	1·08	1·41
From Jan. 1st	31·24	33·43	29·88	33·66	28·24		27·74	27·93	31·87	27·51	27·39	28·22	27·96	25·94	23·97	26·27		26·60	25·21	26·10	27·20	23·03	23·44	25·98

Daily Rainfall. **KENT.** December, 1888.

Day of Month	W. Wickham (Layham's F.)	Keston (Heathfield)	Woolwich	Keston (TowerFields)	Keston (Bradfield)	Hayes Common	Bickley	Forest Hill	Greenwich	Beckenham (Foxgrove)	Deptford
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1	..	·01	..	..	..	..	..	..	..	..	..
2	·01	·01	·03	..	..	·01	·05	·04	·03	·05	·04
3	·07	·07	·01	·05	·03	·03	·01	·03	·01	·01	·01
4	·02	·04	·01	·02	·01	·01	·02	·05	·01	·02	..
5	·01	·02	..	..	..	·01	·02	..	..	·01	..
6	..	..	..	..	..	..	..	..	..	..	..
7	..	·01	..	..	..	..	..	..	..	..	..
8	·17	·15	·13	·15	·15	·15	·14	·14	·13	·14	·11
9	..	·02	..	..	..	..	..	..	..	..	..
10	..	·02	..	..	..	..	..	..	..	..	..
11	..	·01	..	..	..	..	·03	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..
13	..	·02	..	..	..	..	·01	..	..	·01	..
14	..	..	·01	..	..	·01	..	..	·01	·01	..
15	·06	·02	·01	..	·02	·01	·02	..	..	..	..
16	·01	·02	..	..	..	..	·01	..	..	..	..
17	..	·02	..	..	..	..	..	·02	..	..	..
18	..	·01	·01	..	·01	..	·01	·02	..	..	..
19	..	..	..	·05	..	..	..	..	..	..	..
20	·06	·04	·02	·03	·03	·04	·03	·02	·01	·02	·01
21	·40	·39	·15	·40	·37	·40	·29	·14	·12	·24	·12
22	·01	..	·01	..	..	·01	..	..	..	..	..
23	·01	·02	..	·01	..	·01	·01	·02	..	..	..
24	·24	·22	·21	·21	·18	·20	·15	·19	·24	·15	·21
25	·22	·21	·11	·19	·16	·18	·12	·08	·08	·08	·07
26	·03	·05	·03	·04	·04	·02	·05	·04	·02	·03	·02
27	·24	·27	·12	·25	·16	·15	·18	·18	·12	·18	·11
28	·16	·17	·15	·16	·16	·12	·12	·10	·09	·13	..
29	·13	·12	·07	·12	·11	·09	·11	·06	·06	·09	·05
30	..	·02	..	..	..	·09	..	..	..	..	..
31	..	..	..	..	..	..	..	..	..	..	..
Total	1·85	1·96	1·08	1·68	1·43	1·54	1·38	1·13	·93	1·17	·75
From Jan. 1st	29·46	31·32	26·02	30·09	28·15	28·15	30·02	26·65	27·50	26·30	..

Note.—The observations are taken at 9 a.m., except at Brixton (8 a.m.), Croydon (Dingwall Road) and Kew Observatory (10 a.m.), and Hayes Common (9.30 a.m.).

Returns have been received this month from Purley (Reedham Asylum) (height, 375 ft.), Ashtead (D'Abernon Chase) (300 ft.), Wimbledon (Mount Ararat) (157 feet), New Malden (Gosforth Lodge) (48 ft.), and New Malden (Sewerage Works) (45 ft.), in Surrey; and from Knockholt (785 ft.), Chislehurst (The Chesnuts) (325 ft.), Orpington (220 ft.), Eltham (Victoria Road) (205 ft.), and Wilmington (25 ft.), in Kent.

The gauge at Beddington was on October 10th removed to another situation, and the return for the remainder of the year will not be printed in full. The total rain was 1·51 ins.

NOTES.

(December, 1888.)

The month has been an open one, without snow, but very foggy, particularly during the middle and end, and the temperature has been rather above the average. At Kew the mean percentage of bright sunshine has been 14, which is about the average. The rainfall is below the December average of 1871–80 at Greenwich by 1·14 in., at Kew by 0·60 in., and at Beckenham by 1·05 in.; of 1877–86 at Sutton by 0·32 in.; and of 1878–87 at West Norwood by 0·75 in., at Croydon (Nantwich House) by 0·55 in., at Addiscombe by 0·63 in., and at Waddon by 0·45 in.

APPENDIX III.

MONTHLY RECORDS.

STATION.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	YEAR.
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
*Ashtead....	·99	·91	2·82	1·44	1·17	2·72	7·22	1·94	·84	1·78	3·90	1·69	27·42
*Sutton	·87	1·07	2·84	1·66	·64	2·14	6·17	2·47	1·07	1·31	3·85	1·54	25·63
*Wimbledon.	·95	1·00	2·20	1·98	·81	2·40	5·73	3·06	1·44	1·61	3·60	1·15	25·93
*Esher	·96	1·18	2·56	1·58	·95	2·84	5·63	2·12	1·01	1·39	3·61	1·13	24·96
*Chislehurst.	·78	1·16	2·68	1·58	·71	3·71	6·66	2·92	·61	1·20	3·80	1·11	26·92
*Eltham	·86	·92	2·40	1·64	·62	3·37	6·74	3·42	·86	1·52	4·28	1·12	29·75

APPENDIX IV.

MEANS OF FIVE YEARS.

GREENWICH OBSERVATORY.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	YEAR.
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.
1841—45....	1·86	1·60	1.52	1·00	2·08	1·68	2·60	2·48	2.34	3·40	3·43	1·18	25·17
1846—50....	1·62	1·83	1·15	2·34	1·86	1·36	1·97	2·47	2·07	2·98	1·68	1·89	23·22
1851—55....	2·26	1·17	1·60	1·34	1·90	2·17	3·79	2·74	1·89	3·56	2·40	1·21	26·03
1856—60....	1·72	0·99	1·19	1·82	2·41	2·54	2·22	2·24	2·79	2·55	1.70	1·80	23·97
1861—65....	1·85	1·05	1·96	1·06	2·45	2·22	1·46	2·14	1·79	2·74	2·52	1·06	22·30
1866—70....	3·01	1·88	1·69	1·59	1·97	1·48	2·21	2·18	2·61	2·39	1·33	3·04	25·38
1871—75....	2·43	1·11	1·12	1·50	1·43	2·37	3·07	2·09	2·58	3·19	2·16	1·67	24·72
1876—80....	1·84	2·10	1·36	2·75	2·13	2·58	2·19	3·29	2·28	2·69	2·60	2·47	28·28
1881—85....	1·58	2·06	1·33	1·58	1·55	1·90	1·77	1·55	2·85	2·83	2·22	1·75	22·97
1841—85....	2·02	1·53	1·43	1·66	1·98	2·03	2·36	2·35	2·36	2·93	2·23	1·79	24·67

KEW OBSERVATORY.

1856—60....	1·78	1·13	1·34	2·13	2·28	2·27	1·69	2·85	2·63	2·52	1·49	1·45	23·56
1861—65....	1·73	1·02	2·18	1·05	2·22	2·49	1·48	2·12	2·05	2·69	2·12	0·95	22·10
1866—70....	2·50	1·79	1·40	1·31	1·44	1·48	1·59	2·02	2·64	1·91	1·32	2·65	22·05
1871—75....	2·26	1·09	1·03	1·50	1·41	2·48	2·59	1·24	2·55	3·12	2·14	1·52	22·93
1876—80....	2·01	2·26	1·48	2·75	2·18	2·43	3·07	3·35	2·31	2·41	2·26	2·51	29·02
1881—85....	1·69	2·35	1·34	1·61	1·54	1·77	1·77	1·78	2·78	2·98	2·42	1·72	23·75
1856—85....	1·99	1·61	1·46	1·73	1·84	2·15	2·03	2·23	2·50	2·60	1·96	1·80	23·90

APPENDIX V.

Falls of 1·0 in. and upwards.

June 26th.

Caterham, 1·16 in.; Caterham Valley, 1·54 in.; Forest Hill (Surrey), 1·60 in.; West Norwood, 1·09 in.; Keston (Heathfield), 1·05 in.; Woolwich, 1·63 in.; Keston (Tower Fields), 1·18 in.; Bickley, 1·48 in.; Forest Hill (Kent), 1·70 in.; Greenwich, 1·77 in.; Beckenham, 1·29 in.; Chislehurst, 1·43 in.; and Eltham, 1·30 in.

July 6th.

Kenley, 1·25 in.; Forest Hill (Surrey), 1·00 in.; Croydon (Nantwich House), 1·28 in.; Purley, 1·17 in.; Addiscombe, 1·21 in.; Croydon (Dingwall Road), 1·30 in.; West Norwood, 1·03 in.; Waddon and Croydon (Brimstone Barn), 1·10 in.; Beddington, 1·12 in.; Brixton, 1·05 in.; Forest Hill (Kent), 1·02 in.; Ashtead, 1·28 in., and Eltham, 1·43 in.

July 30th.

Kenley, 1·60 in.; Addington, 1·32 in.; Forest Hill (Surrey), 1·59 in.; Croydon (Nantwich House), 1·09 in.; Purley, 1·10 in.; Addiscombe, 1·42 in.; Croydon (Dingwall Road), 1·23 in.; West Norwood, 1·61 in.; Beddington, 1·48 in.; Woolwich, 1·28 in.; Bickley, 1·63 in.; Forest Hill (Kent), 1·18 in.; Greenwich, 2·49 in.; Beckenham, 1·05 in.; Deptford, 2·54 in.; Ashtead, 1·25 in.; and Eltham, 1·16 in.

August 1st.

Forest Hill (Surrey), 1·17 in.; Sutton, 1·19 in.; West Norwood, 1·43 in.; Carshalton, 1·13 in.; Brixton, 1·26 in.; Wimbledon, 1·15 in.; Raynes Park, 1·16 in.; Keston (Heathfield), 1·25 in.; Woolwich, 1·25 in.; Keston (Tower Fields), 1·51 in.; Keston (Bradfield), 1·27 in.; Bickley, 1·12 in.; Greenwich, 1·29 in.; Deptford, 1·27 in.; Wimbledon (Mount Ararat), 1·13 in.; Chislehurst, 1·31. in; and Eltham, 1·21 in.

August 28th.

Reigate Hill, 1·06 in.; and Kenley, 1·05 in.

74.—WELL GAUGINGS IN THE CROYDON DISTRICT.

Communicated by THOMAS WALKER, M. Inst. C.E., Borough Engineer. All levels are given in feet above Ordnance Datum

	Warlingham.		Kenley Valley.					Brighton Road Valley.		
	Slynes Oaks	Crewes Farm	Bughill Farm	Marden Lodge	Well Farm	Garston House	Gt. Roke Farm	RussellHill F. Cottages	Purleybury	Croham Villas
Level of Mouth	591·8	560·4	375·5	354·2	333·1	276·7	236·4	221·1	207·2	265·3
Bottom	267·6	231·2	253·5	240·2	224·1	206·7	185·9	173·1	164·0	184·8
1883. Oct. 16-18	305·0	249·9	261·6	..	..	..	..	..	..	193·5
Nov. 5	303·8	247·4	256·5	..	..	..	..	..	..	..
Dec. 5	307·6	253·0	267·3	..	..	..	..	..	..	191·3
Dec. 31	313·8	259·9	275·5	..	..	..	..	..	..	192·9
1884. Feb. 15	324·1	268·2	287·6	..	..	..	..	..	..	194·6
May 1	333·8	290·3	308·8	..	..	..	..	..	..	198·2
Aug. 11	306·3	254·6	265·1	..	..	..	..	..	..	192·8
Sept. 19	302·1	244·0	253·5	..	..	..	..	..	..	190·2
Oct. 24	301·7	240·4	Dry	..	..	..	..	..	..	188·2
Dec. 5	299·2	238·3	Dry	..	..	..	..	..	..	185·6
1885. Jan. 23	299·8	236·2	Dry	..	..	..	..	..	..	Dry
Mar. 27	331·8	275·8	268·3	..	..	..	..	..	..	193·9
July 3	308·8	263·4	..	..	..	..	..	..	..	194·3
Sept. 16	306·0	248·4	..	..	..	..	..	..	..	190·3
Nov. 20	302·6	242·1	..	..	..	..	..	..	..	185·4
Dec. 11	322·9	257·4	..	..	..	..	..	..	..	189·6
1886. Apr. 7	341·2	297·8	..	..	..	..	..	..	..	199·4
May 14	333·6	289·6	..	..	..	..	..	..	..	198·0
June 18	343·0	293·2	..	..	..	..	..	..	..	198·2
Aug. 3	324·9	283·3	..	..	..	..	..	..	..	197·0
Sept. 7	315·3	270·3	284·0	281·9	278·7	244·7	205·4	181·2	175·5	195·4
Oct. 12-22	310·0	259·2	266·1	265·8	263·6	234·7	200·2	178·8	172·2	192·2
Nov. 19	307·2	252·7	261·6	260·5	258·0	230·0	197·3	177·2	170·7	190·4
Dec. 18	313·0	259·7	272·5	268·8	264·7	230·7	197·4	177·4	170·5	190·5

74.—WELL GAUGINGS IN THE CROYDON DISTRICT.

Communicated by THOMAS WALKER, M. Inst. C.E., Borough Engineer. All levels are given in feet above Ordnance Datum.

	WARLINGHAM.		KENLEY VALLEY.					BRIGHTON ROAD VALLEY.		
	Slynes Oaks	Crewes Farm	Bughill Farm	Marden Lodge	Well Farm	Garston House	Gt. Roke Farm	RussellHill F. Cottages	Purleybury	Croham Villas
Level of Mouth	591·8	560·4	375·5	354·2	333·1	276·7	236·4	221·1	207·2	265·3
Bottom	267·6	231·2	253·5	240·2	224·1	206·7	185·9	173·1	164·0	184·8
1887. Jan. 21	357·1	291·4	319·0	305·2	296·1	244·4	204·7	181·1	175·5	195·8
Feb. 25	364·6	313·4	342·0	330·2	318·1	259·5	213·8	186·4	180·9	200·3
April 4	342·3	300·4	323·1	316·7	309·3	259·3	215·7	187·7	182·0	199·6
April 13	..	..	..	..	..	..	..	..	..	..
May 24	323·2	282·9	300·0	296·5	292·1	251·7	210·4	184·4	178·9	197·2
July 13	314·1	267·9	280·6	278·7	275·8	242·2	..	181·2	175·0	195·3
Aug. 15	310·3	259·9	270·5	269·4	266·6	236·2	201·2	179·6	173·0	193·8
Sept. 15	307·3	253·3	260·7	260·6	258·2	230·7	198·2	177·6	171·1	191·7
Oct. 31	303·8	245·8	Dry	250·0	248·1	222·4	193·9	175·6	168·6	188·8
Nov. 22	..	..	Dry	245·3	244·4	218·8	192·3	175·1	167·9	..
Dec. 17	304·3	242·3	Dry	245·7	243·7	216·5	191·2	174·8	167·7	187·4
1888. Jan. 6	306·8	243·3	255·5	253·4	250·2	219·1	192·2	175·1	168·0	188·9
Feb. 10	307·4	249·3	258·4	256·5	253·2	223·6	194·4	176·2	169·2	190·4
Mar. 12	307·3	250·6	259·0	257·1	254·6	225·1	195·3	176·6	169·7	190·6
Mar. 27	312·5	253·4	..	..	..	..	..	..	..	..
April 13	335·4	275·1	300·3	289·1	281·4	230·0	199·3	178·4	172·0	194·3
May 15	337·7	285·8	307·5	298·0	291·1	245·0	204·7	181·0	175·3	196·6
June 19	323·3	280·4	297·8	292·8	287·8	246·9	206·4	181·6	177·2	196·3
July 23	326·6	276·7	294·2	288·2	283·2	244·5	205·2	181·2	175·6	196·1
Sept. 8	333·9	284·8	305·1	297·5	291·4	247·6	207·6	182·8	177·1	196·9
Oct. 6	321·0	277·4	293·2	289·5	285·1	247·0	207·0	182·2	176·7	197·5
Nov. 16	312·3	264·7	277·0	275·2	272·3	241·0	203·6	180·6	174·7	194·5
Dec. 31	322·3	273·1	290·6	284·5	280·1	240·7	203·1	..	174·3	194·8

74.—WELL GAUGINGS IN THE CROYDON DISTRICT.

Communicated by THOMAS WALKER, M. Inst. C.E., Borough Engineer. All levels are given in feet above Ordnance Datum.

	Addington.	Wickham.						Addington.	Selsdon.	Warlingham.
	Addington Village	Sparrows Den	Wickham Court	Rouse Farm.	Nashe.	Waits Farm	Layhams Farm	Addington Lodge Fm.	Selsdon	Kennel Farm
Level of Mouth	267·3	226·4	299·8	317.4	337·9	372·0	509·6	491·3	438·6	605·7
Bottom	202·2	176·4	178·5 (bore 93·0)	180·4	182·9	190·1	218·6	242·3	194·4	316·7
1883. Oct. 16-18	..	198·1	..	199·4	206·2	210·1	245·1	247·3	224·3	347·2
Nov. 5	215·0	..	..	..	..	..	..	244·2	217·9	345·9
Dec. 5	212·9	..	..	..	..	..	..	244·7	215·9	345·9
Dec. 31	213·3	..	..	..	..	..	..	247·8	219·9	344·2
1884. Feb. 15	215·2	192·2	195·6	..	202·5	206·1	245·8	251·5	223·6	343·4
May 1	224·7	195·7	200·2	202·8	212·3	215·7	248·6	264·3	240·1	350·4
Aug. 11	214·0	191·4	195·0	195·3	201·3	204·7	233·9	247·6	220·2	342·4
Sept. 19	209·3	188·7	191·6	191·4	196·5	200·7	237·5	244·9	211·0	334·7
Oct. 24	205·7	186·5	189·3	189·0	193·5	198·0	241·8	244·9	205·4	333·1
Dec. 5	202·3	183·7	186·7	186·3	190·6	194·6	240·6	242·3	199·6	330·1
1885. Jan. 23	Dry	181·7	183·7	183·5	187·6	191·8	238·0	Dry	196·9	325·9
Mar. 27	208·7	182·8	187·5	189·1	197·0	200·0	245·1	251·3	219·8	334·7
July 3	212·7	184·8	190·0	191·8	199·6	203·9	246·7	251·0	224·2	338·9
Sept. 16	206·2	181·9	185·8	186·6	193·0	197·5	244·2	243·2	208·5	337·4
Nov. 20	Dry	178·9	183·0	182·9	187·6	192·9	240·6	242·5	200·1	331·2
Dec. 11	204·2	179·1	183·6	184·1	189·4	194·0	241·8	243·8	203·3	332·7
1886. April 7	225·1	189·9	196·3	199·9	211·2	215·1	251·2	268·2	243·8	358·8
May 14	223·3	191·1	196·8	200·0	209·7	214·0	250·1	264·2	239·4	359·7
June 18	223·2	191·3	196·7	199·7	208·9	213·3	249·6	263·8	239·3	362·4
Aug. 3	220·6	191·7	197·2	199·0	207·4	212·1	248·0	258·3	234·8	359·9
Sept. 7	216·0	190·3	195·4	196·4	203·6	208·3	247·1	251·8	228·1	356·3
Oct. 12-22	211·3	187·8	192·7	192·3	198·4	203·5	246·5	247·0	220·6	351·9
Nov. 19	206·9	185·1	189·7	189·0	193·9	200·0	245·3	245·0	210·2	347·7
Dec. 18	205·3	184·2	189·2	187·8	192·9	198·4	244·8	245·7	207·1	345·4

74.—WELL GAUGINGS IN THE CROYDON DISTRICT.

Communicated by THOMAS WALKER, M. Inst. C.E., Borough Engineer. All levels are given in feet above Ordnance Datum.

	Addington.	Wickham.						Addington.	Selsdon.	Warlingham.
	Addington Village	Sparrows Den	Wickham Court	Rouse Farm	Nashe	Waits Farm	Layhams Farm	Addington Lodge Fm.	Selsdon	Kennel Farm
Level of Mouth	267·3	226·4	299·8	317·4	337·9	372·0	509·6	491·3	438·6	605·7
Bottom	202·2	176·4	178·5 (bore 93·0)	180·4	182·9	190·1	218·6	242·3	194·4	316·7
1887. Jan. 21	212·2	185·2	190·5	190·9	198·2	203·0	246·9	252·1	222·2	347·4
Feb. 25	224·7	190·7	193·0	200·4	211·8	215·3	251·4	270·7	244·1	355.7
Apr. 4	228·6	193·2	198·3	202·7	213·5	217·5	253·6	270·2	247·5	362·4
Apr. 13	228·2	193·2	198·2	202·5	212·9	216·7	253·4	269·0	246·3	..
May 24	224·2	192·9	197·3	200·4	209·4	214·0	252·1	262·8	239·4	359·0
July 13	218·2	190·3	194·3	196·5	203·6	208·3	249·4	255·3	230·6	353·7
Aug. 15	213·6	187·9	191·6	193·3	199·4	204·4	246·6	251·3	223·9	350·5
Sept. 15	209·7	185·7	189·2	190·6	195·9	200·9	246·3	249·7	217·1	347·7
Oct. 31	205·0	182·7	185·8	186·5	191·4	196·6	246·0	246·7	207·3	342·5
Nov. 22	..	..	..	..	..	..	..	..	..	..
Dec. 17	202·8	180·4	183·7	184·0	188·9	194·3	244·0	244·8	202·2	337·4
1888. Jan. 6	203·5	180·0	183·7	184·3	189·4	194·7	244·2	244·2	202·8	335·7
Feb. 10	205·3	180·0	183·8	184·8	190·8	196·1	245·1	245·3	208·1	333·3
Mar. 12	205·8	179·9	184·1	185·1	191·2	196·5	246·2	246·0	210·1	332·4
Mar. 27	206·8	180·2	184·4	185·6	192·0	197·0	247·0	246·2	210·9	331·7
Apr. 13	209·7	181·1	185·7	187·4	194·7	199·3	247·3	249·5	218·8	331·7
May 15	215·3	183·4	188·5	191·3	200·1	204·9	248·7	255·5	229·9	335·1
June 19	217·2	184·9	190·3	192·9	201·9	207·0	248·6	257·1	232·6	341·9
July 23	215·7	184·9	190·2	192·8	201·1	206·3	249·0	254·7	230·3	347·9
Sept. 8	215·3	185·7	190·7	193·5	201·7	206·2	247·0	253·9	231·6	352·5
Oct. 6	212·2	185·6	190·3	192·9	201·0	205·4	248·6	250·6	228·6	354·5
Nov. 16	209·8	183·8	188·0	190·2	196·9	201·7	247·9	248·0	223·5	353·4
Dec. 31	209·3	182·9	186·2	189·7	197·2	201·2	247·6	249·2	222·2	351·3

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Croydon Microscopical and Natural History Club.

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